A Tradition in Transition:

Understanding the Role of Shifting Cultivation for Sustainable Development of Northeast India

THE ENERGY AND RESOURCES INSTITUTE
Creating Innovative Solutions for a Sustainable Future

Japan Fund for Global Environment

A Tradition in Transition:

Understanding the Role of Shifting Cultivation for Sustainable Development of Northeast India

THE ENERGY AND RESOURCES INSTITUTE
Creating Innovative Solutions for a Sustainable Future

Japan Fund for Global Environment

Authors

Alka Michael
Angshuman Sarma
Srijani Bhattacharjee
Anirban Datta Roy
Kankana Trivedi
Amit Kurien
Kasturi Chakraborty
Tarujyoti Buragohain
Naveen Pandey
Karthik Teegalapalli
Dibyendu Paul
Sarala Khaling

Reviewers

Brajesh Kumar Tiwari
Ayyanadar Arunachalam
Kuang-Chung Lee
Paulina Karimova
Uttam Kumar Sahoo
Dietrich Schmidt-Vogt
Maiko Nishi
Devon Dublin

Editorial Team

Aniket Kumar Shaw, Yoji Natori, Siddharth Edake

Suggested citation

Shaw A K, Natori Y, and Edake S. 2022. *A Tradition in Transition: Understanding the Role of Shifting Cultivation for Sustainable Development of North East India*. New Delhi: TERI

Published by

The Energy and Resources Institute (TERI)
TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003
India

Tel. 2468 2100 or 7110 2100
Fax 2468 2144 or 2468 2145
India +91 • Delhi (0)11
E-mail teripress@teri.res.in
Website www.teriin.org

Supported by

Japan Fund for Global Environment of the Environmental Restoration and Conservation Agency

FROM THE DIRECTOR GENERAL'S DESK

It gives me immense pleasure to share that The Energy and Resources Institute (TERI), in collaboration with Japan Fund for Global Environment (JFGE), is coming up with this volume titled, **"A Tradition in Transition: Understanding the Role of Shifting Cultivation for Sustainable Development of Northeast India"**. The volume, compiling different case studies from Northeastern States, provides a holistic idea about shifting cultivation and also addresses some of the key questions pertaining to it.

Shifting cultivation, or is popularly known as *Jhum* in North East India, is being practised in Northeast India since time immemorial. However, time and again it has been observed that the tribal communities of the Northeast are discouraged from practicing *Jhum* due to the prevalent narrative that *Jhum* is primitive and unsustainable, which leads to biodiversity loss, habitat fragmentation, and carbon emission. However, new global research has challenged this view and recent publication of Food and Agriculture Organization (FAO) suggests the need for re-examination of such perceptions. Many scholars and researchers have pointed out the fact that *Jhum* is not merely an alternative method of farming but a form of landscape management that has not only evolved over centuries of experimentation but is also inseparable from the culture and the way of life of those who continue to practice *Jhum*. However, with modernization and changing society in Northeast India, this tradition is currently in transition and possibly declining due to increasing economic and financial aspirations of *Jhum* cultivators rather than by the environmental concerns associated with the practice. Hence, it becomes imperative to understand the role of shifting cultivation for sustainable development in the present context.

Through this book volume, we envisage to gather wisdom pertaining to shifting cultivation in Northeast India, providing useful knowledge and lessons so that these traditional practices and knowledge can contribute to sustainable development in India and beyond.

My heartiest congratulations to all the authors, who have conducted such successful case studies and came up with pertinent inferences. Also, I would like to congratulate the TERI team for coming up with this book publication.

Dr Vibha Dhawan
Director General
The Energy and Resources Institute, New Delhi

PREFACE

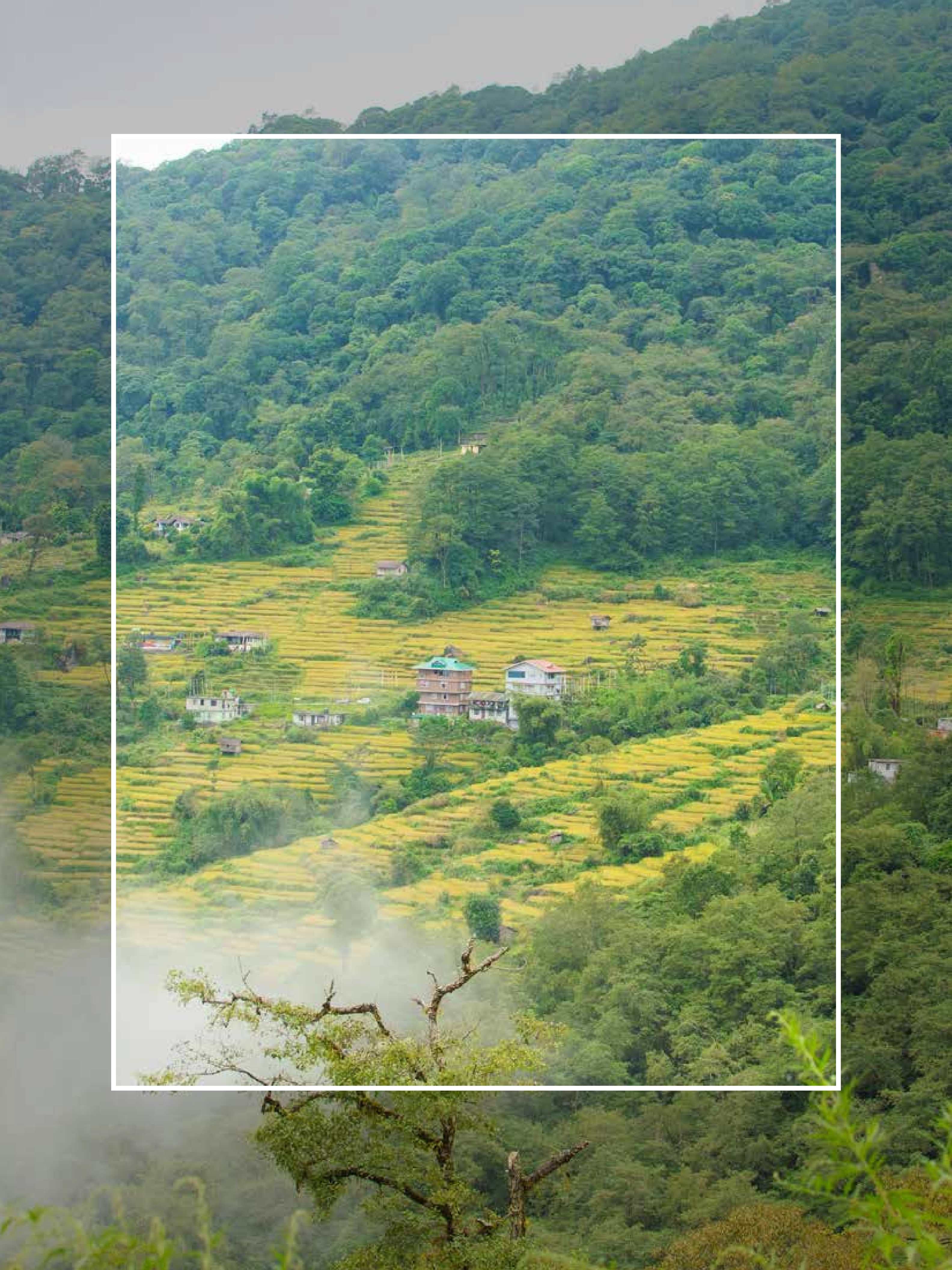
Shifting cultivation has conventionally been regarded as an environmentally and economically inviable form of land use. Although a school of critics consider shifting cultivation to be detrimental for the environment as it disrupts the ecology of the region where it is practiced, numerous scientific and agro-ecological researchers have challenged this perception and have depicted that shifting cultivation is perhaps more sustainable than settled agriculture and monoculture. This traditional agricultural practice is not merely an alternative method of farming but a form of landscape management that has not only evolved over centuries of experimentation but is also inseparable from the culture and the way of life of those who continue to practise shifting cultivation. Empirical analysis revealed that such attachment or bonding takes three forms, namely nature-bonding (attachment to the natural landscape), social bonding (attachment to the local community and traditions), and economic bonding (attachment to the form of livelihood and to the place). Keeping the same in mind, The Energy and Resources Institute (TERI), supported by Japan Fund for Global Environment of the Environmental Restoration & Conservation Agency (JFGE) worked towards documenting the traditional agricultural practices and clarifies their scientific underpinning to have the "wisdom" benefit sustainable development for the coming generations.

The publication was developed through a multistage process. Each manuscript received comments from their respective reviewer, which helped the authors in improving their manuscripts in substance, quality, and relevance. Apart from that, a synthesis workshop was conducted in November 2021, where some of the authors were present in person whereas others joined through virtual meeting platform. The authors presented their case studies and received comments both from the designated reviewers and from the other workshop participants. The basic ideas contained in the synthesis of the concluding chapter were developed from the presentations and discussions during the workshop, and the chapter was made available for review by authors before finalization. It is our hope that this publication will be useful in providing information and insights to practitioners, researchers, and policymakers on the role that traditional agricultural practice like shifting cultivation can play in moving towards a sustainable world.

We would like to thank all the authors for their contribution and the reviewers including Kuang-Chung Lee, Paulina Karimova, Dietrich Schmidt-Vogt, Devon Dublin and Maiko Nishi for providing insightful remarks and valuable inputs into the discussions. Further, we would like to thank the TERI Press Team for proofreading all the manuscripts and ensuring a smooth publication process. Our grateful thanks are also due to Dr Jitendra Vir Sharma, Director Land Resources Division TERI, and Japan Fund for Global Environment for supporting the activities required during the publication of this academic volume.

Editorial Team

TABLE OF CONTENTS



INTRODUCTION
SHIFTING CULTIVATION IN NORTHEAST INDIA IN THE CONTEXT OF SOUTH AND SOUTHEAST ASIA

Aniket Kumar Shaw[1], Yoji Natori[2], and Siddharth Edake[3]

Introduction

Shifting cultivation, also commonly known as Swidden, *Jhum* in Bangladesh and northeast India, "rotational farming" by Karen people in northern Thailand, Shwe Pyaung Taungya in Myanmar, Lunxi di in China, Khoriya in Nepal and various local names in Indonesia, can be described as a traditional agricultural practice in which farmers slash down an area of secondary forest, burn the area and grow crop for a limited period of time, and then they move to a different location and let the area to fallow in order to restore soil fertility. The secondary succession restores forest on the area, through a process which takes 10–15 years (Oliver Springate-Baginski, 2013). This practice of agriculture is intricately related to the socio-cultural and economic well-being of indigenous communities and is also a source of livelihood for many communities across the globe (Brady, 1996). Numerous studies across the globe have observed that shifting cultivation fields sequester carbon that is emitted during field preparation, thus being carbon neutral (Yuen *et al*., 2013); ensures the hydrological characteristics (Ziegler *et al*., 2009) of the landscape; helps in reducing soil erosion (Valentin *et al*., 2008) and enhance the soil organic carbon and soil nutrients (Bruun *et al*., 2006).

---

1 Research Associate, The Energy and Resources Institute, New Delhi

2 Associate Professor, Akita International University, Japan

3 Senior Manager, Sustainable Landscapes & Restoration Programme, World Resources Institute, India

Overview of Shifting Cultivation in South and Southeast Asia

To better understand the context of shifting cultivation in northeast India, the focus of this volume, we consider the situations that surround shifting cultivation in South and Southeast Asia first.

Conflicting Views about Shifting Cultivation

The argument that shifting cultivation is deleterious to the environment dates back to the middle of 19th Century. The colonial rule viewed shifting cultivation as a "primitive", "unproductive" and even "pre-agricultural" practice (Oliver Springate-Baginski, 2013). McGrath (1987) considered shifting cultivation as a strategy of resource management in which the cultivable fields are shifted to exploit the energy and nutrient capital of the vegetation-soil complex of the future site. The practice of shifting cultivation is commonly viewed as related to forest fragmentation, soil loss/erosion and changes in the biophysical environment. It is considered as a major driver of deforestation, globally and Myers (1991) reported that shifting cultivation accounted for 61% of overall tropical forest destruction. Food and Agriculture Organisation of the United Nations (FAO) described it as "the custom of cultivating clearings scattered in the reservoir of natural vegetation (forest or grass-woodland) and of abandoning them as soon as the soil is exhausted" (FAO Staff, 1957). The notion of the shifting cultivation as transient, unplanned, wasteful land use practices, created the unfavourable policy environment, which often compelled the policymakers to ban shifting cultivation.

As a result, in the last few decades, a rapid transformation from shifting cultivation to permanent cropland or mono-culture plantations has been observed in the South-East Asia (Bruun *et al.*, 2009; Heinimann *et al*., 2017).

However, many researchers and scholars have challenged the perception that shifting cultivation is environmentally destructive. For instance, there are multiple studies, which manifest that shifting cultivation dispenses many ecological services in terms of carbon storage in the soil, biodiversity, hydrology, and vegetation (Fox, 2000; Nielsen *et al*., 2006).

Environmental Benefits of Shifting Cultivation

The climate change discourse may make shifting cultivation as an unfavourable practice, since it involves clearing of trees, which results in carbon emission. However, in the consideration of the entire cycle, it absorbs what it emits. Shifting cultivation systems have relatively high carbon sequestration because they typically facilitate vegetation recovery during the fallow periods (Fox, 2000). The prime cause of deforestation in Asia is the expansion of intensive permanent agricultural practices and large-scale transformation of forests into industrial plantations (UNFCCC Intersessional Meeting, Bangkok 2009). In recent years, countries such as Malaysia and Indonesia have initiated land conversion programmes that favour large-scale oil palm plantations, while rubber plantations have been expanded in Southwest China, Cambodia and Laos (IWGIA and AIPPF, 2009). In opposite to what is sometimes argued for, the carbon sequestration potential of such commercial tree plantations like palm monocultures, is smaller than that of agroforestry practices like traditional shifting cultivations (UNFCCC Intersessional Meeting, Bangkok 2009). Bruun *et al*. (2009) estimated the carbon stock to be 74–80 tC/ha for shifting cultivation systems in South Asia with long fallow periods (8 years or more), which is more than commercial plantations of rubber (50 tC/ha) and oil palm (36 tC/ha). However, when the fallow period is reduced to 4 years, the carbon stock is decreased to 8–9 tC/ha. Even such degraded Swidden agriculture stocks more carbon than sedentary agriculture, with estimated 1–4 tonne/hectare. In the Huay Hin Lad community in northern Thailand, agricultural practices like shifting cultivation are potentially capable of sequestering 59,255 tCO_2/yr whereas emits only 2042 tCO_2/yr (AIPPF and IWGIA, 2012).

In one of the most hallmark studies on the shifting cultivation (Conklin, 1957), more than 280 forms of food crops and 92 varieties of rice were found in Hanunoo of Mindoro Island in the Philippines. A four-year research study in the Sop Moeidi district of Mae Hong Son province in northern Thailand, concluded that around 50–60 species of crops, including a few ornamentals, were usually present in local Swidden fields (Rerkasem *et al*., 2009). The long-fallow process plays a pivotal role in preserving the sustainability by restoring soil fertility, by providing a gamut of plant and wildlife products for sale and subsistence, and by providing other ecosystem services such as water flow regulation and protection against erosion (Rerkasem *et al*., 2009). Furthermore, toxic external inputs such as pesticides, herbicides and any synthetic fertilizers, which harm soil and water systems, are not usually used during shifting cultivation (Springate-Baginski, 2013), hence shifting cultivation practice enriches biodiversity.

The shifting cultivation in Southeast Asia is not only diverse and nuanced, but also evolving. Earlier, root crops, such as yam and taro, were intercropped, which now have been replaced by grain crops, such as rice and millets (Rerkasem *et al*., 2009).

Shifting Cultivation and Societal Perspective

Indigenous communities throughout Asia have endured numerous types of human rights abuses as a consequence of state policies and interventions aimed at eradicating shifting cultivation (AIPPF and IWGIA, 2012). Laws and policies that stigmatize and/or attempt to abolish this conventional subsistence activity in Asian countries such as Myanmar, Bhutan, Bangladesh, Laos, Malaysia, Nepal, Indonesia, Vietnam and Thailand, are impacting the well-being of millions of citizens residing in the uplands and forests of the country. The large-scale involuntary resettlements have been conducted with severe consequence in those people affected regions. A research in Northern Laos reported exceptionally high human mortality rates, in certain instances rising up to 20%, due to communicable diseases such as malaria, cholera or diarrhoea in relocation sites (AIPPF and IWGIA, 2012). Even, the survival of the traditional livelihood patterns of indigenous communities, which are focused on shifting agriculture and subsequently indigenous knowledge, spirituality and other cultural traditions closely linked to it, is at stake owing to the reluctance of governments to recognize shifting cultivation as an existing mode of agricultural activity (AIPPF and IWGIA, 2012).

There is also the persistent issue of food security that indigenous population are facing as a consequence of policy interventions that aimed at preventing or restricting shifting cultivation. In northern Thailand, for instance, the development of reserved forests and protected areas has led to a substantial decrease in the amount of land accessible for shifting agriculture. Many indigenous groups face prosecution and incarceration by practicing shifting cultivation. In Vietnam, the introduction of the Forest Land Allocation (FLA) resulted in a reduction in area under shifting cultivation (Sikor and Nguyen, 2011). While 62–70% of local rice supply used to come from shifting cultivation, restrictions on the practice of shifting cultivation by FLA prompted 85% of households to stop the shifting cultivation and pursue permanent farming to maintain their livelihoods (Sikor and Nguyen, 2011). Between 1991 and 2010, the production of upland rice declined from 160 to 30 tonnes in the village of Bu and from 100 to 40 tonnes in the village of Que in Cong Cuong District of Nghe An Province (Sikor and Nguyen, 2011). Similarly in Bangladesh, indigenous people in the Chittagong Hill Tracts (CHT) are finding it challenging to satisfy their food needs due to the reduced production from shifting agriculture (Khisa and Mohiuddin, 2015). This is a result of a shortened fallow cycle, as the areas available for shifting cultivation are reducing due to multiple reasons, including forced possession of fallows by protection camps, afforestation projects by the Forest Department, expansion of forest reserves in the shifting cultivation areas (Khisa and Mohiuddin, 2015).

Shifting Cultivation in Northeast India

We now pay closer attention to northeast India. In the northeast region of India (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura), shifting cultivation is commonly known as *Jhum* and it is a prevalent form of agriculture there. In this region, shifting cultivation method begins by selection of a forest patch and clearing of the vegetation normally in the month of December and January. The cleared vegetation is then left for drying and is burned in the month of February and March. The site is cultivated for food crops and harvested. After the last harvest, farmers move to a new land, and agricultural lands become fallow lands in order to regenerate. It again involves the entire process of clearing the selected patch of forest, followed by a short span of crop cultivation and long span of fallow period in the cyclical shifting of cultivation sites (Hossain, 2011).

Jhum cultivation is the primary occupation and key source of livelihood for roughly 620,000 people, comprising 100 separate indigenous tribes and sub-tribes in the northeast India (Ramakrishnan, 1992). In Mizoram, around 54% (or 58,000 households) of rural communities in Mizoram practiced *Jhum* cultivation to support their livelihoods as of 2000 (Maithani, 2005). The indigenous shifting cultivators practice mix cropping whereby the farmers grow a variety of crops to meet the requirements of the household. The surplus produce is sold in nearby markets and towns. In Meghalaya, shifting cultivation practiced by the tribal communities is a mixed cropping system and it maintains high crop diversity. Although most of the crops grown by the farmers are for self-consumption, the surplus is sold in markets for cash income. In all, 14 or 16 crops to over 24 crops variety are grown by villages in the Khasi Hills. While in the villages of Garo Hills, as many as 30–35 crops are sown in shifting cultivation plots. Although mixed cropping is predominant in most of the systems, people are becoming increasingly interested in growing cash crops in their plots (Deb *et al*., 2013).

The selection of crops for mix cropping in addition to the principal food crops is greatly influenced by the traditional knowledge of the farmers acquired over time and the market demand on the other hand. Datta *et al*. (2014) in their study of the Jhumias of Tripura found that about 80.71% of the tribal farmers develop an annual cultivation plan through experience for the entire farm and plan the number of crops to be grown based on the area selected for *Jhum*. The indigenous Jhumias are very reluctant in adopting foreign crops and varieties. They have their own self-saved varieties of paddy, maize and vegetables that they have been preserving through generations. Depending on the weather, site and soil, the different varieties are sown in a particular plot. Preservation of seed for future crop is considered to be their spiritual responsibility and women folks are mainly responsible for the task (Bhagawati *et al*., 2015).

Given the small scale of land holdings and agricultural deflation characteristic of northeast India, it is uncertain whether settled cultivation would be a reasonable alternative of living for the *Jhum* cultivators (Ninan, 1992). On the other hand, diversification of land use practices is also occurring amongst the communities who practice shifting cultivation in order to satisfy both food and cash requirements (AIPPF and IWGIA, 2014). In Nagaland, the jhumias—farmers who practice *Jhum*—have been able to adapt their farming practices in order to meet changing needs and conditions and, above all, to respond to the possibilities provided by increased consumer access. Farmers have modified crop collection and planting techniques in a creative way to sustain both income development as well as food security (AIPPF and IWGIA, 2014). In Nagaland, for instance, farmers have begun to domesticate some varieties of wild plants from the fallow land, which are in high demand in urban markets.

Northeast tribal communities still have close bonds of identification with the *Jhum*, and their cultural calendar is characterized by festivals and ceremonies that derive significance from the tradition. Thirteen separate festivals linked with *Jhum* cultivation were observed by the Adis (Teegalapalli and Datta, 2016). The agricultural period starts with the Aran festival observed in February, followed by the clearing of forests at the end of February. These festivals are aligned with the practices performed during cultivation: chopping, burning, fencing, seed sowing, weeding, and harvesting. The purpose of these festivals include driving away bad spirits and propitiating good spirits to boost trees, ensure healthy crop yields, and protect their crops from pests (Teegalapalli and Datta, 2016). Jhuming in Tripura begins with selection of plots in the early autumn (November and December), whereby the tribesman cuts the undergrowth to make small clearing to perform religious rites aimed at getting the approval of the supernatural. Thus, *Jhum* is a way of life and expression of tradition.

However, socio-economic circumstances surrounding the shifting cultivation are changing in Northeast India, as elsewhere. With the increasing population, the traditional practice of *Jhum* cultivation has also undergone changes. The traditional cultivation, which was undertaken for self-subsistence using simple tools as sticks or hoe for dibbling to sow crop seeds with long fallow periods, has transformed to the intermittent short fallow periods or transformation to permanent agricultural land (Yadav *et al*., 2012). A recent study reported that the most favourable fallow period in the northeast India is between 7 and 11 years (Thongs *et al*., 2019). However, due to the increase in the number of *Jhum* plots with increase in population, there has been a decrease in the patch size of the *Jhum* fields and shortening of the fallow period (Thongs *et al*., 2019).

In other parts of the region, Mokokchung district of Nagaland for example, the area under shifting cultivation is decreasing as the number of farmers practicing traditional shifting cultivation is decreasing. This is because with the increased and improved educational level and changing aspirations of the younger generation, rural–urban migration, poor productivity, low cash income from subsistence-based shifting cultivation, unavailability of community labour sharing or paid labourers and little or no support from the government for shifting cultivation (Erni, 2015).

Areas under the *Jhum* system have maintained agrobiodiversity through local laws, activities and informal networks for exchanging seeds and traditional information and knowledge, while the diversity of plants has been significantly reduced in most regions where shifting agriculture is replaced by settled agriculture (Alam, 2016). Further replacement of shifting cultivation will result in a major loss of seed genetic resources (Alam, 2016). Diverse crops are cultivated in *Jhum* fields. In the West Siang region of Arunachal Pradesh, the Adi tribal community grows 71 types of crops by practicing *Jhum* cultivation (Teegalapalli and Datta, 2016). In Nagaland, on an average, forty-one types of crops are grown, including six varieties of rice in the *Jhum* fields (Nakro, 2011). The regenerating forest after Jhum cultivation contributes to conservation of agrobiodiversity (Mukul *et al*., 2016), and bamboos are among the main secondary succession species in the fallow fields that facilitate growth of secondary forest by enriching soil nutrients and microbial communities (Arunachalam and Arunachalam, 2002).

Fallow lands sequester and store more carbon dioxide. Overall aboveground carbon (woody, non-woody, coarse deadwood and litter biomass carbon) expanded from 6.0 tonnes of CO_2 ha^{-1} in the youngest *Jhum* fallow (5 years old) to 32.55 tonnes of CO_2 ha^{-1} in the oldest *Jhum* fallow (21–25 years old) (Gogoi, Sahoo, & Saikia, 2020). Soil carbon increased significantly, too, from 14.91 tonnes of CO_2 per hectare in 5-year-old fallow to 48.38 tonnes of CO_2 per hectare in 21–25-year-old fallow (Gogoi, Sahoo, & Saikia, 2020). Since *Jhum* cultivation cycles within the defined extent repeatedly, it is carbon neutral and does not cause new deforestation.

As we briefly surveyed above, shifting cultivation is subjected to confused contexts. The chapters in this volume consider *Jhum* in northeast India from perspectives of the environment (e.g., biodiversity conservation, co-benefits in the form of ecosystem services, climate change mitigation & adaptation), society (e.g., formal and traditional institutions, traditional knowledge, health and nutrition, human migration, food security, gender issues etc.), economy (e.g., livelihoods, farm economics, alternative income sources, etc.) and policy (national and local) to address the following overarching questions:

1. How is the governance of shifting cultivation adapting to changing socio-economic circumstances?
2. Does or can shifting cultivation contribute to biodiversity contribution?
3. How does shifting cultivation support community livelihood?
4. What is the new role that shifting cultivation can play that will make for a sustainable society and environment?

Collectively, this volume aims to bring clarity to shifting cultivation in northeast India.

References

Alam, M.A. 2016. Shifting Cultivation in North-East India: Trend, Benefits and Challenges. *Managing Editor*, 02: 85–114

Arunachalam, A., and Arunachalam, K. 2002. Evaluation of bamboos in eco-restoration of 'jhum' fallows in Arunachal Pradesh: ground vegetation, soil and microbial biomass. *Forest Ecology and Management*, 159 (3): 231–239. doi: 10.1016/s0378-1127(01)00435-2

Bagawati K., Bhagawati G., Das R., Bhagawati R., and Ngachan S. V. 2015. The structure of jhum (traditional shifting cultivation system): Prospect or threat to climate. *International Letters of Natural Sciences*, ISSN: 2300-9675, 46:16–30. doi:10.18052/www.scipress.com/ILNS.46.16

Baginski, O. 2013. Rethinking Swidden Cultivation in Myanmar: Policies for sustainable upland livelihoods and food security. Retrieved 27 June 2020, from https://www.burmalibrary.org/sites/burmalibrary.org/files/obl/docs20/Rethinking_Swidden_Cultivation_in_Myanmar-Pyoe_Pyin-2014.pdf

Bruun, T. B., Mertz, O., and Elberling, B. 2006. Linking yields of upland rice in shifting cultivation to fallow length and soil properties. *Agriculture, Ecosystems & Environment*, 113(1–4): 139–149

Bruun, T. B., De Neergaard, A., Lawrence, D., & Ziegler, A. D. (2009). Environmental consequences of the demise in swidden cultivation in Southeast Asia: carbon storage and soil quality. *Human Ecology*, 37(3), 375-388.

Conklin, H. C. 1957. Hanunoo Agriculture. A Report on an Integral System of Shifting Cultivation on the Philippines. FAO, Rome

Datta J., Gangadharappa N. R., and Debnath A. 2014. Sustainability of jhum cultivation as perceived by the tribal people of Tripura. *International Journal of Social Science*, 3 (2): 179–190

Deb S., Lynrah M. M., and Tiwari B. K. 2013. Technological innovations in shifting agricultural practices by three tribal farming communities of Meghalaya, northeast India. *Tropical Ecology*, 54(2):133–148

Erni, C. 2015. Shifting cultivation, livelihood and food security: new and old challenges for indigenous peoples in Asia. *Shifting Cultivation, Livelihood and Food Security*.

FAO Staff (1957). Shifting cultivation. Unasylva 11: 9–11.

Fox, J. 2000. How blaming 'slash and burn' farmers is deforesting mainland Southeast Asia. *Asia Pacific Issues*, 47: 1–8

Gogoi, A., Sahoo, U., and Saikia, H. 2020. Vegetation and ecosystem carbon recovery following shifting cultivation in Mizoram-Manipur-Kachin rainforest eco-region, Southern Asia. *Ecological Processes*, 9(1). doi: 10.1186/s13717-020-00225-w

Heinimann, A., Mertz, O., Frolking, S., Egelund Christensen, A., Hurni, K., Sedano, F., ... & Hurtt, G. 2017. A global view of shifting cultivation: Recent, current, and future extent. *PloS one*, 12(9), e0184479

Hossain M. A. 2011. An overview of shifting cultivation with reference to Bangladesh. *Scientific Research and Essays*, 6(31): 6509–6514

International Work Group for Indigenous Affairs(IWGIA) and Asia Indigenous Peoples Pact Foundation (AIPPF). 2009. Shifting Cultivation And Climate Change. Retrieved 27 June 2020, from https://www.iwgia.org/images/publications//0514_Briefing_paper_shifting_cultivation_final.pdf

International Work Group for Indigenous Affairs (IWGIA) and Asia Indigenous Peoples Pact Foundation (AIPPF). (2012). Drivers of Deforestation? Facts to be considered regarding the impact of shifting cultivation in Asia. Retrieved 27 June 2020, from https://www.iwgia.org/images/publications/0576_Drivers_of_deforestation.pdf

International Work Group for Indigenous Affairs(IWGIA) and Asia Indigenous Peoples Pact Foundation (AIPPF). (2014). Shifting Cultivation, Livelihood and Food Security: New and Old Challenges for Indigenous Peoples in Asia. Retrieved 27 June 2020, from https://www.iwgia.org/images/publications/0694_AIPPShifting_cultivation_livelihoodfood_security.pdf

Kapoor, M., Sarma, K., and Yadav, P. 2013. Impact of Slash-And-Burn Agriculture on Forest Ecosystem in Garo Hills Landscape of Meghalaya, North-East India. *Journal of Biodiversity Management & Forestry*, 01(01). doi: 10.4172/2327-4417.1000102

Khisa, S. K., and Mohiuddin, M. 2015. Shrinking jhum and changing livelihoods in the Chittagong Hill Tracts of Bangladesh. Shifting cultivation, livelihood and food security, 41

Kuotsu, R., Chatterjee, D., Deka, B.C., Kumar, R.,Ao, M., and Vikramjeet, K. 2014. Shifting Cultivation: An 'Organic Like' Farming in Nagaland. *Indian Journal of Hill Farming*, 27: 23–28

Maithani, B.P. 2005. Shifting Cultivation in North-East India Policy Issues and Options. Krishna for Mittal Publications, New Delhi, India

McGrath, D.G. 1987. The role of biomass in shifting cultivation. *Human Ecology*, 15: 221–242; doi:10.1007/BF00888381

Mukul, S., Herbohn, J., and Firn, J. 2016. Tropical secondary forests regenerating after shifting cultivation in the Philippines uplands are important carbon sinks. *Scientific Reports*, 6(1). doi: 10.1038/srep22483

Myers N. Ed. 1991. Tropical forests and climate. pp. 3-21, Kluwer Publishers, London, UK

Nielsen, U., Mertz, O., and Noweg, G. T. 2006. The rationality of shifting cultivation systems: labor productivity revisited. *Human Ecology*, 34: 210–218 doi:10.1007/s10745-006-9014-4

Nakro, V. 2011. Traditional Agricultural Practices and Sustainable Livelihood: A Thematic Report. Department of planning and Co-ordination, Government of Nagaland. Kohima, Nagaland, India

Nielsen, U., Mertz, O., and Noweg, G. T. 2006. The rationality of shifting cultivation systems: labor productivity revisited. *Human Ecology*, 34: 210–218 doi:10.1007/s10745-006-9014-4

Padoch, C., and Pinedo-Vasquez, M. 2010. Saving Slash-and-Burn to Save Biodiversity. *Biotropica*, 42(5): 550–552. doi: 10.1111/j.1744-7429.2010.00681.x

Ramakrishnan P.S. 1992. Shifting agriculture and sustainable development. Man and the Biosphere Series. Vol. 10. UNESCO-The Parthenon Publishing Group, Paris

Rerkasem, K., Lawrence, D., Padoch, C., Schmidt-Vogt, D., Ziegler, A., and Bruun, T. 2009. Consequences of Swidden Transitions for Crop and Fallow Biodiversity in Southeast Asia. *Human Ecology*, 37(3): 347–360. doi: 10.1007/s10745-009-9250-5

Sikor, T and Nguyen, Q. T. 2011. Realizing Forest Rights in Vietnam: Addressing Issues in Community Forest Management. RECOFTC, Hanoi

Teegalapalli, K., and Datta, A. 2016. Shifting to settled cultivation: Changing practices among the Adis in Central Arunachal Pradesh, north-east India. *Ambio*, 45(5): 602–612. doi: 10.1007/s13280-016-0765-x

Thong, P., Sahoo, U. K., Pebam, R., and Thangjam, U. 2019. Spatial and temporal dynamics of shifting cultivation in Manipur, Northeast India based on time-series satellite data. *Remote Sensing Applications: Society and Environment*, 14: 126–137

Valentin, C., Agus, F., Alamban, R., Boosaner, A., Bricquet, J. P., Chaplot, V., ... and Vadari, T. 2008. Runoff and sediment losses from 27 upland catchments in Southeast Asia: Impact of rapid land use changes and conservation practices. *Agriculture, Ecosystems & Environment*, 128(4): 225–238

Yadav, P. K., Kapoor, M., and Sarma, K. 2012. Impact of Slash-And-Burn Agriculture on Forest Ecosystem in Garo Hills Landscape of Meghalaya, North-East India. *J Biodivers Manage Forestry*, 1: 1. of, 2, 2

Yuen, J. Q., Ziegler, A. D., Webb, E. L., and Ryan, C. M. 2013. Uncertainty in below-ground carbon biomass for major land covers in Southeast Asia. *Forest Ecology and Management*, 310: 915–926

Ziegler, A. D., Bruun, T. B., Guardiola-Claramonte, M., Giambelluca, T. W., Lawrence, D., and Lam, N. T. 2009. Environmental consequences of the demise in swidden cultivation in montane mainland Southeast Asia: hydrology and geomorphology. *Human Ecology*, 37(3): 361–373

CHAPTER-1
SHIFTING CULTIVATION IN NORTHEAST INDIA: EXPLORING THE PAST AND QUESTIONING THE FUTURE

Alka Michael*

Abstract

In northeast India, different forms of food production are practised along with a combination of methods in a mosaic of landscapes at varying intensities. Shifting cultivation is one such form, exercised by communities inhabiting upland areas in the region. For sustenance, it is often supplemented with collecting food from forests, growing vegetables, and reliance on domesticating animals. Community ownership of natural resources is an important characteristic of shifting cultivation. However, this is being gradually eroded as in many places land is in individual hands.

Scholars and scientists have been questioning the future of shifting cultivation against the backdrop of increasing population pressure, migration, and urbanization. In communities that are transitioning towards a settled cultivation or where male members have taken up jobs elsewhere, female members are relegated to the background. Denied access to any form of economic support and the burden of running a household impact their nutritional, health, and economic status. People living in areas that are not easily accessible by roads or remain cut-off for months due to floods or other reasons rely mainly on shifting cultivation for food supply, as the public distribution system is not possible all year round.

The traditional shifting cultivation system has a potential to lead to a sustainable society and healthy environment. The usage of indigenous varieties of seeds proves to be more resilient to the environmental changes as compared to the newly introduced hybrid varieties. Thus, instead of finding alternatives to shifting cultivation, which have often failed, there is a need for viable solutions to make it more productive and less degradative, for the future. This paper examines traditional farming societies in the region and juxtaposes them with the pressing issues in the current scenario with regards to shifting cultivation and the changing role of women.

* Associate Professor, Department of History, Gargi College, University of Delhi

Introduction

In the upland region of northeast India (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura), shifting cultivation, locally known as *Jhum*, continues to be a dominant mode of food production. It forms the economic basis of most of the rural households in the region. However, this set-up is in transition due to increased urbanization, changing socio-economic conditions, and transformation of the role women play in these communities. Due to this, the ecological knowledge and cultural traditions of these communities, which have been continuously transmitted from generation to generation, are in a process of getting lost. The region is endowed with rich natural resources of land, water, vegetation, etc. It is well known for its floral and faunal diversity, land-use patterns, agricultural practices, and traditional knowledge base. The judicious use of these resources could bring about economic prosperity to the region. Being part of the Himalayas and Indo-Burma Biodiversity Hotspots, the region is recognized world over for its rich species and a high level of endemism. The discovery of forest clearing implements (the Naga collection at Pitt Rivers Museum) along with landscape archaeology,[1] provide the earliest evidence of shifting cultivation in the region. The archaeological evidence in terms of implements discovered from sites support the prevalence of shifting cultivation in the region in the earliest times. Communities such as the Garos, Nagas, Karbis, and Dimasas were found to be practising shifting cultivation in the form of a complex agricultural cycle, as reflected in the ethnographic accounts (Singh 2003). Studies show that in societies where shifting cultivation is practised, women play a vital role in the production process and are also involved in decision-making. Division of labour also seems to be more equitable in shifting cultivation than in settled agriculture. A few questions that the author attempts to raise in this paper are: firstly, how is the governance of *Jhum* cultivation adapting to changing socio-economic circumstances? Secondly, does or can shifting cultivation contribute to biodiversity contribution? Thirdly, how does shifting cultivation support community livelihood? Fourthly, what is the new role that *Jhum* cultivation can play to achieve a sustainable society and environment?

This study is based on some of the ethnographic accounts, official data, reports, and research studies conducted on the practice of shifting cultivation in the region. There are several studies that have documented the changes in societies emerged over a period of time in this region. The official records and reports have enormous data pertaining to shifting cultivation, challenges being faced, and the shifts in policies.

Biodiversity, climate, and land in Northeast India

The history of the earliest settlements in the Brahmaputra valley dates back to the pre-historic period. The environmental setting of the river Brahmaputra was conducive for the emergence of a mosaic of settlements in the region in the Neolithic period. The river has influenced the nature of

[1] Landscape archaeology studies the probable distribution of sites in a region, where the landscape itself can be reconstructed by human geographers who have contributed a great deal to the study of prehistoric subsistence patterns.

settlements, flora and fauna, geographical features, and climatic conditions, as most settlements in the region have a riverine character (Michael 2000).

O.H.K Spate (1965:600) remarks that Assam possesses very marked individuality and it is in a sense transitional towards High Asia and Indo-China and even to China itself. Further, this region has earned the unique distinction of being the world's wettest place under the influence of the southwest monsoon characterized by wet summer and dry winter. The available natural resources are rich, diverse, and unique in the region. The forest area that is spread all over the mountain ranges has high biodiversity resources, pastures, and rangelands. The hilly areas in this region form the most important mountain farming areas in the world and are also well known for the origin of many crops and cultivated tree species (Vavilov 1951). The uniqueness of the region is that it is the meeting place of three distinct vegetation zones as highlighted in the following quote:

The tropical rain-forests which cover northeast India, Bangladesh and Southeast Asia are areas in which complex ecosystems have their greatest manifestations. These areas being the meeting place of three distinct vegetation zones have a wide range of edible plants. Further, the alternate wet and dry periods caused by seasonal monsoon, set in motion a set of processes for plants to develop large food storage, such as underground tubers which are present in the region in a large variety: and this is a great source of food for the indigenous population of this area". (Harris 1972)

Ethnographic accounts of the agricultural system of various communities in the region tend to categorize land based on the purpose to which it is finally put to. Land in this region can be broadly categorized into three types, which are *Jhum* land, wet land, and dry land. The *Jhum* lands are those where slash and burn methods of cultivation are practised. Usually, after clearing jungles and bushes, trees and shrubs are then left to dry and burn. The ashes of these add mineral nutrients in the *Jhum* fields.

The uncultivated land is usually a forested area or is covered with tall grasses and reeds. The availability of a variety of soils in the Brahmaputra valley provides suitability for the cultivation of a variety of crops. The broad categories under which the soil types can be divided are also based on its pattern of usage. Variations in the character of soil arise due to location, proximity from the river, forested areas, hilly tracts, and natural phenomena such as floods.

Environmentally, this region features prominently due to three reasons: fragility of the mountain ecosystems, richness of the region's high bio-diversity, and growing awareness of the need to protect and conserve it. Despite its strategic importance and potential, be it in terms of human or natural resources, the region still remains outside the mainstream of the country's development.

Emergence of Agricultural System in Northeast

With regard to the emergence of an agricultural system, scholars have portrayed this region as an area of 'relative isolation' or 'peripheral area'. Yet, the natural resource abundance and diversity of this region is reflected since pre-historic times. The region has a diverse agricultural system comprising foraging, shifting cultivation, pastoralism, fishing, and settled rice cultivation within divergent environmental zones in the utilization of resources as the communities in the past have adapted to the environment of this region. The communities in the past have adapted to the environment due to their dependence on various resources.

Scholars studying agriculture have primarily focused on settled plough cultivation in the plains. The study of agriculture now is not just limited to settled agriculture but shifting agriculture has also come to play an integral role.

Ramakrishnan (2004) refers to the forest farmer as who lives in the tropical region and has managed the traditional shifting agriculture (like the hill people in northeast India, calling it '*Jhum*'). He calls the traditional shifting agriculture as essentially an agroforestry system organized both in space and time over centuries. With increasing pressure on forest resources from outside and population pressure from within and the consequent declining soil fertility through land degradation, agricultural (*Jhum*) cycle has got shortened due to shortage of good forest cover. The *Jhum* farmer is held responsible for all the ills in the region.

Many social scientists have described shifting cultivation as a way of life of the societies practising it. Shifting cultivation fields and their surrounding forests provide two alternative sources of subsistence to the dependent community. In case of crop failure, forest resources provide food supplies in addition to house building material, fuel wood, and timber (NITI Aayog 2018). Anthropologists do not view this form of agriculture as an uninformed, casual, and careless food-getting strategy. Rather, they often have well-developed techniques of clearing, firing, fertilizing the soil, and crop rotation. Although some shifting cultivators depend primarily on one crop, many cultivate several crops, as depending on one may not fulfil the necessary proteins (nutrition) required for the human body (Nanda 1984).

Ludden (1999) presents a contrast between the communities practising swidden farming and those engaged in settled cultivation. He argues that this contrast was seen in terms of caste and tribal societies and between hills and plains. He states that the two co-existing systems maintain their social distance and otherness, even as they interact and share a symbiotic relationship with each other. There exists a competition for land, labour, and natural resources between the two groups, which often led to encroachment by the plain inhabitants into the forest territory. Consequently, *Jhum* cultivators further move deeper into the jungle.

Traditionally, shifting cultivators grew only food grains and vegetables. However, most communities have shifted to cultivation of cash crops such as ginger, turmeric, pineapple, jute, etc. Among food grains, the traditional varieties of rice, followed by maize, millet, Job's-tears, and small millets are the principal crops. Among vegetables, a variety of legumes, potato, pumpkins, cucumbers, yams, tapioca, chillies, beans, onion, and arum are cultivated. In fact, the choice of crop is now mostly consumption oriented. Ginger, linseed, rapeseed, perilla, orange, pineapple and jute are the important cash crops grown in *Jhum* fields. The cash crops are mostly sold in the local weekly markets and in recent years, owing to a growing market in urban settlements as well (NITI Aayog 2018).

A section of researchers believe that regular practise of shifting cultivation with necessary and effective reforms can do little damage to soil as high humidity and fairly long duration of rainfall in the region do not permit the soil to remain uncovered for long. Some form of vegetation grows immediately to cover the top soil and checks erosion. Also, there is no ploughing, hoeing, and pulverization of soil during agricultural operations, so the soil remains compact. Moreover, *Jhum* lands are generally located on hill slopes where sedentary cultivation cannot be developed easily. These researchers also regard that *Jhum* evolved as a response to the environmental character of land under special ecosystems. It is practised for livelihoods, not without knowledge of its adverse effects (NITI Aayog 2018).

Furthermore, scholars are of the opinion that it would be erroneous to conclude that the mere adoption of settled agriculture by upland farmers in northeast India means that the same farmers have given up shifting cultivation. A shifting cultivator may adopt multiple settled farming practices, but still continue to practise shifting cultivation. Crucial for arriving at a realistic and accurate understanding of the 'problem', data on geographical distribution and typology of shifting cultivation (distorted, innovative, modified, or traditional) are required for designing interventions (NITI Aayog 2018).

The State's intervention in the life and economy of the *jhumias* has been a colonial legacy. The impact of the colonial policy towards the treatment of the *Jhum* land, justified the perception of the State towards such an agrarian system. Some aspects of *Jhum* cultivation reinforced the bias of the officials against it. In the northeast, the land revenue department could not earn large revenue due to the prevalence of *Jhum*. The upland areas under colonial domination were subjected to a house tax rather than a land revenue assessment. Usually, the need to encourage the extension of permanent cultivation collided with the forest department's obsession with forest conservation. The land revenue officials were also skeptical of the extension of *jhumming* as were the foresters. This fact imparted an added confidence to the forester's point of view that saw *Jhum* as a wasteful form of cultivation. This official policy of the British was carried forward after independence by the Indian State without taking into account the relevance of *Jhum* in the hill economy of the tribal communities (Das 2006).

The total area under shifting cultivation and the total number of households that are engaged in it are not clear. The Task Force on Shifting Cultivation set up by the Government of India, in their report of 2003, estimated a cumulative area of 1.73 million hectares under the practice in the northeastern region during 1987–97. It was based on a report of the Forest Survey of India, which was published in 1999. More recent figures are provided by the Indian Council of Forestry Research and Education, published in the Statistical Year Book 2014 by the Ministry of Statistics and Programme Implementation. The figures inform about a significant reduction in the area under shifting cultivation over the last decade (NITI Aayog 2018).

However, a data comparison suggests that the figures for 2010 presented in the Indian Council of Forestry Research and Education document are more or less same as published in Wastelands Atlas of India (2010) for 2005-06 for Assam, Manipur, Mizoram, and Tripura. Variation in data published by various agencies raises serious concerns regarding the accuracy of figures provided by different agencies. Thus, highlights the need for urgently generating authentic data for the current area under shifting cultivation on a decadal time series basis. This should be possible through remote sensing. It would provide a reliable basis for accurately assessing the area under shifting cultivation in each State as well as temporal trends of change over the last few decades (Niti Aayog 2018:5).

Jhum and Socio-economic Changes

The north-eastern region is undergoing tremendous change. There have been changes in the composition of the population as well. There are various tribes inhabiting different pockets in the region. However, they also move within and outside the region to seek education and employment opportunities. The natural calamities in the region have also been continuous phenomena, with flooding of the river Brahmaputra and its consistent shifting course. The region is also prone to earthquakes, which keep on occurring at regular intervals. Thus, the population constantly move due to natural and other factors. Additionally, there are people who have settled here from other regions, such as Bengalis and *Marwaris,* who are engaged in business activities and other professions.

The region's socio-economic profile is also in a constant state of flux due to urbanization and globalization. The new wave of consumerism also reflects in the changing lifestyles and food habits of the people. It has permeated into the region with shifting trends from the demand for ecologically viable textiles, manufactured mostly by the local women, to a greater dependence on brand names and factory produced cloth from outside. A shift in food habits is also seen – from a rice-based food culture to more 'fast food' offered by the so called well-known companies. Many of the finer culinary processes in the region such as usage of bamboo shoot, herbs, fermented food, unique varieties of rice and the products made from them, preservation and drying of various kinds of plants and meats, etc., are gradually getting lost.

In the long run, all these majorly impact the women, who have been the carriers of this tradition. Their livelihoods also depend heavily on these existing forms and due to a transition towards a market-based economy, they are at a loss. There are many self-help groups and women's NGOs who have been working to revive these home-based women entrepreneurships. Notwithstanding, it seems these attempts are unable to keep pace with the extent of commercialization.

'Shifting cultivation' owing to the pressures of rapid urbanization and commercialization is also questioned for its sustainability and viability with regard to increasing pressure on food demand. The changing nature of the land-use patterns has taken place to meet the needs of urban expansion and a spurt in construction activities. The hilly areas are also now brought into the fold of construction with modern buildings as well as quarrying activities.

There is a need to assess the changes in shifting cultivation with regard to the social, economic, and cultural advances. Factoring in women, who under the traditional system played an integral role as decision-makers and self-reliant in terms of basic needs of food, shelter, and clothing is also required.

Urbanization in the Northeast

An analysis of urban development in post-independence India shows that there has been an uneven regional distribution of cities and towns. No other region illustrates this better than the northeast. Much like in the rest of the world, tribes in India were traditionally associated with land- and forest-based livelihoods. Accordingly, their traditional habitats had been rural and forested areas. However, this changed during the colonial period. Tribal people were not only integrated into the modern state, but also into the wider economy and society. But, this integration was not uniform. This modernization had a far-reaching impact on the tribal society, resulting in changes in different spheres of their social life. Following independence, this process of change increased. Some of the most striking changes in the tribal society are transition from agriculture to modern occupations, expansion of modern education, emergence of the middle class, switch from traditional political institutions to modern institutions of governance, and the shift from traditional religions to different denominations of Christianity (Khakha 2019).

The region's path to development has been severely constrained by an intricate web of geographical, political, social, and economic problems. It seems that changes have taken place due to economic globalization in the northeast region. The structural adjustment and consequent liberalization of the national economy has not yet benefited the region's economy and not profited due to the changed economic environment. It has been argued that the prospect of globalization is not promising for the region, as it is unable to attract global players due to geo-political factors. As the region failed to participate in the globalization process, no significant change has been identified in its urban areas. Instead, urban growth rates in bigger north-eastern states declined considerably in the post-reform period (1991 onwards)in comparison to the preceding decade.

The urban areas in northeast India have been frequently reorganized through inclusion and denotification of towns due to administrative reasons. A large part of the urban growth process is due to notification of smaller villages as towns and expansion of bigger towns through incorporation of outlying villages in the region. The region's economic backwardness due to geographical, political, and socio-economic factors results into its physical and economic isolation. The failure to integrate with the outside world positioned the region into a mere consuming space (Saitluanga 2013).

Women in the Northeast

Fernandes and Barbora (2002) argue that while it is true that the tribal tradition of the northeast gave more rights to women than caste societies, the situation is changing in favour of patriarchy and at times of patriliny even in matrilineal societies. Women in the northeast, whether they are tribals or not, enjoy a higher status as compared to other parts of the country.

The difference between shifting cultivation and settled agriculture is another form of distinction between societies. There is also a difference in the form of ownership. By and large shifting cultivation depends on common property resources. Studies in eastern India show that among most *Jhum*-practising tribes, the village council takes decisions on the area to be cultivated. It also determines the size of the plot each family could cultivate according to the number of mouths to feed. Families with excess labour assist those with a shortage of workers. At this stage, the man of the house chooses a plot and performs rites to mark the beginning of cultivation. From that moment, women takes charge of the plot and control production and labour. The division of work has traditionally been more equitable in societies practicing shifting cultivation as compared to those engaged in settled agriculture. Hence, in a community-based system in which there is a division between the family and social spheres, women have greater control over the resources meant for immediate use than in settled agriculture, which is controlled by the man (Fernandes and Barbora 2002).

The Aka, Dimasa, and Garo are *Jhum*-cultivating societies in which women played an important role in decision-making in the domestic sphere of the family. The demand of a few Garo men for decision-making role in the domestic sphere shows signs of change in these societies (Fernandes and Barbora 2002). They have gone beyond barter to a monetary economy. Money is by and large under men's control, particularly when they depend less on *Jhum* and the forest and more on a job outside. In this situation, men claim for the main decision-making role, despite their encounter with the commercial world, the family remains the centre of their life which changes with more commercialization (Fernandes and Barbora 2002).

According to the agricultural statistics, the state-wise classification for the north-eastern region of workers, as shown in Table 1, indicates a large number of female working population out of the total female population. Table 2 shows the state-wise classification of women agricultural workers for 2011 out of the total number of workers. The data reveal that women comprise almost 50% of the work force in the agricultural and the non-agricultural sectors. This also explains the higher position that women possess in the north-eastern region.

Table 1: State-wise classification of workers for 2011

State-wise	Total Female Population	Female Working Population	Female Main Workers*
Arunachal Pradesh	669,815	237,384	177,612
Assam	15,266,133	3,428,130	1,652,481
Manipur	1,417,208	565,202	359,028
Meghalaya	1,475,077	481,910	336,055
Mizoram	541,867	195,965	151,725
Nagaland	953,853	426,767	298,975
Sikkim	287,507	113,780	69,884
Tripura	1,799,541	424,195	189,138

Source: Government of India (2018)

* Those workers who have worked for more than 6 months in a year.

Table 2: State-wise classification of agricultural workers for 2011

State-wise	Total Cultivators	Female Cultivators	Total Agricultural Labour	Female Agricultural Labour
Arunachal Pradesh	302,723	149,860	36,171	17,794
Assam	4,061,627	961,864	1,845,346	716,136
Manipur	574,031	246,922	114,918	68,886
Meghalaya	494,675	217,345	198,364	92,022
Mizoram	229,603	100,121	41,787	19,299
Nagaland	537,702	278,248	62,962	31,105
Sikkim	117,401	54,074	25,986	13,103
Tripura	295,947	67,079	353,618	139,512

Source: Government of India (2018)

Jhum and Community Livelihood

It has been observed that traditionally people inhabiting the mountains perceived and managed the environmental resources in their habitats for their basic needs. The forest has been the most important resource system that provides a range of diverse resources in the region. The people perceived the forest as a source of food and water and it provided support to human life. The management of land resources including land use, land protection, forests, planting, harvesting, and distribution practices were based on their perception of the human–environment relationship. Forests, rangelands, and the farming system were managed by the tribal communities themselves as a form of a multiple use system. The forest resources were carefully maintained as the forest fulfilled the needs of the communities. The cultural beliefs of the tribes in this region have contributed a lot to biological diversity and environmental protection, along with materials such as food, shelter, medicine, plants, and many social customs and religious rituals. The principle of co-existence between the natural environment and human beings is thus developed and presented as a distinctive physical phenomenon in the mountainous section of the region (Aier and Changkija 2003).

The International Centre for Integrated Mountain Development (ICIMOD) in collaboration with NERCORMP and MRDS during 2002–2009 conducted studies in the West Garo Hills, Meghalaya and Ukhrul district, Manipur. They outlined that despite adoption of multiple farming systems, 70% of the households in Ukhrul and over 90% in West Garo Hills still continue to practise shifting cultivation, complementing other farming systems (NITI Aayog 2018).

A study of the agricultural operations of the Karbis reveals that the entire agricultural cycle was carried out throughout the year, also shown in Table 3 (Pandit and Das 1993). It includes the collection of roots and tubers from the forest area and also the assessment, preservation, and storage of food items for lean periods. The farmers follow their self-formulated cycle of agricultural activities considering several factors such as climate, celebration of festivals, etc. Alongside, members of the community contribute to the performance of various tasks at different levels, such as food gathering, which is a manual task, and assessment, which requires mathematical calculations.

Table 3: Agricultural calendar of the Karbis who are engaged in shifting cultivation

Month	Corresponding Month in Karbi Language	Nature of Operation
January	*Arkoy*	*Sokrio* (paddy is brought home from the field)
February	*Thang thang*	*Ritland* (*Jhum* fields are selected)
March	*Therapo*	*Mamte* (forest areas are burnt)
April	*Jangami*	*Meri* (weeding)
May	*Aru*	*Nong-chingdi* (seeds are sown)
June	*Wosik*	*Hen-up-Kardong* (bamboo shoots and wild tubers are gathered from the forest)
July	*Jakhang*	*Hen-up-Kardong* (bamboo shoots and wild tubers are gathered from the forest)
August	*Pai pai*	*Sok-mendu-lutai* (paddy is cut and kept in the jungle rest house)
September	*Chiti*	*Bihen-up-ahi* (bamboo shoots and wild tubers are gathered from the forest)
October	*Phre*	*Sokthe* (paddy harvest time)
November	*Phaikuni*	*Sok-bui-pangni* (paddy stored)
December	*Matijong*	*Sok-bui-cheyong* (assessment of the quantity harvested)

Source: Pandit and Das (1993)

Shifting cultivation can be seen not just as a different form of agricultural practice or land use but as a whole system of religious beliefs, attitudes, and performance of rituals along with farming (Das 1993). The shifting cultivators perform their agricultural tasks with a certain element of sacredness. All operations begin with the performance of rituals and community feasting for praying the deities for a good harvest.

The Karbi women play an important role in the economy. Whether in cultivation, cutting, weeding, clearing jungles for *Jhum* or collecting fruits, tubers, medicinal plants, herbs, firewood, etc., Karbi women work side by side with men. Nevertheless, social and religious taboos exist. For example, they are not allowed to attend a village court or partake of food along with men in religious and community feasts (Fernandes and Barbora 2002).

Jhum has been associated with community life and tradition. In 2004, a workshop was held on shifting cultivation in Shillong, which was attended by various stakeholders such as farmers, environmentalists, scholars, and NGOs. The workshop favoured a review of the existing policies on *Jhum* and *Jhum* farmers. It was highlighted that *Jhum*-based productive activities have a positive role to play in providing livelihood for the tribal people while it ensures conservation of the environmental resources on a sustainable basis (Ganguly 2005).

New Role of *Jhum* for Sustainable Society and Environment

The research conducted on shifting cultivation so far can be categorized into two: one that highlights the negative role played by shifting cultivation and its impact on environmental degradation. And, the other set of research presents an alternative model of *Jhum* and its implications, suggesting and recommending ways of coping with *Jhum* practices.

Since the colonial period, shifting cultivation has been looked upon as an unsustainable system. It is also stated that slash and burn agriculture leads to deterioration of the vegetative cover on the hills. Thus, forest lands degenerate into infertile grasslands and barren lands. Hence, it was argued that this system of agriculture is unsustainable and economically impoverishing for the people dependent on it. Also, in the post-independence period, the colonial contention of unsustainability of shifting cultivation was the basic premise of formulating development plans for tribal and hill villages. The main thrust of this approach was to wean the cultivators from shifting agriculture and to rehabilitate them by providing land to practise settled cultivation in plains or terraced cultivation in hills or raising plantation crops, etc. (Ganguly 2005).

Furthermore, there are two approaches with regard to improvement of agro-technology for *Jhum* cultivation. First is the improvement of the existing *jhuming* and second is the replacement of the present form of *jhuming* by alternative programmes. Since the strategy to ban *Jhum* cultivation has not been a success, efforts are needed to develop improved *Jhum* cultivation practices to meet the challenges of soil and water conservation. Improvement of shifting cultivation would work better for farmers living in remote areas, where a transport network is not accessible.

The general strategy adopted for the *Jhum* fields in these areas should be to gradually change the mixture of crops in relation to the length of fallow period. Different techniques should be promoted to minimize the depletion of soil, water, and forest resources in the composition of the crop mixture. The techniques would be directed for the different levels of soil, water, and forest resources, which are themselves conditioned by different durations of the fallow period. Attempts should be made to decrease the relative importance of rice in *Jhum* fields and increase the production of other crops such as pulses, vegetables, tubers, and rhizomes. The production of more cash crops as well as multipurpose fast growing trees in the abandoned *Jhum* fields should be encouraged. Some of the important measures that can improve the present form of *jhuming* are: contour bunds/trenches between the crops, intercropping, toposequential cropping, use of handy tools in sowing, weeding and harvesting operation, generation of subsidiary source of income through sericulture, mushroom and livestock farming, etc. (Satapathy 2003).

The Proceedings of the Workshop on Prioritization of Strategies for Agricultural Development in Northeastern India (2001) highlights that the new wave has branded this system as anti-development and has accused it as deleterious to the environment. The proceedings recommend that instead of attempting to eliminate it, attempts should be made to improve it by modern means. Based on scientific experiments, the Agricultural University in Jorhat developed a suitable model alternative to shifting cultivation. The model includes use of manures and fertilizer, growing of field crops (rice, sesamum, and maize) along the slope, inclusion of perennial horticultural crops (pineapple and mandarin orange), and use of perennial grasses for conservation of soil and maintenance of soil fertility. This model was seen as suitable for hills with gentle slope. This model needed extensive demonstration in the field (Pathak 2001).

In northeast India, shifting cultivation functions on an institutional framework that is by and large based on a common-pool resource (CPR). The communities have evolved a set of customary laws, rules, and traditions that govern the CPR and regulate tenure. Over the years, due to modernization, population increase, and pressure of market forces, these institutional arrangements have weakened, leading to distortion of *Jhum* and degradation of the CPR. In several places *Jhum* is no longer being practised on community or village lands. Thus, any transformational approach for shifting cultivation has to consider this development to protect the interest of the poor *Jhum* farmers. The inconsistency and incongruence among government policies related to shifting cultivation need to be addressed. The dispute over land use categorization of *Jhum* land should be resolved. Land under shifting cultivation should be recognized as agricultural land where farmers practise agroforestry for producing food rather than viewed as forest land being destroyed (NITI Aayog 2018).

Conclusion and Practical Application

The transition in the last 70 years from centuries of isolation to intense interaction with the outside world has been so rapid and abrupt that traditional management systems are in the process of getting crumbled. The challenges that traditional mountain societies are facing in the transformation from a subsistence economy to a market-oriented one are varied, complex, and difficult. The transition from isolation to intensive interaction with advanced cultures has led to the weakening of the traditional and natural resource management systems in the region. Although, external interventions have often proved counterproductive in the region. Thus, it is important to realize that traditional knowledge and management systems are the best way to sustain the livelihood of traditional societies in this region (Aier and Changhija 2003).

Research needs to focus on opportunities offered by mountain specificities. Studies on blending traditional knowledge on resource use and management with modern scientific approaches should be strengthened. This could be achieved by building upon traditional agriculture in the northeast and assessing their strengths while seeking solutions to address the challenges brought about with changes. The approaches for transformation – and supportive research and development – should not completely negate traditional land use, but balance the traditional with the modern. And, wherever possible, the approaches should improve the productivity of existing practices through acceptable technological interventions by the communities. Research should focus on appropriate technological forms and approaches for value addition of typical or niche products found in shifting cultivation systems. It should also include development of appropriate farm and processing machineries suitable to upland systems without impinging upon the upland forest ecology and community participation (NITI Aayog 2018).

The local adaptations of the shifting cultivators were heavily influenced by the community structure and cultural life . The traditional food production and procuring systems and previously existing ecological balance are now collapsing under pressure of population expansion and increasing food demand. Consequently, there have been expansion of *Jhum* area and reduction of the fallow period. To resolve the problems of shifting cultivation, attention was turned to agroforestry. Since shifting cultivation is a type of agroforestry, scientific agroforestry is not so much an 'alternative' to shifting cultivation. However, it can be seen as a systematic approach to reintegrate the basic elements into more productive, sustainable, and politically viable forms of land use, even under population pressure, which leads to competing use of land and labour. (Mohapatra and Chandra 2017).

Programmes aimed at eradicating shifting cultivation in the northeast exist since the start of the 20th Century. Initially these programmes were based on the assumption that the introduction of cash crops would help to wean people away from *Jhum*. Thus, *Jhumias* were given planting material and financial help to switch over to these crops. However, it was soon realized that cash crop cultivation could not be adopted as an alternative to *jhuming* as people practise it mainly to meet their essential food requirements. The *Jhumias* are unable to shift overnight to plough agriculture from hoe agriculture, and only the better-off families can afford to hire the additional labour required for transplanting and maintaining terraces. Attempts to resettle *jhumias* by distributing marginal lands for permanent cultivation in Tripura have led to greater indebtedness, land alienation, and impoverishment of the resettled families.

A series of research projects on the agro-ecological systems of the northeast has led to a shift in focus from *Jhum* control to *Jhum* management, specifically, the management of the fallow land. The unique socio-economic conditions of different communities in the region require location-specific solutions to deal with the problems currently affecting *Jhum* cultivation. The major constraints for the continuity of shifting cultivation, identified by the NITI Aayog (2018) report are – lack of coordination between different departments, inexperience of extension staff in 'participatory development' techniques, lack of service facilities such as credit, input supply, and marketing, and lack of scientific analyses of farming systems in different locations and micro-climatic conditions. By emphasizing on the needs of the people and avoiding the 'one size fits all' approach, there is a need to sensitize the government agencies regarding the special needs of the hill tribes. Additionally, evoking a better response to the unique features of the various farming systems in the region is required (Kandpal and Bhowmik 2017).

Agroforestry systems are suitable for enhancing productivity and reducing fallow period of *Jhum* lands, such as the Alder-based system in Nagaland. The Angami tribe of Nagaland practises an alder-based sustainable *Jhum* system, which was developed in Khonoma village in Nagaland. It provides about 57 food crops to supplement the staple crop rice. The root nodules of the alder (*Alnus nepalensis*) plants improve soil fertility by fixing atmospheric nitrogen into the soil. The fallen leaves add humus to the topsoil. Their wood is used as fuelwood, for charcoal burning, and in construction work. Also, alder saplings collected from nurseries or wild forests are planted in a *Jhum* field located in hills above 1000 m. Thus, with the incorporation of alder trees in *Jhum* lands, the fertility of the fields would be increased (Kandpal and Bhowmik 2017).

The Konyak tribes in Nagaland also have sound knowledge of the ecosystem, which they use in their shifting cultivation practices. In a study (Bhan 2009) conducted in the Nganchin village of Mon district, Nagaland, it was observed that the tree-stand density nowhere in the Naga system matches the Konyak system where at times about 3000 small saplings could be observed in 1 ha of land. They gradually reduce the density during the fallow period. They manage the seedlings and saplings of *Macaranga denticulata* on the *Jhum* field and do not uproot them unless the density is too high for cropping. The species grows in poor conditions and has prolific regenerative capacity. They have a sound knowledge of mixing rice and colocasia, by which the sloppy land is covered under vegetation for a greater part of the year, that is, from April to December. Mixed cropping of rice and colocasia is also practised by Garo and Khasi tribes of Meghalaya and they cultivate colocasia as a supplementary crop. However, both are their main crops to meet their food requirements. The Konyaks have a good sense of fallow management and are aware that the leaves and twigs falling from the trees restore the fertility of the *Jhum* land. They count the number of leaf falls and believe that after seven times of 'leaf fall' the land becomes mature enough to cultivate. That is why they keep the fallow period as 7 years and deliberately retain the seedlings of tree species for establishment during the resting phase (Kandpal and Bhowmik 2017).

In the Khasi hills of Meghalaya, shifting cultivation is known as '*Rep Syrti*'. It involves cutting and burning of forest vegetation on sloppy lands and using the site for 2–3 years to grow rice, maize, millets, beans, cassava, yam, sweet potato, ginger, chillies, and vegetables. Thereafter they shift to another forest site to repeat the same process. At times, a single crop of rice is grown in the second year of *jhumming*. The trees are deliberately integrated with the crop and livestock production system. The choice of a particular tree species and intercrop depends upon the climatic conditions of the area and economic importance of the species (Kandpal and Bhowmik 2017).

The declining productivity of *Jhum* lands is the main threat for sustainability of shifting cultivation. One of the main reasons for rotation of land in shifting cultivation is exhaustion of soil fertility and search for a new fertile land. To make the fallowed *Jhum* lands fertile and less prone to soil erosion, there is a need for the following interventions to increase sustainability:

» Adoption of soil fertility restoration measures and suitable cropping sequence for soil improvement.

» Increasing soil nutrients through conventional sources such as organic manure, crop residue, compost, etc., should be given due emphasis since the farmers are reluctant to use chemical fertilizers.

» Soil and water conservation needs to be carried out through adoption of site-specific land use systems, viz. horticultural-based land use system.

» Agroforestry has been a long-standing custom in the region, where cereals, rhizomes, pineapple, coffee, tea, spices, and vegetable crops are grown along with fruits and other trees such as pine, pear, plum, areca nut, mandarin, guava, coconut, jackfruit, banana, and large cardamom with alder trees.

» Adoption of soil and water conservation measures through terracing, contours, bunds, etc., should be done. Terracing of hills with abandoned *Jhum* land not only helps in reducing hill slopes but also provides a platform for creation of micro water harvesting structures. Terracing is a costly affair and the land use policy for terracing of *Jhum* lands should focus on enhancing agricultural productivity and livelihood security (Hazarika 2017).

If *Jhum* is seen as an integral mode of production within the agricultural system which has strong cultural linkages with the traditional communities, improvement of the system seems to be a viable option for all stakeholders. This includes *jhumias*, government development agencies, and researchers. People should be motivated to balance out the ecological degradation of the production system rather than completely abandoning it.

References

Aier, A. and S. Changkija. 2003. Indigenous knowledge and management of natural resources. In: Subba, T. B. and G. C. Ghosh (eds). *The Anthropology of North-East India*. New Delhi: Orient Longman A

Bhan, S. A Case Study on Shifting Cultivation Practices in Mon district of Nagaland. Journal of Soil and Water Conservtion – 8 (2)

Das, D. 2006. Demystifying the myth of shifting cultivation: Agronomy in the north-east. *Economic and Political Weekly* **41** (47): 4912–4917

Das, D. 2018. State-science, hegemony and shifting the cultivator: Contesting the 'anti-modernity' discourse on shifting cultivation in South Asia. In: Nag, S. (ed.). *Playing with Nature: History and Politics of Environment in north-east India*. Routledge: New York

Fernandes, W. and S. Barbora. 2002a. Changing women's status in India: Focus on the northeast. Guwahati: North Eastern Social Science Research

Fernandes, W. and S. Barbora. 2002b. Modernisation and women's status in north eastern India. Guwahati: North Eastern Social Science Research

Ganguly, J. B. 2005. Some misconceptions about shifting agriculture. *Journal of North-East Indian Council for Social Science Research* **29** (2): 1–5

Government of India. 2018. Agricultural Statistics at a Glance 2018. Ministry of Agriculture and Farmers Welfare, Department of Agriculture, Cooperation and Farmers Welfare, Directorate of Economics and Statistics

Harris, D. 1972. The origin of agriculture in the tropics. *American Scientist* 60: 180–193

Hazarika, S. 2017. Options for natural resource conservation for *jhum* improvement in NEH region. In: *Jhum Improvement for Sustaining Farm livelihood and Natural Resource Conservation in North Eastern Hill Region: Vistas and Frontiers*. Indian Council of Agricultural Research, ICAR Complex for NEH Region, Meghalaya

Kandpal, B. K. and S. N. Bhowmik. 2017. Shifting cultivation in Tripura: Challenges, prospects and alternatives. In: *Jhum Improvement for Sustaining Farm livelihood and Natural Resource Conservation in North Eastern Hill Region: Vistas and Frontiers*. Indian Council of Agricultural Research, ICAR Complex for NEH Region, Meghalaya

Khakha, A. 2019. Tribes and urban development in north-east India: Issues and challenges. *Economic and Political Weekly* **54** (38) (online)

Ludden, D. 1999. *The New Cambridge History of India IV. 4: An Agrarian History of South Asia*. Cambridge University Press

Michael, A. F. 2000. *Along the Brahmaputra: Beginnings of History*. (unpublished, M.Phil Dissertation)

Ministry of Statistics and Programme Implementation. Details available at http://mospi.nic.in/46-twenty-two-fold-classification-land-use, last accessed on May 21, 2021

Mohapatra K. P. and P. Chandra. 2017. Rejuvenation of *jhum* land through agroforestry interventions. In: *Jhum Improvement for Sustaining Farm livelihood and Natural Resource Conservation in North Eastern Hill Region: Vistas and Frontiers*. Indian Council of Agricultural Research, ICAR Complex for NEH Region, Meghalaya

Nanda, S. 1984. *Cultural Anthropology*. California: Wadsworth Publishing Company

NITI Aayog. 2018. Report of Working Group III Shifting Cultivation: Towards a Transformational Approach

Pandit, T. N. and N. K. Das. 1993. Land use system and ecological ethics among the shifting-cultivators of northeast India. In: *The Pre-Agricultural Communities of India*. Calcutta: Anthropological Survey of India, Ministry of Human Resource Development

Pathak, A. K. 2001. Technology, development and its impact on farmers' fields. In: *Proceedings of Conference on 'In Prioritization of Strategies for Agricultural Development in Northeastern India'*. New Delhi: National Centre for Agricultural Economics and Policy Research (ICAR), pp 68–74

Ramakrishnan, P. S. 2004. Sustainable development of *Jhum* with conservation of biodiversity in north-east India: Where do we stand? In: *Man and Society*: *A Journal of North East Studies* **1** (1)

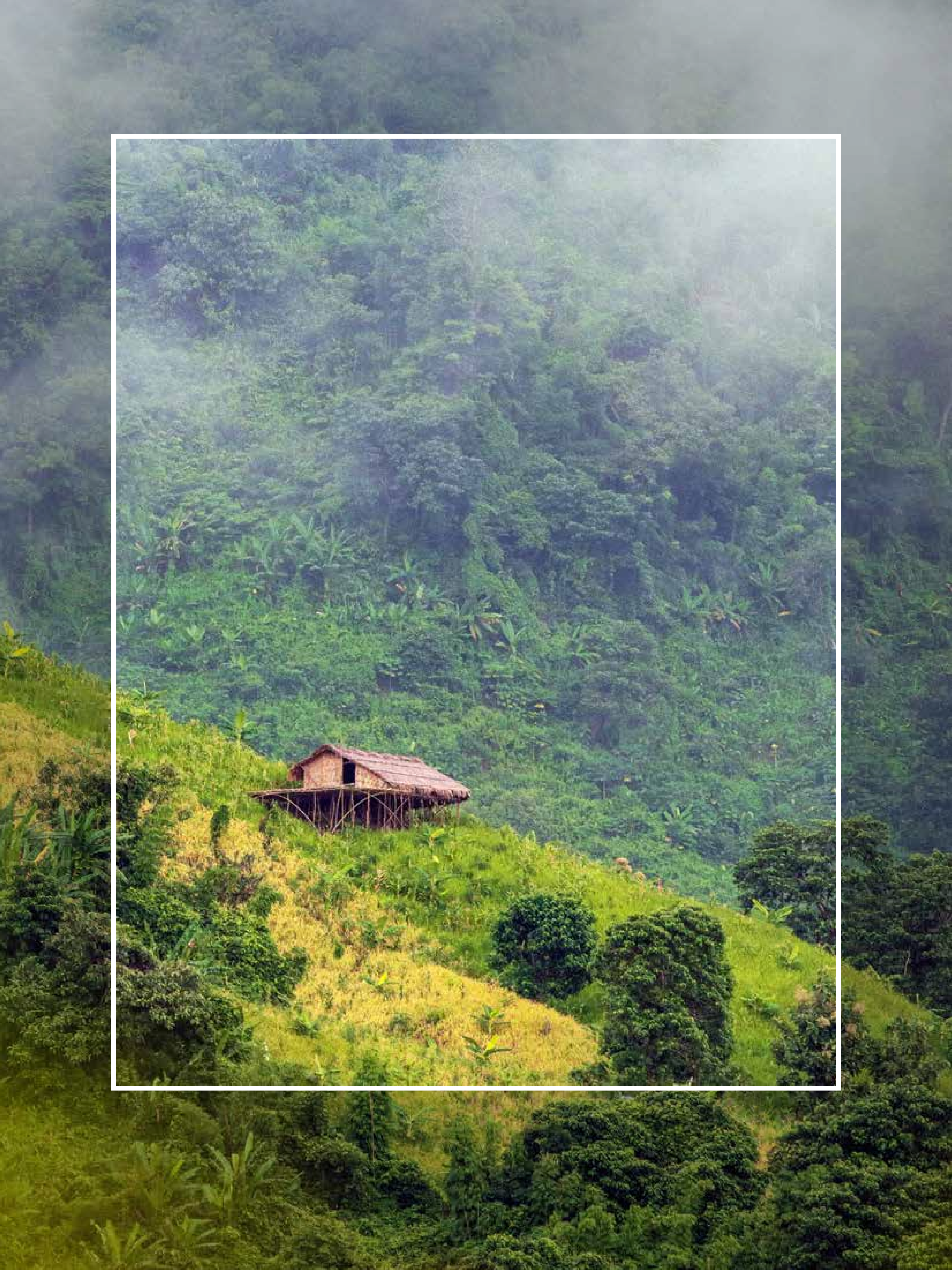
Saitluanga, B. L. 2013. *Globalisation, Urbanisation and Spatial Inequality in India with Special Reference to North East India*. England: ACCB Publications

Satapathy, K. K. 2003. Methods and techniques of land management in north-east India. In: Husain, Z. (ed.). *Environmental Issues in North-East India*. New Delhi: Regency Publications

Singh, K. S. 2003. *People of India: Assam*. Volume XV Part Two, Calcutta: Seagull Books

Spate, O. H. K. and A. T. A. Learmouth. 1967. *India and Pakistan: A General and Regional Geography*. UK: Methuen and Co. Ltd.

Vavilov, N. I. 1951. *The Origin, Variation, Immunity, and Breeding of Cultivated Plants*. Cambridge: Cambridge University Press



CHAPTER-2

UNDERSTANDING THE LAND USE/LAND COVER DYNAMICS IN A SHIFTING CULTIVATION DOMINATED REGION USING GEOSPATIAL TECHNIQUE

Kasturi Chakraborty[1], Jakesh Mohapatra[2], Sameer Mandal[2], K K Sarma[1], and Ashesh Kr Das[3]

Abstract

Land use/land cover (LULC) change is a global concern; however, the process of the change varies from region to region, depending on the driving force. The rich and highly diverse forest ecosystems of northeast India have been facing tremendous threat due to several driving factors of LULC change (LULCC).Shifting cultivation, also known as *Jhum*, is a traditional agriculture system of the local communities of India's northeast region (NER) for sustenance. It is an integral part of LULC in the region. Due to changing perception, now *Jhum* is regarded as a primary factor of LULCC in the region, leading to deforestation. Thus, a holistic view is required to understand the LULCC scenario for tackling rampant land use change in this region by identifying the appropriate driving factors. For this purpose, Barak basin of NER was selected as a study area. The case study used available LULC maps in GIS database to generate time series satellite images of the region from 1988 to 2016. Furthermore, in this study, *Jhum* cultivation was mapped by visual interpretations for 2020 to observe the *Jhum* trend from 1988 to 2020. The LULC mapping shows a decrease in dense (approximately 12%) and open forest (10%) and shifting cultivation has almost remained constant in the region. The rate of change within 5km x 5km grid shows approximately 25% of forest loss between 1988 and 2016 in some locations. Concurrently, the scrubland open category increased as high as 6%. Besides, rubber and tea plantation mapped using satellite image, the ground observations reveal monoculture/cash crop plantations spreading in the region which is perhaps an irreversible LULC change taking place in this region. This study also

1 Scientist 'SF', North Eastern Space Applications Centre (NESAC), Umiam, Meghalaya-793103. Email: kasturi.nesac@gmail.com

2 Researcher, North Eastern Space Applications Centre (NESAC), Umiam, Meghalaya-793103

3 Retd. Professor, Dept. Of Ecology and Environmental Science, Assam University, Silchar, Assam

discusses various traditional sustainable management practices of the local communities, which were observed during ground surveys. Moreover, the study utilizes the geospatial technology in conjunction with ground-based surveys to understand LULCC in context of shifting cultivation in a prototypical site.

Keywords: Land use/land cover, remote sensing and GIS, shifting cultivation, monoculture

Introduction

Landcover (the biophysical attributes of the Earth's surface) and land use change (human purpose or intent applied to these attributes) play an important role in global climate change phenomena (Turner, Clark, Kates, *et al*. 1990; Vitousek 1992).Changes in landscape structure represent the impacts of land-use change (Forman and Godron 1986). According to IPCC (2018), land use refers to the total arrangements, activities, and inputs undertaken in a certain land cover type (a set of human actions).In the context of forest loss due to land-use change, wildfires are found to be the dominant reason in temperate and boreal forests. Whereas, shifting cultivation and community-driven deforestation are the factors responsible for forest loss in tropical regions (Curtis, Slay, Harris, *et al*. 2018).Shifting cultivation is an interesting LULC type, since the same land is treated under two different LULC categories at two distinct time periods. During the cultivation phase, shifting cultivation lands fall under the category of agriculture, however, the same lands are considered under forests during the fallow phase (Tiwari 2018).

The prevalence of shifting cultivation (locally known as '*Jhum*') in the hilly parts of almost all north-eastern states in India is one of the distinct features of land use int he region. Shifting cultivation is a predominant tropical land use, sustaining subsistence of communities in remote and isolated areas (Morton, Borah, Edwards, *et al*. 2020).Furthermore, Heinimann, Mertz, Frolking *et al*.(2017) expressed issues related to livelihood security and resilience due to shrinkage of shifting cultivation area in the next decade. They predict that shifting cultivation, which has been a globally important form of human crop cultivation for millennia, may be gone by the end of this century. The age-old practice of shifting cultivation is evident from various literatures. For example, Spencer (1966) expressed that shifting cultivation as a highly diverse land use system evolved as early as 10,000 BC in a wide range of socioeconomic and ecological conditions. Conversely, a report on the drivers of deforestation talks about stereotype views from various sources that consider shifting cultivation as primitive, inefficient, and wasteful, leading to poverty, degraded soil and forest, and carbon emissions (AIPP-IWGIA 2012). In addition, several studies, such as Lele and Joshi (2008), Dutta and Das (2014), Reddy, Singh, Dadhwal, *et al*. (2017) listed shifting cultivation as one of the prime drivers of deforestation. The India State of Forest Report outlined a continuous trend of decline in forest cover in NER, particularly, due to shifting cultivation (FSI 2019). Whereas, FAO, UNDP, and UNEP (2008) find that the main cause of carbon emission due to deforestation in Asia is intensification of agriculture and large-scale conversion of forest for industrial plantations instead of shifting cultivation. A study by Reddy, Dutta, and Jha (2013) observed a net deforestation rate slightly positive in NER – 0.02 from 1989 to 1999 due to regrowth of vegetation in abandoned shifting cultivation areas and protection measures. According to Kerkoff and Sharma (2006),' more forests are conserved by shifting cultivators than permanent farmers who make efficient use of their landscape with combined agriculture and forestry through local knowledge. In the midst of these global views, it is important to note the findings of Schmid *et al*., (2021) who highlighted the intensification and expansion of smallholder land systems through expansion of oil palm and rubber plantations and urged for careful land use planning to support nature and people by sustainable development—particularly in biodiversity hotspots.

Satellite remote sensing data with varying resolutions is considered to be an unmatched source of information, which can be used with better confidence than the traditional inventory estimates (Nguyen, Doan, Erkki, *et al*. 2020).In comparison to the labor-intensive field surveys, remote sensing is widely used for accurate mapping of shifting cultivation areas (Roy and Behera 2005). Further, remote sensing in generating maps using high-temporal resolution satellite images can serve as inputs in policy decisions for shifting cultivation management in NER (Das, Mudi, Behera, *et al*.2021). A recent study by Thong, Pebam, and Sahoo (2017) used time series satellite images to provide information on the change in land use, age of jhum cycle, and fallow period in Champhai district of Mizoram. The spatio-temporal dynamics of shifting cultivation within Barak basin was presented by Chakraborty, Sarma, Kundu, *et al*. (2015), highlighting a reducing trend of the shifting cultivation practice.

This study utilizes the remote-sensing and GIS technology (geospatial technology) with ground-based information to understand the role of shifting cultivation in LULC dynamics in the representative basin of NER.

Study Area

For this study, Barak basin was selected as a prototypical region for *Jhum* in NER. The extent of the basin is between 92^0 09' 7.66" to 94^0 23' 4.64" and 22^0 40' 30.38" to 25^0 50' 21.06". The total area of Barak basin is 26146.88 km^2. The basin, as shown in Figure 1, which includes Assam, Manipur, and Mizoram and has small portions of Nagaland and Tripura (North Tripura). The topography of the basin ranges from 15 m to 3000 m. The basin is dominated by a moderate elevation zone of 200–800 m and a slope of 0–30%. The topography is formed by both low-lying areas and a high undulating terrain, which represent the LULC pattern of low-lying plain areas as well as hilly regions. Being a tribal-dominated area, it has its own land use policy, with major share of land owned by local communities.

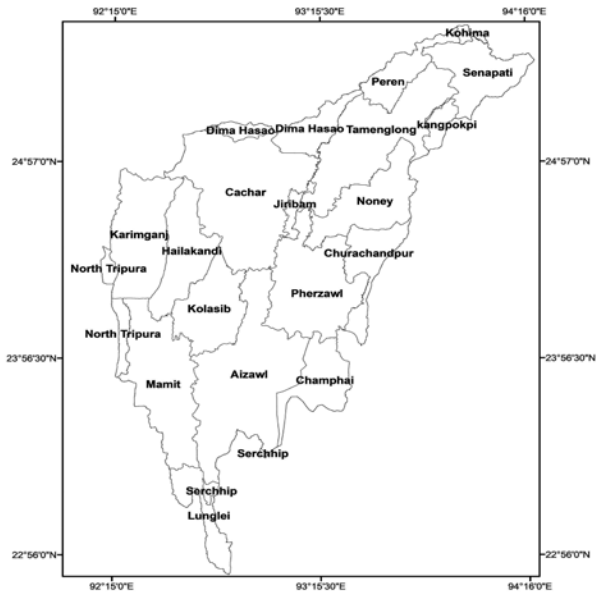


FIGURE 1: Barak basin boundary with district of NER states covered within the basin

Materials and Methodology

This study was conducted under three different categories, which are as follows:

a) Historical LULC change assessment between 1988 and 2010

A historical analysis forms the basis of a landscape evaluation (Marcucci 2000).Thus, an assessment was carried out using remote sensing-based LULC spatial and temporal maps available in literature (Chakraborty, *et al*. 2017) for 1988,1997, 2005, 2010, and 2016. The output maps were generated by using an onscreen visual interpretation technique at 1:50,000 scale through LANDSAT for 1988 and 2016. Also, IRS-LISS III satellite data were used to map for 1997, 2005, and 2010. The details of the database generation are available in Chakraborty (2016). However, it is pertinent to mention that appropriate pre-processing steps such as resampling and Top of Atmosphere corrections were performed for maintaining spatial resolution and radiometry of the temporal images.

The forest loss is the prominent LULC change, which was quantified by the annual rate of forest change using a compound interest formula (Puyravaud 2003). The annual rate equation provides a standard method for comparing land cover changes that were insensitive to the differing time periods (10 versus 5 years) between observations dates (Puyravaud 2003).

The rate of deforestation is expressed as the percentage of remaining forest that is cleared per year.

$r = 1/(t_2 - t_1) * \ln A_2/A_1$........................(Puyravaud 2003)

Where, r is the annual rate of change, A_1 and A_2 are the forest cover at time t_1 and t_2, respectively.

This equation was used to monitor the rate of forest and scrubland change.

(b) Changes in shifting cultivation in selected zones from 1988 to 2020

Since shifting cultivation is more prevalent in forest areas, two sites were selected based on the rate of change from forest to non-forest map. The areas under shifting cultivation from 1988 to 2016 were taken from previous LULC mapping (as discussed in the historical LULC change assessment) and a new map was generated for 2020. For this purpose, the same methodology was followed to derive shifting cultivation areas in the GIS domain. The remote sensing notes were used by visual interpretation of the False Colour Composite images from LANDSAT data downloaded from United Nations Geological Survey (USGS) website. Based on the spectral reflectance properties, shifting cultivation patches were delineated. For precision, the images of minimum two time periods (between months/years) were observed to assess the patches as true shifting cultivation areas. Hurni *et al*. (2013) suggested the use of multi-season imagery. Further, extensive ground truth data were collected for the validation of maps. This also helped to understand the various conservation measures and ground scenarios of *Jhum* land conversion.

(c) Observations from field surveys and Google Earth imagery

To understand the different phases of shifting cultivation and vegetation forms it creates extensive field work is necessary (Kurien, Lele, and Nagendra 2019). Thus, this study included ground surveys, collection of information on the sustainable mode of *Jhum* cultivation practices being followed by the local communities, interaction with the people involved in *Jhum* cultivation, and literature survey. The empirical study brought out many interesting facts about the *Jhum* practice, reflecting the traditional shifting cultivation methods. Simultaneously, Google Earth images were consulted to observe the dynamics of the *Jhum* patch.

Results

a) Analysis of LULC dynamics from the available LULC maps of 1988–2016

The LULC dynamics of the region from 1988 to 2016 is shown in Table 1. And, the LULC maps of the respective years are given in Figure 2(a) to 2(e).

Table 1 : Overall land use/land cover statistics (area in %) of Barak basin

Land use classes	1988	1997	2005	2010	2016
Built-up	2.48	2.68	2.99	3.70	4.06
Cropland	9.15	9.76	10.45	10.83	10.84
Dense forest	35.68	32.21	28.62	25.19	23.42
Open forest	35.74	32.65	30.54	28.86	28.33
Plantation	0.67	0.75	0.80	0.84	1.22
Scrubland– Dense	6.06	7.52	8.69	9.24	10.25
Scrubland– Open	4.45	6.08	10.24	14.32	14.49
Jhum	3.83	6.40	5.74	4.99	5.34
Waterbodies	1.94	1.95	1.93	2.03	2.03

Forest is the dominant LULC category in this basin. Plantation includes rubber and tea, which could be delineated due to continuous wide area plantations and distinct spectral signature. Scrublands (open and dense) generally occupy topographically high locations in the region. In the basin, forests have reduced, whereas scrublands have increased from 1988 to 2016. Figure 2(f) shows the zones of forest loss classified based on rate of change computation within 5km x 5km grid size between 1988 and 2016. In the figure, very high negative change represents forest loss between 15%and 25%, high negative change represent the areas of forest loss between 10% and 15%, medium negative change is between 6%and 10%, low negative change represent the areas having forest loss between 1% and 6%, and very low negative change are the areas showing <1% change. Also, there are a few sites where no change in the LULC was observed. Also, it can be seen that the whole basin area has been facing an LULC change with minimal area under the positive change category. There are zones in the rate of change map showing a forest loss of up to 25% within 5km x 5km.

LULC maps study area

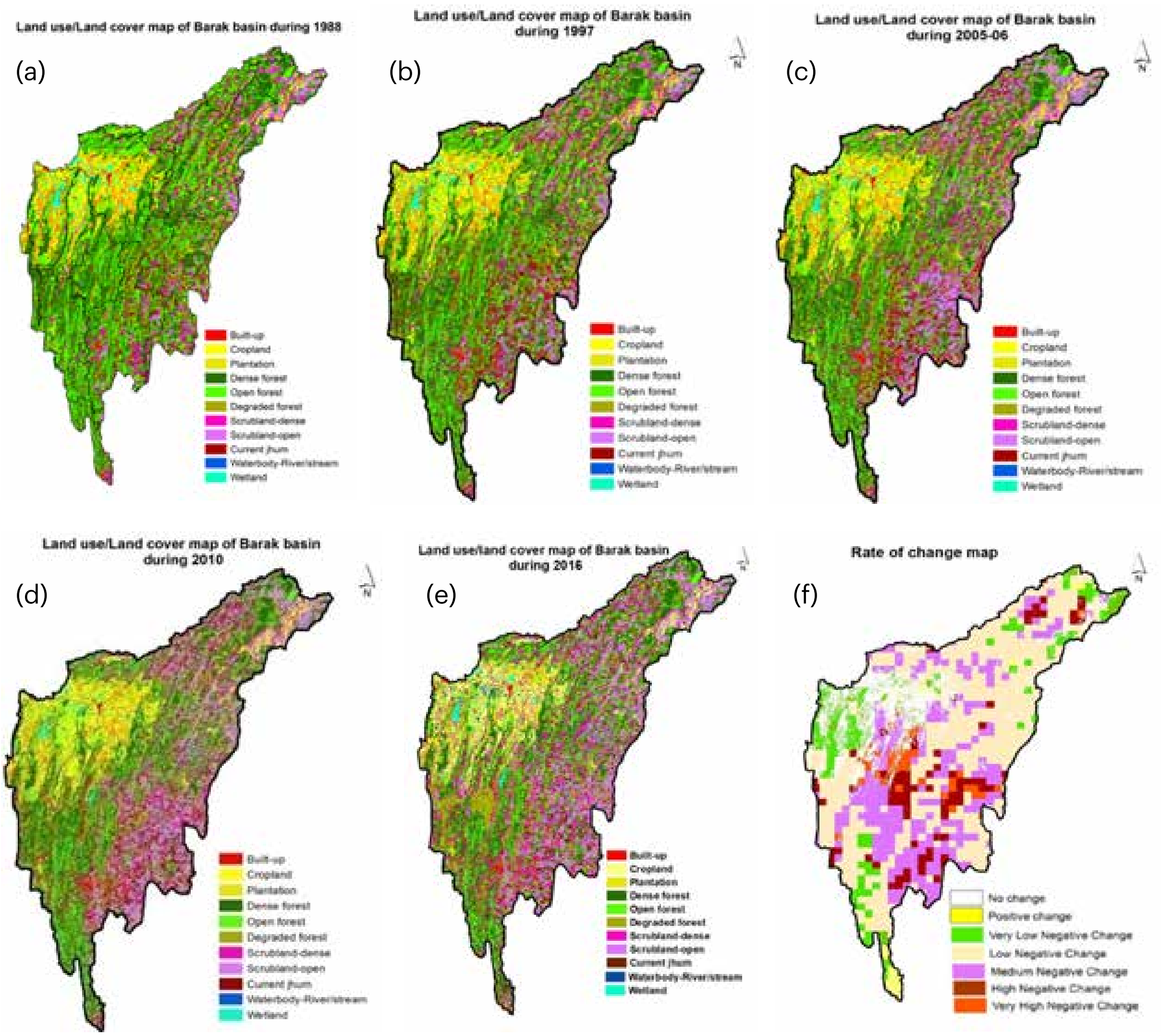


FIGURE 2(a)–(f): Land use/Land cover maps of Barak basin

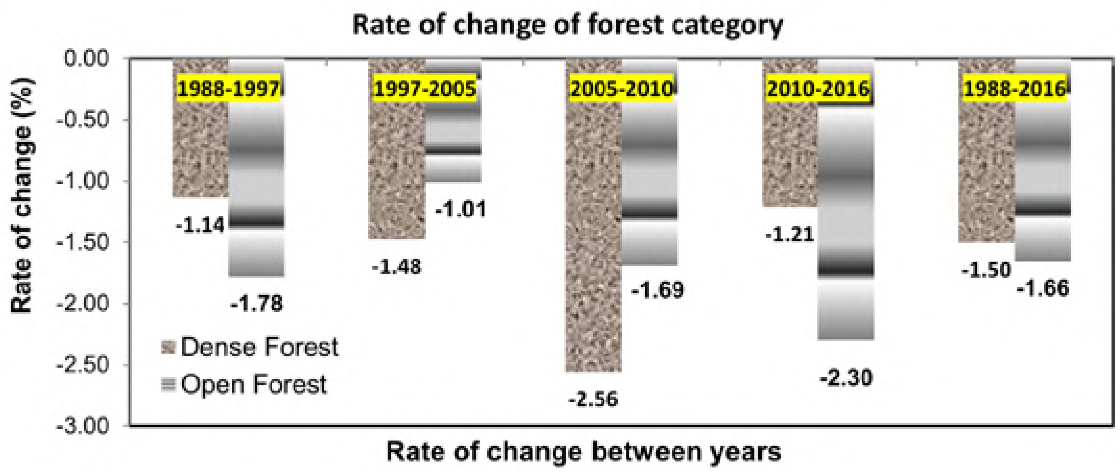


FIGURE 3(a): Rate of change of forest category from 1988 to 2016

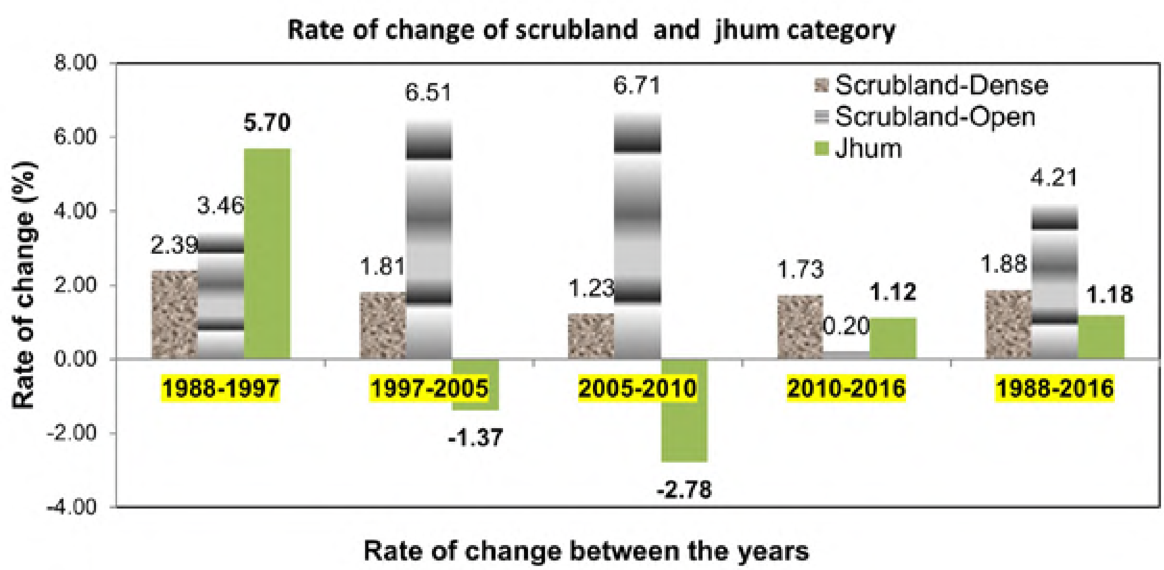


FIGURE 3(B): Rate of change of scrubland category from 1988 to 2016

b) Changes in shifting cultivation trend in selected zones from 1988 to 2020

A downward trend of shifting cultivation was observed between 1988 and 2020 in both the sites, as shown in Figure 4. The decrease in area is prominent in case of Aizawl where lots of *Jhum* eradication measures are being taken up.

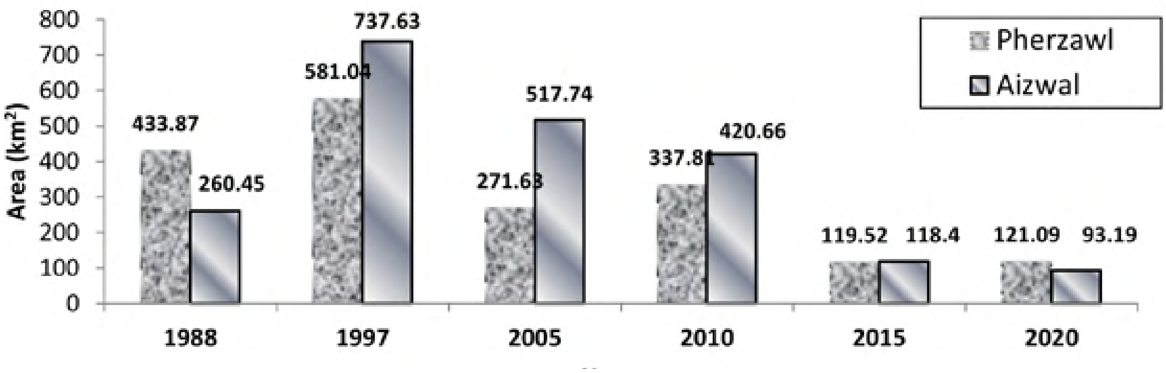


FIGURE 4: The change in shifting cultivation during different time periods in Pherzawl and Aizawl

c) Observations from Google Earth imagery and field surveys with examples of management practices

In the context of deforestation, Google Earth images, as shown in Figure 5, reveal that there has been forest re-growth post shifting cultivation, which is contrary to the belief that the cultivation is only responsible for forest loss. This LULC dynamics plays a very important role in the overall LULCC scenario in any shifting cultivation-dominated landscapes. Other than the Google Earth imagery, several literatures were referred to in this study. Further, a few of the *Jhum* plot management efforts practised by communities and local authorities in the region are presented in Photos 1–8.

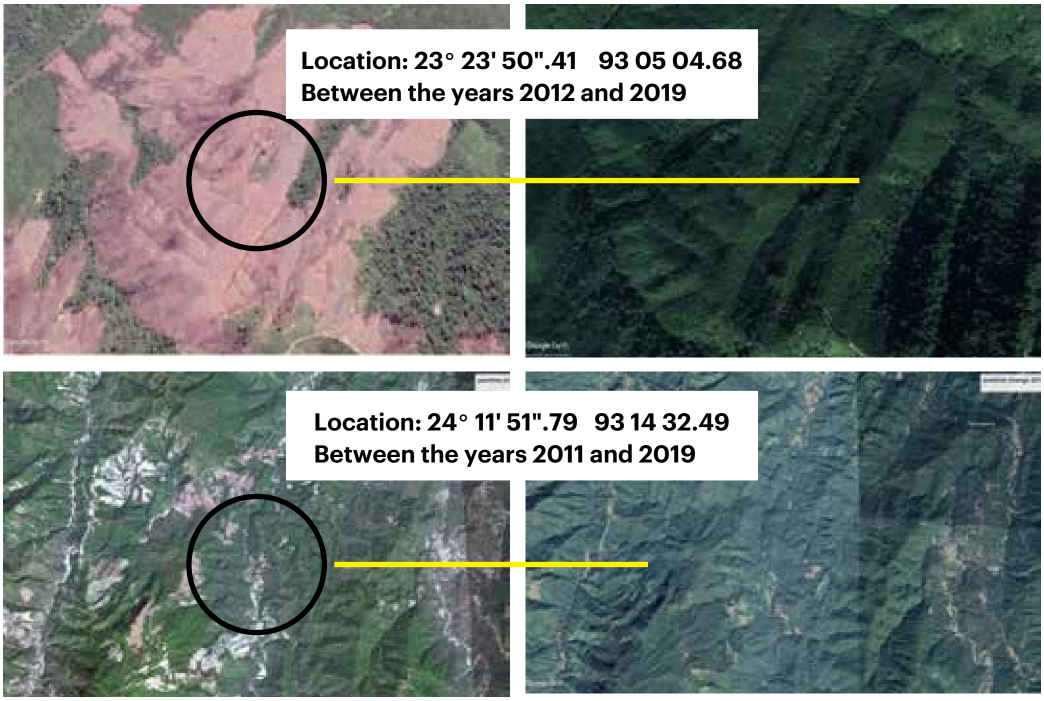


FIGURE 5: *Jhum* cultivation sites showing growth in vegetation

The Alder-based *Jhum* cultivation is one of the oldest and unique of its kind. Similarly, the rice-based *Jhum* practice is also the oldest form, which preserves a unique rice variety.

PHOTO 1: Alder-based *Jhum* cultivation in Khonoma village, Nagaland

PHOTO 2: Approximately 3 years old abandoned *Jhum* plot

PHOTO 3: Hill paddy cultivation in Churachandpur district, Manipur

PHOTO 4: Plantation after *Jhum* cultivation in Churachandpur district, Manipur

PHOTO 5: Bamboo plantation in *Jhum* fallow, Churachandpur district, Manipur

PHOTO 6: *Quercus* spp. Coppice retained for regeneration in *Jhum* fallow, Chandel district, Manipur

PHOTO 7: Passion fruit cultivation in abandoned Jhumland in Kohima district, Nagaland

PHOTO 8: Plantation of *Parkiatimoriana*–nitrogen-fixing tree for soil restoration in Churachandpur district, Manipur

During field visits, changing land use scenario in many shifting cultivation-dominated areas were observed. In such cases, various plantation practices were adopted that were triggered by commercialization and instant economic benefits. Photos 9–14 show the examples of various plantations being adopted in shifting cultivation sites of NER.

PHOTO 9: Jhumlands being converted to rubber plantation on Assam–Mizoram border

PHOTO 10: Extensive increase in Areca nut plantation. Field photo from Garo hills, Meghalaya

PHOTO 11: Jhum land converted to oil palm plantation in Mizoram

PHOTO 12: Jhum land converted to oil palm plantation in Mizoram

PHOTO 13: A field photo of opium (poppy) cultivation in Manipur

PHOTO 14: Involvement of local community in opium (poppy) cultivation in Manipur

The traditional and most sustainable Alder *(Alnusnepalensis)*-based *Jhum* cultivation, as shown in Photos 1 and 2, is a famous practice of Angami Nagas of NER. During a field visit, it was found that a separate site was planted with firewood species to reduce dependence on forests. Photo 3 shows the practice of hill rice cultivation, which preserves a unique rice variety, by the local communities. Photo 4 shows that the fallow *Jhum* plots are replanted with a mix of tree species such as *Gmelinaarborea, Duabanga* species, pine, bamboo, etc. Field Photos 5 and 6 show another interesting example of a *Jhum* cultivation area management practice from Manipur. Bamboo plantation in an abandoned *Jhum* area in Churachandpur district is shown in Photo 5. A coppice *Jhum* plantation site, as shown in Photo 6, is an example of the *Quercus*-based *Jhum* land management. In Photo 7, passion fruit cultivation is shown, which were planted using saplings received from State Agriculture Departments for the development of the abandoned *Jhum* lands. Photo 8 shows a plantation of nitrogen fixing tree *Parkia* spp. (*Parkia timoriana*) in the interior parts of Churachandpur district, Manipur.

During the field visits, certain instances of Jhum land conversion to other land use types were observed. Photo 9 is an example from a site on Assam–Mizoram border where a transition from shifting cultivation to rubber plantation was observed. An example of widespread areca nut plantation in Garo hills, Meghalaya is shown in Photo 10. A conversion of *Jhum* land to oil palm cultivation was also observed in some parts of Mizoram, as shown in Photos 11 and 12. The field photographs 13 and 14 present a recent trend in the LULC conversion to poppy cultivation. These are from the interior parts of Churachandpur district where large tracts of forest lands/*Jhum* lands were converted to poppy cultivation. The involvement of local communities in poppy cultivation can be observed in the photographs.

Discussion

Jhum—an ancient practice of cultivation of nearly 9000 years old—is regarded as a first step in a transition from food gathering and hunting to food production (Sharma 1976; Borthakur 1992). The system is prevalent in NER of India, practised by tribal people of the hilly areas in the region (Tripathi and Barik 2003). More than 100 indigenous tribes and 6.2 lakh families depend on *Jhum* in this region (Ramakrishnan1992).This land use practice exists within the bounds of socio-ecological limitations (Ramakrishnan 2015). The selection of land (mostly during December–January) is done by village elders or clan leaders based on their traditional soil fertility knowledge (Bhuyan 2019). The science behind *Jhum* is based on an intuitive experience of a farmer whose foundation is based on a long tradition. Such traditions have much to offer with regard to concepts and ideas to the modern agricultural organization (Ramakrishnanan 1984). Additionally, traditional farming systems, like shifting cultivation, are highly resilient to a range of shocks and vulnerabilities influenced by external factors (FAO 2019).

Although this system is considered as an ancient traditional practice, there are claims regarding the negative impacts of shifting cultivation including deforestation and soil loss. FAO (1957) declared shifting cultivation as the most serious land use problem in the tropical world. Shifting cultivation has been referred to as a primary driving force for deforestation in tropical Asia (Myers1993). According to FAO, it is a backward and inadequate system for tropical forest conservation (Mertz, Padoch, Fox, et al. 2009). It is reported that shifting cultivation leads to habitat fragmentation, deforestation, and forest degradation (Roy 2011; Schmidt-Vogt, Leisz, Mertz, et al. 2009; FSI 2011, 2019; Roy, Behera, Murthy, et al. 2015; Chakraborty 2009). Bhatt, Jat, Arunachalam, et al. (2019) attributed shorter *Jhum* cultivation cycle to a high degree of land degradation. Furthermore, it is asserted that the non-availability of timely employment avenues leads to tribals holding on to the non-viable resource utilization primitive practice to sustain their families (Panda and Sarkar 2017).

This study on the Barak basin represents the pattern of LULCC taking place in the NER. Chakraborty (2009) conducted a study on Barak basin in which zones of forest disturbance were identified through principal component analysis techniques using coarse resolution time series MODIS EVI 250m data. In the present study, available LULC maps of previous years in the GIS database (Chakraborty, *et al*. 2017) provided a base map to study the LULC spatial and temporal dynamics within the basin. It is very clear that the basin has been going through a rapid LULC change with decreasing forest areas and increasing scrubland areas. It was found that the dense forest cover depleted at a rate of 2.56% between 2005 and 2016. The LULC change, as shown in Figure 2, shows that there has been a forest to non-forest conversion at a rate of as high as 25% between 1988 and 2016 within a 5-km grid. Such sites definitely need immediate attention. On the other hand, areas under *Jhum* decreased from 1988 to 2020. This indicates towards other factors responsible for land use change in the region, particularly in the hills districts, evident by the increasing scrubland. Ground observations showed that forests are cut indiscriminately either for fuel wood or for the purpose of selling in the market for a profitable return. The ground observations also revealed the conversion of shifting cultivation areas to monoculture commercial crops in forest areas and on fertile plots. Chakraborty (*et al*., 2018) studied the rapid expansion of rubber plantation using remote sensing-based mapping in a sub-watershed of Barak basin.

Furthermore, conversion of shifting cultivation areas due to rapid spread of opium (poppy) plantation (Photos 7 and 8) is the most recent pattern of LULCC in Chandel and Churachandpur districts of Manipur. Such instances are also reported from Arunachal Pradesh. Kramer *et al*. (2014) observed the local farmer's compulsion to grow opium for their survival in South East Asia. Additionally, the rising price of opium attracts investors from large towns, resulting in a widespread deforestation as it is secretly grown deeper in forests and at inaccessible places. For continuous production, poppy is cultivated using high doses of fertilizers. Poppy is a narcotic drug and psychotropic substance and the cultivation permissions are provided under general conditions notified by the Central Government. This not only converts the fertile land but has a social implication. Nonetheless, the local farmers with a repository of traditional knowledge are accepting poppy cultivation in the *Jhum*lands. Similarly, oil palm plantations are becoming largest driver of virgin forest loss in south-east Asia and its expansion in northeast India will replace habitats of significant wild plant and animal species (Srinivasan and Velho 2018). Mixed oil palm with intercrop is a more efficient land use system considering the land sharing versus land sparing perspective (Khasanah, *et al*. 2020). India one of the largest consumer and importer of oil palm oil, is pushing towards self-sufficiency by rapid expansion of plantation occurring at the expansion of biodiversity rich landscapes (Srinivasan, *et al*. 2021).

To study the current land use change scenario in NER, it is important to consider various traditional sustainable *Jhum* management practices. There are views that *Jhum* is a 'low-external agricultural input technology' suitable in ecologically-sensitive and hilly terrains where use of modern technology has limitations (NEPED and IIRR, 1999). There are several ways of attaining sustainability in *Jhum* lands, and one such example is alder (*Alnus nepalensis*)-based age-old farming practice in the region. Alder-based *Jhum* cultivation has several advantages. The most important is the biological nitrogen fixation in alder through a symbiotic relationship with nitrogen fixing actinomycetes of the genus *Frankia* thereby improving soil quality (Rathore, Karunakaran, and Prakash 2010). Its foliage has fodder value serves as sources of fire wood and charcoal, furniture making, etc. This model is an example of sustainable model of land use evolved through numerous years of testing (Kehie, Khamu, and Kehie 2017).

Another is *Jhum* paddy cultivation, which preserves important hill rice species and at the same time, retains original tree species in the field that regenerate during the fallow phase. According to Kithan (2014), *Jhum* paddy cultivation constitutes 56.50% area and 49.26% of rice production in Nagaland. The sound ecosystem knowledge of the Konyak tribes is an exemplary instance of shifting cultivation management. Furthermore, approximately 3000 saplings of 42 species such as *Macaranga denticulata,Sapium baccatum, Grewia* spp., *Quercus* spp., *Schima wallichii, Alnus nepalensis,* etc., can be found in 1 ha of *Jhum* land practised by Konyak tribes (Prakash, Roy, Ansari, *et al*. 2017).

Several *Jhum* plots have a mix of species such as banana and pineapple, etc. *Quercus* spp. is considered to be an ideal coppice and fire-resistant species. Thus, with a mix of this species and similar other species, the *Jhum* land can regenerate faster. There is a scope for soil reclamation and restoration in the abandoned *Jhum* areas. Agroforestry-based systems can be adopted with soil-enriching nitrogen-fixing tree species composition such as *Parkia, Alnus,* and *Albizia* in combination with leguminous crops including *Vignasps., Cajanuscajan, Glycine max,* etc. (Devi and Choudhury 2013). Agroforestry systems are found to be promising land use systems for conserving abandoned jhum areas and soil carbon stocks (Tiwari, Kumar, Thakur, *et al*. 2017). There are several economically viable and fast-growing trees in *Jhum* fields that are encouraged by Nagaland Environment Protection and Economic Development (NEPED) projects in Nagaland. These species are *Gmelina arborea* (gomari), *Alnus nepalensis* (Alder), *Tectona grandis* (Teak), *Melia composite* (Ghoraneem), *Terminalia myriocarpa* (Hollock), *Cedrela serrata* (Hill toona), *Spondias axillaris* (Hog-Plum), *Aquilaria agallocha* (Agar), *Duabanga grandiflora* (Khokon), *Anthocephalus cadamba* (Kadam), etc.

The paan (betel leaf) *Jhum* practised by the Khasia community in Barak valley is an example of a traditional knowledge-based agroforestry practice with high economic output and sustainability (Nath, Reang, Das, *et al*. 2016). According to Rana, Dutta, and Rathi (2012), tribals of NER practising shifting cultivation takes care of all the essential crop species (approximately up to 40) in the same field. They have been practising a mixed land use system where a large number of crop species are managed over both space and time. Furthermore, the inventory of oak-based *Jhum* system reported diverse agroforestry crops consisting of as many as 33 species that belong to 28 genera under 15 families (Singh and Teron 2019). The fast growing bean leguminous tree species *Parkiatimoriana* is considered as a tool for reclamation of degraded *Jhum* lands of Manipur. The species not only acts as a carbon sink but also supply soil nitrogen (Singh 2019). Pandey, Adhiguru, Sah, *et al*. (2020) demonstrated the loss of exceptional agro-biodiversity after the conversion of shifting cultivation to rubber plantation, leading to degradation of ecosystem services.

To mitigate LULCC in the shifting cultivation areas, the new land use policy in Mizoram aims to put an end to the practice of *Jhum* by providing alternate sustainable land-based activities (Anonymous 2009). The decisions are taken by the people who remain outside the *Jhum* spaces (Leblhuber, Shahnaz, and Vanlalhruaia 2012). Mandal and Shankar (2016) compared and reported the lowest bird species richness in oil palm and teak plantations compared to *Jhum* lands and natural forests in the core and buffer zones of Dampa Tiger Reserve, Mizoram. The shifting cultivation area around the tiger reserve was planted with teak and oil palm plantations in response to the state's new land use policy. The policy's goal is to eradicate the so-called 'wasteful' shifting agriculture in Mizoram (Singh 2009). Tripathi, Vanlalfakawma, and Lalnunmawia (2017) assessed various land use policies being implemented in Mizoram and found that the revised new land use policy encouraged the large-scale red oil palm (Elaeis guineensis) cultivation in the region. This led to shrinking of shifting cultivation areas and as farmers started producing the same amount of food from smaller plots by following shorter durations, the pressure on land was escalated. The same study also highlighted that the ecological services in terms of regeneration during the fallow stage are still not recognized by policymakers. In a recent study by Thong, Sahoo, Pebam, et al. (2019b), it was observed that socio-economic factors namely, education and occupation contributed significantly to the decrease of shifting cultivation in Champhai district of Mizoram. Besides the cultural tradition, the socio-economic factors such as age, income, and family size of farmers influence the dynamics of shifting cultivation in Champhai district of Mizoram (Thong, Pebam, Thangjam, et al. 2018).

The satellite remote sensing and GIS technology significantly helps in temporal monitoring of *Jhum* at short time intervals (Hadeel, Jabbar, and Chen 2011). A report published by NITI Aayog (Tiwari 2018) recommended remote sensing-based area estimations along with adequate ground truthing for *Jhum* cultivation mapping. Using the earth-observing time series satellite image of *Jhum* lands, Thong, Sahoo, Pebam, *et al*. (2019) reported that there has been a reduction in the *Jhum* field size without a significant increase in the number of *Jhum* plots.

Conclusion

The generalized concept that identifies shifting cultivation as the only reason for deforestation and forest degradation needs serious attention. For indigenous people, shifting cultivation is a way of life. It is intricately linked to cultural, ecological, and economic aspects of tribal communities in the region (Ramakrishnan1992). It is emerging as a misunderstood and controversial land use form. This practice is an ideal form of agriculture as long as the human population density is not too high and fallow periods are long enough to restore soil fertility (FAO, IWGIA, and AIPP 2015).

With technology advancement, the present day forest mapping and statistics should clearly present the natural and the plantation components of a forest cover. It is essential to look into the forest regrowth in *Jhum* areas versus the expansion of monoculture plantations. Darlong (2008) highlighted that it would be unfortunate if developmental programmes based on misjudged opinions about *Jhum* suppress this unique form of agriculture. While *Jhum* is scientifically sound from the point of yield returns, the present-day problems are related to the distortion in the system due to shortening of *Jhum* cycle to approximately 5 years (Ramakrishnan 1984). In a study on *Bangnis* (Nyishis) of East Kameng, Arunachal Pradesh, Gupta (2005) concluded that strategies to deal with *Jhum* should revolve around improving the system in consultation with local communities rather than replacing it, which locals oppose. Ziegler (2012) considered cash crop plantation of lower carbon and biodiversity value, which is replacing shifting cultivation in many Southeast Asian nations. Whereas, in a recent study by Thong *et al*., 2019 (a) it was found that estimated total living woody biomass carbon ranged from 0.98 Mg/ha in 5 years fallow to 142.58 Mg/ha in 20 years fallow. Therefore, fallow restoration, prevention of establishment of plots in primary forests, carbon-based payment for ecosystem services (PES) are the means to achieve conservation goals in a shifting cultivation-dominated tropical land use systems (Morton, Borah, Edwards, *et al*. 2020).

There is no denial of the fact that *Jhum* is a dominant LULC category of this region, which leads to large forested areas being cleared every year. However, there are several instances of forest regeneration in *Jhum* areas, as already discussed in this chapter with a few examples. From this study, it is observed that the present-day crisis of deforestation and land degradation is arising due to many other factors besides *Jhum* cultivation. In this region, since the major share of the land is community owned, a more robust *Jhum* and land management strategy has an answer to the deteriorating LULC scenario. In the *Jhum* lands, there is a scope of reverting back to the forest land along with several ecological benefits including conservation of biodiversity, carbon storage, use of traditional knowledge, and incomparable benefits compared to monoculture/cash crops associated with *Jhum* cultivation. However, the recent trend of monoculture being accepted by the local inhabitants due to economic benefits and incorporated in the LULC policy decisions can bring an irreversible LULC change. Thus, rather than abolishing *Jhum*-based land use system, which is practised from time immemorial, strategies should focus on cultivation to be carried out in true traditional manner with a community knowledgebase. The policy decisions may implement measures on fixing the duration of the abandoned *Jhum* plots. Examples of conservation from other villages can be shared to different villages for motivation. Also, alternate livelihood sources and their marketing strategies may be developed to reduce the dependence on forests. According to Kerkhoff and Sharma (2006), shifting cultivation is perceived to be outdated and destructive but the farmers have much to teach the world about the efficient use of landscape.

Notwithstanding that this study used medium resolution satellite data, it is suggested to use high resolution temporal images to detect various drivers of forest to non-forest conversion, which could not be mapped in this study. Geospatial technology should be adopted as a means to monitor and manage *Jhum* lands and land use dynamics. This study emphasizes that the decrease in shifting cultivation along with the rapid spread of monoculture plantation/cash crop plantations is an indicator of the changing land use scenario of this region. It provides a baseline data to study several important aspects of *Jhum* cultivation that have climate change implications. Lastly, the transition from a *Jhum*-based system to a monoculture practice may have a long-term ecological impact on the entire region with no further scope to revert back to a diverse benign environmental system.

Acknowledgement

The authors would like to put on record their sincere thanks to Nagaland Forest Department, Nagaland Science and Technology Centre, Kohima, Nagaland, and Manipur Forest Departments for logistic support during the field visits.

References

Asia Indigenous Peoples Pact (AIPP) and International Work Group for Indigenous Affairs (IWGIA). 2012. Drivers of deforestation? Facts to be considered regarding the impact of shifting cultivation in Asia: Submission to SBSTA on the drivers of deforestation

Bhatt, B. P., M. L. Jat, A. Arunachalam, A. Pattanayak, and N. Prakash.2019. Roadmap for agricultural development in north-eastern hill (NEH) region, India. Policy Brief, Published by Indian Council of Agricultural Research, New Delhi

Bhuyan, R. 2019. A review note on shifting cultivation in northeast India amidst changing perceptions. *Dhaulagiri Journal of Sociology and Anthropology* **13**: 90–95

Borthakur, D. N. 1992.*Agriculture of North Eastern Region*. Guwahati: BeeCeePrakashan

Chakraborty, K. 2009. Vegetation change detection in Barak basin. *Current Science* **96** (9): 1236–1242

Chakraborty, K. 2017. Assessment of land use/land cover change with particular reference to forest dynamics and its impact in Barak basin of North East India (Doctoral thesis), Assam University, Silchar

Chakraborty K., K. K. Sarma, S. S. Kundu, and A. K. Das. 2015. Shifting cultivation in Barak basin of North East India – a geospatial approach. *International Journal of Advancement in Earth and Environmental Sciences* **3**(2):21–29

Chakraborty, K., S. Sudhakar, K. K. Sarma, and A. K. Das.2018. Recognizing the rapid expansion of rubber plantation-a threat to native forests in parts of northeast India. *Current Science* **114** (1): 207–213

Curtis, P. B., C. M. Slay, N. L. Harris, A. Tyukavina, and M. C. Hansen. 2018.Classifying drivers of global forest loss. *Science* **361** (6407): 1108–1111

Darlong, V. 2008. Harmonizing *Jhum* (shifting cultivation) with PGS organic standards in northeast India: Key features and characteristics of *Jhum* for process harmonization.16th IFOAM Organic World Congress, Modena, Italy, June16–20

Das P., S. Mudi, M. D. Behera, S. K. Barik, D. R. Mishra, and P. S. Roy. 2021. Automated mapping for long-term analysis of shifting cultivation in Northeast India.*Remote Sensing* **13**: 1066.https://doi.org/10.3390/rs13061066

Devi, N. L. and B. U. Choudhury. 2013. Soil fertility in relation to fallow cycles and land use practices in shifting cultivated areas of Chandel district Manipur, India. *IOSR Journal of Agriculture and Veterinary Science* **4**(4):1–9

Dutta P. and S. Das. 2014. Looking into the trend of deforestation in North East India: A way forward. *International Journal of Social relevance and Concern* **2**(10): 20–27

Food and Agriculture Organization (FAO) 1957.Shifting Cultivation. Unasylva 11:1

Food and Agriculture Organization (FAO). 2019. Mountain agriculture: Opportunities for harnessing Zero Hunger in Asia. Bangkok

Food and Agriculture Organization (FAO), International Work Group for Indigenous Affairs (IWGIA), and Asia Indigenous People Pact (AIPP).2015. *Shifting Cultivation, Livelihood and Food Security: New and Old Challenges for Indigenous Peoples in Asia*. Food and Agriculture Organization of the United Nations & Asia Indigenous Peoples Pact, Bangkok

Food and Agriculture Organization (FAO), United Nations Development Program (UNDP), and United Nations Environment Program (UNEP). 2008. UN Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD). Framework Document. p. 3

Forest Survey of India (FSI). 2011. India State of Forest Report (ISFR), Forest Survey of India, Ministry of Environment and Forests, Govt. of India, Dehradun

Forest Survey of India (FSI). 2019. India State of Forest Report (ISFR), Forest Survey of India, Ministry of Environment, Forest and Climate Change, Government of India, Dehradun

Forman, R. T. T. and M. Godron. 1986. *Landscape Ecology*. Wiley, New York

Gupta V. 2005. *Jhum* cultivation practices of the Bangnis (Nishis) of Arunachal Pradesh. *Indian Journal of Traditional Knowledge* **4**(1): 47–56

Hadeel A., M. Jabbar, X. Chen. 2011. Remote sensing and GIS application in the detection of environmental degradation indicators. *GeoSpatial Information Science* **14**: 39–47

Heinimann, A., O. Mertz, S. Frolking, A. C. Egelund, K. Hurni, and F. Sedano. 2017. A global view of shifting cultivation: Recent, current, and future extent. *PLoS One* **12** (9): 1–21. e0184479. https://doi.org/10.1371/journal. pone.0184479

Hurni, K., C. Hett, A. Heinimann, P. Messerli, and U. Wiesmann. 2013. Dynamics of shifting cultivation landscapes in Northern Lao PDR between 2000 and 2009 based on an Analysis of MODIS Time Series and Landsat Images. *Human Ecology* **41**: 21–36

Intergovenmental Panel on Climate Change (IPCC). 2018: Annex I: Glossary Matthews, J.B.R. (ed.). In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. Masson-Delmotte, V. P.,H. O. Zhai, D. Pörtner, J. Roberts,P. R. Skea,A. Shukla,W. Pirani,C. Moufouma-Okia,R. Péan,S. Pidcock,J. B. R. Connors,Y. Matthews,X. Chen,M. I. Zhou,E. Gomis,T. Lonnoy,M. Maycock,W. T. Tignor (eds.)

Kehie, M., S. Khamu, and P. Kehie. 2017. Indigenous alder based farming practices in Nagaland, India: A sustainable agricultural model. *Journal of Traditional and Folk Practices* **5**(2): 82–152

Kerkhoff, E., and E. Sharma. 2006. Debating shifting cultivation in the eastern Himalayas. Farmers' Innovations as Lessons for Policy. International Centre for Integrated Mountain Development (ICIMOD), Kathmandu

Khasanah, N., V. M. Noordwijk, M. Slingerland, M. Sofiyudin, D. Stomph, A. F. Migeon, and K. Hairiah. 2020. Oil palm agroforestry can achieve economic and environmental gains as indicated by Multifunctional Land Equivalent Ratios. *Frontiers in Sustainable Food System* **3**(122) doi: 10.3389/fsufs.2019.00122

Kithan, L. N. 2014.Indigenous system of paddy cultivation in terrace and *Jhum* fields among the Nagas of Nagaland. *International Journal of Scientific and Research Publications* **4**(3): 1–4

Kramer, T., E. Jensema, M. Jelsma, and T. Blickman.2014. Bouncing back—Relapse in the Golden Triangle. Amsterdam, Netherlands: Transnational Institute (TNI)

Kurien, A.J., S. Lele, and H. Nagendra. 2019. Farms or forests? Understanding and mapping shifting cultivation using the case study of West Garo Hills, India Land **8**(9): 133

Leblhuber, S.K. and H. Vanlalhruaia. 2012. *Jhum* cultivation versus the new land use policy: Agrarian change and transformation in Mizoram. In: *Fields and Forests: Ethnographic Perspectives on Environmental Globalization*, edited by Münster, D., U.Münster, and S. Dorondel. *RCC Perspectives* (5): 83–89

Lele, N. and Joshi P. K. 2009. Analyzing deforestation rates, spatial forest cover changes and identifying critical areas of forest cover changes in North-East India during 1972–1999. *Environmental Monitoring and Assessment* **156** (1): 159–170.

Mandal, J. and R. T. R. Shankar. 2016. Shifting agriculture supports more tropical forest birds than oil palm or Teak plantations in Mizoram, northeast India. *The Condor: Ornithological Applications* **118**:345–359

Marcucci, D. 2000. Landscape history as a planning tool. *Landscape and Urban Planning* **49**: 67–81

Mertz, O., C. Padoch, J. Fox, R. A. Cramb, S. J. Leisz, N. T. Lam, and T. D. Vien. 2009. Swidden change in Southeast Asia: Understanding causes and consequences. *Human Ecology* **37**: 259–264

Morton, O., J. R. Borah, and D. P. Edwards. 2020. Economically viable forest restoration in shifting cultivation landscapes. *Environmental Research Letters* **15** (6). 064017.

Myers, N. 1993. Tropical forests: The main deforestation fronts. *Environmental Conservation* **20**:9–16

Nagaland Environment Protection and Economic Development Project (NEPED) and International Institute of Rural Reconstruction (IIRR). 1999. Building upon traditional agriculture in Nagaland, India. Nagaland Environmental Protection and Economic Development, Nagaland, India and International Institute of Rural Reconstruction, Silang, Cavite, 4118

Nath, A. J., D. Reang, A. K. Das, B. Brahma, and M. Das. 2016. Traditional practice of Paan *Jhum* cultivation among Khasia community in Bark Valley, Assam, *Journal of Traditional and Folk Practices* **02.03 & 04** (1): 96–99

Annonymous, 2009 New Land Use Policy (NLUP): Executive summary. Government of Mizoram, Aizawl

Nguyen, H. T. T., T. M. Doan, T. Erkki, and E. Ronald McRoberts. 2020. Land use/land cover mapping using Multi-temporal Sentinel-2 Imagery and Four Classification Methods–A case study from DakNong, Vietnam. *Remote Sensing* **12**(9): 1367

Tiwari, B. 2018. Report of Working Group III Shifting Cultivation: Towards a Transformational Approach Contributing to Sustainable Development in Indian Himalayan Region.

Panda, B.K. and S. Sarkar. 2017. Shifting cultivation in north-east India: Growth and progress. *DeraNatung Government College Research Journal* **2**: 69–90

Pandey, D. K., P. Adhiguru, U. Sah, N. Devachandra, S. Dubey, and C. Deo.2020. Is rubber monoculture banishing agrobiodiversity and happiness? Evidences from shifting cultivation landscape of Tripura, northeast India. *Current Science* **118** (1): 108–113

Prakash, N., S. S. Roy, M. A. Ansari, S. K. Sharma, P. Punitha, B. Sailo, and I. M. Singh. 2017. *Jhum* improvement for sustaining farm livelihood and natural resource conservation in north eastern hill region: Vistas and frontiers, ICAR Research Complex for NEH Region, Meghalaya, India

Puyravaud, J. P. 2003. Standardizing the calculation of the annual rate of deforestation. *Forest Ecology and Management* **177** (1–3): 593–596

Ramakrishnan, P. S. 1984. The science behind rotational bush fallow agriculture systems (*Jhum*). *Proceedings of Indian Academy of Science (Plant Science)* **93**: 379–400

Ramakrishnan, P. S. 1992. Shifting cultivation and sustainable development: An interdisciplinary study from north eastern India. MAB Series, UNESCO, Paris, Vol.10

Ramakrishnan, P. S. 2015. Shifting agriculture and fallow management options: Where do we stand? In: Cairns Falcom (eds). *Shifting Cultivation and Environmental Change: Indigenous People, Agriculture and Forest Conservation*. Routledge, Taylor & Francis Group

Rana, J. C., M. Dutta, and R. S. Rathi. 2012. Plant genetic resources of the Indian Himalayan region–An overview. *Indian Journal of Genetics and Plant Breeding* **72**(2): 115–129

Rathore, S. S., K. Karunakaran, and B. Prakash. 2010. Alder based farming system a traditional farming practices in Nagaland for amelioration of *Jhum* land. *Indian Journal of Traditional Knowledge* **4**: 677–680

Reddy, C. S., K. Dutta, and C. S. Jha.2013.Analysing the gross and net deforestation rates in India. *Current Science* **105**(11): 1492–1500

Reddy, C. S., S. Singh, V. K. Dadhwal, C. S. Jha, N. R. Rao, and P. G. Diwakar. 2017. Predictive modeling of the spatial pattern of past and future forest cover changes in India. *Journal of Earth System Science* **126** (8): 1–16

Roy, P. S. 2011. Geospatial characterization of biodiversity: need and challenges. In: ISPRS Archives XXXVIII-8/W20; workshop proceedings on earth observation for terrestrial ecosystem. 10–16

Roy, P. S. and M. D. Behera. 2005. Assessment of biological richness in different altitudinal zones in the Eastern Himalayas, Arunachal Pradesh, India. *Current Science* **88**(2): 250–257

Roy, P. S., M. D. Behera, M. S. R. Murthy, A. Roy, S. Singh, S. P. S. Kushwaha, and S. Gupta. 2015. New vegetation type map of India prepared using satellite remote sensing: Comparison with global vegetation maps and utilities. *International Journal of Applied Earth Observation and Geoinformation* **39**:142–159

Schmid, M., A. Heinimann and J. Zaehringer. 2021. Patterns of land system change in a Southeast Asian biodiversity hotspot. *Applied Geography*126: 102380

Schmidt-Vogt, D., S. J. Leisz, O. Mertz, A. Heinimann, T. Thiha, P. Messerli, and T. M. Dao. 2009. An assessment of trends in the extent of swidden in Southeast Asia. *Human Ecology* **37**:269

Sharma, T. C. 1976. The pre-historic background of shifting cultivation in North East India. NEICSSR, Shillong, Meghlaya. East Indian Council for Social Science Research, Shillong, Meghalaya

Singh, A. B. and R. Teron. 2019. Traditional oak agroforestry practices in Mima village of Kohima district, Nagaland State, Northeast India. *Indian Journal of Hill Farming* **32**(2): 203–215

Singh, D. 2009. The new land use policy: People and forest in Mizoram. In: *Environmental Issues in India: A Reader* (M. Rangarajan and B. Agarwal, Editors). Dorling Kindersley, India: 298–315

Singh, M. K. 2019. Potential of underutilized legume tree Parkiatimoriana (DC.) Merr. In: Eco-restoration of *Jhum* fallows of Manipur. *Journal of Pharmacognosy and Phytochemistry* **8**(2): 1685–1687

Spencer, J. E. 1966. *Shifting Cultivation in Southeastern Asia*. Berkeley and Los Angeles: University of California Press.

Srinivasan, U., Velho, N., Lee, J.S.H. et al. Oil palm cultivation can be expanded while sparing biodiversity in India. Nat Food 2: 442–447 (2021). https://doi.org/10.1038/s43016-021-00305

Thong, P., R. Pebam, and U. K. Sahoo.2017. A geospatial approach to understand the dynamics of shifting cultivation in Champhai district of Mizoram, North-East India. *Journal of the Indian Society of Remote Sensing* **46**:1713–1723

Thong, P., R. Pebam, U. Thangjam, and U. K. Sahoo. 2018. Influence of socio-economic factors on the existing shifting cultivation practices in Champhai district of Mizoram. *Indian Journal of Hill Farming* **9**(3): 325–336

Thong, P., U. K. Sahoo, R. Pebam, and U. Thangjam. 2019a. Spatial and temporal dynamics of shifting cultivation in Manipur, Northeast India based on time –series satellite data. *Remote Sensing Applications: Society and Environment* **14**: 126–137

Thong, P., U. K. Sahoo, R. Pebam, and U. Thangjam.2019b. Changing trends of shifting cultivation and its drivers in Champhai, Northeast India. *Indian Journal of Hill Farming* **32**(1): 1–4

Thong, P., U. K. Sahoo, U. Thangjam, and R. Pebam. 2020. Pattern of forest recovery and carbon stock following shifting cultivation in Manipur, North-East India.*PLoS ONE* **15**(10): 1–20

Tiwari, B.K, R. Kumar, L. Thakur, and A. Salve.2017. Agroforestry for sustainable rural livelihood: A review. *International Journal of Pure and Applied Biosciences* **5**(1):299–309

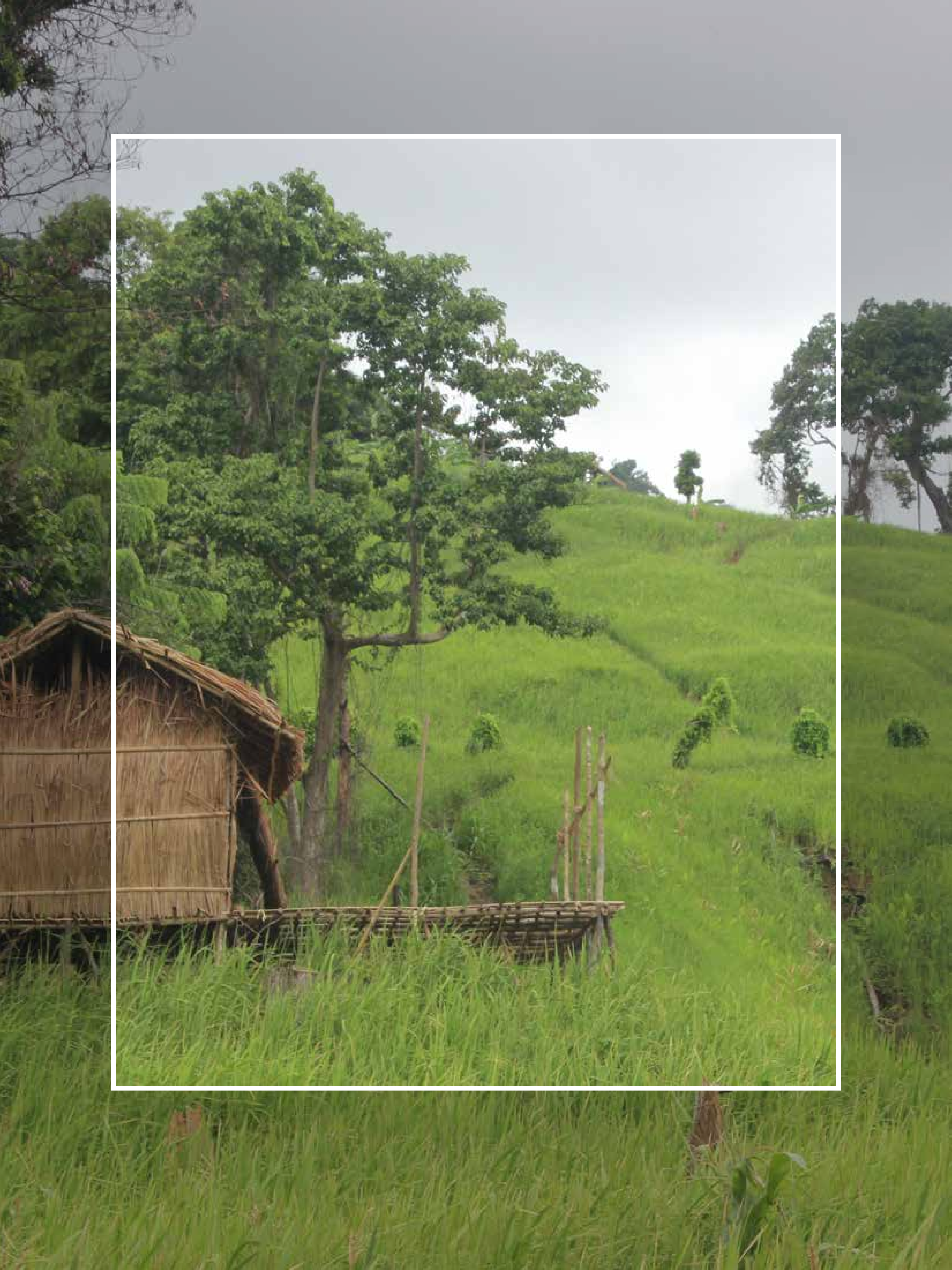
Tripathi, R. S. and S. K. Barik. 2003. Shifting cultivation in north-east India. In: Proceedings: Approaches for increasing agricultural productivity in hill and Mountain ecosystem Eds: Bhatt, B. P., K. M. Bujarbaruah,Y. P. Sharma, PatiramICAR Research Complex for NEH Region, Umiam, Meghalaya: 317–322

Tripathi, S. K., D. C. Vanlalfakawma, and F. Lalnunmawia. 2017.Shifting cultivation on steep slopes of Mizoram, India: Impact of policy reforms. In: *Shifting Cultivation Policies: Balancing Environmental and Social Sustainability Cairns* M. (ed.): CABI Publishing, London: 395–413

Turner II, B., W. C. Clark, R. W. Kates, J. F. Richards, J. T. Mathews, W. B. Meyer.1990. The Earth as transformed by human action: Global and regional changes in the biosphere over the past 300 years. Cambridge, UK: Cambridge University Press; and New York, NY: Clark University

Vitousek, P. M. 1992.Global environmental change: An introduction, in Fautin, D.G.,D.J. Futuyma, and F.C. James(eds). *Annual Review of Ecology and Systematics* **23**: 1–14

Ziegler, A. D., J. Phelps, J. Q. Yuen, E. L. Webb, D. Lawrence, J. M. Fox, T. B. Bruun, S. J. Leisz, C. M. Ryan, W. H. Dressler, O. Mertz, U. Pascual, C. Padoch, and L. P. Koh. 2012. Carbon outcomes of major land cover transitions in SE Asia: Great uncertainities and REDD+ policy implications. *Global Change Biology* **18**(10): 3087–3099



CHAPTER-3
CAN SHIFTING CULTIVATION ENSURE LOCAL FOOD SOVEREIGNTY?

Angshuman Sarma*

Abstract

This paper is about different perspectives around *Jhum* cultivation, its institutional demonization and destruction, its contestations with the larger political economy and its internal conflicts. It will discuss changes, challenges and constraints brought by different trajectories of *Jhum* cultivation and reflection of that in local food sovereignty.

There are two perspectives on shifting cultivation; one is to see it as 'primitive' and non-conversion of *Jhum* cultivators to sedentary agriculture as 'problem'. Such a notion spread across from the colonial period to the present days, resulting in privatization of communal land and commercialized crops that forced people to shift to cash crop plantation or sedentary agriculture. The second one is that far from being 'primitive' shifting cultivation was the result of certain topography, material culture, and is an end in itself.

In the post-colonial period, the Indian nation-state demonized shifting cultivation. Policies and actions by the state are to make such land and product taxable, assessable, commercial or, failing that, to replace it. Cash crop, mono-cropping or plantation-style agriculture has been encouraged in place of the more biodiverse form of production that was prevailing. But, that does not mean *Jhum* can be an end in itself. Challenges are coming from corporate food giants, land alienation and entry of cash economy in tribal societies. A bigger change is the emergence of tribal elites and eventual class cleavage within tribal societies. But at the same time, indigenous innovations in *Jhum* cultivation could be synergistically managed to achieve greater sustainability of shifting cultivation. Such innovations are often oriented and focused on intervention and modification at different stages and aspects of shifting cultivation.

* PhD Research Scholar at Centre for Informal Sector and Labour Studies, Jawaharlal Nehru University New Delhi | E-mail: angshumansarma13@gmail.com

The point is not to see shifting cultivation as ‘primitive’ or as ‘problem’ nor as end in itself rather needs to integrate scientific upgradation and to recognize experienced innovations coming from within communities to maintain the sustainability of the way of life and continue to achieve food sovereignty

Introduction

Throughout the eastern Himalayan uplands, shifting cultivation has historically been an important economic activity. Even in the colonial period, shifting cultivation or *Jhum* was one of the important sources for survival of people in these highlands and hence in the hills of the northeast (NE) India. But the centrality of the shifting cultivation in the tribal identity was more a result of the integration of the tribal population into the colonial and capitalist system. The basic essence of shifting cultivation lies in the moral foundation of collective labour, sharing, social exchange among the community and custodial responsibility for the land. It is a kind of antidote to the colonial and capitalist logic of extraction, disposition, and accumulation.

Traditionally, the economy of the tribal communities in northeastern states of India depended on subsistence agriculture with forest and land as the main resources. It depended on community ownership, also known as collective management or co-ownership or common property resources (CPRs) in the modern language of governance. The CPRs include the common grazing ground, *Jhum* (shifting) cultivation land, forests for non-timber forest produce such as edible fruits, leaves and vegetables, small timber and medicinal herbs, watersheds, rivulets, rivers, ponds and other community assets that give other protein foods such as fish, crab, etc. (Fernandes, 2020).

Shifting cultivation or *Jhum* is a method of farming on temporary fields. The fields are abandoned after one or two years of cultivation generally, allowing shrubs and trees to grow back. People then cultivate another plot. The alternation between periods of ‘cultivation’ and ‘fallow’ ensures the continuation of a jungle cover that helps to maintain biodiversity (Maaker, Kikon, and Barbora, 2016). A field subjected to *Jhum* carries a combination of crops varying from three to ten crops at a time, these include cereals such as rice, millet and maize and a large number of vegetable crops with different periods of maturity and some traditional cash crops.[1] This enables the farmer to take out different crops for subsistence, at different intervals, one after the other (Dikshit and Dikshit, 2014). Traditional cash crops are those that have been cultivated by indigenous people for subsistence, as food or non-food use like making cloth or building house, but now become commercialized (Behera, Nayak, Andersen, and Måren, 2016). In contrast, modern cash crops have never been part of the traditional cultivation of the region but gradually appeared in statistical records due to market mechanism or imposition from above as per some policy. The broom grass, synsar (*Thysanolaena latifolia*) is grown in *Jhum* fields in Nongtraw village in Meghalaya and gives income to few families in the village (FAO, 2021). But in many other parts of Meghalaya and Nagaland, broom is being cultivated as a cash crop.

1 Traditional cash crops are distinctly different from modern cash crops which were brought and made people cultivate them through government policies and market forces.

The use of only a hoe and no plough prevented soil erosion in *Jhum* field. Root crops were sown before the rains to protect the soil. Paddy and other crops were sown after the rains began. Weeding was graded. Some weeds that preserved soil were left behind. Over the years, the *Jhum* economy has undergone many changes; land availabilities have decreased leading to a shortening of the *Jhum* cycle, which brought questions on its viability.

There is a dialectical relationship between shifting cultivation and the global and the regional political economy, which influenced the nature of the economy and politics of the region. Apart from the late entry of modern governance to northeast India highlands (Baruah, 2020), there is another reason why even in the neoliberal regime, these eastern Himalaya highlands are not completely integrated into the global food chain, despite demonization of indigenous production methods here. When many tribal and indigenous communities are on the verge of losing land, getting evicted or facing other precarity and 'epistemic violence' in other parts of India or Globe, the tribal population in this part of India got some protection under constitutional safeguard under the 'sixth schedule' in the Indian constitution. The Indian constitution provides special autonomy to tribal-dominated states in northeast India under which rights over land and forest remained with the communities or local bodies. The same constitutional safeguard gives the native communities autonomy over land ownership and use (Chaudhury, 2013).

FIGURE 1: Geographical map of northeast India

Source: Google Earth

The historical nature of communal land ownership, collective labour and control of agricultural inputs in the hands of the farmer or the community remained in many corners of northeast India. But such a method of production is increasingly being abandoned, called 'primitive' and market-oriented productions making inroads (Maaker, Kikon, and Barbora, 2016). Despite that, indigenous farmers of northeast India still possess some of their local seeds, land management, and cropping pattern. As a result, that allows us to study shifting cultivation and its contribution to achieving food sovereignty.

This is a review paper, hence entirely based on secondary sources. Data presented here were taken from different reports by research institutions or civil society organizations or by the individual researcher with the primary study.

Historical Evolution of Shifting Cultivation and Land Tenure

Traditionally, in the broader range of *Jhum* Economy in northeast India, individual rights subsumed in the communitarian ownership. Private ownership of property was hard to find. The formal ownership of land in most cases lies with the headman or chief. *Jhum* with primitive tools and instruments of production could not reach to get economies of scale[2] (Ray, Sarma, and Chakraborty, 2007). Although there was variation in how the system of communal ownership got translated into practice. While some communities like the Angami gave proprietary rights over terrace fields to individual families, the Aka of Arunachal Pradesh gave usufruct right over land to its members (Fernandes and Pereira, 2005). Also, a distinction has been made between exclusive *Jhum* systems and non-exclusive *Jhum* systems. For example, the latter is either a settled farming system like wet paddy terrace cultivation or has cultivators who have plots which are *Jhum* plots (community ownership) and non-*Jhum* plots (individual). In other communities like the Kuki, the land belonged to the village chief and he would allot the land to families for *Jhum* cultivation (Haokip 2009: 304–308). The *Jhum* land can be inherited by an individual as per the customary laws of the Reangs of Tripura in the patrilineal line. But the general ethos guiding the system was community-oriented and not individual-based.

[2] However, permanent terrace cultivation coexisted along with shifting cultivation. Apatanis and Monpas of Arunachal Pradesh, Maos and Tangkhuls of Manipur, Angamis of Nagaland and Khasis of Meghalaya widely practise terrace cultivation along with Jhum. But the extent was not larger enough to give a significant surplus.

The foundation of the communitarian system of the *Jhum* economy lies in the customary laws of tribes across the eastern Himalayan region. The landholding systems of tribals revolve around shifting cultivation in which the land–man relationship is based on three basic principles:

1. Allocative principle: the village or clan head is vested with the power to make dispositions among members from time to time
2. Allottee has usufructuary rights only
3. Allottee has to cultivate the land with family labour endowments.

Generally, it is the village council that is used to allocate land and oversee land use for shifting cultivation. The size of the land disposed to a family is in proportion to the family labour endowment or amount of available seeds from the previous harvest that one unit of family labour can sow (Basu, Dutta, Patra, and Das, 2020). Broadly, this makes the per capita labour output ratio equal across families, which in turn ensures economic equality and social equilibrium (Darlong, 2004).

But *Jhum* in all parts of northeast India went through various trajectories in the colonial and post-colonial period. Studies (Ray, Sarma, and Chakraborty, 2007) depict primarily two different trajectories that shifting cultivation has passed through in the Colonial period: First, forest Department came into existence and second plantation cash crop producing estates (tea estates mainly) were introduced that paved the way for interaction with capitalist modernity (Goswami, 2010). Forest Department demarcated forest land and agricultural land with the oriental gaze. Tea estates at foothills came to trigger changes that have far-reaching consequences. The colonial state did not understand the itinerant form of land use in hills and imagined foothill forests as *terra nullius*. For the tea business, the first time mountain land was commercialized, which have many far-reaching effects ranging till now. Colonial anthropologists created different categories of hill and foothill population ('Aboriginal Tumulian', 'Caucasian Tribe', etc.) (Scott, 2010) as per the experience of tea planters and from a colonial perspective. Such a categorization has changed not only their engagement with the tea industry but also their present. Colonial sources often projected shifting cultivation as 'destructive to the forests.' Unpublished proceedings of departments, settlement reports and other records betray a broad bias towards sedentary permanent cultivation (Prasad, 2003).

In the post-colonial period too, the homogeneous land reform agenda and individualization of land rights challenged the historical process of communal egalitarian land system in the hills of northeast India. New economic crops and plantations were introduced and encouraged. Credit was also provided and various incentives were given, which were alien to this land. The efforts are high for making community lands taxable, assessable, commercial or, failing that, to replace it with mono-cropping cash crop production. When miles and miles of land in hills are being appropriated under modern cash crop cultivation that not only links the tribal population to the global volatile economy it also hampers local livelihood and food sovereignty. According to James Scott (Scott, 2010), the intervention of the state in re-arranging land relations and re-organizing land tenure systems is inherently a project of rearranging the moral landscape. The intervention is like reordering the societies and communities and their land as taxable, surplus generating, and commercially viable.

The subsistence land use pattern and absence of a written record of right scoped the investors—both big and small-first to aggrandize communal land by primitive means and then with the state patronage for capital fixation. *Jhum* is generally practised on slopes of up to 20-degree gradient. But with the privatization of land and expansion of commercial horticulture plantations, the shifting cultivation is retreating to steeper and less fertile land (Maaker, Kikon, and Barbora, 2016).

Such a tricky situation draws attention from various anthropologists, ecologists, development strategists and of course policymakers, who saw the issue of shifting cultivation from different perspectives. The range of perspectives can be broadly categorized into two different camps.

Two Perspectives

There are two ways to see shifting cultivation. One perspective is to see it as unproductive and ecologically devastating. Such a notion spread across from the colonial period to the present day. It is a historical fact that during the past centuries, 'sedentarization' of people has taken place in most nation-states leading to a transformation of manifold customary land tenure systems into a uniform modern property regime based on individual ownership (Richard, 2002: 13–14). Ever since the project of modern state formation began, most nation-states emphasized sedentarization of people as fundamental to nation-building. The shifting cultivation was antithetical to the project of nation-building (Scott, 2010). It is held that the modern state was averse to shifting cultivators. In the colonial and postcolonial period, new land laws introduced individual ownership that forced people to shift to sedentary agriculture. The economic argument against shifting cultivation is the need for 'economies of scale' from which profit and revenue can be generated. The developmental cause given is that it cannot feed an increasing number of populations. The strategic argument against shifting cultivation is that it ties up the *Jhum* cultivators to land. Finally, since monetary income from *Jhum* is low (?) *Jhumias* remain 'poor'. And the paternalist idea is that they should be 'rescued' from such poverty by 'developmental' activities such as sedentarization or cash crop plantations. However, policymakers do not always recognize direct benefits such as food sovereignty, even when they are well documented. While governments need food security for their people, they feel shifting cultivators should stop their practices to start earning an income.

The second way to see it, as reflected by many well-meaning scholars of tribal and ecological history suggest shifting cultivation in traditional mode as ecologically viable, sustainable and self-sufficient both in terms of food and employment. Their defense to shifting cultivation is rooted in the defense of community custom and tradition because they saw these as alternatives to a modern way of life. Such an ideology became dominant amongst Gandhian movements of the twentieth century. Though they made valuable critiques of modern capitalist development, their anti-modern critique of the industrial mode of production derives epistemological origin from ecological romanticism of the early twentieth century who upheld the traditional way of life as viable alternatives (Prasad, Against Ecological Romanticism, 2003). That happens mainly because they do not see the relationship between shifting cultivation and the larger political economy of the changing world around. But the reality is as ethnographers (Maaker, Kikon, and Barbora, 2016) observes, "as road connectivity improves, private educational facilities develop, and the electrical grid is extended, people increasingly aspire towards modernity. The conspicuous absence of the state as a service rendering entity, notwithstanding its overwhelming visibility as a security force in the region, has resulted in a growing presence of private players. Private health care, educational institutes, loan companies, and consumer agencies have produced a debt culture and rural populations across the hill states of northeast India are increasingly becoming indebted and are mortgaging homes, *Jhum* lands and crops to attend to health emergencies or children's education, or to pay agents for securing jobs in urban centres across India and abroad". So, while the points of variations and sustainability are well taken from such neo-populist and ecological romanticism paradigms, the problem with such an analysis lies with the point that with the capitalist intervention of the state, entry of cash economy and with more interaction metropolis, change in local administration and political set-up, elite capturing is also happening within tribal communities. Inner community land and wealth accumulation by few is happening. That being the practical situation it is difficult to conclude shifting cultivation as an end in itself.

Most of the government policies are tilted towards the first perspective. Maybe because for the State the interest is to integrate, monetize the people, land and resources of these peripheral zones so that they became an auditable contributor to gross national product (Maaker, Kikon, and Barbora, 2016). Most of the government commission, committee's reports depicted shifting cultivation as a 'problem', as a cause of soil erosion and deforestation. Though few of them accept that it is a way of life for indigenous people so there is a need to phase out with 'awareness' or sedentarization. (Shukla Committee report, 1997; Rajmani Committee Report, 1997). Report of the Task Force on Strategy for Management of Shifting Cultivation (2002) exceptionally recommended 'improvement' of shifting cultivation for its development rather than 'replacement'. In the recent report "Peace, Progress and Prosperity in the North Eastern Region, Vision 2020" by the Ministry of Development of Northeastern Region, the Government of India also talks about the necessity "to wean the tribals away from *Jhum* cultivation". The policy document mentions the practice of *Jhum* in hills as the reason for low productivity, deforestation and soil erosion and considered the conversion of *Jhum* cultivators to settle cultivation or cash crop as 'progression'. (NEC, 2008)

Policies Against Shifting Cultivation by State Governments

Following colonial legacy Indian state too took different policy measures and action plans to evince land-use patterns in hill areas of the northeast and earmarked funds to stop shifting cultivation. Rubber and coffee plantations and other cash crops are encouraged in the hills. As the cash economy grips into the masses in upland, subsistence cultivators are also drawn into a money-oriented economy. In this new economy, they are increasingly seen as the poor, dispossessed, and landless. State governments in the northeastern states have also fallen prey to such hegemonic ideas. It is within this context the interventions by state governments to integrate the *Jhum* uplands need to be examined.

Various boards set up by the Government provide subsidies to individuals who wish to take up permanent cultivation. The attempts to incorporate modern cash crop cultivation have been culturally styled as 'development' or 'economic progress', and many from highlands too have internalized that. Scholar Melville Pereira mentions, how during a field trip to Churachandpur, Manipur in 2012, he was surprised to hear a village elder appreciating the 'gesture' of the Coffee Board providing Rs 60,000 per acre as a subsidy to start a coffee plantation in the *Jhum* land of the village.

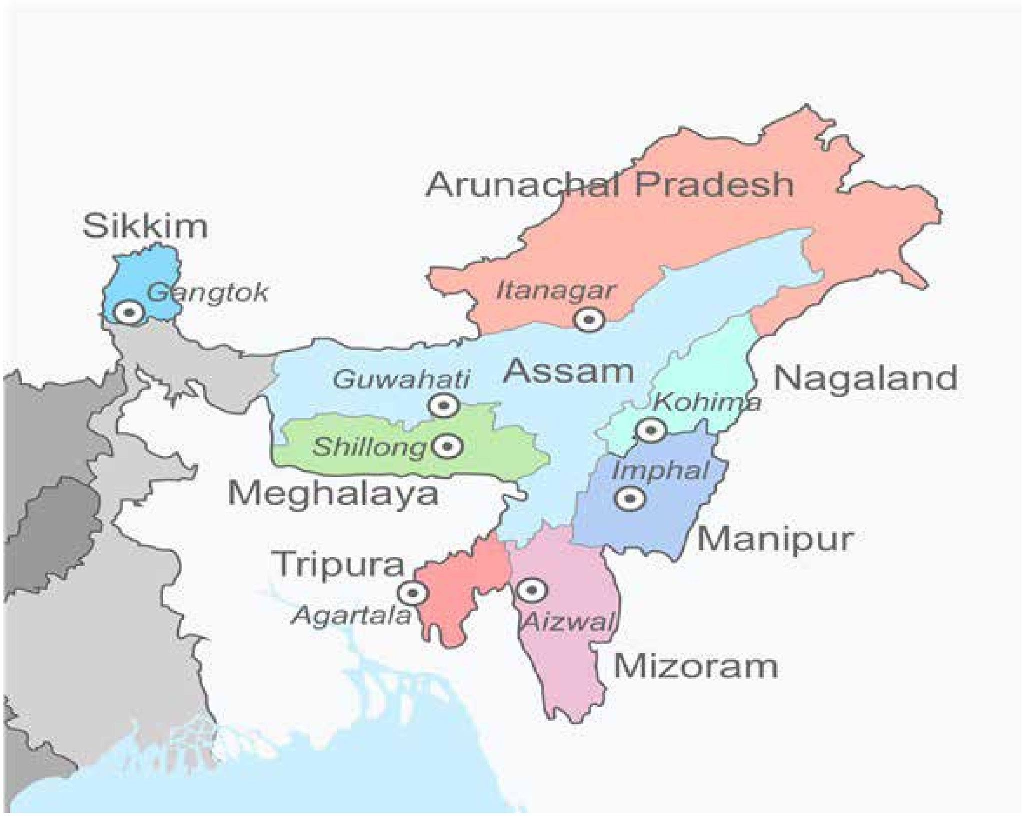


FIGURE 2: Political Map of Northeast

The modus operandi for weaning the people from shifting cultivation varied from state to state. In Tripura, *Jhumia* Rehabilitation Colonies were set up by the government and the *Jhumias* were given individual plots of settled wet-rice cultivation and were provided with various extension services and input supports. The first plan was drawn up in 1953–54 in which *Jhumia* families were allotted 5 acres of arable land and a grant of Rs 500 for land development and purchase of essentials to support settled farming. Again in the 1980s, the state government first attempted to shift *Jhumia* households to tea and coffee plantations by providing financial assistance. This, however, was a failure owing to factors such as unsuitable soil quality, lack of technical know-how, and absence of post-production infrastructure. The focus then shifted to introducing rubber plantations—which initially saw good outcomes in terms of increased income of the *Jhumia* families. But after 1990 when the economy became open and rubber prices became subject to international completion and price volatilities, the price of rubber received by farmers crashed (Prasad, 2016). New efforts are going on to encourage betel nut orchards. Also, there were efforts to engage *Jhumias* in Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA),[3] but without much success. Now the possibility of working together in the *Jhum* field does not exist as people work in other places that guarantee employment with income. Many people from Reang tribe in Tripura also say that they do not have enough land to *Jhum* and that the *Jhum* does not provide enough income and food grains as before to manage the affairs of the family (Das and Das, 2014).

Assam's *Jhum* Control Scheme was a part of the soil conservation programme. Under the *Tongiya* system,[4] the services of the *Jhumias* were used for the afforestation programme. Assam undertook horticulture on the hills on an extensive scale. The Nagaland *Jhum* Land Act, 1970, recognized the individual right to transfer *Jhum* land though only within the village and community boundaries. Therefore, the Act has recognized both the customary land rights and established private authority over the land. In the Angami and Chakhesang areas of Nagaland, the hill slopes were terraced for the practice of continuous cultivation. Terrace cultivation was extended by giving subsidies to the farmers and the *Jhumias* were urged to grow commercially valuable and quick-growing species on suitable *Jhum* plots. In Manipur, wet-rice cultivation was extended through land reclamation and irrigation facilities in the Ukhrul district as a part of the *Jhum* control programme. The Soil Conservation Department of Manipur also undertook measures for discouraging shifting cultivation. In Arunachal Pradesh too the *Jhum* control scheme rested on the introduction of terrace cultivation. The Government of Mizoram discouraged shifting cultivation from the very first Five-Year Plan. The Village Council Act of Mizoram in 1953, endowed the latter, wide-ranging powers for the management of land and forest. The Lushai Hills district (Jhuming) Regulation, 1954 and the Pawi Lakher Autonomous District Council (*Jhum*) Regulation, 1956, empowered the District Councils to regulate land and forest (except the Reserved forests). Two strategies were adopted for this: giving up *Jhum* and use the terrace for cash crop cultivation (Ray, Sarma, and Chakraborty, 2007).

Changing Material Conditions: Growing Land Inequality

Policy-induced structural shift to the commodification of food, commercialization of agriculture and privatization of land gave rise to an endogenous constraint also for shifting cultivation. That is the growing land inequality within communities. Today, inner community land inequality has increased in the northeastern region, while a section became wealthier capturing disproportionately huge areas of land under control (Fernandes, Baruah, and Milik, 2019).

In Mizoram, most of the farmers, who gave up *Jhum* cultivation had more than four hectares of land and were located near large towns. These farmers no longer remained owner-cultivators

[3] A central government funded rural employment project that is supposed to give 100 days of wage employment to rural population.

[4] *Tongiya* villages are created by the forest department to safeguard the boundaries of forest areas. They recruited some people whom they allowed to stay at Tongi Ghar (House on Tree) and look after the boundary of the forest and plant trees, etc. But gradually with time, they became proper villages.

but became new affluent elites in the Mizo society. They employed hired labour to cultivate their terraced fields, while they had taken other occupations. These entrepreneurial elites were a product of the new agronomy promoted by the state that created class division and social stratification in the hitherto egalitarian land system of the Mizo community. This new class had more than four acres of land each (Das D, 2006). This led to incipient class interest within the entrepreneurial elites. Lalnunmawia and Lalzarliana wrote that over the years large areas of *Jhum* lands were privatized, which gave rise to tenant farming in shifting cultivation areas and absentee land ownership, opening avenues for land conflicts (Lalnunmawia and Lalzarliana, 2013).

The situation in Arunachal Pradesh is precarious. Unlike Article 371A and 371G that protect land in Nagaland and Mizoram respectively, 371H which applies to Arunachal Pradesh does not protect indigenous land. Arunachal Pradesh elites try to "control as much land as possible" because restrictions on transactions in land markets put land values on a steep upward curve. But newly enclosed lands are also turned into commercial agricultural estates producing tea, horticultural crops, or vegetables. Commercial agriculture, however, is only a tiny part of the state's economy. Powerful politicians and their relatives control almost all tea and large horticultural estates in that state. They benefit from substantial state support in the form of direct subsidies, marketing assistance, and indirect subsidies such as the illicit use of workers on the government's payroll in private estates (White, Mishra, and Upadhay, 2009; Baruah, 2020).

In many cases, the introduction of new seeds and breeds contributed to displacing local ones. In a report by the Food and Agricultural Organisation (FAO, 2021) the Khasi people from Nongtraw village in Meghalaya reported that they have lost many traditional varieties as new crops have been introduced. Eight varieties of potato have disappeared in the last few decades, whilst three have been introduced in their place. The same is the case for sweet potato, where five traditional varieties have been replaced by only two over time. Some other species, such as millet, are still grown but varietal diversity has decreased over time, and they are planted in smaller areas.

In the Garo Hills of Meghalaya, the communal ownership of the *a.king*[5] land by the *Nokma* is fast making way for individual land ownership. The Garo Hills Autonomous District Council, by issuing *pattas* or land holding documents, has encouraged private ownership of land. In the early 1990s, the Garos were encouraged to plant rubber. The financial institutions and banks gave loans only to *patta* holders. Those without the *pattas* were not given any subsidy and financial help. Even the ADC that should have safeguarded the *a.king*. Land finally succumbed to this approach and issued *pattas* liberally. This has led to some individuals and families amassing large tracts of land.

The increasing state encapsulation of the uplands of northeast India has many consequences. Apart from the accumulation of land by few, the communitarian ethos of labour was destroyed. The concept of wage labour crept into the tribal societies, where communal labour was increasingly

5 *a.king*- land held by particular motherhood.

fetishized under the market economy. This scenario gave rise to daily-rated labour, master roll labour, unpaid labour and feminization of labour in different hill areas of the region. This destroyed labour as a socially embedded concept broke the corporate living of the tribal communities, their cultural practices, and marked the threshold of the conflict between the community process and the neoliberal process. For example, in *Jhumia* villages in Tripura now there has been a rising presence of hired labour though the percentage is very low yet (15% on average) (Basu, Dutta, Patra, and Das, 2020). Generally, hired labour is a trait of the capitalist system. Landless workers enter the rural wage market and are hired by people who have some land and want them to help out along their family labour.

Beyond Myth

While critics of shifting cultivation continue to be vocal and well-represented both among policymakers and in the public domain, the communal ethos of food production among tribal communities have been structurally transformed and ideological state apparatuses have built narratives against shifting cultivation. Moreover, many times the centralized nation-state ignored its regional specificities under its economic policies, which were mostly backed by neo-classical economic thought. Many surveys and national policies take India as a unit and apply homogeneous methods of valuation for all regions and hence undermine many regional intricacies and nuances. That too contributed to a narrative against *Jhum*.

One main narrative against *Jhum* is that it is less productive. Many times comparisons have been done between the yield of the individual crop in *Jhum* and that is in monoculture commercial cropping. But, such a method does not count the fact that mixed cropping is an essential feature of *Jhum*. Typically, 10–13 crops are cultivated in the mixed cropping and sequential harvesting system. So, such comparisons can't be done ignoring all other crops grown together with the crop for which the comparison was done. Moreover, the input cost in *Jhum* is near zero. That way it maximizes yield while minimizing cost—with no cost of fertilizers, pesticides or insecticides. In fact, as per agricultural scientists mixed cropping is a biological pest suppressant. Productivity in *Jhum* cultivation has to be seen differently, like how *Jhum* cultivation do efficient use of natural growth patterns of different crops. *Jhum* cultivators in places use efficient techniques for mix cropping. For example, rice and taro are two of the most important crops. Intercropping seems unlikely because taro is a wide-leaved crop that could overshadow the rice. However, Konyak farmers in Mon, Nagaland take advantage of certain crop features for productive interaction. Rice is erect while taro is broad-leaved, and rice has fibrous superficial roots, while taro has deep rooting tubers. Both are sown at the same time, but the rice germinates much ahead of taro covering the entire field. This process suppresses the growth of taro, which does not emerge in time to compete for sunlight. The taro emerges later and only reaches full coverage after the rice has been harvested (Kerkhoff and Sarma, 2006). Mixed cropping of rice and taro has also been reported among the Khasis and Garos of Meghalaya, India. In Ukhrul (Manipur, India), in fields that are five years old or more, maize is the dominant crop, grown in combination with tall varieties of rice, beans, taro, and pumpkin (Kerkhoff and Sarma, 2006).

The *Jhum* cultivators usually cultivate 8–10 varieties of crop items in a particular *Jhum cultivation* land in a year. Mixed cropping is an effective form of land use pattern as they are using limited space for optimum production in a specific time. In the process, a small piece of *Jhumming* land accomplishes almost all the needs of *Jhumias* and reduces his reliance on other allied activities or external inputs (Das and Das, 2014). Primary research by P S Ramakrishnan shows that "On a steep slope of 30–40° angle, the soil nutrient environment is very transient. One of the important objectives of the *Jhum* farmer, therefore, is to capitalize upon the highly transient resource base as quickly and effectively as possible through a mixed cropping system. Maximizing economic yield in such a transient environment is critical. The *Jhum* farmer ensures effective use of the nutrient gradient on the steep hill slope by emphasizing upon species that have a high nutrient-use efficiency along the nutrient-poor top of the slope and by organizing less use-efficient species along the nutrient-rich base of the slope. By this, he can achieve a high leaf area index for optimizing photosynthesis and maximizing economic yield (Ramakrishnan, Tropical Tree Architecture and Photosynthesis, 1984)"

Moreover, products from fallow land are also ignored. Fallow land, that is, the *Jhum* land that after cultivation is quickly covered by bamboo, bushes, and other 'secondary vegetation' are registered as open forest to a good extent (Karlsson, 2011). Far from being 'abandoned' land, these fallows are usually actively managed by farmers and used for various purposes like foraging. They are the rural commons.

Another main argument against *Jhum* is that it increases soil erosion. But communities that do *Jhum* cultivation are aware of that and take steps to prevent it. In Nagtraw village in Meghalaya terraces are built-in *Jhum* fields to slow down the flow of water and stabilize the soil. Logs are kept laterally at the edges of the plots to prevent soil from being washed away. People also grow shken (variety of bamboo) and synsar (broom grass) along field margins during the main rainy season to prevent soil erosion. These plants have deep roots and hold the soil in place during heavy rainfall events (FAO, 2021).

Some studies demystified *Jhum* cultivation and nullified the arguments like the non-viability of *Jhum*. Extensive research by P S Ramakrishnan shows that to produce a single unit of food, industrialized agriculture needs huge fossil fuel energy subsidies, sophisticated chemical control measures for pests and HYV seeds, and at least five to ten units of fuel energy. On the other hand, five to fifteen units of food energy obtained from each unit of energy expended in shifting cultivation (Ramakrishnan, Shifting Agriculture and Sustainable development, 1993).

Another study was done in Khakchang village (village of Reang tribe) in Tripura on paid out cost, taking a comparison of the gross value of output from sedentary cultivation in comparison to *Jhum* cultivation. In Khakchang, *Jhum* cultivation was the most prominent cropping pattern with 52 per cent of the gross cropped area. A rough estimate found that the average farm business income from *Jhum* cultivation was as high as Rs 29,327 per acre. This was mainly due to the high average gross value of output relative to the small amount of paid-out costs incurred by the households involved in *Jhum* cultivation. Since no external inputs are used in the *Jhum*, with all inputs coming from the system itself, rather than brought from market, paid out cost is very low (Basu, Dutta, Patra, and Das, 2020).

Another narrative around shifting cultivation is that it causes environmental degradation (Ray, Sarma, and Chakraborty, 2007). But a primary data-based study by P Ramakrishnan showed that the success of shifting cultivation is affected adversely by forest degradation, not the other way round. Forest fallow land is the most important part of the farming system and the main source of productivity. The fallow management starts during the land clearing, as many communities protect selected trees against burning. They further intercrop and maintain trees during the cropping phase to enhance the re-growth of preferred species in the fallow. Selected patches are maintained to protect water sources and to serve ecological (seed conservation) and religious purposes. Fallow forest management requires careful land use planning at the landscape level. This maintenance of fallow forests is the reason why shifting cultivation areas have a higher forest cover and biodiversity than permanently cultivated land or tree plantations. The basic philosophy of shifting cultivation is to "create forest, not to destroy forest". Shifting cultivators have to maintain the healthy growth of secondary forests with enough biomass. Without the forest, the next *Jhum* cannot be cultivated (Darlong, 2004).

So, it is important to accept shifting cultivation, not as a necessary evil. Rather need to regard it as an agricultural practice that evolved very much as a reflex to the physiographical character of the land. But an important outcome came from a regional seminar that happened in 1976 in Shillong. The seminar agreed that shifting cultivation is a way of life. But like any other way of life is subject to change, shifting cultivation is also changing. However, the forces of change should emanate from within the society.

Indigenous Innovations and Adaptation

Farmers have already developed adaptations to enhance production based on their experience and the limitations of their land. A common occurrence of *Jhum* cultivation in northeast highland is that the fallow period has been becoming shorter. But studies by the team led by P S Ramakrishnan (Ramakrishnan, Shifting Agriculture and Sustainable development, 1993) reveal that total biomass (root and shoot) obtained from seed grains like rice, sesame, corn are 2.5 to 20.5 times higher in the 30-year *Jhum* cycle than that in 10 or 5-year *Jhum* cycle. On the other hand, yield from leaf and vegetables is maximum in the 5-year *Jhum* cycle (in fact, 2.8 to 20.5 times higher than the 10 or 30 years cycle).

Jhum cultivators are mostly seen in Dholai District in Tripura, people are more into vegetable production. Because with a fallow period of 3–4 years, the vegetables give a good yield and have high demands in local markets at nearby plains and *Jhum* cultivators get a good price. Particularly in the locations that have direct road transportation connection vegetable production have got impetus. Moreover, in the *Jhum* areas of Tripura along with paddy, and vegetables, cotton is also produced as a traditional cash crop. Cotton goes to market. Cultivation happens for one year only at one plot. By *Bhadro*[6] month harvesting is completed and next *Poosh*[7] month slashing and burning in new plot starts (Basu et al, 2022). Such adaptations can be called local market-friendly adaptations but without being market-driven in the sense that production inputs are not controlled by the global food value chain. There is another kind of adaptation that can be called community adaptation. When a drastic reduction in shifting cultivation was observed in Chuchuyimpand Village in Nagaland, the village council resolved that the community as a whole must provide all support and community service to the few shifting cultivators left. During the *Jhum* cultivations, *Jhumia* families living in temporary huts near the *Jhum* plots were common among many hill communities.

Farmers are enhancing the biological efficiency of the forest fallows through sophisticated practices to maintain useful trees on their cropland, thereby intensifying the shifting cultivation. Multipurpose trees, usually nitrogen-fixing, tree species are protected during the slash-and-burn phase and managed during the cropping phase. Coppicing and pruning are used to reduce competition for sunlight, and also to optimize the production of fodder, mulch, and other tree products (Kerkhoff and Sarma, 2006). For example, the alder-based *Jhum* cultivation in Khanama village in Nagaland, is known as the 'Khanama model' of shifting cultivation. The practice includes appropriate spacing of the alder trees, pollarding appropriate height and allowing it to coppice for a particular period before they are re-pollarded, a combination of crops, keeping a cycle of two years' crop and two years' fallow. This innovative agroforest system had facilitated the intensification and optimization of *Jhum* cultivation. In this system, cultivators follow two years of cultivation followed by two years of fallow period with local manipulation of the alder plantations in the *Jhum* field with definite spacing.

The case studies on Ukhrul (Manipur, India) and Zunheboto (Nagaland, India) provide another two examples of indigenous innovations of shifting cultivation. In Ukhrul, cropping has expanded from three to five years, and beyond in exceptional cases, and Zunheboto to up to five or six years. This intensification is made possible by innovations in crop selection, combination, and sequencing, and the adoption of erosion prevention measures. The main restriction to how many years a particular plot can be cropped is the increasing occurrence of weeds, and the second is soil quality. A further benefit of this innovation is that it does not compromise on the basic tenets of shifting cultivation, particularly mixed cropping, sequential harvesting, and risk spreading, and is therefore particularly convenient to farmers.

The Noctes and Nishis of Arunachal Pradesh pollard or prune, which means they do not cut the entire trees of Moralia/Jágr (*Macaranga denticulate)* at the time of clearing the forests for *Jhum*. When they vacate the area, they sow seeds of these trees in blank areas so that they will be available to provide house building material and firewood when they return for re-jhumming the area years later. Similarly, the Wanchos leave *Schima wallichii* trees standing in the area, which

---

[6] It is a month of lunisolar calendar followed in South and Southeast Asia. In Gregorian calendar, it is from mid of August to mid of September. It is the starting of autumn.

[7] It is also a month of lunisolar calendar. In Gregorian calendar, it corresponds to December–January.

they do not cut entirely. Farmers are also developing and experimenting with various models of agroforestry and crop species comb in their respective fields. With appropriate field studies and documentation, many of these models could perhaps be replicated as farmer-led indigenous innovations (Darlong, 2004).

Food Sovereignty

Apart from the demystification of the top-down narrative of economic and ecological inviability of shifting cultivation, one important issue that many times doesn't get enough space in discussion is the contribution of shifting cultivation for local-level food sovereignty. Food sovereignty emphasizes ecologically appropriate production, distribution and consumption, social-economic justice and local food systems as ways to tackle hunger and poverty and guarantee sustainable food security for all people.[8]

Emerging from the work of *La Via Campesina*[9] food sovereignty has a very strong focus on small-scale producers who produce more than 70 per cent of the food in the world. Food sovereignty does not consider food production to be just an economic activity geared for supplying cheap food to the middle and upper classes. Instead, it believes that producers' well-being has to be paramount and agriculture is a livelihood system that is dependent on the various capitals (human, social, financial, physical, and environmental) embedded in the local landscape.

The harvesting time of various crops in shifting cultivation is spread over six to eight months in a year and carry both subsistence crops (such as maize, vegetables, pulses, rice, and tubers) and traditional cash crops (such as cotton, ginger, and turmeric). Such a diversity of crops, and their ripening over several months, provides food throughout the year and reduces the risk of a failed harvest of some crop. In Nongtraw village in Meghalaya, potato is grown alongside, millet, mustard, sesame, beans, maize, sweet potato, cucumber, cocoyams, and Job's tears. These crops grow in the same plot but are harvested at different seasons (FAO, 2021). The seeds for crops in *Jhum* are derived from previous harvests (no dependency on seed merchants), and many are unique varieties, that are well attuned to the specificities of soil and climate. (Dikshit and Dikshit, 2014)

In a 2006 village-level survey in Khukchang village in Tripura, surveyors found that the mixed cropping on *Jhum* land often involved the cultivation of thirty or more varieties of plants (Basu, Dutta, Patra, and Das, 2020). A total of 63 varieties of crops were listed in the village, with a maximum of 42 crops being grown by a single household. In Meghalaya, in a cluster of villages in the West Garo Hills as many as twenty-three varieties of rice and twenty-five varieties of millet were being cultivated in the *Jhum* fields (presentation by Dhrupad Chaudhury, natural resource expert working for IFAD, at a seminar on biodiversity in Northeast India held at St. Mary's College, Shillong, November 27–28, 2002).

8 Nyeleni Newsletter no 13. Details available at https://nyeleni.org; last accessed on November 9, 2021

9 *La Via Campesina* is an international movement bringing together millions of peasants. Details available at https://viacampesina.org/en/; last accessed on November 9, 2021

That is how the historical value of shifting cultivation also lies in in-situ conservation of so many varieties of edible foods. A preliminary study by the National Bureau of Plant Genetic Research (NBPGR), Barapani, Shillong shows crop germplasm varieties in shifting cultivation in northeast India are tremendous. The study showed as many as 674 varieties of maize, 298 varieties of upland rice, 200 varieties of grain legume, 37 varieties of brinjal, 60 varieties of ginger, 250 varieties of taro, 242 varieties of yam, etc. Although rice was the basic staple diet, millet and other crops were also grown, including beans, gourds, cucumbers, spinach, and various spices.

But the changing cropping pattern towards commercial purpose and plantation of horticultural crops and the market focus of agro-based industries is squeezing out the local availability of staple food crops. A survey by (Behera, Nayak, Andersen, and Måren, 2016) in seven villages (two *Jhum* cultivation, 3 traditional cash crops, 2 modern cash crops) has shown that the diversity of food production is much higher in *Jhum* cultivating villages. Three types of cereals, 6 types of tubers, 11–15 types of vegetables, 4–6 types of leafy vegetables, 4–6 types of spices and one type of pulse were produced and consumed in the villages that do shifting cultivation. It means total 33–35 types of food makes their diet so diverse. Contrary to that, villages with cash crop production in that dietary diversity comes down to 13–20 kinds of food. The same survey shows villages with *Jhum* cultivation, except occasional meat or fish every other food item that enters kitchen comes either from own production or hunting or fishing at a nearby river or forest or foraging. Villages switching over to cash crops are abandoning cultivation of food crops altogether or with marginal production of one kind of cereal. Rice has replaced the consumption of millet and maize as the main staple in villages switching over to cash-crop cultivation. Further, people living under cash-crop regimes mostly depend on white rice, unlike people of the *Jhum* systems who consume three kinds of cereals, millets, maize, and brown rice. People in cash-crop villages occasionally consume wheat flour, which is not produced locally, and the consumption of potato is rapidly replacing traditional tubers such as taro, sweet potato, tapioca, and yam. Traditionally, farmers rear chicken and pigs at their homesteads for household consumption, while the cash-cropping farmers depend on industrial farm-raised chicken (Behera, Nayak, Andersen, and Måren, 2016). Those who shifted to rubber became dependent on the market for food.

The Third Perspective: Traditions and Innovations for Securing *Jhum*- Based Food Sovereignty

Adaptation by indigenous people is not new. *Jhum* or many other indigenous food systems survived many millennia by adapting to external change and dynamics (FAO, 2021). Even now, there are innovative adaptation experiments to bridge modern techniques and traditional food systems to achieve food sovereignty. Of course, agroecology will play an important role in that.

In Nongtraw village in Meghalaya, a group of 16 youths from the community have formed a cooperative society for marketing millet. They sell both raw (grains removed from stem) and processed form (ground into a powder) millet, the latter of which is packed nicely for sale at the market. They introduced an electric mill that reduced the labour and time required for processing finger millets produced at the *Jhum* field that have fastened the value addition before the product goes to market. This is a classic example of how scientific and local/indigenous knowledge have been bridged. Millet production comes from *Jhum*. But, when Public Distribution System (PDS) came into the picture supplying rice, the consumption patterns of people changed and they started relying on rice more and more. Eventually, millet production too got declined. By 2010, at Nongtraw village only household was left with millet cultivation. But the picture changed when organizations working for food sovereignty stepped in to mobilize and convinced people to revive millet production. This is because all millets are very high in fibre and nutrients. North East Slow Food and Agrobiodiversity Society (NESFAS) trained the members of "Nongtraw Multipurpose and Marketing Co-operative Society" to make local millets ready to be sold in the local market. If people can get adequate income keeping the *Jhum* culture then there will be no incentive for occupational mobility. With the cooperative, the mill and local market connectivity people of Nongtraw are earning enough. With electricity at home people could do bamboo basket making at night also. The indigenous ethos of collective labour and collective ownership has been given the shape of a cooperative society. A modern instrument has been used but producing millets with local knowledge, resource and seeds at the *Jhum* field. There is no motor accessible road to their village, they have to carry their products from their village up side 3000 steps. Peasants get low prices from middlemen or those who sell by themselves also have to give in low price because they don't have storage space (FAO, 2021).

There are some experiments to make shifting cultivation adaptive and the Regional Agricultural Research Station, Diphu, Assam has conducted some experiments relevant to hill agriculture with special reference to shifting cultivation. Efforts are being made to find out improved practices identical to *Jhum* cultivation but more productive and less injurious to soil and environment. But, Food Sovereignty is not a simple set of technical solutions or a formula that can be applied—it is instead a 'process in action'. According to the material realities and culture of a locality, different models may evolve. So, the crux of the issue is—the efforts for adapting and innovating with the *Jhum* model are completely driven by peasant themselves. The state is not seen to play a role.

The idea of bridging scientific and local/indigenous knowledge has to come as a policy perspective for achieving food sovereignty where *Jhum* will play the central role. As has been discussed earlier, political and economic dispensation in governments, policymakers or intelligentsia has to stop seeing *Jhum* as an evil. That's why the role of the nation-state also can't be ignored. Food sovereignty is also based on the assumption that sovereignty is possible (Ajl, 2018). In developing countries/global south where the internal economy is linked to global capital which have unprecedented mobility, the national capacity to take sovereign economic planning is extremely limited. International financial institutions don't prefer preferential rural interest rates. So, as long as the economy of a nation-state and international financial infrastructures are linked to a sovereign policy for an indigenous food system like *Jhum*, that is a kind of anathema of financialization of crop and land. In fact, food sovereignty was proposed in reaction to the term 'food security'. Food sovereignty also contested the food and agricultural trade agenda promoted at the time by the World Trade Organisation (WTO). The WTO envisaged a world where all agricultural goods would be produced and traded according to where the production costs are lowest. Agreements often obliged states to dismantle domestic agricultural economies and supports, leading to the expansion of monoculture crops and increased mechanization (Anderson, 2018). That is why the idea of food sovereignty has to be linked with national sovereignty because without influencing the state local food sovereignty cannot be maintained since as we have seen it is the nation-state that implements policies to replace non-marketable, taxable production methods.

But, northeast India comes under the Sixth Schedule of the Indian constitution. It's a special provision in the Indian constitution that gives certain regions local autonomy. Major highland areas in the northeast come under this and there is customary law-based local governance in many states. So instead of internalizing hegemonic ideas by intellectual state apparatuses like "*Jhum* is evil" they should try for scientific upgradation of agroecology for a *Jhum*-based food sovereignty with community knowledge being at the centre stage. In that way, food sovereignty and sustainability of *Jhum* is also about intellectual self-reliance of sixth schedule areas while framing agricultural and land policies that means it is also about strengthening federalism against a centralized state.

Conclusion

Agriculture is an important activity for a major section of the population in developing countries. The view that industrialization is the only desired objective of development for an agrarian society has been highly contested (Jha, Moyo, and Yores, 2013). Rather national sovereignty is seen as the prime goal. And for that, a *sine qua non* is food sovereignty. Against this background, the question of shifting cultivation has to be seen. The recent pandemic has highlighted the destructiveness of industrialized agriculture upon the biosphere and humans. Even the call for adopting New Green Deal in agriculture is also on the surface. People are looking for an opportunity to move from corporate-controlled global food supply chains, which are based on narrow motives like decreasing unit cost rather than diversity or sustainability. A more diverse sustainable way of agriculture that can ensure food sovereignty is desired where people will have the right to determine the pattern of food production and consumption—taking into consideration rural and productive diversity. What is important is that rather than seeing *Jhum* as a 'problem' or 'primitive' one needs to see how *Jhum* can be transformed, by reinventing and upgrading to be economically and environmentally sustainable agriculture that ensures food sovereignty at the local level. Various kinds of innovations are already taking place, some have organically emerged from peasants and few others are from experts. It is important to adopt a holistic and integrated approach that modifies and improves the *Jhum* cultivation scientifically to enhance productivity and meet the necessities of the *Jhumias*.

Historically speaking, shifting cultivation is a distinct stage in the evolution of agriculture and modern land husbandry practices. But the reason why this pre-historic practice has been continued is embedded in the ecology and material culture. Shifting cultivation has become an integral part of all upland communities in the eastern Himalayan region. It is so ingrained with the life and institution of the people that almost all social festivals and ceremonies are rooted in the shifting cultivation cycle.

There had been a quiet revolution within the practice and amongst shifting cultivators across the region in innovating ways for optimizing *Jhum* cultivation. Survival instincts or otherwise, innovations have been the inherent strength of shifting cultivators to changing circumstances. They adopt various strategies for intensification of shifting cultivation through indigenous processes of field trials. These innovations need to be recognized and appreciated. There are strong reasons to believe that many of the aforementioned models are based on the principles innovated under various circumstances that are scientific—though growing landlessness and land inequality in tribal highlands do not suffice to such expectations. So, the issue here is not to romanticize *Jhum* but to make an attempt to understand it from a holistic view.

References

Ajl, M. 2018. Delinking, food sovereignty, and populist agronomy: notes on an intellectual history of the peasant path in the global South. *Review of African Political Economy*, 64–84. DOI:https://doi.org/10.1080/03056244.2018.1443437

Anderson, F. 2018. *Food Sovereignty Now: A Guide to Food Sovereignty*. European Coordination via Campesina.

Baruah, S. 2020. *In The Name of Nation.* California: Stanford University Press.

Basu, R., R. Dutta, S. Patra, and A. Das, A. 2020. Agrarian Structure, Production, and Agrarian Relations in Khakchang. In: M. Swaminathan, R. Basu, and V. K. Ramachandran, *Socio-Economic Surveys of Three Villages of Tripura: A Study of Agrarian Relation*, pp. 72–93. New Delhi: Tulika.

Behera, R. N., D. K. Nayak, P. Andersen, and I. E. Måren. 2016. From *Jhum* to broom: Agricultural land-use change and food security implications on the Meghalaya Plateau, India. *Ambio*, 63–77.

Chaudhury, L. R. 2013. Decentralization under the 6th Schedule of the Indian Constitution: A Study in the Context of Karbi Anglong District. *The Echo* 103.

Darlong, V. 2004. *To Jhum or Not to Jhum*. Dimapur: The Missing Link.

Das, D. 2006. Demystifying the Myth of Shifting Cultivation: Agronomy in Northeast. *Economic and Political Weekly* 4914.

Das, S. and M. Das. 2014. Shifting Cultivation in Tripura – A Critical Analysis. *Journal of Agriculture and Life Sciences* 49.

Dikshit, J. K. and K. R. Dikshit. 2014. *North-East India: Land People EConomy*. New York; London: Springer.

FAO. 2021. *Indigenous People's Food System: Insights on sustainability and resilience from the front line of climate change*. Rome: FAO and Alliance of Bioversity International and CIAT. DOI: https://doi.org/10.4060/cb5131en

Fernandes, W. 2020. Land Issues and Liberalisation in Northeast India. In: D. Mishra and P. Nayak, *Land and Livelihoods in Neoliberal India*, pp. 265–282. Singapore: Palgrave.

Fernandes, W. and M. Pereira. 2005. *Changing Land Relations and Ethnic Conflicts: The Case of North-Eastern India*. Guwahati: NESRC.

Fernandes, W., J. Baruah, and A. Milik. 2019. *Ownership Management and Alienation: Tribal Land in Northeast India*. Guwahati: NESRC and OKD.

Goswami, R. 2010. Rivers and History. JNU.

Jha, P., S. Moyo, and P.Yores. 2013. The Classical Agrarian Question: Myth, Reality and Relevance. *Agrarian South: Journal of Political Economy*.

Karlsson, B. 2011. *Unruly Hills: A Political Ecology of India's Northeast*. New York: Berghahn Book.

Kerkhoff, E. and E. Sarma. 2006. *Debating Shifting Cultivation in Eastern Himalayas*. Kathmandu, Nepal: ICIMOD.

Lalnunmawia, F. and C. Lalzarliana. 2013. *Land Use System in Mizoram*. New Delhi: Akash Publishing House.

Maaker, E. D., D. Kikon, and S. Barbora. 2016. Shifting Ground? State and market in the uplands of Northeast India. *The Newsletter, International Institute for Asian Studies*, 6–7.

Means, G. P. 2013. *Tribal Transformations: The early History of The Naga Hills*. New Delhi: Prestige Books.

NEC. 2008. *Northeastern Region Vision 2020*. New Delhi: Ministry of Development of Northeastern Region, Government of India.

Prasad, A. 2003. *Against Ecological Romanticism*. New Delhi: Three Essays Publishers.

Prasad, A. 2016. Tribal Livelihood and Agrarian Crisis. In: N. Sundar, *Scheduled Tribes and Their India*, pp. 493–509). New Delhi: Oxford University Press.

Ramakrishnan, P. S. 1984. Tropical Tree Architecture and Photosynthesis. *Proceedings of the Indian National Science Academy*, pp. 567–571. Springer.

Ramakrishnan, P. S. 1993. *Shifting Agriculture and Sustainable development*. New Delhi: Oxford University Press.

Ray, A. K., B. Sarma, and G. Chakraborty. 2007. *Accumulation and Dispossession: Communal Land In North East India*. New Delhi: Aakar.

Scott, J. C. 2010. *The Art of Not Being Governed*. Guwahati: Orient Black Swan.

White, B. H., D. Mishra, and V. Upadhay. 2009. Institutional Diversity and Capitalist Transition: The Political Economy of Agrarian Change in Arunachal Pradesh India. *Journal of Agrarian Change*, 512–547.

CHAPTER-4
CROP DIVERSIFICATION AND ECONOMY OF JHUM CULTIVATION IN NORTHEAST INDIA

Tarujyoti Buragohain[1]

Abstract

This study assesses the impact of various government interventions on transition of *Jhum* cultivation for sustainable development in the northeastern region (NER). India had 4.4 lakh hectare (ha) land under *Jhum* cultivation in 2008–09, which declined to 3.9 lakh ha in 2015–16. About 3 lakh ha (78%) concentrates in seven northeastern states. Nagaland has the largest share (97,933 ha, 32.6%), followed by Mizoram (69,155 ha, 23%), Arunachal Pradesh (50,911 ha, 17%), Manipur (49,996 ha, 16.7%), Meghalaya (23,787 ha, 7.9%), Assam (5260 ha, 1.8%), and Tripura (3062 ha, 1%). The area under *Jhum* cultivation decreased by 0.53 lakh ha from 2008–09 to 2015–16 despite an increase in the area under *Jhum* in Manipur (68%), Mizoram (15%), and Tripura (10%) during the same period.

India is self-sufficient as far as food grain production is concerned. However, the northeastern states such as Assam, Meghalaya, Mizoram, and Tripura produce insufficient food grains for self-consumption owing to less effective land management practices, sometimes due to lack of adequate cultivable land due majorly to the topography like in Mizoram or flood-prone areas in Assam. For instance, there is the shortage of food grains of about 1.7 million tonnes per year. All the northeastern states have been implementing various agricultural development programmes and schemes aiming at increasing productivity and farmers' livelihood. Country's pioneering R&D organization the Indian Council of Agricultural Research (ICAR) has been contributing significantly to the agricultural development through new and productive crop varieties, animal breeds, and package of practices and testing them in farmers' fields through All India Coordinated Research Projects and Krishi Vigyan Kendras (KVKs). One of the successful programmes of ICAR

1 Associate Fellow at National Council of Applied Economic Research (NCAER), 11 Indraprastha Estate, Parisila Bhawan, New Delhi 110002 | Email: taru@ncaer.org

has been the National Agricultural Innovation Project (NAIP) that transformed the agricultural sector, particularly in the north-eastern region. A women beneficiary of this programme from Arunachal Pradesh reported a total return of ₹13,896 from her *Jhum* field. The NAIP programme implemented in her village helped her to increase productivity of cereals by 2.71 tonnes/ha and vegetables by 5.25 tonnes/ha and enabled a net earning of ₹73,800 from the same area. This enhancement in the income was due to increase in livestock and fish production. In the state of Mizoram, as a result of the implementation of the New Land Use Policy (NLUP) with effect from July 2010, the total rice production increased to 58,994 tonnes during 2013–2014 with about 10% contributed only by NLUP beneficiaries. Likewise, the adoption of Integrated Farming System (IFS) has been successful in Nagaland. For instance, crop diversification, livestock, fishery, and secondary farming increased employment opportunities to about 603 man-days as compared to 72 man-days in the traditionally practised *Jhum*. Poultry, piggery, dairy, fishery, mushroom farming, vermicomposting, and fruits in cropping cycle enhanced the income by 6.54 times compared to the traditional *Jhum*. In the state of Tripura, there was a yield gap of 1.04 lakh tonnes during 2011–12 when the state recorded 7.52 lakh tonnes of food grains as against the required 8.56 lakh tonnes. But then in the 10 years of implementation of NAIP, the food grain production has increased by 2.39 lakh tonnes in the state.

Keywords: Food security, agriculture, *Jhum*, crop diversification, farming system

Introduction

It is globally recognized that shifting cultivation is a way of life for many indigenous, tribal, and other poor and marginalized upland communities. The system involves clearing of hill slopes by cutting and burning of forests and bushes and growing mixed crops (Dwivedi, 1992). Food and Agriculture Organization (FAO) declared shifting cultivation as the most serious land use problem in the tropical areas (FAO, 1957). Shifting cultivation has been practised widely by the indigenous communities, particularly in Africa, Latin America, and parts of Asia. In early 1980s, FAO estimated about 400 million hectares (Mha) of areas under shifting cultivation across the world (Lanly, 1985). It is currently practised in a wide variety of forms by 500 million to one billion people around the world (Thrupp, Hecht, and Browder, *et al*., 1997). Shifting cultivation not only is an intricate part of the way of life of indigenous groups, but also plays a pivotal role in planning and guiding their traditional customary laws and regulations (Cherrier, Maharjan, and Maharjan, 2018).

India had 4.4 lakh ha of land area under *Jhum* cultivation in 2008–09, which declined to 3.9 lakh ha in 2015–16 (Department of Land Resources, 2019). About 78% of this area is distributed across the seven northeastern states. Nagaland has the largest share (97,933 ha, 32.6%), followed by Mizoram (69,155 ha, 23%), Arunachal Pradesh (50,911 ha, 17%), Manipur (49,996 ha, 16.7%), Meghalaya (23,787 ha, 7.9%), Assam (5260 ha, 1.8%), and Tripura (3062 ha, 1%). The area under *Jhum* decreased by 0.53 lakh ha from 2008–09 to 2015–16. However, there was an increase in the area under *Jhum* in Manipur (68%), Mizoram (15%), and Tripura (10%) during the same period (Table 1).

More than 100 indigenous tribes and sub-tribes in the northeastern region depend on shifting cultivation for their livelihood (Ramakrishnan, 1992). About 4.43 lakh tribal families have been practising *Jhum* cultivation in the region (North Eastern Council Secretariat, 2015). In northeastern states, about 80% population live in rural areas and about 70% depend on agriculture for their livelihood. Food insecurity is the major concern of the region as all these states experience environmental challenges that affect the socio-economy of the communities and sociocultural ecology of the demography. The recommendation of the Indian Council of Medical Research (ICMR) clearly indicates that the region would require an approximately 80.78 lakh tonnes of cereals, 4.43 lakh tonnes of pulses, 6.06 lakh tonnes of oilseeds, 6.05 lakh tonnes of fruits, and 20.20 lakh tonnes of vegetables for its projected population of 55.33 million in 2030 (National Commission on Population, 2019). The food grain requirement would be more than 12% over the existing production. The *Jhumias* traditionally grow rice, maize, and various types of vegetables and fruits such as cabbage, ginger, turmeric, linseed, orange, apple, and pineapple. Productivity of *Jhum* cultivation is much lower than any other type of settled cultivation. Government has been implementing various programmes and policies with some innovative methods to diversify crops and farm integration that are suitable for the area to enhance productivity on the *Jhum* land. The chapter aims to assess the impact of various government interventions on the outmigration of hill farmers from the traditional *Jhum* cultivation.

Methodology

This chapter is based on secondary data collected from various government sources (e.g., Ministry of Statistics and Programme Implementation (MoSPI)), various issues of Wasteland Atlas of India, various issues of Agricultural Census of India, economic surveys of states, published documents and reports of the government, and published articles in the peer reviewed journals by the researchers in agriculture in general and shifting cultivation in particular relevant to the northeastern region.

Economy of the Northeastern Region

The states Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura, popularly known as seven sisters, are characterized by low levels of economic development as measured by major development indicators. All the seven states together contribute only 2.7% to the total national gross value added (GVA) (₹12,803,128 crore) for the year 2018–19 at constant prices. The average share of agriculture, forestry, and fishing to state gross value added (SGVA) is presented in Figure 1.

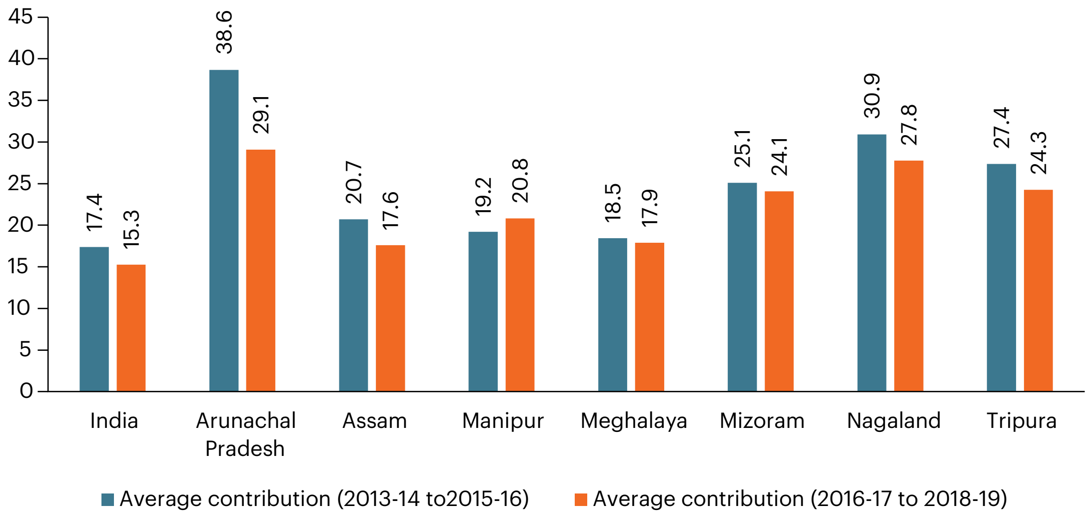


FIGURE 1: Average contribution (%) of agriculture, forestry, and fishing to the total GVA at constant prices

Source: GSVA/NSVA by Economic Activities. Ministry of Statistics and Programme Implementation (MoSPI), Government of India

The average share of agriculture, forestry, and fishing to SGVA for both the periods, that is, 2013–14 to 2015–16 and 2016–17 to 2018–19, was higher than the national average. The higher contribution of agriculture, forestry, and fishing to the SGVA indicates the low level of economic development. For instance, per capita income for the year 2011–12 at constant prices was lower than the national average of ₹71,609 except for Arunachal Pradesh. Despite the significant growth of per capita CAGR per cent in 2018–19, the per capita income of the region remained lower than the national average, except for Mizoram that recorded the highest CAGR 8.2% of per capita income, and the per capita income of Mizoram increased from ₹65,347 in 2011–12 to ₹122,465 in 2018–19 and surpassed the national average of ₹105,361 (Figure 2).

Land Use Pattern of Northeastern Region

NER occupies around 8% of the total geographical area and about 56% of the total geographical area under forest with wide inter-state variation. The highest area under forest is observed in Arunachal Pradesh (80.3%), followed by Manipur (76.1%), Mizoram (75.2%), Tripura (60%), Nagaland (52.1%), Meghalaya (42.2%), and Assam (23.6%) (Table 1).

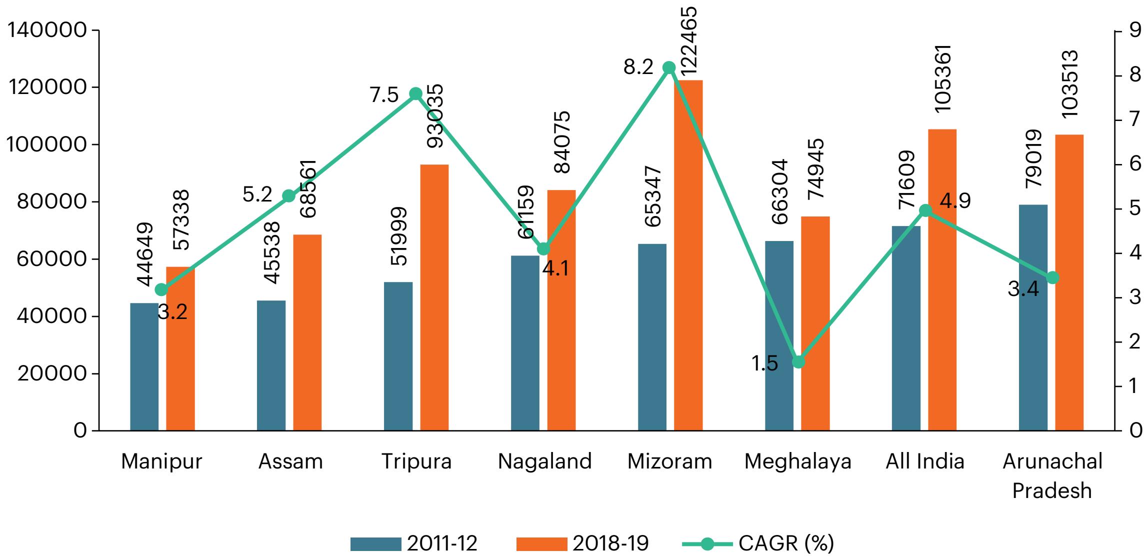


FIGURE 2: Trend of per capita income at constant price and CAGR (%)

Source: GSVA/NSVA by Economic Activities. Ministry of Statistics and Programme Implementation (MoSPI), Government of India

Table 1: Pattern of distribution of land in Northeastern states

	Geographical area ('000 ha)	% of area under forest 2015–16	Net area sown ('000 ha) 2015-16	Area under *Jhum* current 2008–09	Area under *Jhum* current 2015–16	Per cent area under *Jhum* 2015–16
Arunachal Pradesh	8,374	80.3	227	82,167	50,911	16.96
Assam	7,844	23.6	2827	8,202	5,260	1.75
Manipur	2,233	76.1	383	29,668	49,996	16.66
Meghalaya	2,243	42.2	286	28,173	23,787	7.93
Mizoram	2,108	75.2	219	60,208	69,155	23.04
Nagaland	1,658	52.1	384	141,453	97,933	32.63
Tripura	1,049	60.0	255	3,031	3,062	1.02
NER	25,509	56.1	4581	352,902	300,104	100.0
All India	328,726	21.9	140,130	439,685	387,127	

Source: Department of Land Resources (2019), Northeastern Council Secretariat (2015), Ministry of Agriculture and Farmers Welfare (2019)

Major Central Government Schemes

The major central sector schemes include the following:

(i) Watershed Development Project in Shifting Cultivation Area (WDPSCA) was implemented in the NER from 1st April 1995 to 31st March 2012. The states designated horticulture and/or soil conservation as the nodal department for implementing the scheme (Seventh Report 1994–95).

(ii) 'National Food Security Mission' was launched in October 2007 in all states and UTs. This mission continued during 12th five-year plan (2012–17) with a target of additional food grain production of 25 million tonnes.

(iii) Given the problems and prospects in agriculture, the National Development Council (NDC) launched the 'Rashtriya Krishi Vikas Yojana' (RKVY) in 2007–08. One of the major objectives of the scheme is to provide autonomy and flexibility to states to plan and execute schemes as per local/farmers' needs.

(iv) 'National Mission for Sustainable Agriculture' (NMSA) was implemented in 2010 for enhancing agricultural productivity, especially in rainfed areas, focusing on integrated farming, water use efficiency, soil health management, and synergizing resource conservation.

(v) 'National Innovations on Climate Resilient Agriculture' (NICRA) is a network project of the ICAR and was implemented in 2010–11. The project aims to enhance resilience of Indian agriculture to climate change and climate vulnerability through strategic research and technology demonstration.

(vi) 'Horticulture Mission for Northeast and Himalayan' (HMNEH) states has been implemented since 2003–04 for the holistic growth of the horticulture sector covering fruits, vegetables, root and tuber crops, mushrooms, spices, flowers, aromatic plants, coconut, cashew, cocoa, and bamboo.

(vii) 'Sub-Mission on Agricultural Mechanization' scheme was implemented in 2014–15 with one of the major objectives of increasing the reach of farm mechanization to small and marginal farmers and to the regions where availability of farm power is low.

(viii) 'Sub-Mission on Agroforestry' (SMAF) under NMSA was initiated in 2014 to expand the tree coverage on farmland in complementary with agricultural crops to make agriculture less vulnerable to climatic change.

(ix) 'National Livestock Mission' (NLM) was launched during 2014–15 for the development of the livestock sector with the objectives to enhance the level of nutrition and standard of living of livestock keepers and farmers, especially smallholders, through sustainable, safe, and equitable interventions. Under NLM, a Sub-Mission on Pig Development in Northeastern Region was provided.

Government of India has been implementing these schemes on cost sharing basis. The pattern of sharing between the Centre and northeastern states is in the ratio of 90:10 (NERCORMP, 2020).

Crop Diversification and Status of *Jhum* Cultivation

Arunachal Pradesh

Arunachal Pradesh is the largest hill state of northeastern region. About 80% of the population lives in rural areas and *Jhum* cultivation is the main livelihood for about 70% of the tribal community. The farmers mainly grow paddy of different varieties for their own consumption and also for preparing local wine (Apong) (Bhuyan, 2019). Other important food crops grown are the maize and millets. The farmers grow vegetables including cucumber, pumpkin, beans, chilli, soybeans, gourd, tomato, cabbage, brinjals, and so on. The root crops sown near tree stump or on the slopes include potato, sweet potato, turnip, beetroots, radish, yam, cassava, tapioca, and so on. Farmers also grow fruits, namely, apple, orange, kiwi, pineapple, banana, and passion.

Pattern of Land Distribution

Agricultural production and income of farmers depend on the size of land. All farmers are categorized into five groups based on land ownership: (i) marginal (less than 1 ha), (ii) small (1.01–2.0 ha), (iii) semi-medium (2.01–4.0 ha), (iv) medium (4.01–10.0 ha), and (v) large (>10 ha) (Agricultural Census of India, 2015-16).

In Arunachal Pradesh, only 20% were marginal farmers in 2005–06. It increased to 24% in 2015–16 (Table 2). As against this, the percentage of marginal farmers in all India level increased from 64.8% to 68.5% during the same period (Appendix 1). In Arunachal Pradesh, medium and semi-medium farmers together were 52.5% in 2005–06, which decreased to 48.6% in 2015–16. At the national level, it was 15.9% in this category. The percentage decreased to 13.4% during the same

Table 2: Trend and pattern of landholding in Arunachal Pradesh (number in thousands and area '000 ha)

Size Class	2005–06		2010–11		2015–16	
	Number	Area	Number	Area	Number	Area
Marginal <1.0 ha)	22 (20.2%)	11	21 (19.6%)	12	27 (24.0%)	14
Small (1.0 to <2.0 ha)	22 (22.9%)	33	19 (17.7%)	26	24 (21.1%)	31
Semi-medium (2.0 to <4.0 ha)	30 (27.5%)	85	34 (31.1%)	94	29 (25.3%)	77
Medium (4.0 to <10.0 ha)	27 (24.8%)	169	28 (25.6%)	155	26 (23.3%)	153
Large (>10 ha)	4 (3.7%)	63	7 (6.0%)	97	7 (5.9%)	104
All size	109 (100%)	361	109 (100%)	384	113 (100%)	380

Source: Various issues of Agricultural Census of India

Note: Figures in parentheses indicate per cent of total.

period. In contrast, in Arunachal Pradesh large farmers increased from 3.7% in 2005–06 to 5.9% in 2015–16, whereas there was decrease in large farmers from 0.85% to 0.57% during this period at the national level. Despite of dominating semi-medium, medium, and large farmers, the food grain production is not enough to meet the requirement to be a self-sufficient state as more than 50% of land is under *Jhum* cultivation.

Change in Area Under Jhum Cultivation

Apart from cereals, the farmers grow diverse cash crops such as ginger, turmeric, and large cardamom and fruits such as orange, kiwi, passion fruit, and apple in large scale without using chemical fertilizers. They have a great demand for these organic products in the national market. Hence, the prosperous and affluent farmers also become wholesale dealers and employ several small farmers who gain from such a business (Kalita, Baruah, Datta, *et al*., 2017). The area under large farm category increased from 63,000 ha in 2005–6 to 104,000 ha in 2015–16 (Table 2).

Therefore, the area under *Jhum* cultivation has been decreasing over the years. In 2003, about 56% of the net area was under *Jhum* cultivation, which declined to about 22% in 2015–16. The area under *Jhum* cultivation has decreased from 111,691 ha in 2003 to 50,911 ha in 2015–16 (Figure 3).

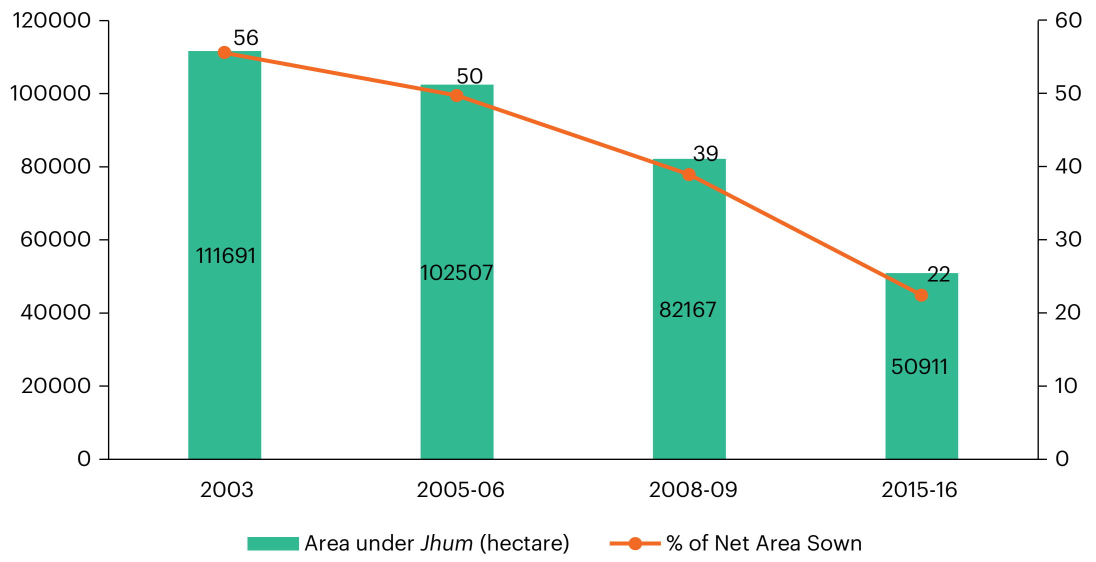


FIGURE 3: Change in area under *Jhum* cultivation and % of net area sown in Arunachal Pradesh

Source: Department of Land Resources (2019)

Government Interventions

During 11th (2007–12) and 12th (2012–17) five-year plans, several schemes and programmes were implemented by the Government of Arunachal Pradesh and Central Government for *Jhum* improvement through crop diversification. Under these flagship programmes, a total of 123.22 ha had been covered through different programme modules designed by the Arunachal Pradesh Centre of the ICAR Research Complex for NEH Region (Kalita, Baruah, Datta, *et al.*, 2017). Some common interventions were intercropping: maize, legumes, vegetables, spices, agroforestry trees, water harvesting structures, site-specific soil and water conservation measures, polyhouse for production of seedlings and high value crops, vermicomposting and in situ nutrient management, and livestock interventions. Many farmers have been benefitted under the schemes. A women beneficiary of this programme reported an increase in economic return from ₹13,896 to ₹73,800 from her *Jhum* land, as the cereal productivity increased by 2.71 tonnes/ha and vegetables by 5.25 tonnes/ha in the same unit of land. Livestock and fish integration transformed her livelihood support system significantly

Schemes during the 11th (2007–12) and the 12th (2012–17) five-year plan for *Jhum* improvement include the following:

» Improvement of *Jhum* through horticulture interventions

» Integrated Community Large Cardamom and Orange Plantation in *Jhum* land in Kurung Kumey district

» Establishment of large cardamom garden at Rissi village under Palin circle of Kurung Kumey district

» Establishment of orange and cardamom at Chesing Rijo (Magria) village of the eastern circle of Upper Subansiri district

» Cultivation of hi-tech orange garden at Logyi area of Karbak village of Kambang circle in West Siang district

» Establishment of Biotechnology Training and Development Centre at Ziro

» Organic cultivation of kiwi and large cardamom at Ziro in Lower Subansiri district

» Cultivation of hi-tech orange garden at Lutak area of Gensi circle in West

» Siang district (Kalita, Baruah, Datta, *et al.*, 2017)

Assessment

Although various factors are involved in crop diversification and improved livelihood in Arunachal Pradesh, farmers with large land size felt empowered and took leadership to grow cash crops. It further encouraged small farmers too. This improved income and livelihood of the small farmers too. Market demand, government policies and programmes, and initiatives of large farmers are the major drivers for crop diversification.

Manipur

In Manipur, about 90% of 2,233,000 ha of the geographical area is under hills and forests. Only about 10% of the area is under valley. The population of Manipur is 28.56 lakh, of which 41% belong to scheduled tribes (Census of India, 2011). Agriculture plays a pivotal role in the economy. The farmers grow mostly rice and maize. However, there is ample scope for bringing more land under fruit cultivation in the hilly areas. The major fruits grown in the state are pineapple, orange, lemon, banana, guava, peaches, and so on.

Pattern of Land Distribution

Owing to limited arable land, about 83% of farmers are marginal and smallholding operators and use about 60% of the total land, which makes it difficult for them to practise any subsistence farming. There are negligible large farmers in Manipur (Table 3). *Jhum* cultivation has been widely practised in most of the hills and forest areas. Food grain deficit has been a persistent issue and the government has to import from other states to meet the requirement. The food grain deficit was 127,000 tonnes in 2012–13 It declined to about 88,000 tonnes in 2013–14 and further increased to 158,000 tonnes in 2015–16 (Table 4). The per capita consumption rate of food grains was estimated to be cereals 191.02 kg and pulses 6.08 kg.

Table 3: Trends and pattern of landholding in Manipur (number in thousands and area in '000 ha)

Size Class	2005–06		2010–11		2015–16	
	Number	Area	Number	Area	Number	Area
Marginal (<1.0 ha)	77 (51.3%)	40	77 (51.0%)	40	77 (51.0%)	40
Small (1.0 to <2.0 ha)	49 (32.7%)	63	49 (32.4%)	63	49 (32.4%)	63
Semi-medium (2.0 to <4.0 ha)	22 (14.7%)	55	22 (14.8%)	55	22 (14.8%)	55
Medium (4.0 to <10.0 ha)	3 (2.0%)	14	3 (1.8%)	13	3 (1.3%)	13
Large (>10 ha)	Neg	Neg	Neg	Neg	Neg	Neg
All size	151 (100%)	172	151 (100%)	172	151 (100%)	172

Source: Various issues of Agricultural Census of India.

Note: Figures in the parentheses are per cent of total. Neg: Negligible

Table 4: Status of food grain requirement, production, and deficit in Manipur

Year	Food Grain ('000 tonnes)		
	Own Production	Requirement	Deficit
2012–13	437.6	582.7	127.08
2013–14	488.6	595.5	88.48
2014–15	493.4	608.5	96.16
2015–16	444.0	621.8	158.61
2016–17	504.8	635.4	111.04
2017–18	520.7	649.3	108.62

Source: *Economic Survey of Manipur 2018-19*. Directorate of Economics & Statistics, Govt. of Manipur

Change in Area Under *Jhum* Cultivation

The area under *Jhum* cultivation decreased from 111,954 ha in 2003 to 29,668 ha in 2008–09 and increased to 49,996 ha in 2015–16 (Figure 4). Population pressure, inadequate land for cultivation, low education levels, and policy planning and implementation without local participation are all factors that influence farmers' decision to continue shifting cultivation (Rahman *et al*., 2011). Around 3 lakh rural population practices *Jhum* cultivation in Manipur (Singh, Punitha, Ansari, *et al*., 2017). Income of *Jhum* cultivators increased significantly because of the government intervention in *Jhum* area development through crop diversification. The per cent of net area sown under *Jhum* declined from 51.6% in 2003 to 13.1% in 2015–16. However, the Manipur Remote Sensing Applications Centre (MARSAC) reported the area under *Jhum* cultivation to be 122,147 ha for the year 2017 (Singh, Punitha, Ansari, *et al*., 2017).

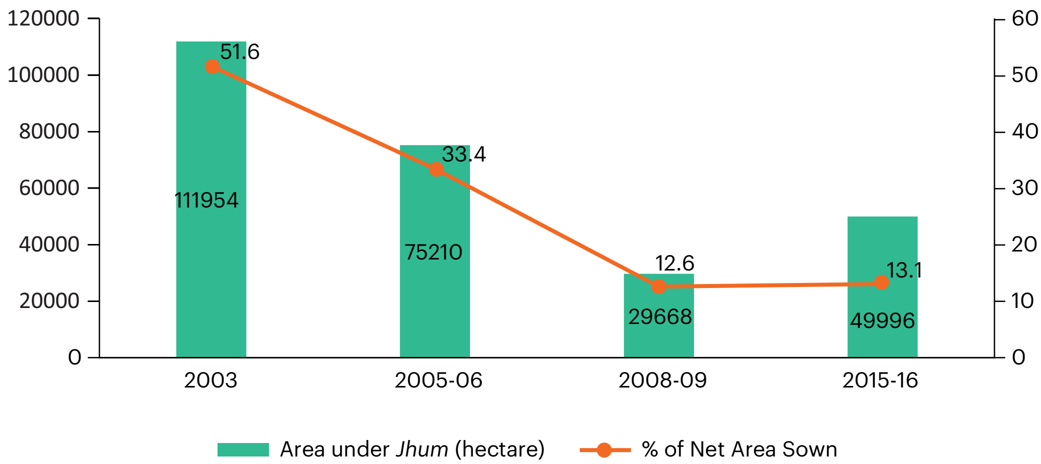


FIGURE 4: Change in area under *Jhum* cultivation and % of net area sown in Manipur

Source: Department of Land Resources (2019)

Government Interventions

Shifting cultivation is widely practised in hilly areas and settled terrace farming in foothills or low slope areas above the adjacent rivers and streams. One of the major interventions of *Jhum* areas in Manipur is crop diversification through inclusion of pulses in *Jhum* areas in which was grown only rice mix.

The technology demonstrated new varieties such as pigeon pea (UPAS-120), rice bean (local), rajma (Chitra)–potato, rajma (Chitra)–pea (Rachna), rice bean (local)–pea (Azad pea), and groundnut

(ICGS-76)–lentil (HUL-57). After this practice, the *Jhum* farmers produced 1.2–1.76 tonnes pigeon pea/ha, 1.3–1.7 tonnes rice bean/ha, 1.4–1.9 tonnes rajma/ha, 1.4–1.8 tonnes pea/ha, and 0.85 tonnes lentil/ha. The net returns varied across farmers. The beneficiaries especially from *Jhum* cultivated areas received net returns of ₹56,000 to ₹105,000/ha (Ansari, Saraswat, Sharma, *et al.*, 2017).

Assessment

Government intervention through technical demonstration and inclusion of pulses in *Jhum* areas with crop combination is the major driver for crop diversification in Manipur. Farmers realized the benefits with respect to productivity and profitability from such combinations. This has also encouraged them to continue with *Jhum* cultivation.

Meghalaya

Meghalaya is an agrarian state with 80% of its total population dependent on agriculture for livelihood. Meghalaya has a population of about 2,964,007, of which 86% are scheduled tribes (ST) (Census of India, 2011). The population growth is higher in Meghalaya as compared to the national average. The estimated number of people engaged in *Jhum* cultivation is 257,140 – around 14% of the rural population of Meghalaya (Jeeva, Laloo, Mishra, *et al.*, 2006).

Pattern of Land Distribution

Marginal and small farmers consist of about 82% and owned about 53% of area in 2005–06, which declined to 79% in 2015–16. Meghalaya has no large farmers. It is also observed that the overall cultivated area increased from 241,000 ha in 2005–06 to 300,000 ha in 2015–16 (Table 5). Government has been implementing various programmes to increase food grain production to meet the requirement of its population. The production of food grains has been increasing over the years and the extent of food deficit has been reducing (Table 6).

Table 5 Trend and pattern of landholding in Meghalaya (number in thousands and area in '000 ha)

Size Class	2005–06		2010–11		2015–16	
	Number	Area	Number	Area	Number	Area
Marginal (<1.0 ha)	112 (55.2%)	55	103 (49.0%)	46	123 (52.8%)	56
Small (1.0 to <2.0 ha)	55 (27.1%)	73	58 (27.6%)	77	60 (25.9%)	80
Semi-medium (2.0 to <4.0 ha)	29 (14.3%)	73	41 (19.4%)	113	40 (17.2%)	109
Medium (4.0 to <10.0 ha)	6 (3.0%)	34	8 (4.0%)	47	9 (4.0%)	51
Large (>10 ha)	Neg	6	Neg (0.11%)	4	Neg (0.11%)	4
All size	203 (100%)	241	210 (100%)	287	232 (100%)	300

Source: Various issues of Agricultural Census of India.

Note: Figures in parentheses indicate per cent of total. Neg: Negligible

Table 6: Status of food grain requirement, production, and deficit in Meghalaya (lakh tonnes)

	2004–05	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12
Production	2.24	2.59	2.70	2.91	3.36	3.49	3.61	3.79
Requirement	3.68	3.75	3.83	3.91	3.99	4.06	4.14	4.22
Deficit	1.44	1.16	1.13	1.00	0.63	0.57	0.53	0.43

Source: Chapter IX, Meghalaya State Development Report. Development of Agriculture and Allied Sectors, Planning Department of Meghalaya

Change in Area Under Jhum Cultivation

Resource degradation, low productivity, tendency to encourage large family size, and little or practically no scope for adoption of modern agricultural technology are some of the drawbacks of this system (Christanty, 1986). The area under *Jhum* has been declining over the years (Figure 5). In 2003, the area under *Jhum* was 62,721 ha (27.63% of the net area sown), which declined to 23,787 ha (8.32% of the net area sown) in 2015–16.

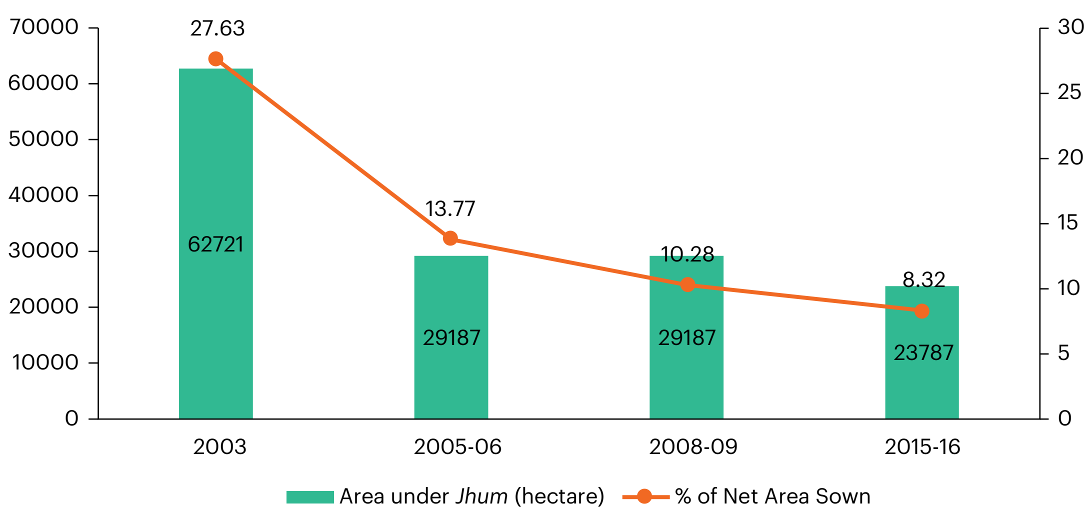


FIGURE 5: Change in area under *Jhum* cultivation and per cent of net area sown in Meghalaya

Source: Department of Land Resources (2019)

Government Interventions

The major food crops grown by the farmers are rice and maize and a majority of the farmers grow food crops for their own consumption. Besides the food crops, Meghalaya is known for its oranges (Khasi mandarin), pineapple, banana, jackfruits, and temperate fruits like plums, peaches, and pears. The popular cash crops that are traditionally cultivated include turmeric, ginger, black pepper, and areca nut. Strawberry, flowers, and so on are grown for commercial purposes. The modern cash crop system is largely a government intervention aimed to stop the *Jhum* system

(Behera, Nayak, Andersen, *et al.*, 2016). Commercial broom plantations are commonly planted in abandoned *Jhum* land with scanty soil across the plateau in Meghalaya (Tiwari Kumar, Lynser, *et al.*, 2008).

Various bodies such as national committees for agriculture and other commodity committees have recommended that to provide a better method of agriculture, it would be useful to introduce plantation crops in the region as one of the important alternatives. Some horticultural crops grown on hill slope gave extremely encouraging economic return. Yield potential of newly planted Assam lemon orchard was found to be 11,300, 12,800, and 37,200 kg/ha during 3rd, 4th, and 5th year, respectively (Das, Layek, Mohapatra, *et al.*, 2017).

Economy of *Jhum* Cultivation

The farmers in Meghalaya adopted several management practices that make the shifting cultivation system economically sustainable. These include the following:

» Harvesting of crops is carried out almost continuously for a period of nine months, which provides food security for almost the whole year. The crop mix is such that it provides all nutritional needs of the people.

» Production of a variety of crops from the same field for both subsistence and cash income.

» Least vulnerable to market forces and at the same time taking advantage of the market.

» The system fulfils almost all day-to-day requirement of the farmers, that is, food, fibre, fuelwood, medicine, timber, and so on (RCNAEB, 2010).

Assessment

Low productivity of traditional crops under *Jhum* cultivation and low income of the farmers are the main drivers of crop diversification – moving to horticulture and plantation crops for commercial purpose without compromising on the main principles of shifting cultivation in Meghalaya.

Mizoram

Mizoram has 21,087 km^2 area constituting about 0.64% of the total geographical area of the country. The state had 10.91 lakh population in 2011 that increased from 8.88 lakh in 2001 (Census of India, 2011). The decadal growth of population over 2001 to 2011 is 22.78%, which is much higher than the national average of 17.64%. *Jhum* cultivation is the main source of livelihood of about three-fourths of its rural population. Rice is the staple diet of all people in Mizoram. Food shortage is an acute problem in Mizoram. Rice requirement of the state per year is estimated to be about 180,000 MT. The present rice production is only about 62,000 MT, providing only 34% of its rice requirement (Government of Mizoram, 2017-18).

Pattern of Land Distribution

The state of Mizoram has predominantly mountainous terrain and hardly any land on plain areas for settled cultivation. There are no large farmers. The marginal and small farmers constituted 82%

in 2005–06 that increased to 87% in 2010–11 and again decreased to 81% in 2015–16. Similarly, the semi-medium and medium farmers constituted 16.7% that decreased to 12.7% and increased again to 19% during the same period (Table 7). The principal crop is paddy and others are maize, cucumber, beans, arum, ginger, mustard, sesame, and cotton. Some pulses such as cowpea, rice beans, and French beans are cultivated under shifting cultivation. Various studies on shifting cultivation indicates that the lack of viable employment and income earning opportunities was mostly responsible for the continuation of *Jhum* cultivation with low quality land for crops. Lack of infrastructure, particularly irrigation, road, communication, market, and rural electrification, was another important factor. Increasing rice production and diversification of agriculture farming would therefore enhance rural livelihood and reduce poverty in villages and are imperative for food security of the state (Government of Mizoram, 2017-18).

Table 7: Trend and pattern of landholding in Mizoram (number in thousands and area in '000 ha)

Size Class	2005–06		2010–11		2015–16	
	Number	Area	Number	Area	Number	Area
Marginal (<1.0 ha)	43 (47.8%)	27	50 (54.7%)	30	45 (50.8%)	27
Small (1.0 to <2.0 ha)	31 (34.4%)	41	30 (32.4%)	38	27 (30.6%)	35
Semi-medium (2.0 to <4.0 ha)	14 (15.6%)	32	10 (10.8%)	24	14 (15.4%)	32
Medium (4.0 to <10.0 ha)	1 (1.1%)	7	2 (1.9%)	9	3 (3.6%)	15
Large (>10 ha)	Neg	3	Neg (0.29%)	4	Neg (0.32%)	4
All size	90 (100%)	110	92 (100%)	105	90 (100%)	112

Source: Various issues of Agricultural Census of India.
Note: Figures in parentheses indicate per cent of total. Neg: Negligible

Change in Area Under *Jhum* Cultivation

The area under *Jhum* was 114,695 ha, which declined to 69,155 ha in 2015–16 (Figure 6). The high per cent of the net area sown under *Jhum* implies the encroachments of forest land. The actual forest land was 89% of the total geographical area in 1991, which declined to 75% in 2015–16.

Government Interventions

Various schemes have been implemented to improve agricultural productivity through crop diversification by the government since the 11th five-year plan (2007–12). More notable is the NLUP implemented in 2010–11. The NLUP was implemented with a budget of ₹2800 crore (₹28 billion). The main objective of the scheme was to completely abolish *Jhum* cultivation by 2015 and to put all families dependent on *Jhum* cultivation under the system of settled farming. Impact of the schemes is that there is total potential area for wet rice cultivation (WRC) of about

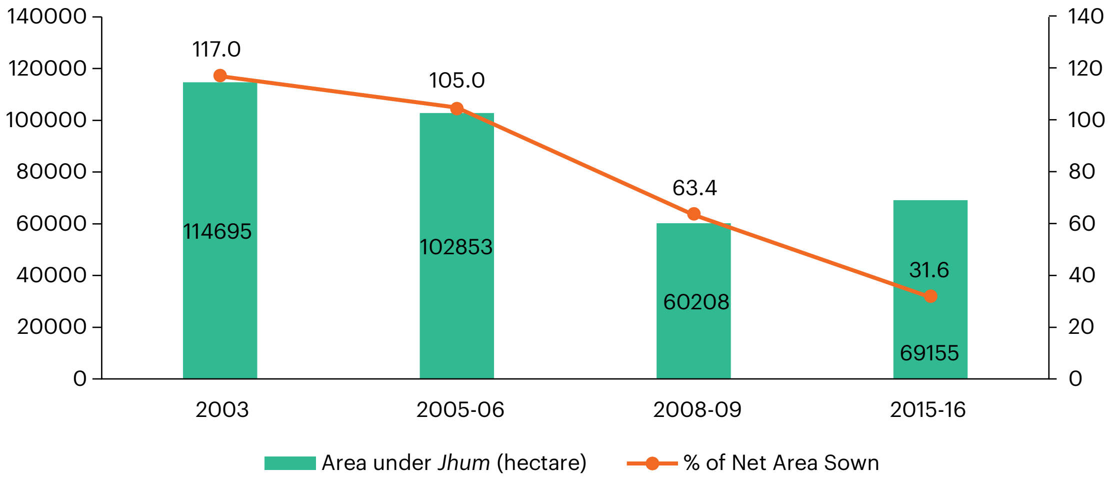


FIGURE 6: Change in area under *Jhum* (hectare) and % of net area sown in Mizoram

Source: Department of Land Resources (2019)

74,644 ha (Economic Survey 2017-18). At the time of the implementation of NLUP, the area under wet rice cultivation (WRC) was 12130 ha (16.25%). In 2016–17, NLUP covered 36,858 ha, including the *Jhum* area. The rice production also increased from 47,201 MT to 61,516 MT in 2016–17. The increase in rice production was 14,315 MT, which was more than 30% increase. The total number of *Jhumia* families was 68,433 in 2010–11. This number decreased to 47,714 in 2016–17, showing a decrease of about 30% over a 6-year period. Out of the total potential cultivated area of 101,000 ha, only 1878 ha of land was used for oil palm in 2010–11. After the implementation of NLUP, the area under oil palm increased to 17,588 ha and 2290 farmers were benefitted by the scheme in 2013–14 (Singh, Boopathi, Dutta, *et al*., 2017).

Impact of ICAR Initiative

Large-scale field level demonstration on maize was organized in eight districts of Mizoram covering an area of 534.50 ha under TSP (Tribal Sub-Plan) and NICRA programme in collaboration with KVKs and district agriculture officers. With these interventions, productivity of *Jhum* field increased from 1.5 tonnes/ha (maize equivalent yield) to 4.6 tonnes/ha and their net income increased from ₹30,400/ha to ₹90,000/ha by selling of maize seed. The NAIP was implemented during 2012–15 with an objective to increase cropping intensity to improve the livelihood of *Jhumias*. The introduced soybean as a second crop in maize cultivated areas in *Jhum* land registered an average yield of 1.48 tonnes/ha and could eventually earned an additional net income of ₹50,000 per ha. Under this programme, the Mizoram centre of the ICAR Research Complex for NEH Region selected 10 progressive farmers from Sawm village of Saiha district to facilitate strawberry farming too. On an average, each farmer could harvest 1750 kg of strawberry with an earning of ₹1.61 lakh per year. Those villages are now popularly called ‘strawberry villages’ by the Government of Mizoram (Singh, Boopathi, Dutta, *et al*., 2017).

Assessment

Improved cereal productivity, increased employment opportunities, and cash requirement are the major drivers of crop diversification in Mizoram.

3.5 Nagaland

Nagaland had a population of 1,990,036 in 2001, which decreased to 1,978,502 in 2011. Surprisingly, there was a decrease in population (11,534) in absolute terms and a negative growth rate in this decade (–0.58%) (Nagaland; Census of India, 2011). Shifting cultivation is practised by as many as 1.9 lakh families, bringing about 94,380 ha of area under *Jhum* cultivation (Rajwhowa, Baishya, Ray, *et al*., 2017). Being a hilly state, mixed cropping of cereals, pulses, oilseeds, vegetables, spices and condiments, and plantation crops is practised under *Jhum* cultivation. Rice is the staple diet of Nagaland. Unfortunately, the state has not been able to achieve self-sufficiency in rice production. Hence, Nagaland has aimed to attain food sufficiency by the year 2025 by optimum utilization of land, various forms of scientific interventions, and quality inputs (Vision 2025).

Trend and Pattern of Land Distribution

Land distribution pattern is very encouraging in Nagaland; 85% land was in the hands of semi-medium, medium, and large farmers in 2005–06, which decreased to 81% in 2015–16. Small and marginal farmers owned 15% of land in 2005–06, further increasing to 19% in 2015–16 (Table 8). In case of all India, this pattern is just the other way round as semi-medium, medium, and large farmers consisted of 17% in 2005–06, which decreased to 14% in 2015–16. Small and marginal farmers had 83% landholding, which increased to 86% during 2015–16 (Appendix 1).

Table 8: Trend and pattern of landholding in Nagaland (number in thousands and area in '000 ha)

Size Class	2005–06		2010–11		2015–16	
	Number	Area	Number	Area	Number	Area
Marginal (<1.0 ha)	12 (7.1%)	6	6 (3.6%)	3	8 (4.2%)	5
Small (1.0 to <2.0 ha)	13 (7.7%)	16	20 (11.4%)	23	30 (15.2%)	37
Semi-medium (2.0 to <4.0 ha)	37 (21.9%)	93	48 (27.2%)	125	63 (32.2%)	169
Medium (4.0 to <10.0 ha)	76 (45.0%)	465	78 (43.7%)	481	74 (37.5%)	431
Large (>10 ha)	30 (17.8%)	593	21 (14.1%)	314	25 (10.9%)	442
All size	169 (100%)	1173	178 (100%)	1074	197 (100%)	1084

Source: Various issues of Agricultural Census of India
Note: Figures in parentheses indicate per cent of total

Nagaland has a suitable climate for agricultural and horticultural produce. It supports multiple crops, namely, rice, maize, millet, gram, mustard, bean, sugarcane, rubber, tea, banana, pineapple, orange, jackfruit, pear, plum, passion fruit, litchi, mango, lemon, sweet lime, potato, sweet potato, tapioca, tomato, pea, chilly, ginger, garlic, cardamom, and so on.

To attain the vision of producing the recommended per capita requirement for cereals to the tune of 500 grams per person per day, the state will have to produce 451,414 tonnes of cereals in 2020 and 510,733 tonnes in 2025 to cater its projected population of about 25 lakhs in 2020 and 28 lakhs in 2025 (Vision 2025 Nagaland).

Change in Area Under *Jhum* Cultivation

In 2003, the area under *Jhum* was 111,660 ha, which increased to 141,453 in 2008–09 and decreased again to 97,933 ha in 2015–16 (Figure 7). Similarly, the extent of the net area sown under *Jhum* cultivation was 36.6% in 2003, which increased to 45% in 2008–09 and decreased again to 26% in 2015–16.

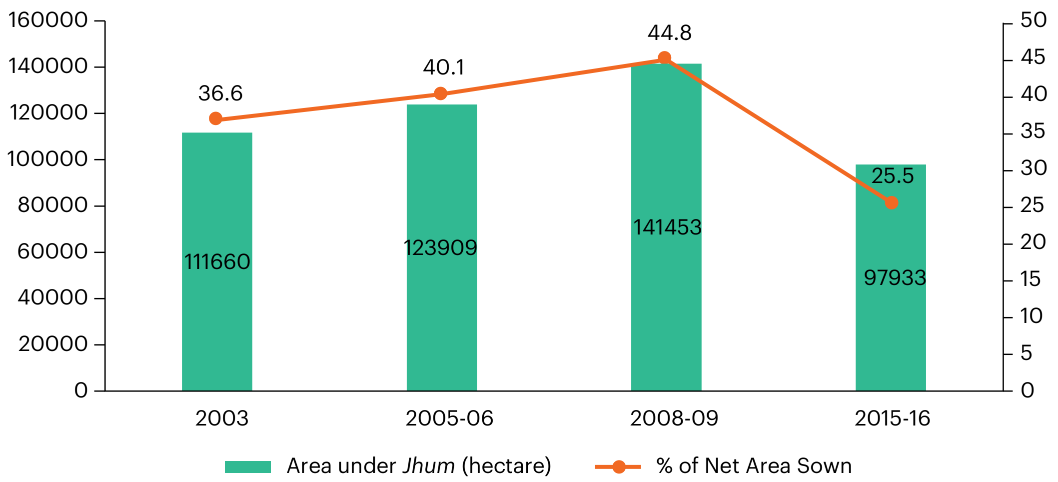


FIGURE 7: Change in area under Jhum cultivation and % of the net area sown in Nagaland

Source: Department of Land Resources (2019)

Government Interventions

The Government of Nagaland has been implementing various programmes to improve the productivity of *Jhum* cultivation. These include the following:

(i) Integrated land development projects

(ii) Integrated watershed development project

(iii) Soil and water conservation programme under RKVY

(iv) ICAR projects on *Jhum* improvement under TSP project

The *Jhumias* are aware of the major negative environmental consequences of *Jhum* cultivation, but they are bound to continue *Jhum* cultivation primarily owing to their ethnic belief of cultural heritage and more importantly the lack of alternate employment opportunities to sustain the family needs throughout the year (Paul, Tripathi, Burman, *et al.*, 2017).

Impact of Integrated Farming System

Under this programme, to improve the existing *Jhum* practices through improved crop varieties in both *kharif* and *rabi* seasons, training was given to some farmers in Humtso village of Wokha district to adopt scientific packages. Overall interventions of crops, livestock, fishery, and secondary farming increased employment opportunities (603 man-days) as compared to traditional *Jhum* farming (72 man-days). Intervention of poultry, piggery, dairy, fishery, mushroom, vermicomposting, and fruits in cropping cycle provided 6.54 times better income than traditional *Jhum* farming.

Another major intervention under this programme was rainwater harvesting. Acute scarcity of water during post-rainy season is one of the major constraints for intensification and diversification of agricultural activities in *Jhum* areas. A study was undertaken at three distinct *Jhum* cultivating villages (Yanthamo, Longsa, and Riphyim) of the Wokha district. The study finds that with the adoption of this system, there was improvement in soil health. Therefore, promotion of rainwater harvesting, crop diversification, and inclusion of animal and fishery components are a viable intervention for the *Jhumias* for overall improvement in productivity, income, employment, food, nutritional, and ecological security through sustainable use of natural resources. Promotion of the integrated farming system has increased overall net income (₹246,160) as compared to the traditional income from *Jhum* farming (₹52,248). Overall interventions of crops, livestock, fishery, and secondary farming increased employment opportunities (506 man-days) as compared to the traditional *Jhum* farming (72 man-days). It can be concluded that the implementation of IFS is a viable intervention for the *Jhumias* for the overall improvement in productivity, income, employment, food, nutritional, and ecological security through sustainable use of natural resources (Rajkhowa, Baishya, Ray, *et al*., 2017).

Assessment

Government intervention to increase employment opportunities and achieve the goal of 'food for all' is the major driver of crop diversification and decreasing the area under *Jhum* cultivation in Nagaland.

Tripura

Tripura is the second most populous state in the northeastern region after Assam. The population increased from 31,99,203 in 2001 to 36,73,917 in 2011. In absolute terms, the population increased by 4,74,714 and the decadal growth was 14.8%, lower than the all India average of 17.7%.

Tripura has an area of 10,491.69 km^2 with about 26% cultivable land and the rest being hilly and forested. Food security is the major problem in Tripura as there has been a huge gap between requirement and production in the state (Table 9).

Table 9: Status of food grain requirement, production, and deficit in lakh tonnes

	Food grain (lakh tonnes)		
	Production	Requirement	Deficit
1999–2000	5.134	7.18	2.046
2007–08	6.49	8.09	1.60
2013–14	7.27	8.66	1.39
2014–15	7.62	8.79	1.17
2015–16	8.23	8.92	0.69
2016–17	8.53	9.05	0.52
2017–18	8.55	9.18	0.63

Source: Economic Review of Tripura (2018-19)

Trend and Pattern of Land Distribution

Land distribution is the major issue in Tripura as 96.5% of all landholders are marginal and small farmers. In 2005-06, the cultivated land accounted for 76.4% of the total area of 280,000 ha (Table 10). There is no large farmer and semi-medium and medium farmers account for about 3%. The area under cultivation increased to 282,000 ha in 2015–16 on account of marginal farmers. About 42% of the population depends on agriculture and allied sector for their livelihood. There are about 19 tribes that continue to practice *Jhum* cultivation as per the provision of forest right accord of 2006 Tribal Act.[2] In Tripura, the area under *Jhum* cultivation was 16,843 ha in the year 2016–17 (provisional) against an average production of 18,190 MT. The average yield per hectare was found at 1080 kg/ha, much lower than that of the settled cultivation of 3092 kg/ha (Department of Agriculture and Farmers' Welfare, 2018–19). The main agricultural crops grown in the state are paddy, maize, wheat, pulses, oilseeds, fruits, vegetables, tea, rubbers, and so on.

Change in Area Under *Jhum* Cultivation

In 2003, about 28,489 ha was under *Jhum* cultivation, which decreased to 3062 ha in 2015–16 (Figure 8). This may be attributed to various government interventions to encourage farmers for settled cultivation.

[2] The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 was passed in the Parliament on December 13, 2006. The President of India assented to the Bill on December 29, 2006 and the Act came into force. The Act recognizes the rights, responsibilities, and authority of the forest dwelling scheduled tribes and other traditional forest dwellers for sustainable use, conservation of biodiversity, and maintenance of ecological balance, thereby strengthening the conservation regime of the forests while ensuring livelihood and food security of the forest dwelling scheduled tribes and other traditional forest dwellers.

Table 10: Trend and pattern of landholding in Tripura (number in thousands and area in '000 ha)

Size class	2005–06		2010–11		2015–16	
	Number	Area	Number	Area	Number	Area
Marginal (<1.0 ha)	491 (86.9%)	139	499 (86.3%)	140	504 (88.0%)	149
Small (1.0 to <2.0 ha)	54 (9.6%)	75	55 (9.5%)	76	48 (8.4%)	70
Semi-medium (2.0 to <4.0 ha)	18 (3.2%)	46	22 (3.7%)	54	19 (3.2%)	49
Medium (4.0 to <10.0 ha)	2 (0.35%)	10	3 (0.48%)	14	2 (0.43%)	13
Large (>10 ha)	Neg	10	Neg (0.01%)	1	Neg (0.01%)	1
All size	565 (100%)	280	578 (100%)	285	573 (100%)	282

Source: Various issues of Agricultural Census of India
Note: Figures in parentheses indicate per cent of total.

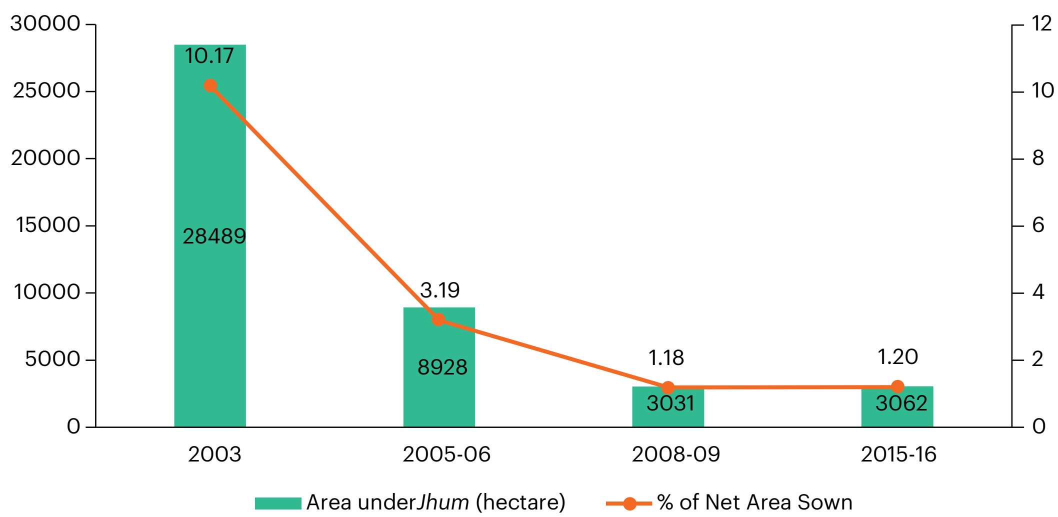


FIGURE 8: Change in area under *Jhum* cultivation and % of the net area sown in Tripura

Source: Department of Land Resources (2019)

Government Interventions

The government of Tripura has given special thrust for increasing area and production of pulses and oilseeds. *Jhum* land is used for raising multiple crops; at least four to five crops are grown in a plot of land and the *Jhumias* mainly use animal dung or plant extracts as soil nutrients and all the settled crops, namely, Aman paddy, *Boro* paddy, pineapple, brinjal, potato, chilli, and pumpkin, were profitable, but crops under *Jhum*, namely, paddy, maize, pulses, and mixed vegetables, did not reflect due returns. The study found that some of the *Jhum* farmers in Gomati district adopted settled cultivation with cross breed piggery. Both men and women were involved in the process. As a consequence, their income increased many times compared to the *Jhum* farming. Womenfolk become educated and participated in the politics and were empowered to take decision in household activities. The tribal women of the study area became empowered socially, politically, and economically (Das and Bordoloi, 2019).

Vision for the Five-Year Period 2015–20

Comprehensive Tripura agriculture plan was proposed for 2015–20 (sector-wise) by utilizing available natural resources extending up to 2020. The objectives of the scheme were (i) conversion of areas under mono/double cropped into triple cropped where irrigation facility can be provided, (ii) redevelopment of *Jhum* farming and maximizing *Jhum* production, (iii) gainful utilization of forest land for sustainable farming and livelihood on which rights were vested with tribal forest dwellers, (iv) encouragement of crop diversification and sustainable agriculture, (v) promotion of zero tillage, (vi) promotion of conservation agriculture, and (vii) strengthening ongoing schemes to improve the production of *Jhum* cultivation (Vision 2030 Tripura).

Ten Years Perspective Plan (2000–01)

Under this plan, the government had targeted to achieve paddy cultivation in more than 17,000 ha of hill land under improvised *Jhum* in 2011–12. In 1999–2000, the area under *Jhum* cultivation was 10,735 ha, which increased to 14,535 ha in 2009–10 and increased further to 16,390 ha in 2010–11 because of modernization and technological intervention. Because of the use of scientific methods and biofertilizers, the productivity increased from 0.5 MT/ha in 1999–2000 to 1.02 MT/ha in 2011–12. The perspective plan has been extended for 2 more years in anticipation to produce 7.52 lakh MT as against the requirement of 8.56 lakh MT and to further reduce the gap between demand and supply. The food grain production has increased by 2.39 lakh MT over the past 10 years (Khandpal and Bhowmik, 2017).

Others Programmes

(A) Tribal Welfare Department

(i) Rehabilitation of landless *Jhumias* under settlement programme (1955–2000) and (ii) *Jhumia* settlement through plantation programme. Under these programmes, 47,571 and 3006 families, respectively, received benefits.

(B) Forest Department

Forest department has initiated rehabilitation of shifting cultivators through (i) soil and water conservation schemes, (ii) NEC (North-Eastern Council) assisted schemes, and (iii) rubber-based rehabilitation schemes. A total of 2226 beneficiaries were benefitted.

(C) Agriculture Department

Integrated scheme for improvement of production and productivity of *Jhum* crops through supply of seeds, supply of fertilizers, horticulture plantation in homestead, and training of *Jhumias* was launched. The scheme was implemented from 1998 to 2004. A total of 6379 families were benefitted.

(D) Horticulture Department

Watershed Development Project in Shifting Cultivation Areas was implemented during 8th five-year plan (1992–97), 9th five-year plan (1997–2002), first year of the 10th five-year plan (2002–2007). A total of 8629 beneficiaries were benefitted.

(E) Autonomous District Council

Assistance was provided for upland *Jhum* farming for land preparation, supply of *Jhum* paddy seeds, sowing, and weeding during 2000–04. A total of 84,000 (some families got more than once) families got benefitted. Integrated tribal *Jhumia* rehabilitation through rubber plantation during 1998–99 benefitted about 1500 families.

Assessment

Government interventions to enhance productivity and production of food grains through increased area and crop diversification for pulses and oilseeds and various horticulture crops are the major drivers for transition of *Jhum* cultivation in Tripura.

Conclusion and Policy Measures

The traditional *Jhum* cultivation has been disappearing slowly due to state-specific government's intervention with crop diversification and technological upgradation in the NER. The area under *Jhum* cultivation showed decrease in all these states from 2003 to 2015–16. However, the area under *Jhum* increased in Manipur and Mizoram from 2008–09 to 2015–16. The MARSAC reported that the area under *Jhum* cultivation was 122,147 ha for the year 2017. Food shortages, unemployment, and cash requirement are the major drivers for crop diversification as well as continuation of *Jhum* cultivation. Income from *Jhum* cultivation continues to be the main livelihood for about 60% of the rural households. The *Jhumias* grow 6-7 cash crops at a time. Some progressive large farmers in Arunachal Pradesh took leadership to produce cash crops in large scale and motivate small farmers to produce such crops and create demand in national markets.

Various earlier studies have focused on the area under *Jhum* cultivation and the number of families practising *Jhum* and so on for different purposes. However, there is no recent authentic and large-scale survey data to assess the extent of the area under *Jhum* cultivation and the number of indigenous families continuing *Jhum* cultivation and earning income from such cultivation.

References

Ministry of Agriculture and Farmers Welfare. 2019. Agricultural Statistics at a Glance 2019. Ministry of Agriculture and Farmers Welfare, Government of India

Ministry of Agriculture and Farmers Welfare. 2019. Agriculture Census in India 2019. Ministry of Agriculture and Farmers Welfare, Government of India

Ansari, M. A., P. K. Saraswat, S. K. Sharma, *et al*. 2017. Changing from subsistence to remunerative cropping: a success story of diversification through legume in *Jhum* land. In National Seminar on Smart Farming for Enhancing Input Use efficiency, Income and Environmental Security (SFEIES), September 19–21, ICAR Research Complex for NEH Region, Umiam Meghalaya

Behera, R. N., D. K. Nayak, P. Andersen, *et al*. 2016. From *Jhum* to broom: agricultural land-use change and food security implications on the Meghalaya Plateau, India. *Ambio*, 45: 63–77

Bhuyan, R. 2019. A review note on shifting cultivation in northeast India amidst changing perception. *Dhaulagiri Journal of Sociology and Anthropology*, 13: 90–95

Cherrier J., K. L. Maharjan, and S. K. Maharjan. 2018. Shifting cultivation: misconception of Asian governments. *Journal of International Development and Cooperation*, 2(4): 1–19

Christanty, L. 1986. *Traditional Agriculture in South East Asia: A Human Ecology Perspective*, 240 p. Boulder: West View Press

Das, A., J. Layek, K. P. Mohapatra, *et al*. 2017. Shifting cultivation: some options to sustainable development in Meghalaya. *Jhum Improvement for Sustaining Farm Livelihood and Natural Resource Conservation in North-Eastern Hill Region: Vistas and Frontiers*. ICAR Research Complex for NEH Region, Umiam, Meghalaya

Das, A. K. and J. Bordoloi. 2019. Jhuming to mainstream farming as an alternative way of livelihood amongst the tribal farmers of Tripura. *Agricultural Situation in India*, LXXVI(12)

Department of Land Resources. 2019. Wasteland Atlas of India 2019. Department of Land Resources, Government of India

Department of Agriculture and Farmers' Welfare. 2018–19. *Approved Annual Plan (2018-19)*. Government of Tripura

Dwivedi, A. P. 1992. *Agroforestry, Principles and Practices*. New Delhi: Oxford and IBH Publication Company

FAO. 1957. Shifting cultivation. *Unasylva*, 11(1)

Government of Mizoram. 2017-18. *Mizoram Economic Survey 2017-18*. Planning & Programme Implementation Department (Research & Development Branch), Government of Mizoram

Government of Tripura. 2018-19. Economic Review of Tripura 2018-19. Department of Economics and Statistics, Planning, Government of Tripura, Agartala

Jeeva, S. R. D. N., R. C. Laloo, and B. P. Mishra. 2006. Traditional agricultural practice in Meghalaya, North-East India. *Indian Journal of Traditional Knowledge*, 5(1): 7–18

Kalita, H., M. S. Baruah, D. Datta, D. Jini, and R. A. Alone. 2017. Status of shifting cultivation in Arunachal Pradesh. *Jhum Improvement for Sustaining Farm Livelihood and Natural Resource Conservation in North-Eastern Hill Region: Vistas and Frontiers*. ICAR Research Complex for NEH Region, Arunachal Pradesh Centre, Basar

Khandpal, B. K. and S. N. Bhowmik. 2017. *Shifting Cultivation in Tripura: Challenges, Prospects and Alternatives*. ICAR Research Complex for NEH Region, Tripura Centre

Lanly J. P. 1985. Defining and measuring shifting cultivation. *Unasylva*, 37: 17–21

National Commission on Population. 2019. Population projections for India and states, 2011-2036

NERCORMP (North Eastern Region Community Resource Management Project). 2020. Compendium of Government of India Schemes and Programmes Relevant to the North Eastern States. North Eastern Region Community Resource Management Project, Shillong

North Eastern Council Secretariat. 2015. *Basic Statistics of North Eastern Region 2015*. North Eastern Council Secretariat, Government of India

Paul, S., A. K. Tripathi, R. R. Burman, *et al*. 2017. *Jhum* cultivation and its consequences on forest and environment in Eastern Himalayan tract of India: a participatory assessment. *Range Management and Agroforestry*, 38(1): 121–126

Rahman, S. A., M. F. Rehman, and T. Sunderland. 2012. Causes and consequences of shifting cultivation and its alternative in the hill tracts of eastern Bangladesh. *Agroforest Systems*, 84: 141–155

Rajkhowa, D. J., L. K. Baishya, S. K. Ray, *et al*. 2017. Challenges, scope, and opportunities of *Jhum* rejuvenation in Nagaland. *Jhum Improvement for Sustaining Farm Livelihood and Natural Resource Conservation in North-Eastern Hill Region: Vistas and Frontiers*. ICAR Research Complex for NEH Region, Nagaland Centre, Medziphema

Ramakrishnan, P. S. 1992. *Shifting Cultivation and Sustainable Development of North-East India*. UNESCO-MAB Series. Oxford University Press

RCNAEB (Regional Centre of the National Afforestation and Eco-development Board). 2010. Study on best practices of shifting cultivation in Meghalaya. Regional Centre of the National Afforestation and Eco-development Board, NEHU, Shillong, Meghalaya

Singh, I. M., P. Punitha, M. A. Ansari, *et al*. 2017. Status of shifting cultivation in Manipur: an overview. *Jhum Improvement for Sustainable Farm Livelihood and Natural Resource Conservation in North Eastern Hill Region: Vistas and Frontiers*. ICAR NEH Region

Singh, S. B., T. Boopathi, S. K. Dutta, A. R. Singh, Lungmuana, S. Saha, V. Dayal. 2017. Shifting cultivation system in Mizoram – status, determinants and strategies for viability and sustainability. *Jhum Improvement for Sustainable Farm Livelihood and Natural Resource Conservation in North Eastern Hill Region: Vistas and Frontiers*. ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib

Thrupp, L. A., S. Hecht, and J. Browder. 1997. *Diversity and Dynamics of Shifting Cultivation: Myth, Reality and Policy Implication*. Washington, DC: World Resource Institute

Tiwari, B. K. and C. Kumar, and M. B. Lynser, *et al*. 2008. *Forest Products of Meghalaya – Present Status and Future Perspective*. Shillong: Research Centre of National Afforestation and Eco-Development Board, Ministry of Environment and Forest, Government of India

Vision 2030 Tripura. Sustainable Development Goals. Government of Tripura Planning (P&C) Department

Vision 2025 Nagaland. Prosperity Through Agriculture: Food for All. Department of Agriculture and Allied, Government of Nagaland

Appendix 1

Trend and Pattern of Landholding in India (number in thousands and area in '000 ha)

Size class	2005–06		2010–11		2015–16	
	Number	Area	Number	Area	Number	Area
Marginal (<1.0 ha)	83,694 (64.8%)	32,026	92,826 (67.1%)	35,908	100,251 (68.5%)	37,923
Small (1.0 to <2.0 ha)	23,930 (18.5%)	33,101	24,779 (17.9%)	35,244	25,809 (17.6%)	36,151
Semi-medium (2.0 to <4.0 ha)	14,127 (10.9%)	37,898	13,896 (10.0%)	37,705	13,993 (9.6%)	37,619
Medium (4.0 to <10.0 ha)	6375 (4.9%)	36,583	5875 (4.3%)	33,828	5561 (3.8%)	31,810
Large (>10 ha)	1096 (0.85%)	18,715	973 (0.7%)	16,907	838 (0.57%)	14,314
All size	129,222 (100%)	158,323	138,348 (100%)	159,592	146,454 (100%)	157,817

Source: Various issues of Agricultural Census of India

Note: Figures in parentheses indicate per cent of total.

CHAPTER-5
REASSESSING JHUM IN ARUNACHAL PRADESH: COLONIAL PERCEPTIONS, INDIGENOUS ENVIRONMENTAL PRACTICES, AND POST-COLONIAL TRANSITIONS

Dr Srijani Bhattacharjee*

Abstract

The chapter discusses the arguments and psychology behind projection of *Jhum* cultivation as a site of contestation in Arunachal Pradesh in the colonial and post-colonial eras. It portrays the sceptical approach of the British authorities towards it and tries to understand the factors behind such an attitude that persisted in the post-colonial era also. The chapter also discusses the administrative standpoint in this regard and analyses the factors responsible for shrinkage in areas under *Jhum* in Arunachal Pradesh after Indian independence. As a counter argument to such projection, it represents *Jhum* as a community exercise and assesses the environment-friendly practices, indigenous knowledge systems and nature conservation norms associated with the cultivation process and describes the factors how *Jhum* has survived in the region under changing socio-economic conditions in the post-independent era.

Introduction

Shifting cultivation is a method of farming in which plots of lands are cultivated for a limited period and abandoned for years for the land to rejuvenate to its previous vegetation. In this cultivation, the flora and foliage over the land are burnt to produce potash which acts as natural manure facilitating the growth of crops. This is a traditional low-technology oriented form of agriculture that persisted in various parts of the world including India since the Neolithic period and precedes the use of plough in agricultural operations (Conklin 1961; Warner 1991; Coomes, Takasaki,Rhemtulla 2011; Junqueira, Conny, Stomph, Clement, and Struik 2016; Fonseca-Cepeda, Idrobo, and Restrepo 2019). In India, it is a major mode of farming by tribes inhabiting northeast India, the Deccan Plateau, and parts of south India. Varied local terminologies are used to refer to shifting cultivation, for instance, *Jhum* in northeast India, Kuruwa in Jharkhand, Koman or Bringa

* Assistant Professor (History), Amity Institute of Social Sciences, Amity University, Kolkata, West Bengal – 700156

in Odisha, Bewar or Dahiya in Madhya Pradesh, Kumari in Western Ghats, Podu or Penda in Andhra Pradesh, and so on. This form of farming is also known as 'fire agriculture' as it involves the use of fire (Elwin 1964).

As a traditional mode of food production in northeast India, shifting cultivation is practised mainly in the upland terrains of Assam, Meghalaya, Mizoram, Nagaland, Manipur, Tripura, and Arunachal Pradesh. The indigenous *Jhum* cultivators are known as *Jhummias* who basically belong to the lower income groups (Ado and Bagra 2018; Lombi 2018; Paul, Das, Pharung, *et al*. 2020). It is an essential part of indigenous customary rights among the hill communities of northeast India which are acknowledged by the Indian Constitution through legislations. In the colonial era, the Assam Forest Regulation of 1891 accepted *Jhumming* as the privilege of the tribal people of Assam (Verma 2012). After independence, rights to shifting cultivation in North East Frontier Agency were specified by the government as part of *Jhum* regulations in the Balipara, Tirap, and Sadiya Frontier Tracts which were in the North East Frontier Agency region. The *Jhum* Land Regulation, promulgated by the Government of Assam in 1947, recognized tribal customary rights over *Jhum* areas in village, community, and individual lands, provided the village community should enjoy the right to cultivate or utilize lands for not less than five years prior to its making (Pandey 1997). Article 12 of the Indian Constitution has also recognized customs as sources of laws as long as they are not contrary to any constitutional provisions (Basar 2014).

Academic and administrative discourses have debated the efficacy of shifting cultivation for a long while. Some condemn it as an ecologically dysfunctional and wasteful practice that pollutes air and erodes topsoil, while others proclaim it as the most plausible method of subsistence farming by the tribes that enshrine the indigenous community knowledge. Hence, shifting cultivation has become an issue of conflict between governing agencies and the people associated with this mode of agricultural system (Malik 2003). This chapter attempts to historically describe why shifting cultivation has been perceived as an element of contestation between the administration and the people of northeast India with focus on Arunachal Pradesh, taking into account the first half of the 19th century till the 20th century period. While doing so, it counters the arguments put forward by the administration about the disastrous impact of shifting cultivation on the natural environment of the state. By highlighting *Jhum* as a community exercise and emphasizing the indigenous knowledge system associated with it, the contents of the chapter contends that shifting cultivation has had been a sustainable exercise in Arunachal Pradesh since ages. It lays importance on the aspect that despite constant attempts on the part of the government to eradicate or substitute *Jhum*, it continues to be the mainstay of the people because on one hand, it is intimately associated to tribal worldview and community life, while on the other, practical factors such as difficult terrain, underdevelopment, and lesser job opportunities in the region often persuade the people to continue with *Jhum* in changing socio-economic circumstances. The chapter also highlights the recent developments in Arunachal Pradesh that have resulted in contraction of *Jhum* lands in the region and describes the factors how *Jhum* is surviving in the changing situations. While concluding, it makes suggestions on making *Jhum* an economically viable and nature sustainable exercise so that it may attract favourable attention of the government. The chapter is a literature, survey-based study conducted in accordance with the verifiable sources such as government reports, primary and secondary literature, journal articles, and doctoral dissertations. Certain case studies on the area by other researchers have been consulted in the course of the study.

Study Area

The region under study area is concerned with the present state of Arunachal Pradesh which was previously known as North East Frontier Agency under the British Raj (Figure 1). The region was a district within the state of Assam under the colonial administration. The region of North East Frontier Agency remained a part of Assam till 1971 and was converted into a union territory on 20 January 1972 as Arunachal Pradesh. The Territory achieved statehood in 1987.Arunachal Pradesh is situated in the Eastern Himalayan zone which is one of the richest bio-geographical areas of the Himalayas (Kerkhoff and Sharma 2006, Mittermeier, Gil, Hoffman, *et al*. 2004). It is a conglomeration of complex hill systems, diverse flora and fauna and is traversed with numerous

FIGURE 1: Map of Assam Province under the British Raj

rivers and rivulets. The state, at present has 26 major tribes with 110 sub-tribes and hence is perceived as 'world's anthropological paradise' (Van Ham 2014). It is divided into 25 districts, inhabited by tribal groups who are diverse in their language, ethnicity, religious practices, social, and cultural traits (Figure 2).

FIGURE 2: Present map of Arunachal Pradesh

The colonial prelude (1826–1947): British attempts to regulate *Jhum*

Owing to topography of the hill districts of British Assam, the tribes residing in these areas have traditionally been practising shifting agriculture since ages. The elevation and slope of land werethe deciding factors behind adoption of this mode of cultivation by the tribes. For instance, the chief form of farming amongst the Lushais was *Jhum* cultivation as the terrain and topography of Lushai Hills except the Champai valley were not conducive for any other form of agriculture. On the other hand, the Khasis practised both shifting and sedentary farming methods as the elevation of lands in Khasi Hills allowed them to practice both modes of cultivation (Sen 1985). In North East Frontier Agency, since the major portion was mountainous, most of the inhabitants practised shifting agriculture. Only exception can be found amongst the Apatanis, the Singphos, and the Khampti tribes who have been practising settled cultivation for longer periods as they lived in river valleys, for instance Lower Subansiri district and plateaus, for instance, Tirap and Namsai districts (see Figure 2).

The British administration since the inception of its rule in Assam had a sceptical approach towards shifting agriculture practised by the hill tribes of the region. There have been tendencies among the colonial administrators to encourage and implement alternative modes of cultivation in the hill districts of the territory. The situation was more or less similar in almost all the hill districts of the region where this method of cultivation was practised. Forest and revenue officials of the colonial administration opposed shifting cultivation for being minimally revenue generative and for its modest contribution to the growth of a market economy which was based on trade in surplus generated. As such aspects were not involved in shifting cultivation, it was not favoured by the British who believed in a capitalist ideology. In 1883, Baden Powell, the architect of land tenure policies in British India was suspicious about the efficacy of shifting cultivation as a productive farming method and suggested for its abolition in different parts of India. In his words; ".... the fact is that this cultivation is so wasteful that somehow or the other it must be put to a stop, just like 'suttee' or any great evil. It consists of destroying large and valuable capital to produce a miserable and temporary return" (Das 2006). In British Assam, the slander against shifting agriculture was more intense as the colonial authorities considered the crops produced under shifting cultivation to be less revenue generative (Das 2006).

British forest officials in Assam did not favour the idea of expansion of *Jhum* by clearing forests as it contradicted their policies of forest conservation. In the plain areas of the province, they protested against expansion of permanent agriculture at the cost of forests while in the hills, they considered shifting cultivation as the greatest catastrophe to the flora and fauna of the areas. In districts where both permanent and shifting cultivation were practised simultaneously by the residents, the British considered *Jhumming* as more harmful to forests. As early as 1832, Captain R. Stewart, the Deputy Commissioner of Cachar district in Assam opined that *Jhum* cultivation was the greatest enemy to the forests of the region which not only burnt large-scale timbers but also altered the tree types of the area under cultivation (Stebbing 1923). Sanderson, the Officer In-charge of Kheddah operations in Dacca observed that lands under *Jhumming* have destroyed areas of fine forests and converted them into dense masses of evergreen mulibamboos (*Melocanna baccifera)* or with coarse grass, plantains and, inferior species of trees (Stewart 1856).[1] Laying stress onthe importance of forest conservation as a solution to damages caused to forests by shifting cultivation, Gustav Mann, the Conservator of Forests in Assam in 1884–85 opted for quick and urgent declaration of better-preserved forests as 'reserves' by properly demarcating and gazetting them as a measure of protection (Mann 1885). The British forest officials in the early 20th century considered that the manure manufactured by burning the trees for fertilizing the soil was a greater loss compared to the food grains produced by this form of agriculture (Stebbing 1923).

Thus, it can be assumed that British forest officials were antagonistic in their stance towards shifting cultivation since the initiation of colonial administration in the region. The revenue officials also perceived it as less revenue generating and economically less lucrative. The colonial approaches in

[1] Kheddah was a system of catching elephants in which stockades are built for the purpose mostly near water bodies or in strategic locations where herds of elephants are trapped.

this context were, however, not uniform across all the hill regions. For instance, in Khasi and Jaintia Hills which had abundant natural/mineral resources and a salubrious climate, fondly preferred by the British for habitation and for political administration, the colonial government entered into agreements with the Khasi indigenous chiefs (*Syiems*) under which the latter were entrusted with the responsibility as representatives of the British government to protect the forests of their areas from *Jhum* cultivation (Hunter reprint 1975). Colonel Shakespear, the Superintendent of Lushai Hills in 1898 introduced wet rice cultivation in the Champai valley as a viable alternative to *Jhum* (Das 1990). In North East Frontier Agency, colonial policies in the late 19th and early 20th centurieswere directed more towards managing tribal raids in Assam plains and regulating British-tribal relations either through involvement with Posa system[2] or through encouraging trade relations with the plains and organization of trade fairs or through implementation of Inner Line Regulation.[3] The creation of political buffer between India and China was also a measure to administer the area and its inhabitants (Luthra 1971). In the province, the government preferred to abstain from interfering in the internal practices of the tribes unless required. Hence, they did not interfere with the farming practices of the people until it undertook some developmental works such as construction of roads. Developmental works in the region commenced when the British government realized the strategic and political importance of the territory as China had started to exercise its claims over Tibet and in the Indo-China borders. Permanent cultivation was introduced in the province as a substitute to *Jhum* by the 1940s when communication between the three administrative divisions (namely, Pasighat to Alo, North Lakhimpur to Zero and Zero to Daporijo) of the region washindered by the hilly terrains and the government thought of linking the areas with a network of roads. Paddy rice cultivation was introduced to the road-side villages as it was believed to prevent soil erosion and the village headmen who acknowledged the supremacy of the British were entrusted with the task of supervising the areas under their control (Kosaka, Saikia, Rai, *et al*. 2015). Thus, the colonial officials internalized an inherent logic that hierarchized settled cultivation over and above *Jhumming*.

Indigenous beliefs and nature sustainable practices associated with *Jhumming* in Arunachal Pradesh

Shifting cultivation in the hill states of northeast India has been interpreted variedly by scholars from different disciplines. Anthropologists consider it more as a form of culture than merely agriculture. Economists define it as a subsistence form of farming while geographers consider it as a form of indigenous adjustment to the physical environment. Arunachal Pradesh is one

---

2 Under the Posa system, villages situated in the frontier areas between the plains and the hills paid certain commodities to the hill tribes in return for which the latter stayed away from raiding the plains.

3 Under the provisions of the Bengal Frontier Regulation Act of 1873, a line of segregation was drawn between the plains and hill districts of Assam as a measure to restrict external and British commercial interests and intervention over the hill areas of the region.

of those hill states of the region where it is a dominant mode of farming practised by the hill communities who have evolved specific indigenous names for it. It is known as *mo-di rwwkh* or *tump rwwkh* by the Galos, *mo-di arik* or *tump arik* by the Adis, *jipvrongo* by the Tagins, *ribingpanang* by the Apatanis, *depo or debiarikh* by Nishis, *khalang* by the Monpas and *kargpak* by the Tangsas amongst others (Lombi 2018).

Owing to the mountainous terrain of Arunachal Pradesh, *Jhum* is the cultivation considered most suitable by the tribal inhabitants. Only 5% of the state's geographical area is under permanent agricultural operations, while 65% of the area is under *Jhum* cultivation (Shukla 2016). There are other factors too that have induced the tribes to take up this form of agriculture since early times. In the hills, a farmer faces significant losses due to high initial investments in agricultural fields under settled cultivation if the areas are lost due to flash floods and landslides. In such situations, the losses associated with shifting agriculture are temporary (Maithani 2005). Moreover, the agro-diversity of crops grown in shifting cultivation is a potential factor that attracts the people towards it as it provides food security to them (Lori Ann 2000). In course of years, shifting cultivation became ingrained with the self-sufficient structure of the village economy and the politico-economic and socio-cultural organization of the tribal villages. As shifting cultivation is a collective-community exercise, it engendered a common sentiment attached to the agricultural process and the tradition still continues. Working collectively in *Jhum* fields is still practised in Arunachal Pradesh that leads to better monitoring and labour sharing required for an agricultural exercise. The shared use of workforce leads to proper utilization of labour resource whereby the aged and the juvenile population are usually dispensed with within the food-production process. It also enables distribution of labour in gender terms (Upadhyaya 2020). Since the *Jhummias* produce for their own consumption, conflicts on distribution of produce are lesser (Kalita, Baruah, Datta, *et al*. 2017). The bonding thus formed results in the creation of festivities related to *Jhum*, a common cultural calendar and rites of ancestor worship that give a community identity to the tribes. For instance, the Adi tribe have 13 different festivals connected with *Jhum* which primarily concentrate on warding off evil spirits and appeasing good spirits to strengthen the plants, ensuring abundant crop production, and protection from pests, among others (Datta and Teegalapalli 2016). Teegalapalli, who has researched shifting cultivation at the National Centre for Biological Sciences observes: '...socially this keeps the people together, they help each other out....' (Pendharkar 2018). Distribution of *Jhum* lands to the people is one of the important political functions of the village heads and tribal councils in the region.

Shifting cultivators attach importance to existence of forests adjoining the *Jhum* fields. Maintenance of these forests near farming sites is a prerequisite for shifting cultivators who depend on natural products for food and regular necessities in case crops get destroyed by external factors such as fire or landslide. These aspects associated with shifting cultivation have encouraged the tribes of Arunachal Pradesh to come up with certain nature conservation norms and practices so that the entire effort of farming could be made a sustainable exercise. The tribes of Arunachal Pradesh have evolved *Jhum*-related nature conservation practices in the form of taboos, rituals, social beliefs, and religious norms which have contributed towards maintenance of environmental sustainability connected with the farming process. For example, the tribes of the Subansiri district cultivate areas for two successive years, followed by a fallow period of four to five years or more. The same land is taken up for cultivation only after the land rejuvenates itself to its previous vegetation. The tribes follow this procedure while cultivating fields as they believe that occupying fresh lands and cutting forests would disturb and offend the wood spirits (Elwin 1959). Felling of trees for preparation of *Jhum* fields is a taboo for a Digaru Mishmi woman (Pandey 1997). The Wancho and the Nocte tribes while clearing forests in *Jhum* lands never cut trees and natural vegetation situated in the higher elevation of the *Jhum* site as they believe that its foliage and flora would contribute to soil conservation. Apart from this, contour bonding is done by means of logs and stones in order to prevent soil erosion. These attest to the fact that *Jhumming* practices among the tribes are not entirely devoid of traditions of nature conservation practices.

The Lisu tribes of Arunachal Pradesh have inhibitions against rampant felling of trees while preparing *Jhum* fields, as according to them this would annoy the nature spirit named *Musini* (Mitra 1993). The Adi community of the region undertakes shifting cultivation in the large blocks surrounding their villages by clearing the secondary forests in the hill slopes. Primary forests are rarely cleared for cultivation purposes (Datta and Teegalapalli 2016). The Bangni Nishi tribe believes that certain areas in the vicinity of villages are inhabited by *Wiyus* or nature spirits and therefore clearing these areas for cultivation is strictly prohibited as that might offend the *Wiyus*. While felling of trees for preparing *Jhum* fields, the Nishis do not cut particular type of trees locally known as *Sengri* and *Sengne* (*Ficus* spp.) as these trees are considered to be the abode of *Wiyus*. Even using the wood of these trees is a taboo for them (Gupta 2005). In a similar manner, the Adis refrain from felling certain trees, locally known as *hwwrk* (*Ficus altingia excelsa* and *F. terminalia myriocarpa*) during clearing of *Jhum* lands as they believe that might offend the forest deities (Lombi 2018).

These notions show that shifting cultivation by tribal communities not only have an embedded sense of environmental sustainability but also display an astute understanding of local scientific knowledge gained through traditions and experiences. They have an intimate understanding about the yield patterns, vegetation, crop types to be grown, and the soil types of the land where the cultivation is undertaken. Teegalapalli and his collaborators opine that the Adi community could identify almost nine varieties of soil in the areas of their cultivation and habitation. The Adis know about the crop types to be planted in the *Jhum* fields and in lands situated within or adjoining forest and non-forest areas according to the properties of the soil. Though rice and millet are the staple crops cultivated by them, they also plant beans, taro (a variety of colocasia) and brinjals on boundaries where a farm adjoins another field. If the farm is located next to a forest patch, crops like pumpkins and varieties of long beans are usually grown. The Adis grow these crops near forests as they believe that these crops deplete the fertility of the soil and therefore it is wise to plant them near forested zones where possibilities of soil erosion are comparatively lesser. This attests to the depth of botanical and geological knowledge which the tribes have about their land, soil, and cultivation pattern. In order to make use of objects such as logs and rocks found in the cultivation sites, corn, spring onions, and chillies are planted along fallen logs and rocks (Pendharkar 2018). Thus, the indigenous knowledge of the tribes related to *Jhum* is in reality much more nuanced and extensive than what colonial administrative assessments had projected it to be.

The indigenous land management systems connected with *Jhum* illustrate the sagacity of environmental sustainability among the tribes. For instance, the Adi community divides the village lands into a number of blocks or *patats* under which each block is cultivated as per the shifting cultivation cycles and customary practices of the community whereby a fallow period of 14–15 years is maintained, giving ample time to other blocks to rejuvenate. While selecting sites for *Jhum* cultivation, locations with rare or important medicinal plants are usually avoided. The entire cultivation exercise is undertaken on the basis of calendars meticulously developed by the communities after research of every natural element found in their vicinity. For instance, among the Nishi tribe of the region, the call of a bird locally known as *Choupou* in the months of December and January signals the felling of trees and selection of plots for Jhum cultivation. Similarly, the call of a bird, locally called as *Pipiar* and flowering of a tree variety, locally known as *Sanglo* (*Bombax ceiba*) in the months of January and February indicate the time for burning the fields (Gupta 2005). Practices associated with the farming process show that the *Jhummias* prohibit indiscriminate slaying of fauna during cultivation excluding some animals slaughtered for propitiation of nature spirits. In the management structure associated with grazing in *Jhum* sites, the *Jhummias* systematically organize grazing of Mithuns (*Bos frontalis*) with the help of Lura in which during the cropping and growing seasons, the animals are temporarily confined to a sufficiently larger site with adequate food and water and the site is changed every year. The confinement of animals not only protects the *Jhum* fields but also the soil from erosion and compaction during the rainy season (Kalita, Baruah, Datta, *et al*. 2017). Thus, these exercises associated with *Jhum* cultivation reflect a worldview and an indigenous form of management which is implemented over the natural landscape.

Perceiving *Jhum* from Administrative Perspectives

Indigenous wisdom associated with shifting cultivation in Arunachal Pradesh has not received adequate appreciation from the administration—in both the colonial and the post-colonial eras. Rather as discussed, the administration has projected it to be responsible for forest destruction and soil erosion in the region. Recent academic research on the subject re-establishes the fact that alleging shifting cultivation as disastrous to flora and fauna is undertaken mostly from administrative perspectives (Choudhury and Sundriyal 2003; Das 2006; Patel, *et al*. 2013). Field observations are in contradiction with the views expressed by the administrators. In a case study undertaken in the Kombo Jinyo village in West Siang district of Arunachal Pradesh in 2018 (Ado and Bagra 2018), 60% of the respondents have considered commercial timber logging and firewood business as the major cause for deforestation in the region. Construction of roads, as per 16% respondents, results in deforestation and destruction of fauna. Killing of animals in Arunachal Pradesh is undertaken for food, skins, and hides and religious or medicinal purposes. There have been some incidences of poaching too. Therefore, the region's wildlife destruction cannot be attributed to areas under shifting cultivation only. Some sections of the population also argue that no restrictions on the use of wood products and establishment of forest-based industrial set ups are accountable for forest destruction in the territory. Interestingly none of the respondents have considered shifting cultivation as a responsible factor for forest destruction in the state (Ado and Bagra 2018). On the contrary, recent research (Pendharkar 2018) suggests that chances of rejuvenation of areas deforested under shifting cultivation are greater than areas deforested through other means because when a patch of forest is cleared and burnt, the nutrients in the soil increase as the ash from burning of woody plants gets deposited in the soil. As the crop grows, the nutrients are utilized by the crops which reduce nutrient content in the soil for the time being and are soon replenished in the soil as it regains its green cover during the fallow period.

Even after India gained independence, administrative perceptions towards shifting cultivation in northeast India did not change. During the 1950s, the Food and Agriculture Organization (FAO) of the United Nations requested that governments, research centres, and public and private associations invest in the modernization of agricultural practices and disregard those associated with shifting cultivation. According to FAO, shifting cultivation represented a backward and inadequate system for the conservation of the tropical forest ecosystems in which it was practised. Such global perspectives also influenced the attitudes of the Indian governmental agencies. It is during this phase that government administrative units, for instance, the agriculture and forest departments claimed areas under *Jhum*to be within their jurisdictions. Areas under shifting cultivation are perceived to be within the purview of the agriculture department during the cultivation phase and are categorized as under the concerned forest department when they are in their fallow period. Under this situation, the same piece of land is subjected to various regulations and management, resulting in absence of uniform policies or administration over such areas. The forest department desires to rehabilitate *Jhum* lands through social forestry and energy plantations while the agriculture department intends to promote horticulture, and cash crop cultivation on *Jhum* lands, considering them as arable areas. *Jhum* lands are also considered viable for cash crop cultivation such as timber trees, tea, coffee and rubber. Such ambiguities adversely impact the upland farmers, restricting their control, decision-making and investments over such plots (Down to Earth 2018). Measures to substitute *Jhum* had received boost under the Fifth Five-year Plan (1974–78) that emphasized on soil conservation, centrally sponsored pilot schemes to control shifting cultivation and regional river basin schemes under the North East Council Plan, etc. that emphasize on income generation and improvement of the *Jhummias* through other means (Das 2006). However, there are instances when some of these schemes have proved ineffective as they have failed to take the regional specificities into consideration while framing *Jhum*-regulatory measures. They primarily focussed on aspects such as agro-forestry measures, horticulture, cash crop cultivation, inadequate storage, transportation systems, and agro-processing facilities, without paying necessary consideration to localized aspects of transaction and procurement, and costs associated with the competitive market (Choudhury and Sundriyal 2003).

The above analysis demonstrates that multiple interests of the central and state agencies over *Jhum* lands have induced both the colonial and post-colonial administration to adopt divergent stances towards shifting cultivation in the hill states of northeast India. It was perhaps contemplated by the administrative agencies that such approaches would effectively eliminate the *Jhummias* and would efficiently implement multiple administrative interests over those areas. This may be a factor why indigenous nature conservation norms attached to shifting cultivation have received inadequate appreciation from the administration. Governmental priorities to sedentary agriculture over Jhum, precedence to cash crop cultivation over traditional crops and application of chemical fertilisers over natural manures among others are some of the aspects that reflect the bias of the administration against *Jhum* (Kerkhoff and Sharma 2006). Shifting cultivation has been alleged as a threat to climate change due to the use of fire in the agricultural process and for emitting carbon dioxide into the atmosphere. (Kalita, Baruah, Datta, *et al*. 2017). Such opinions are often formed without any attempt to understand the environmental benefits of fallow period, as in most cases, the administration perceives the fallow areas as either 'open access land' or 'wastelands' and hence allocate these areas for other purposes. As a cumulative result of such factors, there is shortening of *Jhum* cycles with restricted fallow periods (Kerkhoff and Sharma 2006). This reduces lands under *Jhum* cultivation, consequently decreasing cultivable areas under the *Jhummias*. Increase in population and expansion of human settlement is another factor for shrinkage of lands under *Jhum* (Choudhury and Sundriyal 2003).

In recent years, intellectuals are re-scrutinizing and debating the adverse effects of shifting cultivation over forests and biodiversity of northeast India. They observe that high humidity and abundant rainfall in the region facilitate rapid replenishment of the soils and green covers; this in turn reduces soil erosion (Bhuyan 2019). Another view suggests that regular burning increases the stability and sustainability of the ecosystem (Kalita, Baruah, Datta, *et al*. 2017). It is also observed that the indigenous people with adequate knowledge of fire management use it as a mechanism to manage their diverse ecosystem (Kalita, Baruah, Datta, *et al*. 2017). Such suggestions are made on the basis of environment-friendly practices attached to the processes such as keeping of forest fallows, rotation of agricultural fields, involving land planning and allocation at the landscape level; planting and maintenance of trees in cropping phase; common property land tenure regimes to allow shifting of plots, and controlled burning for the re-opening of fallows (Kerkhoff and Sharma 2006).

Jhumming: The present scenario and pointers to the future

In recent years, areas under shifting agriculture have considerably reduced in Arunachal Pradesh due to several factors. One of the most important reasons among them is the continuous stress exerted on conventional farming by the government authorities. As a result, areas under permanent cultivation have increased nearly three times between 1970s and 1990s with a corresponding decline in lands under *Jhum* (Datta and Teegalapalli 2016). Among other reasons, modern infrastructural development in the mountainous slopes, growth of administrative and bureaucratic set-up, changes in market economy of the region, better access to roads, increased capital inflow and accommodation of external population have been highlighted as possible reasons for the decline (Dattaand Teegalapalli 2016). Construction of roads, military enclaves, and dams have encroached over community lands in Arunachal Pradesh, producing impact over indigenous cultivation patterns and shortening of *Jhum* cycles (Sharma and Borgohain 2019). The emergence of tribal elites in the form of politicians, bureaucrats, contractors, and businessmen plays a major role in usurping community lands for cash crop production. Emphasis on cultivation of cash crops such as tea, timber, rubber and coffee has led to encroachment over community lands by private entrepreneurs. As a result, there is concentration of clan and community lands in the hands of a few tribal elites, converting the ordinary members of the population into wage earners or labourers (Sharma and Borgohain 2019). This emerging stratification in tribal societies is found in the form of influential persons who exercise claims over more suitable plots within community lands while the weaker sections have to satisfy themselves with plots which are left out (Thakur 1997). A tendency of tacit control over community lands by the external non-tribal population can also be noticed in some parts of the territory. In such cases, the community lands formally remain under the tribes but in practice they are used by the non-tribal migrants in the area. Barua (2005) refers to this as dejure and defacto property rights, respectively. These factors have resulted in increasing fragmentation of communally-owned lands and forests in the region. To add impetus to the process, the Arunachal Pradesh Land Settlement and Records Amendment Act came into being in 2018 that recognized private ownership of lands in the region for the first time (Sharma and Borgohain 2019). Intra-sectoral transformation and shift towards the service sector by educated sections of the new generation haveresulted in the loss of manpower required for *Jhumming*.

Recognition to *Jhumming* as an indigenous customary right by the government through legislations appears to contradict the administrative attempts to modify or prohibit *Jhum*. After India gained independence, government has been framing policies to convert *Jhum* fields in Arunachal Pradesh into lands under permanent or settled cultivation. For instance, the Integrated Watershed Management Programme (IWMP) was implemented in Upper, West and East Siang districts of the state, under which lands under shifting cultivation were considered as wastelands and proposals were made to bring these lands under cash crop production and horticulture. In some cases, the state government is found to welcome such schemes as these ensure flow of funds from the central government to the state. In the Upper Siang district, an area of 5000 hectares was thought to be brought under settled cultivation by the late 2000 (Datta and Teegalapalli 2016). The enactment of Arunachal Pradesh Land Settlement and Records Amendment Act of 2018 is undoubtedly an effort by the government to legitimize the diversion of community lands for other purposes and alternative agriculture, thereby reducing the areas under shifting cultivation in the state and a consequent reduction in the fallow period involved in it.

The government has attempted to divert the shifting cultivators towards other alternatives by implementing social forestry schemes, national afforestation programmes, plantation missions such as plantation of cash crops, bamboo, and medicinal plants. The Department of Agriculture tried to implement horticulture and settled agriculture with use of fertilizers, high-yielding seed varieties and developed irrigation facilities. However, despite such initiatives on the part of the government, shifting cultivation is still the principal mode of agriculture among the hill communities of Arunachal Pradesh where the type of farming is undertaken in over 50% of the net sown area (Datta and Teegalapalli 2016). It is the primary method of cultivation among the lower income groups, the higher income households also engage themselves in other occupations like timber business and livestock rearing, etc. The lack of capacity-building (local entrepreneurs and skills training) to start and work in industries also adds to indigenous dependence on *Jhum*. With the forest concessions granted to them by the government, some locals have started wood and veneer sawmills which are mostly worked by contractors of non-tribal origin who siphon out a large share of the revenue generated to outside the state with the mill owners receiving only a small amount (Bhattacharjee 2000). Backward roads and transportation systems in the region impede the mobility of the people in the remote areas who depend on *Jhum* in such situations.

Jhuming, however, is still being practised in Arunachal Pradesh. Even in areas where settled agriculture is on the rise, shifting cultivation is still indigenously practised. In the Upper Siang district of the region, about a third of cropped area was under shifting cultivation till the 2000s. As per an interview conducted in the area, 95% of the households practice shifting agriculture despite the prevalence of settled cultivation in the territory since the 1960s (Datta and Teegalapalli 2016). Though the yield is potentially higher, lower labour is required and economic incentives are greater in settled agriculture compared to shifting cultivation, *Jhumming* is still the mainstay of the people (Datta and Teegalapalli 2016). According to a survey of 500 people from 52 villages across northeastern states excluding Assam and Sikkim, traditional and institutional social bonding, cooperative behaviour, attachment towards livelihood and the natural landscape have made the *Jhummias* continue with shifting cultivation in the changing socio-economic conditions. Lack of suitable alternatives is another factor and since the mountainous locations in the remote parts of Arunachal Pradesh are mostly inaccessible with lesser job opportunities, the hill communities derive higher economic security from *Jhumming* (Gabay 2020). As per a study conducted in the 12 villages of Arunachal Pradesh, an average of 34.48% of consumption expenditure of the households is dependent on forests that include both usages of floral and faunal products and utilising forests for agricultural purposes (Pulipaka, Bhattacharya, and Chaudhuri 2013).

With the changes that have emerged in the land ownership patterns, rising market demand for certain varieties of crops and governmental emphasis on alternative agriculture in Arunachal Pradesh, the *Jhummias* of the state have brought transformations in the types of crops grown and harvesting patterns under this mode of farming. The growing importance of organic crops has induced some *Jhummias* to grow organic crops and thus a category of niche customers has merged who purchase organic products from *Jhum* fields. Some peasants have also started to integrate cash crops with food crops whereby they produce commodities that have local and regional market demands, enabling them to produce, both for subsistence and for earning profits. *Jhummias* who lack capital depend on traditional subsistence farming while those with access to capital plant cash crops. The profits accrued from selling the agricultural produce in markets enable the households to reinvest it in *Jhum* agriculture (Ado and Bagra 2018).

A Way Forward

Thus, shifting cultivation is not only a form of agriculture but also a way of life for the people of Arunachal Pradesh. Therefore, despite several attempts on the part of the government since the pre-independence era to eliminate *Jhum* by targeting it either as economically less remunerative or disastrous to the natural environment, this mode of agriculture has remained the mainstay among a dominant section of the population. Since mountainous terrains located in the interior offer less job opportunities to the people inhabited there, *Jhumming* and forests provide them with livelihood opportunities. Moreover, as *Jhumming* is a collective exercise, economic, social, and community bonding associated with it plays an important role in its continuation in the changing socio-economic circumstances. Keeping the aspect of nature sustainability in view, the tribes have attached beliefs and practices on nature conservation with it thus making the entire *Jhum* cultivation exercise a well-knit socio-cultural and religious reservoir of indigenous knowledge that shapes tribal identity and traditions.

The premium attached to settled agriculture, horticulture, cash crop production, and timber business, among others by the government in the post-independence era have brought about changes in the tribal land ownership patterns and initiated private ownership of lands, thereby reducing areas under shifting cultivation in Arunachal Pradesh. Under these circumstances, preserving this indigenous institution will require proper understanding of *Jhum* on the part of the government, for making it both an economically viable and environmentally sustainable exercise. The role of the state in developing infrastructure and expanding communication networks may also contribute to making *Jhum* economically viable by establishing linkages between areas under *Jhum* cultivation and with internal and external markets. Development of transport networks on one hand would expand the accessibility of the tribes to other job opportunities, while on the other hand it would facilitate promotion of *Jhum* products to internal and external markets. Research is necessary to ensure economic and environmental sustainability of *Jhum*. There is a necessity to take the indigenous wisdom on nature conservation associated with *Jhum* into consideration. When the government has proper understanding of the values of *Jhum*, it can be expected that it would promulgate policies that would counter usurpation of community *Jhum* lands by private entrepreneurs. The government should recognize the efforts of the *Jhummias* by providing seeds at nominal rates, supplemented with financial assistance so that they can undertake agricultural operations in difficult terrains. The shifting cultivators have been denied credit facilities as without land titles; they are not liable for loans. In this regard, the Central Government is planning to define land use that will enable such growers' access credit along with agriculture-related benefits including subsidies (Toppo 2020). Unstable access to financial support by *Jhummias* has recently received attention; as an issue to be rectified; at the policy level (DTE Staff 2020). Subsequently, the government has announced its intention to consider *Jhummias* as cultivators, which will bring them the cultivation benefits and subsidy mechanisms of the agricultural systems (Gabay 2020). In such a situation, it is hoped that there would be optimistic changes in the perceptions of the government towards shifting cultivation in Arunachal Pradesh.

References

Ado, M. and M. Bagra. 2018. An empirical study of shifting cultivation in Kombo Jinyo village under West Siang region of Arunachal Pradesh. *International Journal of Trend in Scientific Research and Development*, **3** (1): 496–503

Sanjib, B. 2005. *Durable Disorder: understanding the politics of north east India*. New Delhi: Oxford University Press

Basar, T. June 2014. Forest Wealth of Arunachal Pradesh: legal issues and concerns. *The Arunachal Times*

Bhattacharjee, J. B. 2008. *Making of British Assam: H K Barpujari endowment lectures*, pp. 2–10. Kolkata: Institute of Historical Studies

Bhattacharjee, R.P. 2000. *Economic Development of Arunachal Pradesh*. pp. 140–238. New Delhi, Itanagar: Himalayan Publishers

Bhuyan, R. 2019. A review note on shifting cultivation in north east India amidst changing perceptions. *Dhaulagiri Journal of Sociology and Anthropology*, **13**: 92–93

Choudhury, D. and R. C. Sundriyal. 2003. Factors contributing to the marginalisation of shifting cultivation in north east India: micro-scale issues. *Outlook on Agriculture,* **32** (1): 17–28

Coomes, O. T, Y. Takasaki, and J. M. Rhemtulla. 2011. Land-use poverty traps identified in shifting cultivation systems shape long-term tropical forest cover. *Proceedings of the National Academy of Sciences of the United States of America,* **108** (34): 13925–13930

Conklin, H. C. 1961. The study of shifting cultivation. *Current Anthropology,* **2** (1): 27-61

Das, D. 2006. Demystifying the myth of shifting cultivation agronomy in the north-east. *Economic and Political Weekly*, **41** (47): 4912–4914

Das, N (ed.). 1990. *A Study of the Land System of Mizoram*, pp. 16–17. Law Research Institute, Eastern Region, Gauhati High Court, Shillong

Datta, A. and Karthik, T. 2016. Shifting to settled cultivation: changing practices among the *Adis* in Central Arunachal Pradesh, north-east India. *Ambio,* **45** (5): 602–612

Dhar, B. and C. P. Chandra (eds). 2004. *Tribes of Arunachal Pradesh: history and culture,* pp. 65–109. New Delhi: Abhijeet Publications

Down to Earth. 2018. Government needs to address policy ambiguities affecting shifting cultivation: NITI Aayog. Down to Earth. Details available at <https://www.downtoearth.org.in/>, last accessed on 2 February 2021

Elwin, V. 1959. *The Art of the North East Frontier of India*, p. 152. Shillong: North East Frontier Agency

Elwin, V. 1964. *A Philosophy for NEFA*, p. 62. Shillong: J.N. Chowdhury on behalf of the Adviser to the Governor of Assam

Edward, G. 1926. *A History of Assam*, p. 337. London: Thacker, Spink and Company

Fonseca – Cepeda, V., C. J. Idrobo, and S. Restrepo. 2019. The changing chagras: traditional ecological knowledge transformations in Columbian Amazon. *Ecology and Society*, **24** (1): 8

Gabay, A. 2020. Shifting cultivation: more than a means of livelihood, Mongabay. Details available at <https://news.mongabay.com/2020/06/shifting-cultivation-more-than-a-means-of-livelihood/>, last accessed on 8 November 2021

Gupta, V. 2005. Jhum cultivation practices of the Bangnis (Nishis) of Arunachal Pradesh. *Indian Journal of Traditional Knowledge,* **4** (1): 47–56

Hunter, W.W. 1879. *A Statistical Account of Assam* (Reprint 1975),**2**: 212–214. New Delhi: B R Publishing House

Junqueira, A., J. M. A. Conny, B., T. Stomph, C. R. Clement, and P.C. Struik. 2016. The role of Amazon Anthropogenic soils in shifting cultivation: learning from farmers' rationales. *Ecology and Society,* **21** (1)

Kalita H., M. S. Baruah, D. Datta, D. Jini, and R. A. Alone. 2017. Status of shifting cultivation (Jhum) in Arunachal Pradesh India'. *Jhum Improvement for Sustaining Farm Livelihood and Natural Resource Conservation in North Eastern Hill Region: vistas and frontiers,* pp. 4–12. ICAR Research Complex for North Eastern Region

Kerkhoff, E and E. Sharma. 2006. Debating shifting cultivation in the eastern Himalayas farmers innovations as lessons of policy, pp.73–74. Kathmandu: International Centre for Integrated Mountain Development

Kosaka, Y., B. Saikia, C.K. Rai, K. Hage, H. Asada, T. Hui, T. Riba, K. Ando. 2015. On the Introduction of paddy rice cultivation by swiddeners in Arunachal Pradesh, India. *Tropics*, **24** (2): 75–90

Lombi, P. 2018. *An Assessment of Shifting Cultivation in West Siang District Arunachal Pradesh: a case study*. PhD Thesis. Department of Geography, Rajiv Gandhi University, Itanagar

Luthra, P. N. 1971. North East Frontier Agency Tribes: impact of Ahom and British Policy. *Economic and Political Weekly,* **6** (23): 1145–1147

Maithani, B. P. 2005. *Shifting Cultivation in North-East India: policy issues and options*. New Delhi: Mittal Publications

Maitra, A. 1993. *Profile of a Little Known Tribe an Ethnographic Study of the Lisus of Arunachal Pradesh*. New Delhi: Mittal Publications

Malik, B. 2003. The problem of shifting cultivation in the Garo Hills of north-east India, 1860–1970. *Conservation and Society*, **1** (2): 287–315

Mann, G. 1885. Progress Report of Forest Administration in Assam for the year 1884–85. Shillong: Assam Secretariat Printing Press

Mittermeier, R. A., P. R. Gil, P. Hoffman, J. Pilgrim, T. Brooks, C.G. Mittermeier, *et al*. 2004. *Hotspots Revisited: earth's biologically richest and most endangered ecoregions*, p. 390. Mexico City: CEMEX

Pandey, B.B. (ed.). 1997. *Status of Women in Tribal Society Arunachal Pradesh*, p. 393. Itanagar: Directorate of Research, Government of Arunachal Pradesh

Pandey, D. 1997. *Local Government in Arunachal Pradesh*, pp. 24–25. New Delhi and Itanagar: Himalayan Publishers

Patel, T. S. Karmakar, J. Sanjog, S. Kumar, and A. Chowdhury. 2013. Socio-economic and environmental changes with transition from shifting to settled cultivation in north-eastern India: An ergonomics perspective. *International Journal of Agricultural Science and Research*, **3** (2). 117-136

Paul, S, T. K. Das, R. Pharung, S. Ray, N. Mridha, N. Kalita, V. Ralte, S. Borthakur, B. R. Roy, A. K. Tripathi, A. K. Singh. 2020. Development of an indicator based composite measure to assess livelihood sustainability of shifting cultivation dependent ethnic minorities in the disadvantageous north-eastern region of India. *Ecological Indicators*, **110**

Pendharkar, V. 2018.Traditional knowledge of a north-east community holds answer to the misunderstood practice of shifting cultivation. Mongabay. Details available at <https://india.mongabay.com/2018/07/traditional-knowledge-of-a-northeast-community-holds-answers-to-the-misunderstood-practice-of-shifting-cultivation/>, last accessed on 8 November 2021

Pulipaka, S, R. Bhattacharya, and S. K. Chaudhuri (eds). 2013. *Perspectives on North East India Tradition and Modernity in Arunachal Pradesh*, p. 153. Kolkata: Maulana Abul Kalam Azad Institute of Asian Studies and Anshah Publishing House

Sen, S. 1985. *Social and State Formation in Khasi-Jaintia Hills*, pp. 80–86.New Delhi: B.R Publishing Corporation

Sharma, C. K. and B. Borgohain. 2019. The New Land Settlement Act in Arunachal Pradesh. *Economic and Political Weekly*, **54**: 23

Shukla, S. P. 2006. *Strategy for Integrated Development of Arunachal Pradesh*, pp. 18–19. New Delhi: Mittal Publications

Singh, C. 1989. *Emergence of Arunachal Pradesh as State*. New Delhi: Mittal Publications

Stebbing, E.P. 1923. The Forests of India, **2**: 403. London: John Lane, The Bodley Head, Limited

Stewart, R. 1856. Notes on northern Cachar. Journal of Asiatic Society of Bengal, **24**: 434. Thomas, J. Baptist Mission Press

Thakur, A. K. 1997. Peasantisation and state formation in early Arunachal Pradesh. *Proceedings of the Indian History Congress*, **58**: 303–312

Thrupp, L. A. 2000. Linking agricultural biodiversity and food security: the valuable role of agro-biodiversity for sustainable agriculture. *International Affairs,* 76 (2): 265–281

Toppo, A.2021. Shifting cultivation could soon obtain legal stamp. Details available at <https://krishijagran.com/agriculture-world/shifting-cultivation-could-soon-obtain-legal-stamp/>, last accessed on 20 June 2021

Upadhyay, V. 2020. The Gendered Transformation of Land Rights and Feminisation of Hill Agriculture in Arunachal Pradesh: Insights from Field Survey. In: *Lands and Livelihoods in Neoliberal India*, D. K. Mishra and P. Nayak (eds). Switzerland: Springer Nature

Van, H. P. 2014. *Arunachal: Peoples, Arts and Adornment in India's Eastern Himalayas*, pp. 146–147. New Delhi: Niyogi Books

Verma, R. 2012. *People and Forest in North East India Resources, Regimes and Rights*, p. 55. New Delhi: Mittal Publications

Warner, K. 1991. *Shifting Cultivators: Local technical knowledge and natural resource management in the humid tropics.* Rome: Food and Agriculture Organisation of the United Nations

CHAPTER-6
JHUMING IN TRANSITION: CROSSROADS OF CULTURE, ECONOMICS, AND ASPIRATIONS IN TAMENGLONG, MANIPUR IN NORTHEAST INDIA

Naveen Pandey*#, Mordecai Panmei*, Dilunang Pamei*, and Kedar Gore*

Abstract

Jhum is an organic and primitive cultivation system, which adopts rotation of fields rather than rotation of crops. The cultivation system has divided economists, ecologists, and social scientists on its merits and demerits. This paper analyses a shift in the socio-economic and cultural dimension of *Jhum* cultivation at the community level and in the academic circles. It is based on a 2-year observation from April 2018 to March 2020, four participatory risk mapping meetings, and informal interviews with 225 *Jhum* farmers in the Tamenglong district of Manipur in northeast India. The risk of losing cultural identity (perceived risk index = 0.90) and food security (perceived risk index = 0.87) were the most critical risks, along with eight other risks that motivated *Jhum* cultivators to cling to their old practice. Despite the identified risks, *Jhum* cultivation is witnessing inevitable transition, manifested in the selection of crops, land allocation, absence of rituals, avoidance of sacrifices, reduction in the fallow period, and social ecology shift. Villagers in this study spread over 24 villages identified teeming population and diversified needs as the crucial factors fuelling a change in their traditional farming. Furthermore, the fallow period has fallen to 3–5 years in Tamenglong. Villages with a more extensive land reported a more considerable fallow period. The community elders perceive the shrinking *Jhum* cycle as a threat to soil, forests, productivity, and food security. The costs involved in terrace making, water harvesting, and fertilizers discouraged farmers from incorporating significant changes in farming. However, cash crops such as chilli, maize, melons, cucumber, and other vegetables have been combined to meet modern cash needs. In the study area, three-fourths of *Jhum* farmers cultivated vegetables, and nearly half of them included fruits in farming. Also, various social functions and institutions such as marriage, village council, marking of season, and festivals have evolved in sync with the *Jhum* cycle. The traditional rituals, offerings, and sacrifices have been abolished in most villages as the villagers practice Christianity. Local churches and village council representatives promoted

---

* The Corbett Foundation, Tamenglong, Manipur | Email: naveen.vet@gmail.com

Centre for Indian Knowledge Systems, IIT Guwahati

deliberations and participation in restoring degraded forests at the *Jhum* sites under a project by The Corbett Foundation, an NGO. Lastly, carefully planned alternative livelihood opportunities factoring local culture, resources, and interests would reduce population-driven needs. Thus, resulting in *Jhum* cultivation to ensure food security and food sovereignty for the local tribes in Manipur without depleting natural resources. Additionally, engaging churches and the village council is recommended for sustainable land and livelihood management in the region.

Introduction

Traditional farming by the tribes in northeast India has witnessed attempts to arrest or eradicate *Jhum* or shifting cultivation since the previous century (Prakash, Roy, Ansari, *et al*. 2017). In such attempts, the traditional knowledge system that had formed the backbone of the age-old cultivation practice was often undermined. Policymakers have been ignoring the socio-economic, socio-cultural, and geophysical factors that have evolved together and often guided the ushering of a unique mosaic of traditional lifestyle. It is understood that the topography of the area and the fertility of soil shape cultivation practices. Societal experience and perception accumulated through nature and natural resources helped the evolution of traditional farming systems through trial and error (Pfoze, Chhetry, Chanu, *et al*. 2010).

Jhum cultivation is the traditional farming practice in northeast India's tribal and upland areas. It is characterized by the rotation of fields rather than crops, involving a short cropping period followed by a long fallow period where the land is cleared by slash and burn. Half a century ago, *Jhum* cycles were maintained up to 30 years, and the average fallow period was 10.5 years in Tamenglong (Punitha, Chauhan, Singh, *et al*. 2020). However, the cycles fallen to 3 to 7 years in the late 90s and in some places to even 3 to 4 years (Bhuyan 2019; Tiwari and Pant 2018). Absence of draught animals, use of dibble sticks, and exchange of labour are the hallmarks of *Jhum* cultivation. Many wet tropical regions including Southeast Asia, Africa, and Latin America practise *Jhum* cultivation. In northeast India, *Jhum*ing is the primary means of economic mainstay where it is suited for the moist climate and undulating topography.

This traditional cultivation system is under unprecedented pressure. Increasing population, bigger family numbers, increased food demand, and modern days' needs for cash have reduced the length of the *Jhum* cycle. As per the 2011 Census, Manipur's population witnessed 24.5% growth in 2001–11 with 32.59% of the rural population living below the poverty line (Government of Manipur 2021). During the same decade, the population of Tamenglong district increased by 26.19%, whereas over 1991–2001, it was recorded as 29.2% (Government of Manipur 2021). The manufacturing sector's contribution to Manipur's economy is less than 10%, as recorded by the 10th Five Year Plan Document. Thus, agriculture remains the prime occupation and source of livelihood for the people of Manipur.

Jhum cultivation supports nearly 34% of Manipur's population and covers nearly half of the area under permanent cultivation in the state (Prakash, Roy, Ansari, *et al*. 2017). The estimates on how much area is under *Jhum* cultivation in the region show a wide variation in different estimates by different agencies. Tamenglong and the adjoining Churachandpur district of Manipur together account for nearly 45% of the total area under *Jhum* cultivation (Prakash, Roy, Ansari, *et al*. 2017). The Registrar General of India reported only half of the area declared by the Department of Agriculture, Government of Manipur. A study titled 'Task Force on Shifting Cultivation' commissioned by the Ministry of Agriculture, Government of India estimated that 70,000 families in the state cultivated around 90,000 ha of the land. Such a variation in estimating the extent of shifting cultivation could be because of *Jhum* sites appearing as agricultural lands on national land cover maps (Mertz, Padoch, Fox, *et al*. 2009).

For decades, scientists, conservationists, economists, intellectuals, and policymakers have divided views on *Jhum* cultivation. While some argue in favour of *Jhum* for its traditional wisdom, cultural identity, and food security, many others have vehemently opposed it for being primitive, unscientific, and unsustainable for the environment. Deforestation and forest degradation in northeast India, especially in Manipur, Mizoram, Meghalaya, and Nagaland, are primarily due to shifting cultivation (Murthy, Sharma, and Ravindranath 2013). On average, 45–55 km^2 of forest in Manipur gets slashed annually for *Jhum* cultivation (Thong, Sahoo, Pebam, *et al*. 2019). Shifting cultivation is said to be an unscientific and unsustainable form of land use (Ranjan & Upadhyay, 1999). Also, the concern for a decrease in the *Jhum* cycle has not been substantiated by a relevant study (Thong, Sahoo, Pebam, *et al*. 2019). With an increase in the population, the number of *Jhum* plots also increases while the size of those plots decreases (Thong, Sahoo, Pebam, *et al*. 2019).

Jhum cultivation has faced policy-level antagonism by successive governments both at the centre and the state levels since independence. Several schemes such as Social Forestry and National Afforestation Programme emphasized on planting bamboos, timber, and fuelwood. While such projects were short-lived (often 3–5 years) and the net area available for crop cultivation was reduced, they failed to address food security. It also led to a reduction of the *Jhum* cycle. Furthermore, as these projects were not followed up later, the afforested lands fell back to *Jhum* cultivation (Niti Aayog 2018).

Later, the department of agriculture, horticulture, and rural development doled out more settled cultivation practices based on irrigation, fertilizers, high-yielding varieties, and skilled labour set. These were sanctioned without considering the need, scope, and feasibility of such a drastic change. Also, three task forces appointed by the Government of India in 1983, 2002, and 2008 did not achieve their desired objectives. They laid more emphasis on land management than on livelihood enhancement (Tiwari and Pant 2018). Thus, due to lack of technical know-how for a changed practice, poor market linkages, unrealistic irrigation choices, and risk of food insecurity, the successive governments' efforts failed to support farmers to make an informed choice on agricultural best practices (Bhuyan 2019; Maharjan, Cherrier, and Maharjan, *et al*. 2018; Tiwari and Pant 2018).

This study aims to understand the socio-economic and cultural dimension of *Jhum* cultivation at the community level in Tamenglong district, Manipur. It attempts to develop an insight into the issues that *Jhum* cultivators perceive to be critical to follow their traditional cultivation method. This study identifies the challenges cultivators face in diversifying income generation and gauges the community's perception of *Jhum* cultivation's sustainability. The project also looks at the exposition to continue *Jhum* cultivation.

Study Area

This study was conducted in 24 villages of Tamenglong district (24°58′31.73″ N, 93°30′56.27″ E) in Manipur. The study areas occupy 4391 km^2, which is 19.67% of Manipur's total area, that is, 22,327 km^2, also shown in Figure 1.

Tamenglong district is surrounded by the following: Senapati district to the east and northeast; North Cachar Hill District of Assam to the west; Peren District of Nagaland to the north; and Churachanpur of Manipur to the south. Hills running from north to south with steep slopes characterize the topography of Tamenglong district. Five major rivers, that is, Barak, Irang, Leimatak, Makru, and Ijei drain the district. Tribes including Zeliangrong Naga (comprising Rongmei, Liangmai, Zemei, and Inpui) and Kukis are the inhabitants of the Tamenglong district, besides the minority Hmars, Chirus, and Khasis. The proportion of the population living in rural areas of the district is 86.2%, with only 13.8% of the total population of 1,40,651 living in urban areas (Government of Manipur 2021). At the district level, the proportion of scheduled castes population is only 0.02%. In contrast, the proportion of scheduled tribes' population is as high as 95.72%. The literacy rate for men and women in the region is 76% and 64%, respectively (Government of Manipur 2021). Agriculture is the primary occupation of people in Tamenglong.

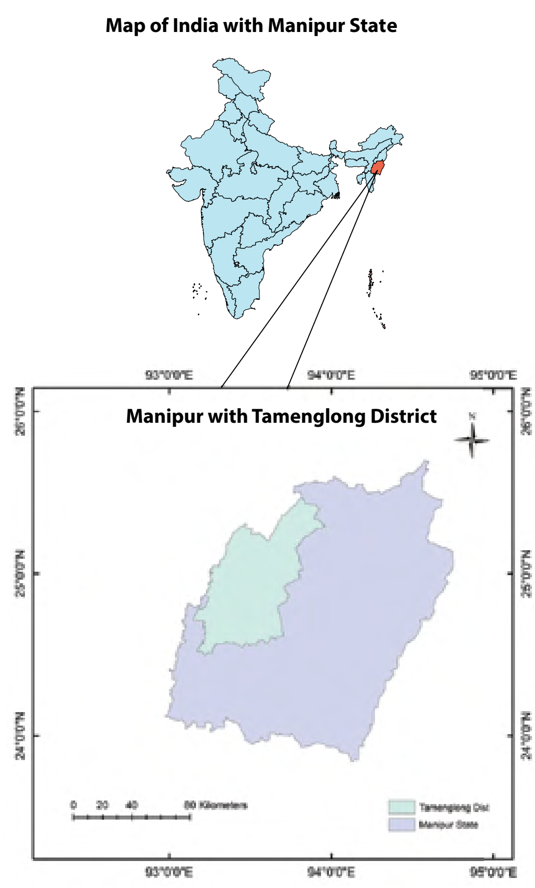


FIGURE 1: Location of the study area in Manipur

The annual rainfall of the district varies from 81.31 cm to 340.00 cm. Rainwater remains the primary source of water for agricultural purposes. All the 18,500 ha of area under cereal crops in Tamenglong district is non-irrigated (Government of Manipur 2021). Red laterite soil, which is a characteristic of hills, is found throughout the district. The river gorges are made of sandy soil. Evergreen forests dominate Tamenglong district's floral heritage. *Pinus khasya* (Khasi Pine or Uchan), *Albizia stipulata* (Chinese Albizia or Khok), *Castanopsis hystrix* (Sahi), *Hydnocarpus kurzii* (Uthou), *Mangifera indica* (Mango or Heinou), *Phoebe hainesiana* (Angaria or Uningthou and is the state tree of Manipur), and *Albizia lebbeck* (Lebbeck or Uyel) form the main trees of the region. *Tectona grandis* (Teak) and *Quercus* spp. (Oak) are also found in the western foothills of the district. Evergreen forests mixed with multi-bamboos are seen in the southern portion of these forests. Animals such as *Hoolock hoolock* (western hoolock gibbon), *Capricornis thar* (Himalayan serow), *Rusa unicolor* (sambar), *Muntiacus muntjak* (barking deer), *Sus scrofa* (wild pig) are found in Tamenglong.

Methodology

The study is based on a 2-year observation from April 2018 to March 2020, which included four participatory risk mapping meetings and several informal interviews with 225 *Jhum* farmers in 24 villages in Tamenglong district. While the participatory meetings were group activities, interviews were conducted with each farmer. Both the activities aimed to understand the nature of *Jhum*ing, changes in practices, challenges in recent times, and perception for sustainability. Though the participatory meetings and individual interviews were not connected, their findings helped in forming an insight into the *Jhum* practice's shift.

Each participatory risk mapping meeting (Webber and Hill 2014) included a group of ten villagers. The total number of men and women participated in four participatory risk mapping meetings was 29 and 11, respectively. The activity, as shown in Photo 1, was designed to gain insight into various risk factors that discourage villagers to give up *Jhum* cultivation and adopt an alternate cultivation practice. The risk was defined as uncertain consequences and exposure to adverse situations in response to a probable shift in the agricultural practice. The first step was to ask the farmers to identify the risks, and then to rank those risks, making it a two-stage effort of ordinal ranking. Respondents were encouraged to engage in a discussion to identify and list as many risks as they perceived.

A severity index was calculated for each risk using a methodology described in other similar studies using participatory risk mapping (Smith, Barrett, and Box 2000; Quinn, Huby, Kiwasila, *et al*. 2003; Webber and Hill 2014). The formula $S_j=1+(r-1)/(n-1)$ was used, where r is the rank associated by each respondent for each risk and n is the total number of risks listed by the respondents. Mean distribution was calculated for all the respondents creating a score ranging from 1 to 2, wherein 1 indicated most severe and 2 indicated least severe. An incidence index (I_j) was created to indicate the proportion of respondents mentioning a particular risk. Zero (0) indicated not mentioned at all and one (1) indicated mentioned by all. Risk index (R_j) was obtained by dividing incidence by severity.

PHOTO 1: A participatory risk mapping exercise in progress

PHOTO 2: An informal meeting with a villager

First household from each village was randomly selected, and then every third household was approached. Only one member from each selected household above 18 years of age was interviewed informally using a semi-structured questionnaire. The respondents were encouraged to engage in open-ended discussions, as shown in Photo 2. The key respondents had ample experience of *Jhum* cultivation. The discussions were directed towards understanding a shift in farming practices, challenges that villagers perceive for future, and how traditional farming sustained their livelihoods. The study's objective was explained to the participants, and verbal consent was obtained before engaging in discussions. Participation in these activities was voluntary, and the participants were allowed to withdraw from it whenever they wished.

The fieldwork for this paper was conducted by the authors Naveen Pandey, Mordecai Panmei, and Dilunang Pamei. As Mordecai Panmei and Dilunang Pamei belong to the study area, acquainted with the native language, it was easy to design and implement the semi-structured interviews. Three teams were formed, each were assigned eight villages to survey in 6 months. Two volunteers from the local community assisted each team, making it a 9-member team in the field. The fourth author of this study, Kedar Gore, helped in analyzing the observations and drafting of the paper.

Result and Discussion

As this study was undertaken as a precursor and later as a component of a project on ecosystem restoration in 24 villages in Tamenglong district, a large number of people (N = 225) were interviewed, as shown in Table 1. Nearly a quarter of respondents were female (N = 55), and three-fourths were male (N = 170). Female respondents were fewer than male respondents as many women had gone to *Jhum* fields or nearby market to sell vegetables or chillis. Women in Manipur take an active role in their family's economy and market initiation (Chingtham 2016). They actively engage in farm activities right from land preparation to post-harvest operations (Chingtham 2016). All the respondents belong to scheduled tribes.

Table 1: Category of respondents

Variables	Category	% Respondents
Gender	Male	75.6
	Female	24.4
Age (years)	Young (<30 years) 18	8
	Middle (31–55 years) 84	37.3
	Old (>55 years) 123	54.7
Family size	Small (2–5) 35	15.6
	Medium (6–9) 148	65.8
	Large (>10) 42	18.6
Jhum experience	Low (<11 years) 58	25.8
	Medium (11–30 years) 108	48
	High (>30 years) 59	26.2

Cultural Dimension of *Jhum* Cultivation

Jhum cultivation in the study area is more than a practice. It is an integral part of the cultural ethos of the native tribes in Tamenglong, and they identify themselves with the *Jhum* practice. The marking of the season revolves around *Jhum* cultivation. Most of the songs are about the *Jhum* cycle, as the community's life revolves around it including festivals and marriage. The state-sponsored efforts of eliminating *Jhum* cultivation are seen by the locals as a threat to their cultural identity.

PHOTO 3: A typical *Jhum* site with crops, chopped trees, standing crops, and women

Jhum is based on cooperative farming, as shown in Photo 3. The whole process of *Jhum*ing starts with consultation meetings of the village council. These meetings are held every year to decide the location for *Jhum* cultivation. The elders have the greatest say in such meetings. However, the specific location for each family is decided by the family head in consultation with other family heads in the village. There are joint families as well as nuclear families in the study area. The size of the family is taken into consideration to decide the size of the *Jhum* land for each family. There is no specific measurement. It is measured in terms of how many crops would fit in a particular area. For example, if we asked what the size of the *Jhum* field was, the villagers would reply, 'My *Jhum* field is five tin of paddy.' This means five tin of paddy can be cultivated in that particular area, which measures around 2 ha. A nuclear family will have two–three tin of areas and a joint family five or more tin. The elders in the villages believe that abandoning the traditional cultivation practice that has its origin as old as their community could adversely affect cooperation and efforts to help each other. Additionally, they fear that an alternative cultivation practice could be more about technology, capital, market, and competition.

PHOTO 4: Elders in the study area associate *Jhum* with their cultural identity and worry about its future

Unchanged Aspects of *Jhum* Cultivation

The slash season starts from the end of December remains till March in the region. People use *daw* (a locally made cutting tool) to clear bamboo and small-sized trees and axes for big trees. After slashing vegetation, the cut parts are left for a month or two to dry up. Most of the vegetation is burnt, and some are deliberately kept half-burnt for mushrooms to grow. If the *Jhum* field is not far from the village, the half-burned wood is carried home to be used later as fuel wood. From the end of March to the first week of April is the burning season. The burning process is regulated in a controlled manner. Fire is monitored while keeping all the canopies and forest around the *Jhum* field intact. The elders check for the wind direction before they begin burning the field. These practices have not seen any substantial change in many decades. Neither fertilizers nor cow dung is used in *Jhum* cultivation in Tamenglong. The soil is already fertile as it is a forest bed.

The role of women is an integral part of *Jhum* cultivation. They are involved right from the first phase of forest clearing until harvesting and selling additional produce in the local market, as can be seen in Photo 5. However, some women in recent times prefer to take care of infants and nursing young ones. Despite these minor changes, the role of women in *Jhum* cultivation and decision-making has remained intact and essentially unchanged in Tamenglong.

The role of women increases after burning, as they are more experienced in sowing the paddy. Women decide the arrangements of vegetables and cash crops in a *Jhum* site. Both the gender takes part in sowing, but the females take the lead role. The reason being the females are much

PHOTO 5: A local market where women sell vegetables and fruits

PHOTO 6: Women actively participate in *Jhum* activities

better at storing seeds and maintaining them. For every plantation to occur, the entire decision will be taken by the person who has the seeds. The women play a vital role in planting, dibbling and harvesting (Photo 6). Elderly respondents expressed concern that if *Jhum* is abandoned, the role of women may see significant changes.

Perceived Risks Against Abandoning *Jhum* Cultivation

The respondents identified ten risks to their livelihood and income if they had considered drifting away from the traditional farming practice of *Jhum*. The risk of losing cultural identity (perceived risk index = 0.90) and food security (perceived risk index = 0.87) were the most critical risks, as shown in Table 2. There were eight other risks that motivated *Jhum* cultivators to cling to their traditional farming practice. The costs involved in terrace making, water harvesting, and fertilizers discouraged farmers to incorporate significant changes in farming. Only three villages in Tamenglong district availed banking facility, and agricultural credit societies were functional in only two villages (Government of India 2011). In the absence of promotion of microcredits and likelihood of a return on investment, there have been insufficient funds (perceived risk index = 0.65, Table 2) that are needed to incorporate changes in the farming system.

Table 2: Result of the participatory risk mapping exercise

Risks Identified	Severity Index (1-2)	Incidence Index (0-1)	Perceived Risk Index
	1 = most severe, 2 = least severe	0 = not mentioned at all, 1 = mentioned by all	Higher the number, greater is the risk
Culture identity	1.13	1.00	0.90
Less food security	1.1	0.95	0.87
Poor water irrigation	1.47	0.98	0.71
Less land	1.51	0.98	0.66
No money to invest	1.57	1.00	0.65
No storage	1.51	0.95	0.65
No market	1.63	0.95	0.60
Less manpower	1.66	0.95	0.58
No government support	1.73	0.88	0.51
No training	1.79	0.80	0.46

Tamenglong district consumes only 0.78% of the total electricity consumption of the State. This translates to only 0.5% of the electricity consumed for commercial purpose in Manipur despite the availability of power supply in all the villages of the district (Government of Manipur 2021; Government of India 2011). It discourages farmers to opt commercial horticulture. The villagers believe that government policies are against *Jhum* cultivation (perceived risk index = 0.51, Table 2). With wet and terrace cultivation and other farming practices, government tries to reduce *Jhum* cultivation in the adjoining districts. The area under cereal crops (18,500 ha) in the Tamenglong district is non-irrigated (Government of Manipur 2021). Thus, to tackle the challenges of irrigation at hillocks (perceived risk index = 0.71, Table 2) in settled terrace cultivation, as shown in Photo 7, expenditure, skill, and a substantial shift from rainfed cultivation are required.

PHOTO 7: Settled farming required elaborate and expensive irrigation arrangements

Due to poor road connectivity, most villagers are discouraged to sell their products. A saturday market in Tamenglong district serves the purpose of selling other produce and vegetables. During a good harvest season of fruits, large quantities of the produce remain unsold in the local market and are wasted in absence of storage, processing, and marketing facilities. Lack of storage is a risk (perceived risk index = 0.65, Table 2) that discourages the villagers from adopting changes in farming practices. The respondents stressed on the need for roads and connectivity to the market in most of the villages (perceived risk index = 0.60, Table 2). Lack of motorable roads in many villages of Tamenglong district, as shown in Photo, contributes to poverty (Pillay 2018). Only 15% of the villages in Tamenglong district could be approached by *Pucca* roads, and only 9% of the villages availed transport and communication (Government of India 2011).

The increasing population has been putting immense pressure on land in Tamenglong. The Registrar General of India Office reported an increase of 26.19% growth in the population of the Tamenglong district between 2001 and 2011 (Government of Manipur 2021). In the region, the number of nuclear families has gone up, resulting in reduced landholding at the family level (perceived risk index = 0.66, Table 2). The overall land area under cultivation has also decreased due to land allocation for non-*Jhum* purposes such as bamboo plantation, horticulture, and settlement.

PHOTO 8: Poor condition of roads affects trade, commerce, and overall well-being

Apart from poor road connectivity and absence of a market, the lack of relevant training for alternative livelihoods is a severe constraint. Thus, there has been increased pressure on *Jhum* cultivation, resulting in shortening of the *Jhum* cycle. In the absence of training programmes (Incidence Index = 0.80, Table 2) for skill development and alternative livelihood generation, the villagers fall back to their traditional farming practice and are forced to experiment with it themselves.

The villagers consider the landholding pattern crucial for ensuring secure access to farming and settlement. It is a social system of cooperation and togetherness. Land always belongs to a landlord. In some villages, one clan has the entire land in its name, whereas in others, a community jointly owns the land. In both the cases, a villager is entitled to have land for settlement and cultivation. The resources from the cultivation belong to the farmer. The land tenure and ownership pattern in the region discourage investment in land upgradation, which inhibits a change in farming practices.

From 2018-19 to 2019-20, there was a decline of 17.7% in food grain production, resulting in a 59% increase in the shortfall of food grains production and requirements for the same period (Government of Manipur 2021). The *Jhum* cultivators are aware of the shortfall of food grains, and they fear a risk to their food security in changing their agricultural practice. A reduction in rice yield in Tamenglong and other eight districts of Manipur was projected (Ravindranath, Rao, Sharma, *et al*. 2011). Climate variability and climate change are additional stresses that affect food production systems; however, these were not identified as risks by the *Jhum* cultivators during the participatory risk meetings.

It was reported that there were no opportunities for unskilled villagers to gain an off-farm income. Consequently, they are bound to revert to *Jhum* cultivation for all their needs. The perceived risks collectively result in the shortening of the *Jhum* cycle.

Changes in *Jhum* Cultivation Practices

Despite the identified risks, *Jhum* cultivation has been going through an inevitable transition, manifested in the selection of crops, land allocation, absence of rituals, avoidance of sacrifices, fallow period, and social ecology shift. The elders recalled that earlier turmeric, ginger, and tapioca were the main crops accompanying rice in the *Jhum* fields. It was informed that they grew only as much was required for a family's consumption. And, growing vegetables to earn an income was not traditionally practised. Now, about three-fourths of *Jhum* farmers in the study area cultivate vegetables, and nearly half of them included fruits in farming in addition to rice. Cash crops such as chilli, maize, melon, cucumber, and other vegetables including okra, pumpkin, brinjal, yam, tapioca, beans, garlic, ginger, turmeric, etc. meet the modern needs of cash. The fallow period has fallen to 3–5 years in many Tamenglong villages. However, villages with more extensive land reported a larger fallow period of 8–10 years. The elders of villages where the fallow period is less than 5 years informed that two decades ago they use to practise a fallow length of more than 10 years.

PHOTO 9: Vegetables and cash crops at a *Jhum* site alongside paddy cultivation

Villagers were aware of how the Naga tribe in neighbouring Nagaland benefitted from ecotourism in villages such as Khonoma and built a sustainable economy around it. Many elders believed that such an alternative source of livelihood from natural resources would collectively encourage them to protect their forests. They associate falling production and increasing cash demand with the shortening of the *Jhum* cycle. Tharon Cave, Zariot Lake, and AtengFall were repeatedly mentioned by the villagers during interviews for the purpose of ecotourism in their region. Tharon Cave in Tamenglong district's Tharon village has an archaeological and historical significance, which has remained largely unexplored by the outside world. Despite growth in domestic and international tourist flow and tourism-based industries in Manipur (Khwairakpam *et al*. 2018), the villagers feel marginalized and deprived of the benefits of ecotourism in Tamenglong district.

Furthermore, various social functions and institutions including marriage, village council, marking of seasons, and festivals have evolved in sync with the *Jhum* cycle in the region. Although, nature worships, traditional rituals, offerings, and sacrifices that have been long associated with the beginning of *Jhuming* are abolished in most villages as the villagers practice Christianity. Local churches and village council representatives promote deliberations and participation in restoring degraded forests at the *Jhum* sites in the study area. Consultations, village meetings, and elders' advice are rooted in the decision-making process for *Jhuming*. The community elders perceive the shrinking *Jhum* cycle as a threat to forests' soil, its productivity, and food security. A study by Nath, Brahma, Lal *et al*. (2016) which was based on data on soil erosion, loss of nutrients, and soil organic carbon reported that a short fallow cannot fulfil the livelihood requirements of an ever-increasing population. The *Jhum* cultivators are aware of the environmental consequences of shifting cultivation, but their ethnic belief in the cultural heritage binds them to traditional farming practices (Paul, Tripathi, Roy Burman, *et al*. 2017).

As per the Forest Report of 2019, Manipur lost 499 km^2 of forest cover between 2017 and 2019, and 108 km^2 of this loss was incurred in Tamenglong district alone (Government of Manipur 2021). A more extended fallow phase promotes an increased amount of accumulated forest floor litters. It ensures higher soil nutrient availability and a healthy state of carbon, potassium, and nitrogen cycles (Saplalrinliana, Thakuria, Changkija, *et al*. 2016). Also, less frequent burning in the more extended fallow phase improves the physicochemical and biochemical properties of *Jhum* soils (Saplalrinliana, Thakuria, Changkija, *et al*. 2016).

Challenges of *Jhum* Cultivation in Changing Society

Jhum in Tamenglong has been suffering from a lack of workforce. The number of towns in Manipur grew from 33 in 2001 to 51 in 2011 (Singh, Singh, and Singh 2016). There is a declining interest in *Jhum* in the younger generation. Though there are various reasons, but the most prominent one being that the production is less when compared with the time and resources they put in practising *Jhum*. An average daily wage earner earns INR 300 to 500 per day in the region, whereas in *Jhum*, working for 150 days in a field in 1 year leads to an earning of INR 200 per day worth return for a family from the agricultural product. Human labour, a critical input of *Jhum* cultivation, has been traditionally met by mutual exchange of labour amongst the cultivators

PHOTO 10: A *Jhum* site adjoining a hillock under a fallow period

(Punitha, Ansari, Pandey, et al. 2018). Many families support each other in harvesting through labour exchange following a mutually agreed harvest timing. However, elders in the study area reported a decline in labour exchange in the last two decades, which was also outlined in a study by Ngaranngam (2019). The proportion of the main workers (who get more than 183 days of work in a year) fell from 38.5% in 1991 to 34.1% in 2011, whereas that of the marginal workers (who get less than 183 days of work in a year) increased from 3.6% to 11.5% in the same period (Government of Manipur 2021). The percentage of workers to non-workers of the state's population is 45.7% and 54.3%, respectively, and only 52.8% of the total workers are cultivators and agricultural labourers (Government of Manipur 2021). Three-fourths of the educated youth respondents in the study area did not contribute to family income as they stay away from *Jhum* cultivation despite being unemployed. The elderly respondents expressed their concern about the youths getting alienated from *Jhum*. It creates a shortage of manpower (perceived risk index = 0.58, Table 2) and threaten loss of cultural identity.

Conclusion and Recommendation

Jhum cultivation is part of the cultural ethos of the native tribes of Tamenglong district. Various practices under *Jhum* cultivation have remained unchanged in Tamenglong except some rituals and sacrifices, which were abolished after the adoption of Christianity by villagers. The native population is aware of the ill effects of narrowing of the *Jhum* cycle on the environment. The fear of losing cultural identity and food insecurity are the most perceived risks of the *Jhum* cultivators. Lack of technical knowledge, poor cash balance at hand for investment, costs related to alternative cultivation practices, and the absence of a market discourage farmers from adopting changes in farming practices. The incorporation of cash crops and vegetables has yielded additional revenue, which sustains the families in Tamenglong.

Jhum cultivation requires a thorough study encompassing its socio-cultural values, food security character, and its impact on the environment and soil quality. The narrowing of the *Jhum* cycle needs to be scientifically studied considering other related aspects.

A carefully planned alternative livelihood opportunities factoring in local culture, resources, and interests would reduce population-driven needs in the region. This way *Jhum* cultivation could ensure food security and food sovereignty for local tribes in Manipur without depleting natural resources. The knowledge system of the indigenous community awaits our assessment and appreciation. The second-year croppings could reduce the demand for forested land for *Jhum* and prolong the *Jhum* cycle as well (Tawnenga and Tripathi 1997).

Based on the observations made during this study, the following are recommended to secure wild habitats and flora and fauna in the community forests of Tamenglong district:

Recommendations by the Community

1. There is a need to undertake capacity building activities to generate alternative livelihood for the local community. The land under cultivation will further degrade if alternative income sources to meet newer cash demands are not generated. The government efforts for skill-based entrepreneurship have been inadequate, sporadic, and inaccessible for people living in remote villages. Alternative livelihood programmes should consider local resources, market availability, and the feasibility of the vocation.
2. Improving road network and market linkages would support new alternative livelihoods. Most of the entrepreneurial initiatives become unviable due to poor connectivity of villages. Roads act as agents of change. New ideas, vocations, opportunities, and the scope for sustainability need better connectivity with markets. Even though new roads have been built in the region in the last decade, the pace of making new roads is languid.
3. The rich flora and fauna, traditional lifestyle, and historical sites such as caves and lakes can support ecotourism in the region to generate income from the protected forests. An exchange

programme in which villagers visit other sites in northeast India, for example, Khonoma in Nagaland, for exposure would help the local community develop trust in ecotourism. Many villagers are aware of such initiatives in Nagaland, and it is strongly recommended to take an advantage of their keen interest in trying it out in the hills of Tamenglong. Till the market linkages are established for non-farm vocations, a model of ecotourism could be established in collaboration with the village councils in rural areas. A network of roads needs to be immediately built for ecotourism in the region.

Recommendations by the Research Team

1. The participatory risk mapping exercise undertaken in this study identified the perceived risks. A systematic review should be conducted to validate the perceived risks identified in this study. The government initiatives to wean people from *Jhum* need to take into account the perceived risks. The risks of losing cultural identity and food security are deeply connected with the tribes' identity and livelihood. Previous schemes to replace *Jhum* with more settled cultivation and horticulture have ignored the concerns of the local people and often failed to bring in a change.
2. There is an urgent need to conduct an evidence-based research on comparative agricultural practices rather than branding *Jhum* as environmentally degrading and primitive. Government policies have been based on the assumption that *Jhum* cultivation is unscientific, unsustainable, and a threat to biodiversity. Thus, there is a need to generate a scientific understanding of the cultivation practice that has evolved with topography and climatic factors.
3. The fallow *Jhum* sites should be supported for ecosystem restoration by active plantation. Such sites should be brought into the ecotourism domain. An awareness campaign should be designed underlying the scope and potential of ecosystem restoration and ecotourism.

Acknowledgement

The authors are thankful to the Axis Bank Foundation for supporting this study. They also express their gratitude to the village council of the studied area and Manipur Forest Department for their cooperation and support.

References

Bhuyan, R. 2019. A review note on shifting cultivation in Northeast India amidst changing perceptions. *Dhaulagiri Journal of Sociology and Anthropology* **13**: 90–95 Details available at https://doi.org/10.3126/dsaj.v13i0.24252, last accessed on October 26, 2021

Chingtham, T. 2016. Women and human resource develoment in Manipur. *Voice of Research* **4** (4): 41–43

Government of India. 2011. District Census Handbook, Tamenglong. **15** (Part XII-A)

Government of Manipur. 2021. Economic Survey, Manipur 2020-21. *Economic Survey, Manipur 2020-21*. Details available at http://desmanipur.gov.in/files/NewsFiles/20Sep2019051341EconomicSurvey,2018-19.pdf

Maharjan, S. K., J. Cherrier, and K. L. Maharjan. 2018. Reviews shifting cultivation: Misconception of the Asian governments. *Journal of International Development and Cooperation* **24**: 71–82

Mertz, O., C. Padoch, J. Fox, R. A. Cramb, S. J. Leisz, N. T. Lam, and T. D. Vien. 2009. Swidden change in Southeast Asia: Understanding causes and consequences. *Human Ecology* **37** (3): 259–264

Murthy, I. K., N. Sharma, and N. H. Ravindranath. 2013. Harnessing REDD + opportunities for forest conservation and carbon stock enhancement in the Northeastern States of India. *Natural Science* **5** (3): 349–358

Nath, A., B. Brahma, R. Lal, A. Das. 2016. Soil under shifting cultivation in eastern Himalaya. *Encyclopedia of Soil Science, Third Edition* 1273–1280. Details available at https://doi.org/10.1081/e-ess3-120053748

Niti Aayog. 2018. *NITI Aayog Report of Working Group III; Shifting Cultivation: Towards a Transformational Approach*. Details available at http://niti.gov.in/writereaddata/files/document_publication/doc3.pdf, last accessed on October 26, 2021

Ngaranngam, K. (2019). Labour exchange in shifting cultivation: The case of the Tangkhul Naga Tribe in Manipur. *Research Review Journals* **04** (04): 456–462 Details available at http://oldror.lbp.world/UploadedData/7747.pdf, last accessed on October 26, 2021

Paul, S., A. K. Tripathi, R. Roy Burman, M. Panggam, S. K. Ray, N. Kalita, R. Vanlalduati, and A. K. Singh. 2017. *Jhum* cultivation and its consequences on forest and environment in Eastern Himalayan tract of India: A participatory assessment. *Range Management and Agroforestry* **38** (1): 121–126

Pfoze, N. L., G. K. N. Chhetry, L. B. Chanu, and A. P. Devi. 2010. Indigenous traditional cultivation practices of the MAO ethnic tribe under Senapati District in Manipur. *Assam University Journal of Science & Technology: Biological and Environmental Sciences* **5** (I): 105–108

Pillay, D. P. K. 2018. Human security approach to internal security: Case study of reconciliation and insurgency in Tamenglong, Manipur. *Strategic Analysis* **42** (4): 413–421

Prakash, N., S. Roy, M. Ansari, S. Sharma, P. Punita, B. Sailo, and I. M. Singh. 2017. *Jhum* improvement for sutaining farm livelihood and natural resource conservation in North Eastern hill region: Vistas and frontiers. 110 pages, ICAR Research Complex for NEH Region, Meghalaya, India

Punitha, P., J. K. Chauhan, R. Singh, D. Ram, and R. J. Singh. 2020. *Jhumias* of Manipur in North East India: Socio-economic characteristics and *Jhum* activities. *Indian Research Journal of Extension Education* **20** (1): 42–47

Punitha, P., M. A. Ansari, D. K. Pandey, D. Ram, S. Datt, P. K. Sharma, M. Aheibam, S. S. P. Jyothi, and N. Prakash. 2018. Shifting cultivation in North East India: Social dimension, cross cultural reflection and strategies for improvement. *Indian Journal of Agricultural Sciences* **88** (6): 811–819

Quinn, C. H., M. Huby, H. Kiwasila, and J. C. Lovett. 2003. Local perceptions of risk to livelihood in semi-arid Tanzania. *Journal of Environmental Management* **68** (2): 111–119

Ranjan Rajiv, U. V. 1999. Ecological problems due to shifting cultivation. *Current Science* **77** (10)

Ravindranath, N., S. Rao, N. Sharma, M. Nair, R. Gopalakrishnan, A. Rao, S. Malaviya, R. Tiwari, A. Sagadevan, M. Munsi, N. Krishna, and B. Govindasamy. 2011. Climate change vulnerability profiles for North East India. *Current Science* **101** (NO.3): 384–394

Saplalrinliana, H., D. Thakuria, S. Changkija, and S. Hazarika. 2016. Impact of shifting cultivation on litter accumulation and properties of *Jhum* soils of north east India. *Journal of the Indian Society of Soil Science* **64** (4): 402–413

Singh N. C., N. J. Singh, and M. K. Singh. 2016. Trends of urbanisation in Manipur from 1901–2011: A Socio-economic analyses. *International Journal For Innovative Research In Multidisciplinary Field* **2** (9): 176–182

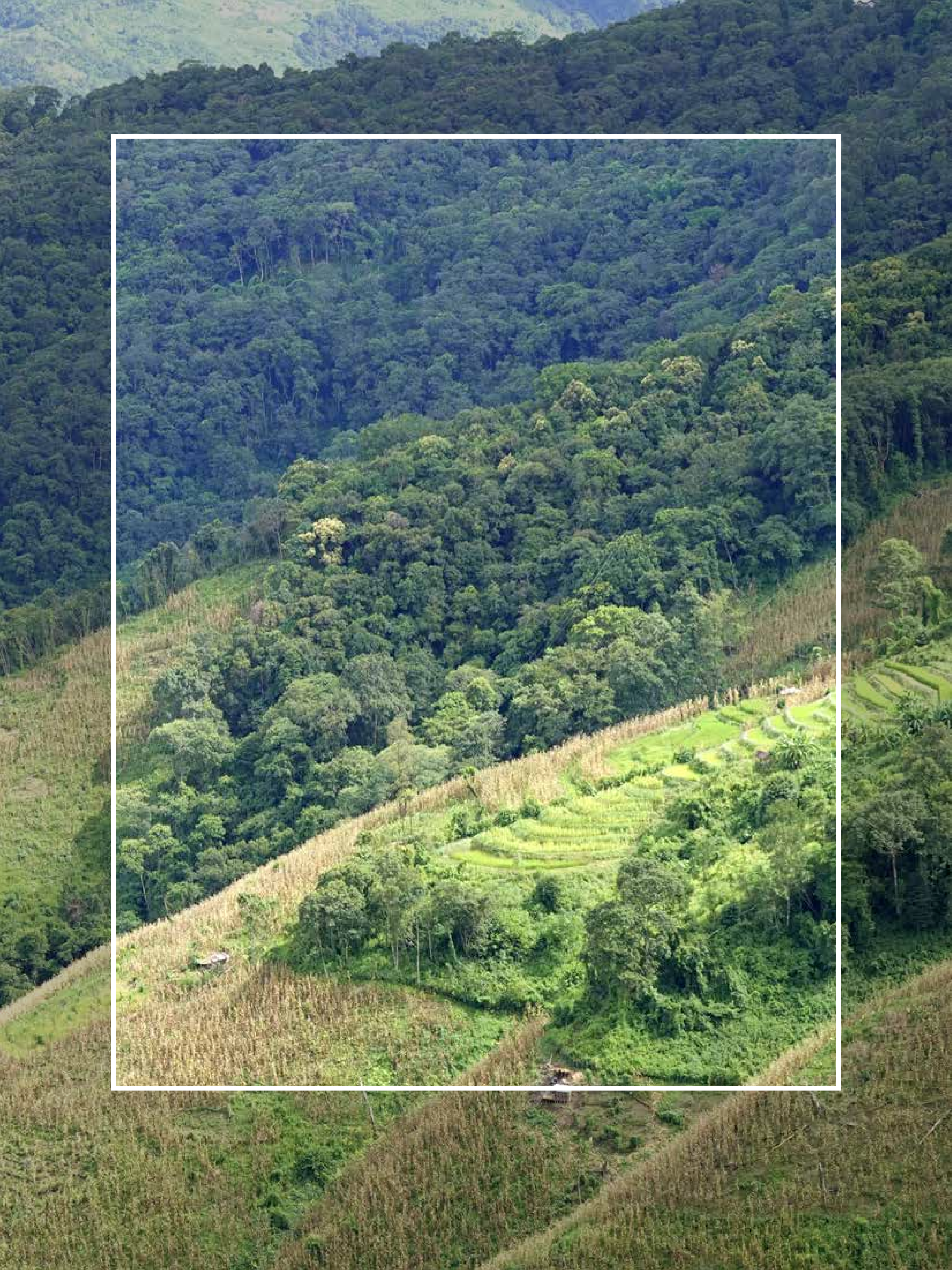
Smith, K., C. B. Barrett, and P. W. Box. 2000. Participatory risk mapping for targeting research and assistance: With an example from east African pastoralists. *World Development* **28** (11): 1945–1959

Tawnenga, U. S. and R. S. Tripathi. 1997. Evaluating second year cropping on *Jhum* fallows in Mizoram, north-eastern India: Soil fertility. *Journal of Biosciences* **22** (5): 615–625

Thong, P., U. K. Sahoo, R. Pebam, and U. Thangjam. 2019. Spatial and temporal dynamics of shifting cultivation in Manipur, northeast India based on time-series satellite data. *Remote Sensing Applications: Society and Environment* **14** (May): 126–137

Tiwari, B. and R. Pant. 2018. Shifting cultivation: Towards transformation approach a draft report. *A Draft Report: National Institute of Rural Development and Panchayati Raj* 0–31

Webber, A. D. and C. M. Hill. 2014. Using participatory risk mapping (PRM) to Identify and understand people's perceptions of crop loss to animals in Uganda. *PLoS ONE* **9** (7): e102912



CHAPTER-7
RESILIENCE OF A SHIFTING CULTIVATION FARMING COMMUNITY – A CASE STUDY OF ADIS OF UPPER SIANG, ARUNACHAL PRADESH, INDIA

Anirban Datta-Roy[1] and Karthik Teegalapalli[2]

Corresponding address: anirban.d.roy@gmail.com

Abstract

Shifting cultivation landscapes across the world are being transformed through active interventions of state agencies into monocultures and market-focused high value crops susceptible to global economic fluctuations. Critical research on these transformations has focused on biodiversity conservation, carbon emissions, and socio-economic implications. These transformations also have direct and immediate consequences for hill farmers that impact their food security and access to the diverse subsistence crops available to them in these systems. Simultaneously, a reduction in agrobiodiversity results in the disappearance of locally important plant cultivars. Replacing such dynamic and diverse landscapes with settled monoculture cultivation also eliminates the fallows and secondary forest that provide important non-timber forest products (NTFPs) for villagers.

We present results from a long-term field study of a shifting cultivation system in the Eastern Himalaya that are related to the persistence of the practice, its recent transformations, and its direct and indirect impacts. The *Adi* community in Upper Siang, Arunachal Pradesh has been practising traditional shifting cultivation in the landscape for centuries and currently has an average fallow period of 11 years. The crop diversity in this system is remarkable with over 40 vegetables, varieties of rice, and several other cereals and pulses, as well as diverse oilseeds, spices, and condiments. The regenerating fallows continue to provide additional crops for up to 2 years following cultivation. With the ingress of settled monoculture cultivation in the last few decades, there have been changes in the agricultural practices, crops produced, and

[1] Foundation for Ecological Security, Guwahati

[2] 447, Els Riviera, Candolim, Goa

food consumption patterns of the communities. Given these transformations, we argue based on empirical examples that far from being more marginalized, as seen in many case studies, communities in this region are adopting 'dual strategies' to balance novel opportunities available to them while continuing their low-risk strategies such as shifting cultivation.

Our results reiterate the importance of locally adapted and resilient agricultural systems such as shifting cultivation to fulfil the sociocultural and economic needs of cultivators. We also describe multiple instances of resilience among the Adi community through adaptations in response to changing agricultural and livelihood practices. The presence of strong local institutions such as Kebang along with the inherent resilience of shifting cultivation systems enabled the Adi people to weather shocks such as the recent COVID-19 pandemic. Future interventions in rapidly transforming mountain landscapes need to proceed with caution and consider the continued relevance of shifting cultivation among the northeast Indian highlands.

Keywords: *Jhum*, Eastern Himalaya, fallows, food security, Kebang, swidden, land use change

Introduction

Shifting cultivation or swidden, often crudely referred to as slash-and-burn cultivation, refers to a wide range of agricultural practices that are undertaken by remote traditional farming communities for subsistence, as well as by more modern communities in urban fringes for produce that is largely sold in nearby markets, and several variants of the practice within (Spencer, 1996). These variations in the practice have led to different perceptions of the practice. These range from being considered as a sustainable practice well adapted to the communities and their environment to a highly wasteful, unproductive practice requiring vast swathes of land, as well as a driver of soil degradation and more recently carbon losses and greenhouse gas emissions (Conklin, 1961; Maithani, 2005; Ramakrishnan, 1992 for the former view and Bandy, Garrity, and Sanchez, 1993; Borah, Evans, and Edwards, 2018; Kotto-Same, Woomer, Appolinaire, *et al*., 1997; Nath, Sahoo, Giri, *et al*., 2020 for the latter view). Irrespective of this wide spectrum, governments and policies in most countries have largely focused on eradicating, modifying, or improving the practice and providing alternatives to reduce the communities' dependence on it without acknowledging and appreciating the nuances of the practice (Ickowitz, 2006; O'Brien, 2002).

About 280 million ha of area is under shifting cultivation globally, according to Heinimann, Mertz, Frolking, et al. (2017), which includes both cultivated and fallow areas, although earlier references have ranged from an area of 260 to 1000 million ha (Sanchez, Palm, Vosti, et al., 2005). In northeast India, where the practice is prevalent, estimates vary significantly; overall, more than six lakh families are dependent on the practice over an area ranging 4–15 lakh ha[3] (Pant, Tiwari, and Choudhury, 2018; Pasha, Behera, Mahawar, *et al*., 2020). Ramakrishnan (1992) suggests that with over a hundred tribes practising shifting cultivation, who are largely isolated due to their language, geography, and sociocultural factors, there may be over a hundred variations

[3] The estimates are likely to vary according to the method used for defining a 'fallow'.

of this practice. According to Maithani (2005), the conditions in the region are ideal for shifting cultivation due to the mountainous topography, hot and humid climate, deep and fertile soils, extensive forest resources (with little over 11% net sown area in the hilly parts of the region), and a sparse human population with communal ownership of land. Given the dependence on the practice and the lack of reliable data on its extent, it is highly unlikely that the approximate prediction based on modelling by Heinimann, Mertz, Frolking, *et al*. (2017) that shifting cultivation in India may disappear by 2030 will hold.

Interventions by the central and state governments and other related institutions to discourage this form of agriculture, which is referred to as *Jhum* in northeast India, have been prevailing over several decades. These interventions have included irrigation schemes, training programmes, seed and fertilizer subsidies, encouragement of mechanization, and creation of links to agricultural marketplaces, and have been compounded by a concerted push in different states in the region towards the adoption of high cash value monocultures such as oil palm and rubber, among other such crops (Maithani, 2005; Teegalapalli and Datta, 2016a). In spite of all these efforts, it is possible that the decline in shifting cultivation is actually due to the actions of the farming families themselves rather than due to the efforts of state and central governments (Maithani, 2005).

Given that there are several variants of the practice as well as varied perceptions of the practice by different stakeholders, government agencies, and researchers, our interest was in documenting the nuances of the practice in a site where the practice was being undertaken traditionally. We aimed to document the direct and indirect benefits of the traditional shifting cultivation practice and to understand the ways in which these communities have coped with recent and historical pressures to shift away from or modify the practice. In other words, we focused on documenting the initiatives that the communities have undertaken that have led to the resilience of the practice in the landscape.

Research Methodology

The Upper Siang district (28.13°–29.34°N and 94.17°–95.40°E) is one of the northern districts in the state of Arunachal Pradesh that was formed out of the larger East Siang district in the year 1994 and is bounded by Tibet to the North (Figure 1). The Siang River that flows in from Tibet is an imposing feature in the landscape and most villages are located in the valleys and hill slopes along the river and its tributaries. Upper Siang, like the other Siang districts, is dominated by the Adi tribe along with Membas, Khambas, and Idu Mishmis who inhabit the border areas to the north of the district. Among the Adis, the major subtribes of this region are the Ashings (on the Siang right bank) and the Shimongs (on the left bank). Our case study of the shifting cultivation practice is based on the field work and interviews undertaken in Ramsing, Bomdo, Janbo, Migging, and Ninging villages in the Upper Siang district.

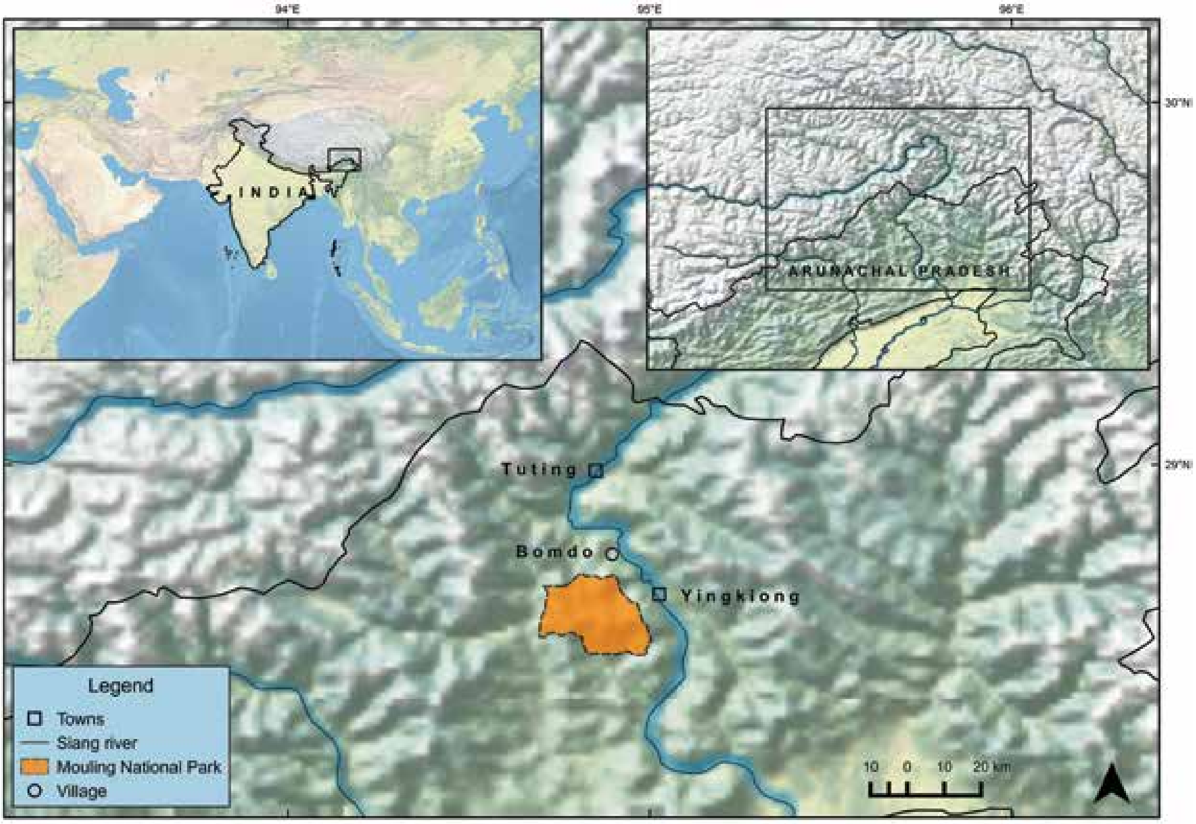


FIGURE 1: Map of study area landscape indicating location of Bomdo village in Upper Siang district and topography of the region

Traditional village institutions are common among different communities in northeast India and continue to play important roles. Among the Adi, the institution of the Kebang has been conducting administrative and judicial affairs for centuries. It maintains order and stability within the village and among clans across the areas of Adi presence. They play a critical role in ensuring the timing and conduct of shifting cultivation. The communal nature of shifting cultivation requires a central authority that can coordinate the activities and the Kebang plays that important role. Apart from the cultivation, supporting activities such as fencing or burning also need to be done within a limited period of time and this is ensured by the Kebang through fines that are imposed on households that do not participate in these community activities. The timing of the activities involved in shifting cultivation is crucial as the success of the entire crop for the season depends upon it.

Initially, we used a snowball sampling method of interviews starting with the village head, who referred us to other households to interview. As far as was logistically feasible, we interviewed people from different economic strata in the village – individuals with regular government jobs such as teachers at school, individuals who regularly undertook government contracts, and subsistence farmers. Besides the formal interviews, we spent a majority of the period from 2009 to 2015 in the Bomdo village (usually from September to May since the village is relatively more accessible due to the lack of torrential rain and landslides during this period). During this period, we interacted extensively with the Adi community in the village and utilized participatory observation techniques to document details about the sociocultural profile of the village as well as agricultural practices. We conducted focus group discussions with important members of the community and panchayat representatives to gather household data on the practice of shifting cultivation and wet rice terrace cultivation within different households in the village. We verified this information on household agricultural profiles by also speaking to representatives from different clans who had more intricate knowledge of agricultural practices of their own clan members. The questionnaire survey is presented as supplementary information in Teegalapalli and Datta (2016a) and the data collected are uploaded in the Dryad Data Repository (https://datadryad.org/stash/dataset/doi:10.5061/dryad.6mq0n).

A Case Study of the Adis in the Upper Siang District, Arunachal Pradesh

Benefits from Shifting Cultivation to Livelihood and Food Security

The definition of food security according to FAO, in short, is that 'it exists when all people, at all times, have access to sufficient, safe and nutritious food which meets their dietary needs for a healthy life' (FAO, 1996). This is precisely what shifting cultivation provides to remote farming communities. The most obvious benefit from the shifting cultivation fields comes in the form of mixed cropping of staple food items such as rice and millet. However, even the staple food crops grown in shifting cultivation fields are characterized by a rich agrobiodiversity that has enabled the maintenance of overall crop genetic diversity through retention of locally important plant cultivars. Many local varieties of rice continue to be tried and tested to match the soil and environmental conditions, while some varieties have been grown for close to a century. Finger millet (*Eleusine coracana*) is an important crop that is usually grown only in shifting cultivation fields. It is consumed as food and also fermented and processed into a popular alcoholic drink (*marua apong*) that is central to Adi social life. Other varieties of rice are grown for specific purposes, such as glutinous rice that is used for preparing rice cakes and a particular variety of rice from which rice wine is prepared.

Apart from the major crops, assorted cereals, oilseeds, pulses, tubers, vegetables, condiments, and so on are grown in the fields (Table 1). While a comprehensive listing of all crops grown in the swidden fields of the study village was outside the scope of this study, field observations and interviews revealed the presence of more than 30 species and 75 varieties used for subsistence purposes by a majority of the households. In the neighbouring West Siang district, a total of 72 crops were reported to be grown by Adi farmers (Yumnam, Bhuyan, Khan, *et al*., 2011). Similarly, Saravanan (2010) has reported 74 indigenous varieties from the East Siang district.

Specific rice varieties grown in the fields are used for producing rice wine (*nogin*) and sticky rice cakes (*itting*), both of which are essential components of Adi life. The most common varieties are known by the generic terms Adi *ampang* and Ashing *ampang*. The other varieties that still exist are the Adi *Takker*/*Kerling*, which is used for making *itting*, and *Moppu takkir*, which is used for making *nogin*. Varieties such as *Ando*, *Pinchi*, and *Polling* have already been lost. Currently, there appear to be five varieties that are planted in shifting cultivation fields. While three varieties are used for making alcohol and rice cakes, the other two varieties are used as food.

It is also interesting to note the reasons for the extinction of some varieties and the consequent loss of agrobiodiversity. The primary reason appears to be that the granaries do not allow for the storage of viable seeds for more than 3 years as they are attacked by insects. Unless a variety is grown continuously from which new seeds can be obtained, disuse inevitably leads to extinction. The other reason provided was the temporary move by roughly one-third of the households to cultivate in two of the neighbouring villages Puging and Ramsing. During this period, they discovered that the seed varieties that would grow well in their own village did not do too well in these villages and had to be replaced by Puging varieties. At the end of this period of 10–12 years, these varieties that they had adopted in Puging and Ramsing were brought back to the village and their popularity led to the disappearance of the older varieties. One variety (*Ando*) that is reportedly lost now was grown earlier due to its hardy nature and the fact that it would ripen the fastest even though it wasn't the 'tastiest'. Respondents explained that the persistence of this variety for many generations was because poorer families would often fall back on this when their stocks ran low and the common variety was still not yet ready for harvesting. It is apparent that the shifting cultivator is not frozen in time, but rather adapting to the local demands and opportunities. In the process, while some varieties have been lost, others have been adopted.

Although shifting cultivation fields are used primarily for subsistence, they can also be used to grow some commercially viable items in small quantities as was being done in the study village. The lack of distribution networks and transportation problems have ensured that there were no large-scale commercial plantations, but villagers did grow ginger and chillies, which were occasionally sold. The famous *bhut jolokia* or *mithun marcha* (Ghost pepper, which is a hybrid of *Capsicum chinense* and *C. frutescens*) is grown for local consumption in the village and stored after smoking and powdering it. These chillies are in high demand in city centres, including the district capital Yingkiong. More recently, large cardamom is also being grown in some of the shifting cultivation fields to be sold.

FIGURE 2: Large cardamom (Eletteria cardamomum) plantation that has recently been started by a few individuals in Bomdo village

Table 1: List of species and varieties grown in shifting cultivation fields and harvested from fallows and primary and secondary forests by the Adi community in Bomdo village

Sl. No.	Scientific/common name/local name	Number of Varieties	Source	Consumption Category
1	*Allium* sp./garlic (local variety)	1	Cultivated	Condiment
2	*Allium* sp./onion (local variety)/*Talat*	1	Cultivated	Condiment
3	*Amaranthus* sp.	1	Cultivated	Vegetable
4	*Brassica juncea*/mustard greens/ *Tuget, Tudor, Asi, Aying tuget*	4	Cultivated	Vegetable
5	*Capsicum* sp./chillies/*silong, sibet, seka, sitin, banko, siri, sika, and petang*	8	Cultivated	Condiment
6	*Carica papaya*/papaya	1	Cultivated	Fruits
7	*Citrus* sp.	2	Cultivated	Fruits
8	*Coix lacryma-jobi*/Job's tears/*Angyat*	1	Cultivated	Pseudo-cereal
9	*Colocasia esculenta*/Yam/*Nyele, Tatbeng, Enyi banye, Panggo enyi, Nyebo, Uselakse, Eli, Engin, Nyindun, Derang engin*	10	Cultivated	Tuber

Contd...

Table 1: *Contd...*

Sl. No.	Scientific/common name/local name	Number of Varieties	Source	Consumption Category
10	*Coriandrum sativum*/coriander	1	Cultivated	Condiment
11	*Cucurbita* sp./pumpkin	2	Cultivated	Vegetable
12	*Dioscorea* sp.	1	Cultivated	Tuber
13	*Elettaria cardamomum*/cardomom	1	Cultivated	Fruits
14	*Eryngium foetidum*/wild coriander	1	Cultivated	Condiment
15	*Glycine max*/soya bean	1	Cultivated	Grain legume
16	*Ipomoea batatas*/sweet potato/ *Ngindun*	2	Cultivated	Tuber
17	*Manihot esculenta*/tapioca	1	Cultivated	Tuber
18	*Murraya koenigii*/curry tree	1	Cultivated	Condiment
19	*Musa* sp./banana	1	Cultivated	Fruit
20	*Oryza* sp./rice	14	Cultivated	Cereal
21	*Phaseolus* sp./beans/*Rontak, Rondong, Peron, Rontung, Dayir*	5	Cultivated	Grain legume
22	*Psidium guajava*/guava	1	Cultivated	Fruits
23	*Saccharum officinarum*/sugarcane	1	Cultivated	Stalks
24	*Sesamum indicum*/sesame	1	Cultivated	Oilseed
25	*Setaria italica*/finger millet/*Marua*	1	Cultivated	Pseudo-cereal
26	*Solanum kurzii*/brinjal/*Yommuk, Yomtin, Kopi, Yomdong, Kosia*	5	Cultivated	Vegetable
27	*Solanum* sp./tomato/*Tumplung*	2	Cultivated	Vegetable
28	*Sorghum* sp./sorghum	1	Cultivated	Cereal
29	*Spilanthes oleracea*/*Marsang*	1	Cultivated	Flowers
30	*Spinacia oleracea*/spinach	1	Cultivated	Vegetable
31	*Zea mays*/corn	1	Cultivated	Cereal
32	*Zingiber officinale*/*Také*	1	Cultivated	Root
33	*Artocarpus heterophyllus*/jackfruit/ *Beleng*	NA	Wild/ cultivated	Fruits
34	*Curcuma* sp./turmeric	2	Wild/ cultivated	Tubers

Contd...

Table 1: *Contd...*

Sl. No.	Scientific/common name/local name	Number of Varieties	Source	Consumption Category
35	*Paris polyphylla/Minong*	NA	Wild/ cultivated	Tubers
36	*Prunus persica/Kombong*	NA	Wild/ cultivated	Fruits
37	*Bambusa* sp./*Bamboo*	>3	Wild	Shoots
38	*Begonia* sp.	NA	Wild	Shoots/stems
39	*Calamus* sp./cane	>3	Wild	Stems/fruits
40	*Castanopsis indica/Korang*	NA	Wild	Fruits
41	*Castanopsis* sp./*Koru mite*	NA	Wild	Fruits
42	*Choerospondias axillaris/Belen*	NA	Wild	Fruits
43	*Diplazium esculentum*/fern/*Dhekia saag*	NA	Wild	Leaves
44	*Elaeocarpus serratus/Jalpayu*	NA	Wild	Fruits
45	*Ficus* sp./wild figs/*Takuk*	>2	Wild	Fruits
46	*Maesa indica*	NA	Wild	Fruits
47	*Emblica officinalis*	NA	Wild	Fruits
48	*Rubus* sp./wild raspberry	NA	Wild	Fruits
49	*Saurauia nepalensis*	NA	Wild	Fruits
50	*Spondias pinnata*	NA	Wild	Fruits
51	*Syzygium cumini/Kerot*	NA	Wild	Fruits
52	*Ziziphus mauritiana*	NA	Wild	Fruits

Role of Fallows in the Shifting Cultivation Landscape of Bomdo

The role of fallows has long been ignored by critics who have mistakenly viewed shifting cultivation purely as an agricultural system. Shifting cultivation is better seen as a dynamic land use system that moves seamlessly between forest and agriculture. The NITI Aayog (Pant, Tiwari, and Choudhury, 2018) also remarks on this and asserts that there is a need to 'categorize shifting cultivation lands as a distinct land use, recognizing that it is both an agricultural and forest management practice conducted on the same plot of land but at sequentially separated times'.

FIGURE 3: Shifting cultivation landscapes are characterised by the juxtaposition of forest and agriculture

FIGURE 4: Firewood for household use is primarily sourced from shifting cultivation fields and stored underneath the houses

Shifting cultivation fallows and the resources obtained from them are crucial for the subsistence needs of farmers although these benefits have not been explored comprehensively by researchers. Our study among the Adi of Upper Siang found that these dynamic landscapes are as important to people when they are producing crops as they are in their fallow stage. Many fallow fields continue to provide vegetables, chillies, herbs, and other products to villagers who visit these areas after the plot has been abandoned.

Shifting cultivation plots are also the principal source of firewood for the people of the village. Firewood is one of the most important items in the village for cooking and to keep warm. There is also the traditional necessity to keep the fire in the hearth always burning. At the end of each *Jhum* season, the poles cleared from each plot are left to dry and then collected and brought back to the village to be stacked underneath the houses. For remote villages like Bomdo that still do not have regular electricity, firewood is essential to survival.

Abandoned plots or fallows continue to provide resources throughout their rotational cycle. With time, these plots regenerate and resultant secondary forests continue to harbour various wild edible products as well as fauna that can be exploited for food and essential nutrition. Fallows are extensively used by 'anthropogenic fauna' like wild pigs and barking deer that in turn are opportunistically hunted for food. The shifting cultivation land use system leads to the creation of a matrix of fallows, forest patches, and recently cultivated areas that provide the perfect habitat for various faunas. These faunas are trapped and hunted by villagers for an important part of their protein requirements. Apart from large and medium mammals (barking deer, wild pig, serow, capped langurs, and civets), these fallow-forest complexes also provide a great diversity of rodents that are harvested through seasonal trapping by the villagers for food as well as cultural significance. We have also documented the presence of 252 species of birds within this mixed-use landscape dominated by fallows (Datta-Roy, Ramachandran, and Teegalapalli, 2018). Seasonal trapping of birds in winter provides another important source of food in the village. The diversity of bird species also demonstrates the importance of shifting cultivation fallows for sustaining biodiversity within mixed-use landscapes.

Apart from wild sources of protein, the fallows also support a substantial population of free-ranging mithun (*Bos frontalis*) that is characteristic of villages in Arunachal Pradesh. Mithuns are free-ranging livestock that have deep historical and cultural links with tribes across the state. Historically, they have been used as currency to pay bride prices and fines and even presently remain critical as one of the few assured avenues for villagers to source cash from their sale. Adult mithuns (~500 kg) are sacrificed during festivals and important occasions in the village, with their meat forming the most important source of animal protein for households. Mithuns also require large forested areas to feed on a diverse array of plants. Taba, Kimsing, Biju, *et al*. (2015) estimated that mithuns depend on 42–60 distinct species of naturally occurring trees, lianas, shrubs, and herbs that can be found growing in the forest-fallow matrix around villages.

The fallows and secondary forests also provide other diverse wild plant foods that have been recognized and used for generations by highland dwellers, including the community in the current study area. Edible items include green leafy vegetables, ferns, banana flowers, fruits, shoots of bamboo species, palm piths, wild tubers such as potato and yam, wild varieties of onions and garlic (more details in Table 1), seasonal mushrooms (five varieties are harvested, locally called *Undong*, *Unchik*, *Tadar*, *Lolun*, and *Umper*), and honey from wild honeybees. Apart from these, edible insects such as ants, hornets, and Pentatomid bugs (locally called *Taari*) are regularly extracted from these diverse landscapes.

Agricultural Transformation and Persistence of Jhum

Since independence from British rule in 1947, agricultural and horticultural departments in India have continued with the colonial approach and actively sought to replace shifting cultivation through the introduction of various alternative crops (Table 2). In the northeast, a prime example of this is seen in the Assam Forest Policy of 2004, which prescribes shifting cultivation landscapes to be 'rehabilitated through community-based reafforestation, agroforestry, horticulture, and specifically approved cash crop cultivation'. The approach is not new, but it does repeat mistakes that have been seen earlier in various parts of southeast Asia. Such schemes fail to recognize that this unique form of organic farming is part of a larger social system that includes culture, customs, and food security and cannot be replaced so easily.

Table 2: Timeline of important events and policies related to shifting cultivation in northeast India from precolonial to modern times

Time period	Events
Prehistory (Neolithic period)	Archaeological excavations have unearthed evidence of shifting cultivation in the Naga Hills, Garo Hills, Cachar, and other parts of Assam highlands. The mountains of northeast India have been home to various ethnic groups practising shifting cultivation from prehistoric times (Dikshit and Hazarika, 2012; Hazarika, 2006)
Precolonial period (prior to 1820)	Plains of Assam were ruled by the Kamarupa Kingdom from 350 to 1140 CE and after which it passed on to the Ahoms. The Ahoms ruled the Brahmaputra valley for ~600 years, but neither of these kingdoms had any significant dealings with the hill tribes (except for the payment of posa or taxes to stop raids) and nor did they prevent them from following their traditional practices. The Adi people of Siang valley practised shifting cultivation and conducted barter trade with Tibet to the north and Assam in the south. Local governance including the systematic practice of shifting cultivation was conducted by the local institution of the Kebang (Deka, 2008)

Contd...

Table 2: *Contd...*

Time period	Events
Colonial period (1820–1947)	The colonial period started with the British East India Company taking over Assam during the Ahom-Burmese war followed by the Treaty of Yandabo in 1826. British too had limited control over the hill areas initially. British interest in the Siang valley increased with their constant need for timber and to use the Siang as a trade route into Tibet, which led to three wars between the Adi and British. During the latter part of the British rule, colonial policies targeted traditional livelihood practices such as shifting cultivation and made specific laws and acts discouraging or making it illegal. Shifting cultivation was seen as 'primitive' and 'wasteful'
Colonial period (1820–1947)	The Forest Act of 1865 established the statutory rights of the forest department over all the forest resources and subsequently ruled that shifting cultivation was not encouraged in these forests. The Indian Forest Act, 1927 started the process of derecognition of traditional land rights of the upland tribes, which were declared as Unclassed State Forests, a category that stands to this day. These acts established the idea that shifting cultivation would be allowed only as a privilege and not as a right and would be subject to the approval of the state and forest departments (Gogoi, 2020)
Independent India (post 1947)	The National Forest Policy, 1952 continued with the colonial approach and formalized the state control over a large area of forest that originally belonged to village communities. This included forest areas that were being used for shifting cultivation by communities in northeast India (Guha, 1983)
Independent India (post 1947)	Establishment of the National Wasteland Development Board in 1985 and the launching of the Integrated Wasteland Development Programme along with it led to the classification of shifting cultivation areas as 'wastelands' and continues till now
Independent India (post 1947)	The National Forest Policy of 1988 advocates the containment of shifting cultivation and stopping its spread, providing alternative avenues of income, propagating improved agricultural practices, and 'rehabilitation' of the land through social forestry plantations

While there are some broad similarities in the history of northeast India, in many aspects they differ depending on the region. Most historical accounts for this region confine themselves geographically to the Brahmaputra valley and the plains of Assam while the uplands are largely neglected. With specific regard to the upland practice of shifting cultivation in the region, colonial era documentation is still available, while local voices are missing. Above is a rough timeline of important events related to the shifting cultivation practice and policy relevant to the Siang valley that were also applicable to most areas in northeast India where such agriculture existed.

Shifting cultivation has managed to persist even among such active attempts to eliminate it from the landscape. The reasons for its persistence are complex and may not be the same everywhere, as it fulfils diverse needs among its practitioners. Shifting cultivation has been on the decline across northeast India, and this trend has been commonly reported by various official and independent remote sensing studies (Heinimann, Mertz, Frolking, *et al*., 2017; Pasha, Behera, Mahawar, *et al*., 2020; Thong, Sahoo, Pebam, *et al*., 2019; Wasteland Atlas, 2019). This decline signals a process of agricultural transformation that is of interest to both academicians and policymakers and has been a subject of various studies across the world (Cramb, 1993; Kilawe, Mertz, Silayo, *et al*., 2018; Padoch, Harwell, and Susanto, 1998; Swe and Nawata, 2020; Thongmanivong and Fujita, 2006). Multiple studies have demonstrated that agricultural transformations among shifting cultivation landscapes do not always traverse the same route or have the same results. With regard to agricultural practices, farmers in transition do not necessarily make a complete shift to the newly introduced crops such as terraced rice or other cash crops. Fox, Truong, Rambo, *et al*. (2000) observed that many farmers in southeast Asia combine shifting cultivation with paddy cultivation to form a subsistence strategy that would also help relieve the pressure of clearing more forests. Such a strategy was observed in parts of Arunachal Pradesh, including the adjoining district of East Siang by Kosaka, Saikia, Rai, *et al*. (2015).

FIGURE 5: Wet rice terraces have become an integral part of the agricultural profile of Bomdo village

We observed a similar trend in the study village and we have also separately documented its persistence in other villages in the Upper Siang district (Teegalapalli and Datta, 2016a). In Bomdo, many areas that were previously under shifting cultivation had been replaced by terraced wet rice cultivation (hereafter, 'terraces' or 'terrace cultivation') and 80% of all farming households owned and cultivated paddy rice in terraces for subsistence purposes. At the same time, most households continued to practise shifting cultivation simultaneously, with 85% of households practising both. Further, it was also found that families with a higher economic status had larger areas under terraces and those with lower economic status had larger areas under shifting cultivation. This is also indicative that a complete transformation of the farming communities may not be feasible owing to economic reasons as well.

Shifting cultivation continued to be practised in the study village and other parts of Upper Siang district in varying degrees, although terraces were prevalent in the region from the early 1960s.

This 'dual strategy' appeared to be a stable strategy that remained even after half a century of attempts by state agencies to promote terraces (and cash crops) at the cost of declining shifting cultivation. Since there was minimal engagement with cash crops at the time of the study (and still continues to be minimal), both shifting cultivation and terraces were used for subsistence. Villagers emphasized the cultural aspects associated with shifting cultivation and its role in fostering community bonds through cooperative agriculture. Apart from the various direct benefits of shifting cultivation mentioned earlier, the ability to practise it without any cash expenditure was considered an important factor for its continued presence. Other researchers have also noted that shifting cultivation fields provide the 'safety net' of food security to the farming families, while providing opportunities to engage in more risky, cash-oriented crop production (Jamir, 2015).

Resilience of Shifting Cultivation Systems

The concept of resilience has been broadly used in different fields resulting in some amount of confusion over the actual meaning and process. However, with regard to social ecological systems, there is agreement on the idea that resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks (Walker, Holling, Carpenter, *et al*., 2004; Folke, Carpenter, Walker, *et al*. 2010). Folke, Carpenter, Walker, *et al*. (2010) further identify three primary aspects of resilience thinking—persistence, adaptability, and transformability—which allow the system to change and remain within a stability domain. Berkes, Colding, and Folke (2000) addressed ecological resilience in the context of traditional ecological knowledge (TEK) and adaptive management practices across the world that provide the capacity to recover after disturbance, absorb stress, internalize it, and transcend it. In this context, they identify shifting cultivation systems (*milpa, Jhum*) as one of the many traditional practices that demonstrate how to cope with dynamic change in complex systems. Such practices based on the principles of adaptive management are thought to further resilience and improve a group's chances for survival.

Ideas of resilience associated with social ecological systems can in fact be applied to shifting cultivation systems and understood in the context of how they have been resilient through adaptability and transformability. Often, factors that appear to be crises are seen as opportunities and many shifting cultivators have managed to adapt and change their practices to keep pace with changing external factors. The resilient nature of mountain communities across the world is well known and Jodha (2000) observed that mountain people have traditionally adapted their strategies to ensure protection and use of fragile and marginal resources and to secure their livelihoods. These strategies have a diversified and flexible resource use, resource recycling, use of common property resources, and various risk-sharing arrangements. He further states that such protective provisions and practices are likely to decline under the conditions created by globalization.

The erroneous notion that shifting cultivators are primitive, unchanging, and frozen in time is not true and has its origins in a convenient colonial justification designed to gain access to communal lands. Shifting cultivation is in fact one of the best demonstrations of innovation and adaptation as the steep tropical highlands with high rainfall could not have supported any other forms of agriculture as useful and productive as this. Berkes, Colding, and Folke (2000) refers to the effective use of fire, succession management, sequential harvesting system, multiple uses of tropical forests, and the use of tools and techniques that support an effective agroforest ecosystem. Farmers have continued to innovate with regard to agriculture as well as alternate livelihoods based on their skill sets and opportunities. The resilience of shifting cultivation systems has been documented in landscapes that were transformed by environmental and developmental forces. The work of Colfer (2008, 1997) on the Uma Jalan of east Kalimantan revealed that farmers continued to practise shifting cultivation during the growth of plantations and took advantage of positive developments such as medical facilities, education, family planning, and wage labour opportunities, while plantations and associated problems exerted a negative impact on their well-being. The alder-based soil improvement through nitrogen fixation used by shifting cultivators in Khonoma, Nagaland documented by Cairns (2007) is also an apt demonstration of the ability of farming communities to innovate and increase resilience.

Our work among the Adi people of Upper Siang brought forth instances of innovation and adaptability in response to recent social and economic changes. These diverse responses appeared to provide a resilience similar in nature to what has been described above. The most prominent observation was related to the ‘dual strategy’ of agricultural transformation in which terraces were adopted by more than 90% of households while they continued to practise shifting cultivation. There are financial and physical limitations on the growth of terraces in the landscape, and some of which were overcome over time through assistance provided by the Agriculture and Water Resources departments. However, in spite of the lack of support for shifting cultivation from government agencies, the majority of households did not abandon it. This allows them to maximize benefits from both forms of agriculture, while tailoring it to their requirements. Shifting cultivation has remained central to the social, cultural, and economic life of the village while terraces have been used exclusively for growing subsistence rice. Simultaneously, we also observed a reluctance to engage with many cash crops that were being pushed by the Agriculture and Horticulture departments (*e.g.*, fruits and hybrid vegetables). This was easily explained by the lack of easy access to markets and the problems with transportation. Instead, most households chose to selectively grow ginger and *bhut jolokia* or *mithun marcha*, both of which are also consumed in the village. This ensures that it is not grown purely for the market and can also be consumed within the village, minimizing the risk associated with it and making it another ‘dual strategy’. In fact, the only two crops that are largely cultivated for commercial sale, albeit at a much smaller scale compared to the conventional cash crop monocultures, are cardamom and *P. polyphylla*, which have been taken up only in the last 5 years, when roads and communication networks have improved.

The Adi community in the study village also has a long history of maintaining high agrobiodiversity and experimenting with newer varieties and evaluating them based on current requirements and limitations. This adaptability has provided a great deal of flexibility and increased their resilience by helping them maintain food security. The preservation of tried and tested varieties of rice along with the inclusion of more useful varieties provides a glimpse into the dynamic nature of the maintenance of crop diversity. This practice is not limited to shifting cultivation varieties, but also extends to the rice varieties used for terraces. In the initial days of terrace cultivation, a few varieties were provided by the Agricultural Department as part of their aggressive push to popularize this form of cultivation. One of these varieties was the well-known IR8, the so-called 'miracle rice' (Rowlatt, 2016). This was locally known as *Ayer* and while this had proven quite successful in parts of East and West Siang, it did not find favour with people in Bomdo. People reported that the reason for abandoning it was that it was not very hardy and collapsed to the ground whenever there were strong winds. Once it was down, rodents could easily feed on it. Another variety was brought from the adjoining village Ramsing and is still cultivated. Yet another variety was brought from the northern village Panggo by an individual named Nalek. One of the more successful varieties was brought to the village by a lady named Ommen. Owing to its success, it was named after her as *Ommen Ammo* and is still being cultivated.

Farmers are also able to gauge the soil and decide on the variety because not all soils are suitable for all varieties. Our previous work shows that the Adi recognized nine varieties of soil and preferred specific varieties for shifting cultivation, terrace cultivation, and bamboo and palm plantations (Teegalapalli, Mailappa, Lyngdoh, *et al*., 2018). They also undertake active interventions to prevent soil erosion and ensure fertility retention. Communities have been continually experimenting with varieties of rice that would suit the soils and micro-climatic conditions in each village (Choudhury, Khan, and Dayanandan, 2013). Such details and specificity are not part of centralized agriculture programmes such as the one applied to most of northeast India that tried to homogenize rice varieties across the region. Regardless, the Adi of Upper Siang have continued their innovation and experimentation to constantly seek the best varieties that may serve their purposes. Even with respect to shifting cultivation, they were able to adopt new varieties that allowed them to cultivate lands in the adjoining villages.

Finally, labour networks and reciprocity, which are characteristics of the cooperative farming of shifting cultivation (unlike private cultivation), are crucial to increasing resilience (Downey, 2010). This resilience is demonstrated in the face of how effectively the commons (fallows and other forest areas) are maintained and how demographic shocks in the form of increasing/decreasing population of the village can be effectively faced.

Many of these characteristics have proven critical during the recent COVID-19 lockdown and restrictions on the market networks that prevented the free flow of commodities across the country. While most parts of the country were struggling to access essential food supplies, our phone interviews with the Adi people suggested that remote villages like Bomdo were self-sufficient. This increased resilience to disasters was possible only through the adaptive management practices associated with shifting cultivation.

Conclusion

In recent times, there have been relatively more studies appreciating shifting cultivation, while there are some studies that continue to reprimand the practice (e.g., Borah, Evans, and Edwards, 2018; Nath, Sahoo, Giri, *et al*., 2020). Even among the studies that appreciate its nuances and the cultural aspects of the farming communities, our study is on the extreme end of this spectrum due to at least three factors.

Firstly, the practice that we documented is being undertaken in a landscape that features relatively large swathes of forests. The Bomdo village is nested within the Dihang-Dibang Biosphere Reserve (area 5112 km^2) and is about 10 km beeline distance from the Mouling National Park (area 483 km^2). Mature forests are rarely cleared for shifting cultivation owing to the labour involved and also since there is no dearth of secondary forests in the landscape (regenerating sites around the village range from 2 to 25 years old (Teegalapalli and Datta, 2016b)). The Adi in Bomdo village usually clear regenerating fallows that are around 10 years old since these are feasible in terms of labour and suitable in terms of soil fertility (Teegalapalli, Mailappa, Lyngdoh, *et al*., 2018). Further, forests that are conserved in the landscape because they either lie in the water catchment area or are preserved for hunting and trapping of birds and animals are also extant in the landscape. Therefore, in our study landscape, shifting cultivation does not cause deforestation at the scales claimed by studies from other sites. Secondly, the human population density in the Upper Siang district is relatively low (~ 5 per km^2) and the overall population of the Bomdo village according to the 2011 census was 444 people, which suggests that the population density is significantly lower than 5 per km^2. According to the Inter-Ministerial Task Force (2008), shifting cultivation is viable only in sites with a population density of less than 20 per km^2. Chidumayo (1997), with a more conservative estimate, suggested that the practice leads to short fallows and deforestation when the population density reaches 3–4 per km^2. These values also point to the practicality of the practice in our study landscape. Finally and most importantly, the local institution, the Adi *kebang*, significantly influences the practice, ensuring that it is undertaken systematically and equitably.

FIGURE 6: Systematic nature of shifting cultivation management by the Kebang ensures that all households cultivate in the same area

Among these three factors that ensure that the practice remains sustainable, strengthening existing local institutions is the only factor that is practically replicable in other villages. The 'dual strategy' of maximizing benefits of both forms of cultivation, shifting and terrace cultivation, which we have discussed earlier, is also replicable in other villages with the assistance of relevant government institutions and agencies. While terrace cultivation ensures that the main cereal crop rice is grown productively, shifting cultivation continues to remain important for the sociocultural aspects of the community, while ensuring the availability of diverse food items that contribute to nutrition and food security in remote landscapes, where access to markets is not readily available. With over 30 species and 75 varieties of crops grown in shifting cultivation fields currently cultivated and harvested from fallows, it is clear that the practice contributes significantly to the food security of the community in Bomdo village. More recently, in the last decade, some crops have been grown in fields cleared for shifting cultivation for commercial sale such as ginger, cardamom, and *P. polyphylla*. Therefore, shifting cultivation fields also provide additional monetary benefits for the farming communities, although at relatively small scales.

Given these factors, government interventions of 'improving' the practice or introducing cash crop monocultures may not be very relevant to the landscape. Further, while they may be initially taken up enthusiastically by the communities and government institutions due to the cash flow involved, these interventions are likely to fail in the long run due to the lack of practicality for the landscape and for the communities. While the Adi community may already be on the path of transition from the practice owing to other factors such as changing aspirations and integration with the global marketplaces, this may not mean that the traditional practice is less effective and less relevant in the landscape. We identify with recent research that observes that state support provided to shifting cultivators in the northeast has been woefully inadequate and what is required is 'a location-specific, community-based development approach for establishment of an integrated livelihood system within the scope of sociocultural beliefs' (Paul, Das, Pharung, *et al.*, 2020).

Repeated attempts to eliminate shifting cultivation by the state and its continued persistence has already demonstrated that externally designed strategies that are not in consonance with the beliefs and practicalities of upland farmers will be rejected. We believe that the ultimate choice of whether to continue the traditional practice or to take up other forms of cultivation or livelihoods must rest with the communities and not forced by external agencies.

References

Bandy, D. E., D. P. Garrity, and Sanchez, P. A. 1993. The worldwide problem of slash-and-burn agriculture. *Agroforestry Today*, 5: 2–6

Berkes F, J. Colding, and C. Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications*, 10: 1251–1262

Borah, J. R., K. L. Evans, and D. P. Edwards. 2018. Quantifying carbon stocks in shifting cultivation landscapes under divergent management scenarios relevant to REDD+. *Ecological Applications*, 28(6): 1581–1593

Cairns, M. 2007. The alder managers: the cultural ecology of a village in Nagaland, N.E. India. PhD Thesis, Australian National University

Chidumayo, E. N., 1997. *Miombo ecology and Management: An Introduction*. Intermediate Technology Publications

Choudhury, B., M. L. Khan, and S. Dayanandan. 2013. Genetic structure and diversity of indigenous rice (*Oryza sativa*) varieties in the Eastern Himalayan region of Northeast India. *SpringerPlus*, 2: 1–10.

Colfer, C. J. P., Peluso, N.L., and Chin, S.C. 1997. *Beyond Slash and Burn: Building on Indigenous Management of Borneo's Tropical Rain Forests*. *Advances in Economic Botany (USA)*, Vol. 11, 247p. New York Botanical Garden.

Colfer, C. J. P. 2008. *The Longhouse of the Tarsier: Changing Landscapes, Gender and Well Being in Borneo*. Borneo Research Council, Inc., Maine, USA

Conklin, H. C. 1961. The study of shifting cultivation. *Current Anthropology*, 2: 27–61

Cramb, R. 1993. Shifting cultivation and sustainable agriculture in East Malaysia: a longitudinal case study. *Agricultural Systems*, 42: 209–226

Datta-Roy, A, V. Ramachandran, and K. Teegalapalli. 2018. An annotated checklist of the birds of the upper Siang region, Arunachal Pradesh, India. *Journal of Threatened Taxa*, 10: 11636–11651

Deka, H. 2008. India's Northeast: A Historical Perspective. *Ishani*, 2

National Remote Sensing Centre. 2019. Wastelands Atlas of India: Change Analysis Based on Temporal Satellite Data of 2008-09 and 2015-16, p. 243. Ministry of Rural Development and Indian Space Research Organisation, New Delhi

Dikshit, K. N. and M. Hazarika. 2012. The Neolithic cultures of northeast India and adjoining regions: a comparative study. *Journal of Indian Ocean Archaeology*, 7: 98–148

Downey, S. S. 2010. Can properties of labor-exchange networks explain the resilience of swidden agriculture? *Ecology and Society*, 15(4)

Erni, C. (Ed.). 2015. Shifting Cultivation, Livelihood and Food Security: New and Old Challenges for Indigenous Peoples in Asia, pp. 3–37. Food and Agriculture Organization of the United Nations, International Work Group For Indigenous Affairs, and Asia Indigenous Peoples Pact

FAO. 1996. Monitoring Progress Since the World Food Summit. World Food Summit, November 13–17, 1996. Rome: FAO. Details available at http://www.fao.org/wfs/index_en.htm

Folke, C., S. R. Carpenter, B. Walker, M. Scheffer, T. Chapin, and J. Rockström. 2010. Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and Society*, 15(4)

Fox, J., D. M. Truong, A. T. Rambo, N. P. Tuyen, L. T. Cuc, and A. S. Leisz. 2000. Shifting cultivation: a new old paradigm for managing tropical forests. *BioScience*, 50: 521.

Gogoi, D. 2020. *Making of India's Northeast: Geopolitics of Borderland and Transnational Interactions*. Routledge India

Guha, R. 1983. Forestry in British and post-British India: a historical analysis. *Economic and Political Weekly*, 18: 1882–1896

Hazarika, M. 2006. Neolithic culture of northeast India: a recent perspective on the origins of pottery and agriculture. *Ancient Asia*, 1: 25–44

Heinimann, A., O. Mertz, S. Frolking, A. E. Christensen, K. Hurni, F. Sedano, L. P. Chini, R. Sahajpal, M. Hansen, and G. Hurtt. 2017. A global view of shifting cultivation: recent, current, and future extent. *PLoS One*, 12: e0184479

Ickowitz, A. 2006. Shifting cultivation and deforestation in tropical Africa: critical reflections. *Development and Change*, 37(3): 599–626

Inter-Ministerial Task Force. 2008. Inter-Ministerial National Task Force on Rehabilitation of Shifting Cultivation Areas. Inter-Ministerial Task Force, Ministry of Environment and Forests, Government of India, New Delhi

Jamir, A. 2015. Shifting options: a case study of shifting cultivation in Mokokchung district in Nagaland, India. In *Shifting Cultivation, Livelihood and Food Security: New and Old Challenges for Indigenous Peoples in Asia*, edited by C. Erni, pp. 159–202. Food and Agriculture Organization of the United Nations, International Work Group for Indigenous Affairs, and Asia Indigenous Peoples Pact

Jodha, N. S. 2000. Globalization and fragile mountain environments. *Mountain Research and Development*, 20: 296–299

Kilawe, C. J., O. Mertz, D. S. A. Silayo, T. Birch-Thomsen, S. M. Maliondo. 2018. Transformation of shifting cultivation: extent, driving forces and impacts on livelihoods in Tanzania. *Applied Geography*, 94: 84–94

Kosaka, Y., B. Saikia, C. K. Rai, K. Hage, H. Asada, T. Hui, T. Riba, K. Ando. 2015. On the introduction of paddy rice cultivation by swiddeners in Arunachal. *Tropics*, 24: 75–90

Kotto-Same, J., P. L. Woomer, M. Appolinaire, et al. 1997. Carbon dynamics in slash-and-burn agriculture and land use alternatives of the humid forest zone in Cameroon. *Agriculture, Ecosystems & Environment*, 809: 245–256

Maithani, B. P. 2005. *Shifting Cultivation in North-East India: Policy, Issues and Options*. New Delhi: Mittal Publications

Nath, A. J., U. K. Sahoo, K. Giri, G. W. Sileshi, and A. K. Das. 2020. Incentivizing hill farmers for promoting agroforestry as an alternative to shifting cultivation in northeast India. In

Agroforestry for Degraded Landscapes, edited by J. C. Dagar, S. R. Gupta, and D. Teketay. Singapore: Springer

O'Brien, W. E. 2002. The nature of shifting cultivation: stories of harmony, degradation, and redemption. *Human Ecology*, 30: 483–502

Padoch, C., E. Harwell, and A. Susanto. 1998. Swidden, sawah, and in-between: agricultural transformation in Borneo. *Human Ecology*, 26: 3–20

Pant, R., B. Tiwari, and D. Choudhury. 2018. Shifting Cultivation: Towards a Transformational Approach, p. 30. Report of Working Group III. NITI Aayog, New Delhi

Pasha, S. V., M. D. Behera, S. K. Mahawar, S. K. Barik, and S. R. Joshi. 2020. Assessment of shifting cultivation fallows in northeastern India using Landsat imageries. *Tropical Ecology*, 61: 65–75

Paul, S., T. K. Das, R. Pharung, S. Ray, N. Mridha, N. Kalita, V. Ralte, S. Borthakur, R. R. Burman, and A. K. Tripathi. 2020. Development of an indicator based composite measure to assess livelihood sustainability of shifting cultivation dependent ethnic minorities in the disadvantageous northeastern region of India. *Ecological Indicators*, 110: 105934

Ramakrishnan, P. S. 1992. Shifting Agriculture and Sustainable Development: An Interdisciplinary Study from North-eastern India. MAB Series, Vol. 10. Paris: UNESCO

Spencer, J. E. 1966. Shifting Cultivation in Southeastern Asia (Vol. 19). University of California Press

Taba, R., A. T. Kimsing, T. Biju, J. Ngukir, T. Tamir, H. Tag, T. Payum, and D. Mize. 2015. Fodder plants of Mithun Bos Frontalis: a case study of West Siang, Arunachal Pradesh. *Journal of Bioresources*, 2: 74–78

Rowlatt, J. 2016. IR8: the miracle rice which saved millions of lives. BBC News. Details available from https://www.bbc.com/news/world-asia-india-38156350, last accessed on June 3, 2018

Sanchez, P. A., C. A. Palm, S. A. Vosti, T. Tomich, and J. Kasyoki. 2005. Alternatives to slash and burn. challenges and approaches of an international consortium. In *Slash-and-Burn Agriculture: The Search for Alternatives*, edited by C. A. Palm, S. A. Vosti, P. A. Sanchez, and P. J. Ericksen, pp. 3–37. New York: Columbia University Press

Saravanan, R. 2010. Traditional Knowledge , Innovation Systems and Democracy for Sustainable Agriculture: A Case Study on Adi Tribes of Eastern Himalayas of North -East India. Proceedings of the International Symposium on Innovation and Sustainable Development in Agriculture and Food. Montpellier, France, pp. 1–10

Swe, K. N. and E. Nawata. 2020. Changing practices from swidden to permanent agriculture in traditional swidden cultivation areas – case studies in three Karen villages of the Bago Mountains, Myanmar. *Tropical Agriculture and Development*, 64: 80–89

Teegalapalli, K. and A. Datta. 2016a. Shifting to settled cultivation: changing practices among the Adis in Central Arunachal Pradesh, north-east India. *Ambio*, 45: 602–612

Teegalapalli, K. and A. Datta. 2016b. Field to a forest: patterns of forest recovery following shifting cultivation in the Eastern Himalaya. *Forest Ecology and Management,* 364: 173–182

Teegalapalli, K. and A. Datta. 2017. Top-down or bottom-up: the role of government and local institutions in regulating shifting cultivation in the Upper Siang district, Eastern Himalaya, India. *Shifting cultivation policies: balancing environmental and social sustainability*, edited by M. Cairns. Routledge, UK

Teegalapalli, K., A. S. Mailappa, N. Lyngdoh, and D. Lawrence. 2018. Recovery of soil macronutrients following shifting cultivation and ethnopedology of the Adi community in the Eastern Himalaya. *Soil Use and Management*, 34: 249–257

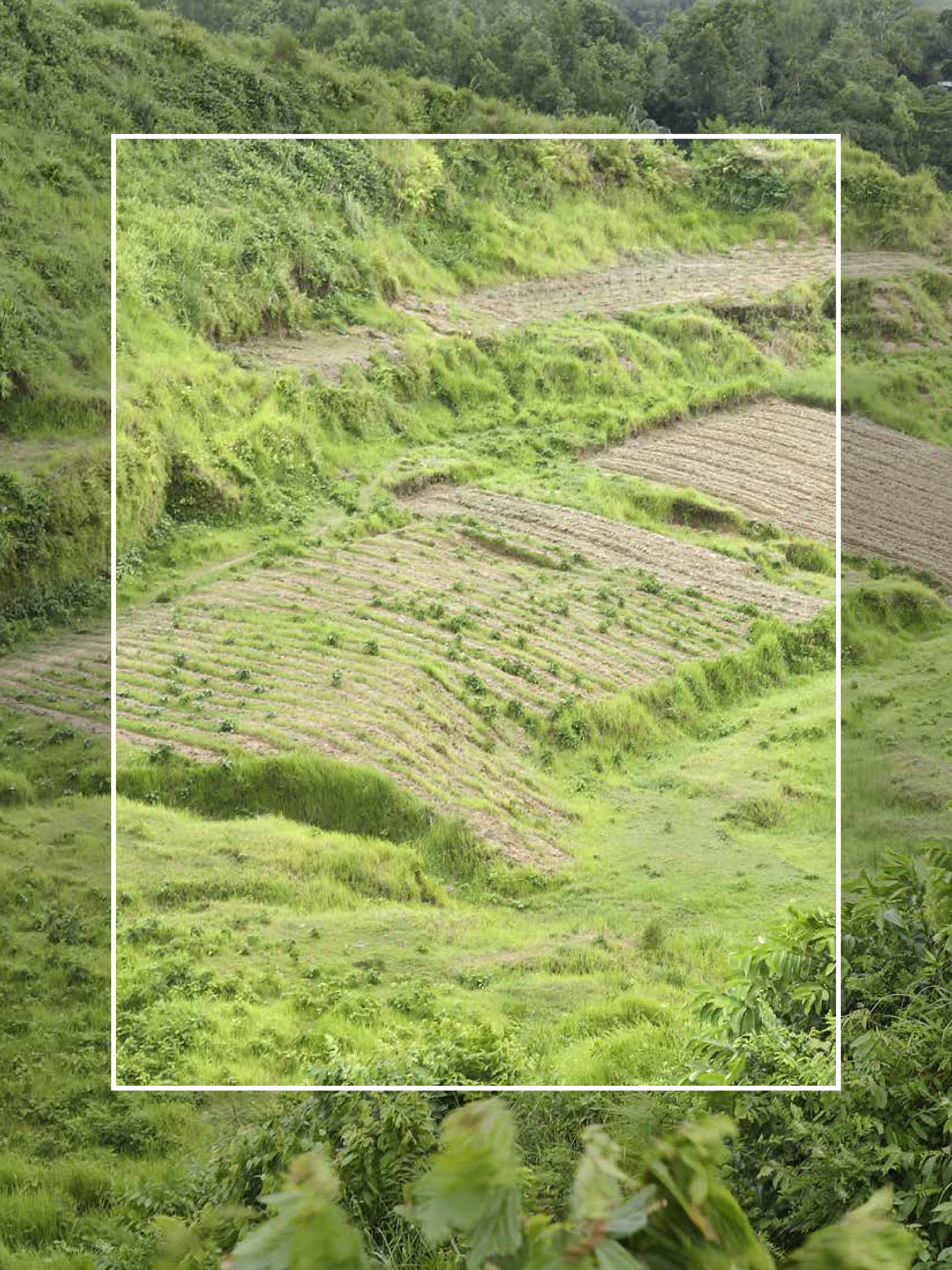
Thong, P., U. K. Sahoo, R. Pebam, and U. Thangjam. 2019. Spatial and temporal dynamics of shifting cultivation in Manipur, Northeast India based on time-series satellite data. *Remote Sensing Applications: Society and Environment*, 14: 126–137

Thongmanivong, S. and Y. Fujita. 2006. Recent land use and livelihood transitions in northern Laos. *Mountain Research and Development*, 26: 237–244

Walker, B., C. S. Holling, S. R. Carpenter, and A. Kinzig. 2004. Resilience, adaptability and transformability in social – ecological systems. *Ecology and Society*, 9: 5

Wasteland Atlas. 2019. Wastelands atlas of India. Prepared by National Remote Sensing Centre, Department of Land Resources, Ministry of Rural Development, India

Yumnam, J. Y., S. I. Bhuyan, M. L. Khan, O. P. Tripathi. 2011. Agro-diversity of East Siang-Arunachal Pradesh, Eastern Himalaya. *Asian Journal of Agricultural Sciences*, 3: 317–326



CHAPTER-08
INDIGENOUS FARMING REVIVAL BY WOMEN IN NAGALAND

Kankana Trivedi*

Abstract

The traditional farming system of Nagaland has been ensuring food security to the tribal communities since centuries, even in times of changing weather conditions. The practice of using multiple farmlands, namely, shifting cultivation, wet terrace rice cultivation, and kitchen gardens, has millet at its core and is understood as the millet-based biodiverse food system of the place. The traditional system of farming has been part of the cultural landscape, integrating the ecology, economics, and culture to address the development and conservation issues such as forest management and resource utilization. Shifting cultivation—on the biodiversity dimension—has been a favourable option as it promotes multi-cropping unlike the villages in Nagaland, which opt for single cropping practice that is always accompanied by the risk of crop failure. Community farming—on individual and common lands—is labour and resource efficient. However, most families who were once practising this farming system have slowly started to discontinue, principally attributable either to their shift towards cash crop farming or for better prospects of livelihood. Gradually even the practice has been changing over time, diluting the social relations and being more destructive to the environment. This shift was supported by the government in the consideration of shifting cultivation to be environmentally destructive. North East Network (NEN) is an organization that has been working with the women farmers in Phek district in Nagaland to revive this system, thereby increasing the resilience of the farmers against climate change, food insecurity, malnourishment, market instability, and loss of biodiversity.

The chapter is an attempt to understand the agroecological practice in the villages of Chizami and Sümi in Nagaland by the environmental action research group Kalpavriksh by conducting a week-long field visit in March 2019.

* Member of Kalpavriksh, Email: kankana.india01@gmail.com

It was investigated that millets have been part of the staple diet and environmentally suitable crops; however, gradually they were getting lost due to reasons such as taste, laborious harvesting method, and less market value. With NEN's intervention, the revival of millets and shifting cultivation (which was earlier seen as an environmentally degrading activity) secured the traditional knowledge of farming and consumption of food. The shift towards the traditional farming system was supported by the local governance body called the village council (VC). The elders of the community also came forward to help and manage the communal land for shifting cultivation. Women farmers created seed banks to conserve and circulate the indigenous varieties of seeds. These exchanges of seeds and produce along with access to community farming ensured everyone including widowed women and others with limited resources had food security. The development of formal institutions such as Chizami Women's Society proved beneficial in connecting the women farmers to the market, even empowering them politically to be a part of the village council, thus significantly contributing to the decision-making processes. This process of transformation within the community has also been ensuring that the traditional knowledge is passed on to the younger generation through various programmes and festivals. With continuous efforts and intervention, this might control the trend of prima facie outmigration of the community members for livelihood. Around 150 households have revived the traditional farming system in both the villages so far (till 2020) with NEN's continuous interventions, attempting to generate sustainable livelihoods. In villages practising shifting cultivation, the report finds that the village economy is doing relatively better and most importantly carries a sense of dignity towards agriculture. It is important to note that this tradition is practised throughout Nagaland; however, each region has unique variations based on its landscape.

The state of Nagaland, in northeast India, has an agrarian economy where 70% of the population of 16 major tribes depends on agriculture for their livelihood. Farming in Nagaland is not only a livelihood but also an integral part of the lives of the Naga communities. The region is mountainous with dependence on farming as well as forest resources such as bamboo, timber, and fisheries for sustenance. Historically, it was a biodiverse farming system consisting of shifting cultivation, Wet Terrace Rice Cultivation (WTRC), and kitchen gardens. These three practices collectively have ensured food security even in times of adverse weather situations. With millets at the centre of the crop production, shifting cultivation, locally known as *Jhum* (meaning collective work) cultivation, constituted as much as 76% of the cropped area of the state as per a United Nations Development Programme's (UNDP) report (Bhaduri 2015). It is also the most important repository of millet cultivation with more than 50–60 varieties of millets, pulses, oilseeds, vegetables, and so on being cultivated (Lulla, Trivedi, & Wani 2019). Although the methods and customs vary from tribe to tribe and geographical location, every community has certain protocols making *Jhum* one of the most ecologically and culturally sustainable forms of agriculture in the region.

Jhum cultivation has been criticized heavily for its ecological and economic impacts by the policymakers and scientists even though it is an extensive and critical part of the larger biodiverse agricultural system in the region linking food sovereignty, ecological sustainability, and culture together. The *Jhum* in Nagaland is based on traditional indigenous knowledge and stewardship of the environment in many areas it is through the establishment of community conserved areas (CCAs) and is a community/family-run process.

However, with the changing livelihood aspirations of local community, labour-intensive process of millet production, reduction of collective farming, government policy support for commercial farming, and many interrelated socio-economic and technological reasons, including changing climate patterns exacerbating these trends, there has been a decline in *Jhum* cultivation in the Naga region including Phek district. During 2000–2010, there had been a change in the extent of shifting cultivation from 5224.65 to 2827.74 km^2, indicating –45.8% decadal change, whereas the change in the area under shifting cultivation between 2003 and 2005–06 shows a shift from 1917.90 to 2827.74 km^2 (NITI Aayog 2018). It is observed that sometimes scrubland turns into *Jhum* land, and often there is a shifting from abandoned to current *Jhum* land and other such scenarios, making the area under shifting cultivation dynamic in nature. The figures are dwindling with each year and every region; for instance, in 2017 *Jhum* in Khezhakeno village in Phek had reduced and it had increased in Nokta Konyak village in Mon district. Whether it was sustainably farmed or not was not covered in the *Report on the Round Table on Sustainable Management of Jhum in North East India,* 2017 (Anonymous 2017). Many families entirely had left *Jhum* farming and in cases where men moved away, there was an increase in the workload of farm activities on women that was earlier shared by all. This resulted in increased workload on community women.

This chapter discusses the millet revival initiative for sustainable development and women empowerment by a civil society organization, NEN, within the premise of shifting cultivation in Phek district of Nagaland.

Phek is located in the southeastern part of Nagaland, within the Indo–Burma and Himalayan biodiversity hotspots in India. The hilly region comprises evergreen vegetation, whereas the lower region comprises deciduous forests (Singh, Lairenjam, Bharali, *et al*., 2009). The district is home to Chakhesang and Pochury tribal communities, where 91% of the total population relies upon agriculture as their mainstay livelihood (Jamir 2011).

It is important to note that while shifting cultivation is a standard practice, communities also practise other forms of cultivation. For instance, Zabo, an indigenous method of settled cultivation, based on integrated watershed system is practised in the Kikruma area of the district. WTRC is practised in the foothills and terraces with low slopes and this is based on the terrain and water availability. The Chakhesang farmers in Sümi and Chizami villages are known for terrace cultivation also, including *Jhum* farming that is largely prominent across the district and the state. In Phek, *Jhum* forms 55% of the cultivated land, followed by terrace fields that constitute 41% (Nagaland Phek Village Profile, 2001).

Methodology

The team at Kalpavriksh, based on the secondary literature review and prior knowledge about the NEN's work in Nagaland, considered it as a case study. The researchers with the help of a semi-structured questionnaire carried out focused group discussions and interviews with the women farmers, village council members, village elders, youth, NEN team, and a senior official, Mr Nakro Vengota, from Nagaland Empowerment of People through Economic Development (NEPED).

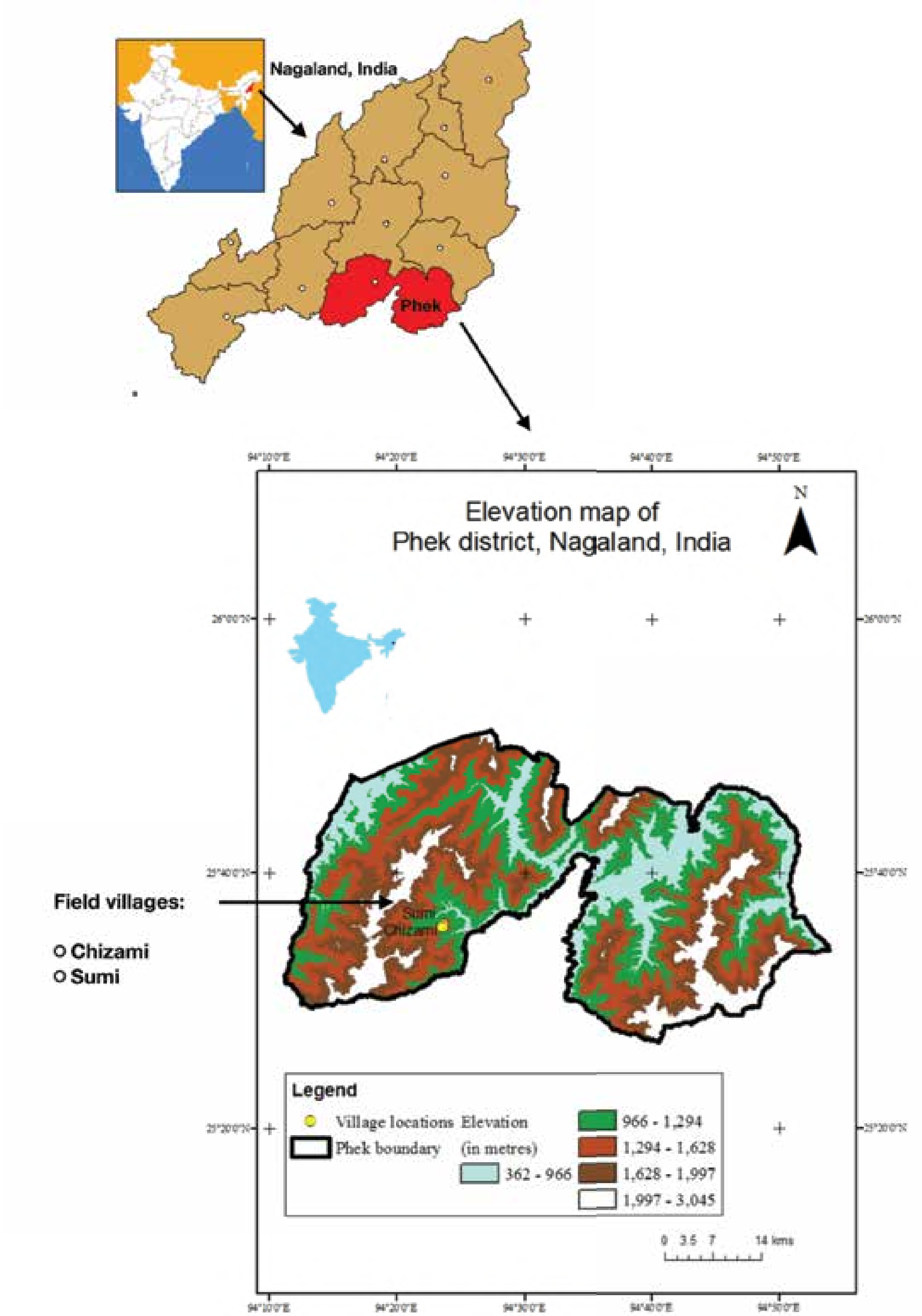


FIGURE 1: Location & Elevation map of Phek District, Nagaland*

Map credit: Manisha Kumari

Analytical framework: Prior to the field visits, the questionnaires were prepared using Alternative Transformation Framework and four-dimensional change framework. These frameworks were useful to understand whether the millet-based biodiverse farming revival was impacting across cross-cutting community issues along the five spheres (i.e., economic, political, social, cultural, and ecological) (detailed out in the 'results' section).

Limitation: Keeping the time and resource constraints, the team could visit only two villages for a period of one week with the primary focus on documenting NEN's work on revival of the traditional agroecological practice. The study could not gather data on the aspect of economic changes and changes in the land use pattern (using GIS mapping, etc.) due to the paucity of time. Language translation was largely arranged, but the local nuances could not be truly captured.

The study was conducted in two villages (i.e., Chizami and Sümi), where NEN has been working with the women farmers to revive the millet-based traditional biodiverse farming system since 2004:

1. Chizami village in Phek district includes 586 households (approximately 2500 individuals), mainly from the Chakhesang tribe that speak the *Kheza* dialect. More than 80% of the population is into agriculture. Chizami is the first village to induct women members in the village council and in the Village Development Board (VDB) (Krocha 2021).
2. Sümi is a neighbouring farming village to Chizami with a total of 112–160 Chakhesang families residing (approximately 508 individuals) and they speak the *Sümi* dialect. The village mostly relies on *Jhum* farming and has lesser terrace fields as compared to Chizami.

Paddy is grown in WTRC, millets and other crops on *Jhum* farms, kitchen gardens are a part of the household where some fruits or daily use crops, medicinal plants, and livestock fodder are grown. These three systems have been co-dependently used for food security based on the terrain of the area. For instance, Sümi has terrace fields located near the river and during heavy monsoon the water channels break leaving the fields flooded, while *Jhum* fields are still intact, securing food supply in the village.

PHOTO 1: Kitchen Garden, Sümi

Photo credit: Arpita Lulla

In Phek district, much of the land is under several clans living in the region and the rest is possessed by individuals and common village land. These *Jhum* farms are not notified as 'forest' but as agricultural land. However, in many parts of Nagaland, including Phek, *Jhum* fields, which are left fallow, are categorized as 'wastelands' by the revenue or forest department.

Under the legal framework of the *Jhum* Land Regulation Act, 1970, the ownership is governed by the customary laws of the community. In terms of landownership for overall farming, the majority of natural habitats (88.3%) (Edake, Sethi, & Lele, 2019) in Nagaland are owned and managed by the clans that live there, and it is further monitored by the VCs and other traditional institutions. A village council is a group of democratically elected representatives from each clan and runs parallel to the role of a ceremonial head of the village called 'Gaon Bura', generally a respected elder of the community. There are also Village Development Board, Women Society, Youth Society, and Student Council for specific subject matters. Along with this, there is a separate tribal body the Chakhesang People Organization (CPO) that specifically deals with issues and disputes within the Chakhesang tribe and has members from 65 villages as representatives. The CPO has banned hunting. To reduce environmental impact, it levies a fine on those who set forest fires. Chakhesang Youth Front (CYF) is the implementing body and it governs this ban (Lulla, Trivedi, and Wani, 2019).

Significance of *Jhum* and Millets for Phek

Jhum is regenerative rainfed farming with no chemical use for its production. Seed conservation (*in situ* and *ex situ*) and seed exchange system is a traditional practice. This method keeps the local genetic diversity alive with almost zero dependence on the market for seeds and enhances the resilience of farmers. The Community Seed Banks (CSBs) are also the traditional seed knowledge base for plant management, seed selection, treatment, storage, multiplication, and distribution (Lulla, Trivedi, and Wani, 2019).

Valued Crop of the System

Millets are the primary crop on *Jhum* farms in Nagaland (refer to Table 1) and play a central role in the agrarian system of Phek. Commonly grown millets in Nagaland are foxtail and great millet (sorghum). Foxtail millets are referred to as *Tekhu-tshu*, meaning 'crop of the needy', in the Kheza-Chakhesang dialect. There are as many as 10 varieties of foxtail millets grown in the state.

The NEN and Deccan Development Society conducted a workshop in 2009 in various farming clusters of Phek as part of the larger project named the Community Charter on Climate Change. The Charter mapped out the climatic changes experienced by the community and mapped the environmental history (NEN started its work on millet revival with women farmers in the region following this event).

When discussed with the community members and village councils on possible solutions to combat the climate change issues, the elders proclaimed millets as a crop that can sustain and emphasized the value of millets for food and fodder security, health security, livelihood security, and ecological security. Women elders in Sümi village described the health benefits of a millet-based diet such as controlling diabetes, joint aches, and building stronger bones since women today complain of these symptoms when the millet consumption is reduced (Lulla, Trivedi, and Wani, 2019).

Millets have worldwide importance and recognition. The year 2023 will be celebrated as the International Year of Millets following India's proposal to the Food and Agriculture Organization. With traditional practices and scientific observations, it is proven that millets are the 'super crop'.

Table 1: Reasons for millet's recognition as a 'super crop'

High nutritional value	Millets are rich in protein, essential fatty acids, dietary fibre, B vitamins, and minerals such as calcium, iron, zinc, potassium, and magnesium (Rao, Bhaskarachary, Christina, *et al.*, 2017). They are gluten free and also rich in health-promoting phytochemicals
Low modern external agricultural inputs	Millets are a rainfed crop providing a solution to water scarcity. They do not require any chemical fertilizer and also can grow on soil with low fertility Millets have higher productivity and faster growing period as compared to wheat and rice
Climate change resilient	Millets can withstand increases in temperatures up to 2–5°C and increasing water stress. They are also known as survival crops that could sustain during a drought
Longer shelf life	Millets can be stored for several years. In Chizami, some species of millet, for example, foxtail millet, can be cultivated even after 20–30 years of storage
Part of multi-cropping, genetic diversity	Millets are part of the multi, mixed, and intercropping as they provide insurance against monsoonal failure and pest attacks and ensure plant genetic diversity
Dual purpose of millets	Being an indigenous crop, millet is used as both food and fodder for cattle. The crop residue is fed to pigs, goats, etc.
Integral part of community diet	Millets as part of the traditional dietary system ensures community bonding, indigenous farming practice, and environmental sustainability

According to a report, analysis of long-term climatic trend data shows that the annual mean maximum temperature of Nagaland is rising at the rate of 0.11°C/decade. The precipitation trend shows an increase in rainfall although the number of drought years has also gone up (Suvigya Management Consultants Private Limited 2017). There are instances where millet has proved to be a climate-resilient crop. The experience shared by a village member can help facilitate understanding:

Hailstorms destroyed the crops, while paddy fields were washed by rain in the subsequent year. In both these circumstances, supplies of previously preserved millets along with some cultivated millets that had survived the shocks helped sustain the village. Nagaland witnessed scanty rainfall in 2009 but millet harvest production was unaffected despite a decrease in water. (Lulla, Trivedi, and Wani, 2019)

Multi-cropping and Biodiversity Conservation for Food Security

Table 2: Crop details of the three agricultural systems in Phek indicative of the extensive diversity of crops uncommon in other farming practices

Crop Details	*Jhum* Area	WTRC	Kitchen Garden
Primary crops	Millets, rice, maize	Rice	Maize, pumpkin, chilly, beans, and yams
Varieties grown	Millets – foxtail (*Etshube*) – sticky and non-sticky, sorghum, and proso millets	Rice – *Menabe* (local gum rice), *Tenibe* (scented rice), *Kehabe* (red rice), and above 20 types of *Kekrube* (white rice)	Chow chow, king chilly, green chilly, cucumber, ladies finger, cabbage, mustard leaf, sweet potatoes, ginger, garlic, brinjal, bitter eggplant, rice bean, long beans, flat beans, winged beans, and colocasia

Contd..

Table 2: *Contd...*

Crop Details	*Jhum* Area	WTRC	Kitchen Garden
Other crops	Up to 57 varieties of edible crops (perilla, beans, potatoes, tomatoes, ladies finger, soya beans, pulses, naga dal, long beans leaves, yardlong beans, rice bean, short beans, winged beans, flat beans, pigeon pea, brinjal, cherry tomato, tree tomatoes, rosella, mint, basil, round cabbage, tree cabbage, cucumber, purple yam, pumpkin, sweet potatoes, bitter eggplant, sponge gourd, mustard leaf, chives, king chilli, *Allium hookeri*, green peas, bitter gourd, dolichos beans, passion fruit leaves, ginger, garlic, sawtooth coriander, taro leaves, chilli, amaranthus, tapioca, colocasia)	Maize, pumpkin, ladies finger, soya bean, chilli, bitter eggplant, brinjal, rice bean, winged beans, Japanese scallion	Grain crop/fruits – sugarcane, orange, pomello, passion fruit, banana, pear, pomegranate, plum, mango, guava, peach, lemon, papaya, etc.
Sowing month	March and April, August	May, June, July	–
Harvest month	From July up to December	September, October	–
Number of cropping per year	2 (rice bean and soybean are sown in August)	1	–

Source: Lulla, Trivedi, and Wani (2019)

One of the most important benefits of multi-cropping is security against crop failures. It also contributes to the conservation of seeds and crops that are native to the region and food diversity. In the case of monocropping, the idea is fuelled by economic prospects; many villages had opted for cash crops (promoted by the state horticulture department) and became 'orange village', 'potato village', and 'cabbage village' replacing millets and other crops. There was an instance where prices crashed due to excessive production of ginger, resulting in massive perished ginger wastage. These instances suggest that multi-cropping provides security against crop failures, market failure and dependence, nutritional imbalances, and soil infertility. Even during the fallow period of *Jhum*, the fallow land provides mushrooms, herbs, tubers, leafy vegetables, and so on to supplement household food requirements.

PHOTO 2: *Jhum* field in Chizami

Photo credit: Arpita Lulla

Participatory and Regulated Social System

The village council and Goan Buras collectively decide which plot of land to be used for *Jhum* farming and by which clan, calendar of events involved in *Jhum*, etc. The *Jhum* plots are community land and are commonly cultivated collectively by a clan, families, or village members. This unique ownership criterion helps with the equitable distribution of harvest as well as losses. Land-related issues, such as resource alienation, are hardly seen as, firstly, a plot of land for farming is given to the landless after a participatory decision-making process. Secondly, collective farming helps single women or widows who might require more hands for farming. These practices within a community have helped maintain economic hierarchies, which is why the community is still connected and has a symbiotic relationship with each other.

Seno Tsuhah from NEN shared that the local Naga tribal communities such as the Chakesang still felt a strong connection with the land. Nearly all their festivals, customs, and traditions revolve around *Jhum* cultivation such as Khutonye and Enonye being the harvest festivals, and Tukhanye is celebrated during the sowing season. Perhaps this is the reason why people are still holding on to it (Anonymous 2017). Also, the community follows animistic rituals, for example, worshipping storm god and nature, enabling the value of co-existence with nature, as shared by the Sümi village council.

Resilient Food Supply Chain

The district remains largely unaffected by the agricultural advancement after the green revolution, as, generally, farmers do not use chemicals on the *Jhum* land. Instead, the crops are rainfed and organic. The methods of enhancing soil fertility are mostly indigenous or alder tree plantation innovation by NEPED (explained below). Such a system of farming has been ensuring healthy diet of the community members, especially due to the consumption of highly nutritious millets.

The community follows farm to table food supply chain, wherein priority is given to self-sustenance and the additional produce is sold in local markets in villages.

Role of Women

Traditionally, in a typical Chakhesang household, women, elders, and the youth are responsible for land preparation for farming tasks such as weeding, seed dispersal, and harvest, whereas men plough and burn fields.

Jhum agriculture is women-driven, which is evident from their significant role in identifying viable seed stock to post-harvest work. With the gradual decline in *Jhum* cultivation over a few decades, women constitute nearly 70% of the agro sector workforce (Morung Express 2019). Despite this, women have been excluded from landholding, which impacts their decision-making in management and protection of the resources at the community level.

Reasons for the Decline of Millet-based Traditional Biodiverse System

» The government policies in the state and the country have been pushing for rice and wheat as staples. They have been promoting cash crops by free distribution of a high-yielding variety of seeds through various programmes and schemes such as Seed Production Programme (2007), Horticulture Mission for North East and the Himalayan States Programme (2005–06). Government officials teach people to shift to permanent WTRC, social forestry, and National Afforestation Programme 1976 for rubber and teak plantation on *Jhum* land, etc., while simultaneously overlooking at the traditional food system, for example, in the case of millets. Earlier, *Jhum* plots yielded more than 40 varieties of crops, but a gradual transition to rice cultivation and cash crops began wiping out the local food diversity.

Traditional Ecological Bye-laws for *Jhumming*

Jhumming (practice of *Jhum* cultivation) is based on ecological principles relevant for the geographical region and has been passed on from one generation to another. The following are some of the fire management, soil management, and multi-cropping principles without which the practice of sustainable Jhum could be in threat:

» The plot selected for *Jhum* always has forests retained on hill tops and ridges (un-encroached community land) as buffer zones. This helps in absorption of carbon produced. Also, water channels and gullies are retained and maintained within the Jhum area.

» During the clearing period, trees are not burnt to the ground, rather the fire is extinguished to leave 1–2 metres of trees above the ground and crops are planted around it. Bolstering it, the head of Chizami Village Council shared, "Mon village experienced warmer weather after they started burning the trees till the ground." According to a study, deforestation not only increases temperature in the tropics but pushes natural systems beyond critical thresholds, for example, rainfall reduces, which has a direct impact on agricultural productivity.

» Creating bunds to control the spread of fire.

» The Angami and the Chakhesang tribes construct boulder to check soil erosion. Additionally, experiments in agroforestry to decrease soil erosion and improve nitrogen content in soil were conducted by the now defunct, Nagaland Empowerment of People through Economic Development (NEPED) in 2005. NEPED introduced alder trees on the Jhum fields, which are now an integral part of the system. It was shared by Mr Vengota Nakro, NEPED, a dedicated agronomist,

"Alder-based systems have shown to improve crop harvest and reduce the ratio of cropping to fallow period. Today, every Jhum field has alder trees that provide nutrients and increase soil fertility."

Indigenous Knowledge System: Many More to Be Documented

» Customarily, in Nagaland, the knowledge and skill of lighting, managing, and controlling fire in *Jhum* land is passed down the generations in the community since time immemorial. At an early age, they are trained about the ways of dealing with the forest, learn how to manage fire and be aware of its implications, which includes assessing wind direction, understanding weather pattern, land topography, biomass, and local conditions. For instance, *Jhum* land is not burnt during windy and rainy days but before.

- According to farmers, it is vital to clear the land at an appropriate time so that fresh wild plants and shrubs, herbs and grasses, trees and leaf litters, etc. are exposed to dew and rain, which further act as in-situ repositories for crops and the wild plant germplasm.
- The arrival of insect Cicadidae signifies the nature's signal for planting paddy saplings in the wet terrace fields.
- This fire-fallow farming method helps fix potash in the soil, thereby increasing its fertility and availability of soil nutrients and activating quiescent soil microorganisms to accelerate the process of nutrient release to plants (NEPED 1999).

- The state government discourages *Jhum* cultivation because according to them it destroys forests and contributes to global warming. In this regard, multiple sanctions have been put in place, for instance, planting an equal number of trees in place of the trees burnt, CPO's ban on forest fires, and high fines for it in Phek.
- The village council also diverted its priorities towards village infrastructural development such as road construction, electricity connection, etc., reducing its attention to farming-related matters.
- Historically, *Jhum* cycles varied in 15–20 years, but it has reduced by 5–8 years in Chizami and 1–2 years in Sümi, due to multiple reasons such as changing demography, reluctance to travel to far off forests. This not only impacts soil fertility and forest regeneration but is also indicative of negative transformation and unsustainable *Jhum* practices. It is equally important to highlight that many community members also use the land unsustainably, for instance, hills in districts Mon, Tuensang are all cleared for *Jhumming*.
- A collective community farming practice has been declining; traditionally, slash and burn, harvest, and post-harvest tasks were distributed amongst men, women, and youth. However, with outmigration for better income and education, the tasks have befallen women. The impact of this trend is not only the burden of increased labour on women but a gap in the intergenerational transmission of traditional knowledge. Wekoweu Tsuhah from NEN shared:

"Earlier, 30–40 families used to cultivate together in 20–30 acres, which has reduced to 15–20 families cultivating in 4–5 acres."

- Tedious and labour-intensive process of de-husking millets and lack of weeding technology are the technological challenges that are leading to a decline in millet production in the region. The arrival of de-husking machines in rice mills are persuading farmers to switch to rice cultivation. This is also because now there are fewer hands to manually do these tasks.
- The district is experiencing erratic rainfall, hotter summers, pest infestation, uncertain seed germination, water scarcity, loss of aquatic life in paddy fields, changing farming cycle, etc.

due to climate variability. These changes aggravate the vulnerability of the rainfed farming. There are crop species such as black sesame, purple yam, a variety of sweet potato, and many more that are getting wiped out, partly due to the changing farming cycle and reduced consumption.

» Both heat and water stresses pose a challenge not only to the community cultivation but also their individual health, food security, and the ability to read nature's signs as part of farming. The farmers relied on many ecological signals to ensure the right time for each farming season until severe climatic events. For instance, a call of a particular bird during sowing and harvesting is not heard anymore.

» Typically, the community used to cut trees in September and burn the fields in the following February. But, now, it is cleared in January–February. This practice may impact the natural cycle and also affect soil fertility and nutrients. However, this change could be due to the changing weather pattern.

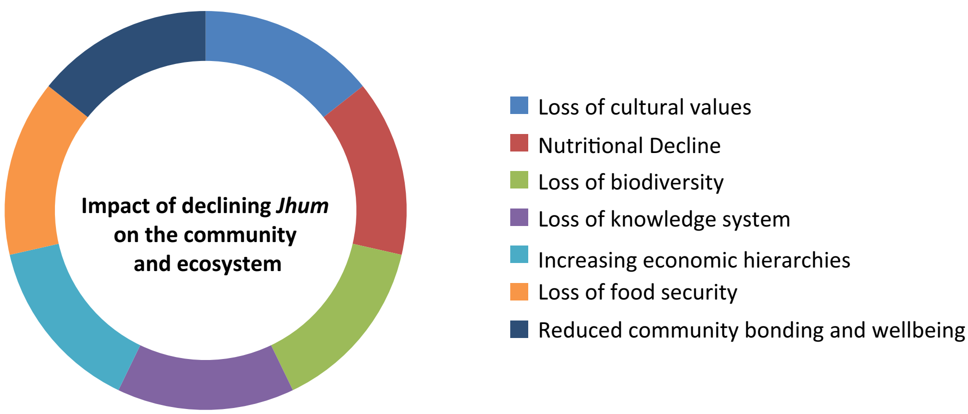


FIGURE 2: Graph showing the extent of Impact of declining *Jhum* on the community and ecosystem

NEN's Initiatives for Revival of the Millet-based Biodiverse Farming System

After having worked on women rights-based issues, NEN in 2004, began its activities in the field of traditional food and farming system, wherein a deeper relationship between women's health and their nutrition was observed in Nagaland, which needed attention. NEN conducted an in-depth study in five villages in Phek, Tuensang, and Kohima districts to find out the challenges and changes in the indigenous farming practice (and detailed value of millets in the region) and women empowerment. It was found that despite challenges, there is willingness and passion among the villagers to revive the crops. Within the compartment of the biodiverse farming system, NEN's initiatives were focused on millet revival.

In Sümi village, around 70% of the total families had left millet cultivation on *Jhum* lands entirely. Until 2019, about 50% of the families had restarted millet cultivation. There is now support from the village council that is rewarding farmers with the highest millet production with Rs 2000 cash prize.

In the case of Chizami, approximately 100 families (out of 600) had given up millet cultivation, and as of 2019, nearly 60% of those came back. Currently, 150 farmers (with an average one-acre plot) from 8 villages have come aboard to revive millet-based biodiverse farming.

Starting with six Chakhesang tribal villages, NEN has been able to reach over 8 Naga tribes and farming communities from across five other Indian states until 2019.

In farmer's testimonials, a farmer from the Millet Farmers Group stated that her yields increased after she joined the group. In 2019, the group harvested between 130 kg and 150 kg of seeds, which were distributed to the community.

Capacity Building	
Exchange learning	NEN has been organizing exposure visits for women farmers in Assam, Meghalaya, Nagaland, and Telangana. These exchanges have been useful to learn more about millets and their advantages.
Network for millet farmers	NEN has established a growing network, named as Millet Farmers Group, comprising 200 (and more to join) millet farmers from 11 villages in Phek as members to discuss new market avenues and farming knowledge and problems.
Financial assistance	NEN also provides small interest-free loans to millet farmers.

Cultural Revival	
Biodiversity festival	For the first time in three decades, NEN organized a biodiversity festival (Ethsünye: Etsu – Millet, Nye –Festival) in 2010 in six Chakhesang villages, which was celebrated traditionally.
Seed conservation	NEN advocates community seed conservation, for example, due to NEN's advocacy on the importance of millet varities, many women farmers like Dikhwetsou Wezah have documented over 83 varieties of seeds on Jhum farm and stored as many as 40 seed species and is known as the seed custodian. It has also set up a Millet Resource Centre in 2011 with the involvement of eight villages to help farmers with any millet/Jhum inquiries.
Attempts to increase millet consumption	There were narratives of people leaving millet consumption because of changing diets, tastes, preference for rice as millet is seen as food for 'poor'. To combat this, NEN developed a millet recipe book highlighting its nutritive qualities to explore the taste of millets and encourage millet consumption. The book not only included recipes of traditional dishes but also of cakes, cookies, sweets, etc.

PHOTO 3: Dikhwetsou Wezah with her collection of seeds and dried vegetables and meat

Photo credit: Arpita Lulla

Youth Development	
Summer farm	NEN has been organizing a week-long residential summer farm school annually since 2016, involving youth in it to learn about sustainable farming traditions. This learning programme comprises lectures, nature walks, field visits, and interactions with community knowledge holders.
Participatory video project	NEN in collaboration with North East Slow Food and Agro-biodiversity Society (NESFAS) and Insightshare, Oxford provided visual film training to the interested community youth so that they create participatory films and documentaries on their community. The films showed their local culture, agriculture, livelihood, and other related aspects.
Community mobilization	These films and other farming-related films are screened on various community platforms to create awareness, consciousness on millet revival, and encourage kids to take up millet farming.

Dialogues with Government	
Marketing and millets for public distribution	To provide millets for mass population in Nagaland, NEN has been in consultation with the Indian Council for Agricultural Research – Krishi Vigyan Kendras (ICAR - KVKs) and agricultural directorate of the state to include millets in the Public Distribution System (PDS) and mid-day meals (MDM) schemes for governmental schools/anganwadi.
State land for Jhum farming	NEN has been in dialogue with the state to retain government land for community farming. This action is particular to support the marginalized section of the community who do not own or have limited individual land.
Consultations with women farmers	Interactive conferences are being organized, wherein government officials and women farmers come to discuss farmer rights, issues, sustainable practices, etc. These conferences are as a mechanism to keep the officials apprised of ground-level issues. These conferences are hosted on important days such as International Women's Day, International Day of Rural Women, and World Food Day.

Outreach and Market Creation	
Marketing at festivals	In an attempt to increase livelihood opportunities for farmers, NEN has led farmers to various arts, culture, and craft festivals to set up stalls. For instance, Chakhesang now has permanent stalls at the Hornbill Festival in the Kohima district after receiving a positive response from urban dwellers travelling from all over the world. It has started only in the past two years and might even expand to other attending festivals in other northeastern states.
Bazaar for the surplus crops	Women's society members have started organizing bi-weekly haats (stalls) to sell their surplus produce.
Permanent millet supply to the market	NEN has been working towards creating a farmer-led round the year local market within their respective areas. The objective is to bring healthier food culture amongst the population and create a secure and stable source of livelihood for the farmers.

PHOTO 4: Women's weekly market in Chizami

Photo credit: Arpita Lulla

PHOTO 5: Farmer's market in Phek, 2021

Photo credit: Akole Tsuhah, NEN

Women farmer's rights-based work	
Rights for equal wages	With the interventions and long-term struggles by NEN, the village council in January 2015 passed a resolution for equal wages for equal agricultural labour.
Representation in institutional bodies	For centuries, women have been barred from decision-making, yet they contribute towards the maximum activities on the farm. As of 2021, four village council members and six members of Management Committees of VDB are women. This is a historical win, resulted after NEN's encouragement and Chizami Women Society's lobbying for years to include 25% women in the VDB Management Committee.
Collective farming on common land	Women societies are collectivizing to farm on a clan or common land to support each other. This process is still in its nascent stage but shows promising land rights and livelihood results, given the right conditions.

Technological Development	
Procurement of machinery	NEN helped procure three de-husking machines, two for two villages and one for common use at the Millet Resource Centre at Chizami. However, the machines were underutilized as only a few learnt its know-how and they were not useful for mass de-husk. Work on technological innovation is in progress to reduce the drudgery involved in millet farming.

Revival of Millets Leading to Socio-economic Reforms and Environmental Protection

With NEN's interventions and the community's interest, there have been significant changes in shifting cultivation governance, adapting to the changing community paradigm. The community is still reviving its indigenous methods of millet-based biodiverse farming, especially when they realized about the importance of self-sustenance during climate change events and the COVID-19 pandemic. Chizami is now seen as a model for sustainable development by nearby villages for its revival initiatives that brought in socio-economic reforms and environmental protection.

- Food sovereignty: Currently, women farmers in Phek are intercropping diverse vegetables with horticulture crops for not only food security and additional income but also for bringing back its food system. Women farmers in Chizami and Sümi have become more conscious of their diet, for instance, Sümi farmers shared about the high-nutritional value of millets, such as protection against diabetes, joint pain, and blood pressure. Also, these women farmers are collectively planning to retain the cultural aspect of farming that prohibits farming to be practised in isolation.
- Renewed collective farming: Collective farming has been recognized as an efficient practice to strengthen institutions and community bonds, reduce the scale of individual loss, ensure food

security, maintain equality within the community, and create balanced resource utilization (as mentioned with examples before). With the wisdom of the elders, Chizami and Sümi village councils have been encouraging people and passed a resolution for collective farming as part of a participatory land management use plan. This has also helped maintain the cultural essence of festivals in which everyone takes part in cleaning villages, clearing bunds, etc.

» Better organic farm production: Apart from Phek, in the Mokokchung district of Nagaland, the village council passed a resolution on the management of land owned by clans and individuals and promoted farming for 120 crops and varieties under a mix cropping pattern as a pilot project. Its results showed an increase of 10% in rice production with improved soil quality as compared to the earlier cropping pattern (Report on the Round Table on Sustainable Management of *Jhum* in North East India 2017).

» Self-motivation for sustainable farming: People have started taking up activities related to sustainable farming on their own. Since 2017, CSBs have been initiated in Chizami, Enhulumi, Sümi, Sakraba, Dzulhami, Thurutsuswu, Ruzazho, Phughi, and Akhegwo in the Phek district with encouragement from NEN. The Chizami seed bank has seven types of millets. These are locally called in many different names, such as, Kutsantshu, Merhatshu, Tsuzelu, Meni Bau, Tumeli, Etsube, Ephekerha, and Eletsube. More than 124 varieties of indigenous seeds are now being conserved in Chizami and 100 in Sümi. During a discussion with women farmers in Chizami, it was shared that the seed bank has offered them a space for learning from each other and bridging a knowledge gap between generations. They focus on linking with external markets and promoting seed exchanges between farming and non-farming communities.

» Raise in income: Incomes of 4400 women in Nagaland have increased by 10% as a result of the sale of organic farm produce from *Jhum* fields. The average incomes of 5008 households have increased by 15%–20% annually through access to existing credit facilities, agriculture revolving funds, and sales from an increased yield of *Jhum* fields (UNDP 2015).

As already mentioned, *Jhum* farmers mostly do sustenance farming and receive on an average Rs 2000/month by the sales of surplus including kitchen garden produce. However, with market accessibility and new market creations, the farm incomes have increased. For instance, 20–30 farmers earned between Rs 60,000 and 80,000 during the Hornbill Festival and 30–40 farmers generated Rs 80,000 together by the sales of organic farm produce (Rs 20,000–30,000), handloom, crafts, etc. in one of the biodiversity festivals. During Farmer's Haat, women usually earn approximately Rs 500–1000. From WTRC, a single household earns Rs 50,000–60,000 or more per year. These figures are shared by an NEN member, Akole Tsuhah, and are approximations and vary from farm to farm, crop to crop. From collective farming, 20 women sold their surplus produce worth Rs 8000 in 2020.

» Improved soil quality: The soil erosion rate in *Jhum* regions in Nagaland, where the UNDP projects are operationalized, has reduced from 50 t/ha per year to 26 t/ha per year (Bhaduri 2015). Millets, pulses, and coarse grains are cultivated along the contour bunds to prevent soil erosion till the time the tranches and bunds get stabilized. These crops help in maintaining an optimal soil and water regimen, thus improving soil quality.

Apart from this, millets are dry land, rainfed crops requiring low water input, therefore, reducing water stress. It is also important to note that millets fall under the category of C4 cereals. The C4 cereals absorb more carbon dioxide from the atmosphere and convert it in to oxygen (Kumar, Tomer, Kaur, et al. 2018).

» Ability to deal with unforeseen events: Owing to COVID-19, several community youths are back to their villages and have taken up farming. Some over self-realization have also decided to stay back to farm as full-time work. There are also multiple examples of farmers discussing the advantages of millet-based biodiverse farming in the face of unsolicited events, making them resilient to external market changes in terms of food security, employability, nutrition, etc.

» Influence on government: After several years of discouraging *Jhum* cultivation as being environmentally damaging, the state government has finally started accepting that *Jhum* cultivation is a successful sustainable agrarian model. The state has invited NEN to discuss the possibilities of a joint proposal for millet production and marketing. The proposal of millet circulation via PDS is for further discussions. However, it is yet to be seen whether such proposals will be implemented or not, but there is a government interest in NEN's activities as a few state representatives have attended programmes on women farmer's rights organized by NEN.

Potential for *Jhumming* in Creating a Sustainable Society

To be able to establish the importance and relevance of traditional *Jhum* cultivation in Nagaland, NEN and the Chakhesang community together have done astounding work. From various experiments, practice, and research it has been observed that this form of farming provides a viable past, present, and future for society and ecology. Learnings from Chizami and Sümi reveal the impact of traditional sustainable farming on health, environmental conservation, food security, women's rights, profound community bond, and identity assertion. However, it is equally important to, firstly, manage the changing unsustainable farming paradigm; secondly, to review the challenges pertaining to farming such as large-scale economic non-viability, technological hindrances, etc.; and, thirdly, to reflect on the socio-cultural coalition (between women and men farmers, lesser landholding and those with plenty, rich and poor, etc.).

Many scholars suggest the integration of traditional knowledge with scientific innovations, like the alder tree experiment by NEPED. There are marketing-related propositions on creating an entire value chain around this system, involving local communities to create a local production–consumption network.

At last, all these efforts will culminate into actions only with a dedicated institutional support at the village, state, and national levels. Policies and agencies are needed to be set up specifically for agroecological farming to rejuvenate the indigenous farming system and to recognize and implement the rights of women farmers.

Acknowledgments

This paper is based on a study conducted to understand and document the initiative of millet revival in a traditional biodiverse agriculture system in Phek, Nagaland with assistance from NEN in April 2019. It was done under the aegis of Kalpavriksh and Oakland Institute collaboration, funded by Oakland Institute.

References

Anonymous. 2017. *Report on the Round Table on Sustainable Management of Jhum in North East India*. Government of Nagaland and the International Fund for Agricultural Development. Details available at <https://focus.nagaland.gov.in/wp-content/uploads/2018/03/Nagaland-Round-Table-Conference-Report.pdf>, last accessed on May 24, 2021

Bhaduri, A. 2015. Sustainable practices in slash-and-burn lands in Nagaland. Indiawaterportal.org. Details available at <https://www.indiawaterportal.org/articles/sustainable-practices-slash-and-burn-lands-nagaland>, last accessed on February 15, 2021

Edake, S., P. Sethi, and Y. Lele. 2019. *Mainstreaming Community-conserved Areas (CCAs) for biodiversity conservation in SEPLS: A case study from Nagaland, India*. Satoyama Initiative. Details available at <https://satoyama-initiative.org/case_studies/mainstreaming-community-conserved-areas-ccas-for-biodiversity-conservation-in-sepls-a-case-study-from-nagaland-india/>, last accessed on March 14, 2021

Jamir, K. 2011. Chapter 2: Agriculture. In: *District Human Development Report - Phek*. Kohima: Department of Planning and Coordination. Details available at <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwi3s8CKkOTwAhXl4jgGHYz9D68QFnoECAIQAA&url=https%3A%2F%2Fwww.in.undp org%2Fcontent%2Fdam%2Findia%2Fdocs%2Fhdr_phek_2009_full_report pdf&usg=AOvVaw03dO6HOrLa64f5fPCnALYw>, last accessed on February 15, 2021

Krocha, V. 2021. Chizami enables women's participation in decision-making. *Morung Express*. Details available at <https://morungexpress.com/chizami-enables-womens-participation-in-decision-making?fbclid=IwAR2wkLUK9baIaAuHaIaFgr3_FM-rf19gZC_ABFOMjxqGw4MeZ4qB3BLX5l0>, last accessed on 14 March 2021

Kumar, A., V. Tomer, A. Kaur, V. Kumar, and K. Gupta. 2018. Millets: A solution to agrarian and nutritional challenges. *Agriculture & Food Security* **7**. Details available at <https://doi.org/10.1186/s40066-018-0183-3>, last accessed on May 22, 2021

Lulla, A., K. Trivedi, and M. Wani. 2019. Reviving the Traditional Millet-based Bio-diverse Agricultural System in Phek District, Nagaland, India. Vikalp Sangam. Details available at https://vikalpsangam.org/article/reviving-the-traditional-millet-based-bio-diverse-agricultural-system-in-phek-district-nagaland-2/

Morung Express. 2019. Women constitute 70% of agri sector workforce in Nagaland. Details available at <https://morungexpress.com/women-constitute-70-agri-sector-workforce-nagaland>, last accessed on January 23, 2021

National Institute for Transforming India (NITI) Aayog. 2018. *Report of Working Group III Shifting Cultivation: Towards a Transformational Approach*, p.6. Details available at <https://niti.gov.in/writereaddata/files/document_publication/doc3.pdf>, last accessed on May 23, 2021

Rao, B., K. Bhaskarachary, G. Christina, G. Devi, and A. Vilas. 2017. Nutritional and health benefits of millets. Hyderabad: ICAR–Indian Institute of Millets Research (IIMR). Details available at <https://millets.res.in/m_recipes/Nutritional_health_benefits_millets.pdf>, last accessed on May 21, 2021

Singh, R., C. Lairenjam, R. Bharali, P. Dutta, and C. Rajkhowa. 2009. Resource inventory of district Phek, Nagaland. Nagaland: Krishi Vigyan Kendra-NRC on Mithun Porba. Details available at <https://kvkphek.nic.in/publications/Resource_inventry_of_phek.pdf>, last accessed on February 15, 2021

Suvigya Management Consultants Private Limited. 2017. Gene pool conservation of indigenous rice varieties under traditional integrated rotational farming system (*Jhum* optimisation) for promoting livelihood and food security as climate change adaptation strategy in Nagaland. Ministry of Environment, Forest and Climate Change (MoEFCC)– National Bank for Agriculture and Rural Development (NABARD). Details available at: <http://moef.gov.in/wp-content/uploads/2018/05/Nagaland.pdf>, last accessed on March 14, 2021

United Nations Development Programme (UNDP). 2015. Sustainable land and ecosystem management in shifting cultivation areas of Nagaland for ecological and livelihood security. Details available at <https://www.in.undp.org/content/india/en/home/operations/projects/environment_and_energy/sustainable_landandecosystemmanagementinshiftingcultivationareas.html>, last accessed on March 9, 2021

CHAPTER-09

DIVERSITY OF SOIL MESOFAUNA UNDER TRADITIONAL JHUM AND SEDENTARY AGROECOSYSTEMS IN MEGHALAYA

D. Paul[1], Jayakumar Rajaiah Bhagianathan Alfred[2], V.T.Darlong[3], P.K.Vatsauliya[4] and A. Nongmaithem[5]

Abstract

Soil as a habitat contains the most diverse assemblages of living organisms. Soil arthropods form an important component of the soil biota, and although small in size, compensate by their high densities. They are usually associated with decaying organic matter. They have varied food habits, with species being detritivores, microbivores, coprovores, saprovores and predators. Collembola and Acarina along with other soil arthropods such as Araneida, Diplura, Protura, Isopoda and Chelonethi constitute the important components of soil mesofauna in terrestrial ecosystems. They are indispensable in the decomposition of organic matter, maintenance of soil physical structure, and efficient nutrient cycling.

Slash and burn (*Jhum*) is the predominant agricultural practice in the Northeastern India and Meghalaya. *Jhum* has been contributing to the conservation of both food crops agro-biodiversity and fallow forest biodiversity. The diverse germplasm varieties in the *Jhum* fields indicate the rich agro-biodiversity. Many studies have documented the contribution of shifting cultivation in biodiversity conservation, and in some cases having more diverse agrobiodiversity than modern farming systems.

[1] Professor & Head, Department of Environmental Studies, North Eastern Hill University, Umshing, Shillong-793022,Meghalaya, India. E mail: pauld97@rediffmail.com

[2] Vice President, Nature, Environment and Wildlife Society, 522C, Lake Gardens, Kundahar, Kolkata-700045, West Bengal, India

[3] Vice Chancellor, Martin Luther Christian University, Lummarboh, Block1, Dongktieh, Nongrah, Shillong-793006 , Meghalaya

[4] Joint Director, Central Silk board, Dehradun 248001, Uttarakhand, India

[5] Instructional designer, Cotiviti India Pvt. Ltd. F-108, Sanskriti Society, Kaspate Wasti Wakad, Pune-411057, Maharashtra

The present discourse examines the effect of shifting agriculture on the prevalence of soil mesofauna and also compares the same with other types of sedentary agricultural practices like terrace and valley cultivation.

Comparison between the forest and *Jhum* revealed that 64% of the fauna was confined to the litter layer. The total fauna was reduced by 75%; Collembola by 85%; Acarina by 74%; and other arthropods by 68%. When the soil layers are compared, the *Jhum* system evidenced a reduction of 30% (total soil fauna); 50% (Collembola); 43% (Acarina); and 23% (other arthropods). As for species diversity, 17 species of Collembola were recorded in the forest system, and 10 species in the *Jhum*. Similarly, 11 species of Oribatid mites (one of the four suborders of Acarina) were recorded in the forest and 9 in the *Jhum*.The densities in the terrace and *Jhum* were depleted by about 50% at Upper Shillong *Jhum* site (163.84) and 70% in the terrace (95.84) while the valley site had a reduction of about 24%. At the Nongpoh site, the depletion was 28% for the *Jhum* site; 54% for the terrace; and 10% for the valley.

Terraces harbored the lowest diversity and densities of fauna. The valley plots evidenced population densities higher than the *Jhum* sites through inputs from higher terrain. Issues of biodiversity conservation in *Jhum*, soil faunal densities and diversity, and governmental interventions on shifting agriculture are discussed.

Introduction

Shifting cultivation: Shifting cultivation, or "slash-and-burn" cultivation or "swiddening," or "rotational farming" is one of the oldest forms of agriculture and remains widely prevalent in tropical regions of the world. The origin of shifting cultivation is credited to the Neolithic period (8000-7000 BC) when human societies adopted sedentary agriculture (Sharma, 1976; Solheim, 1967). The practice involves clearing of a plot of forested land, usually a secondary forest area, cultivating for a year or two, mainly with multiple annual crop species, and, as soil fertility declines, leaving the plot is for recuperation by regeneration of vegetation. The cycle is repeated in another plot of land to be cleared in the same fashion. In the upland areas of South and Southeast Asia, at least estimated 14-34 million people continue to depend fully or partly on shifting cultivation for their livelihood and food security (Erni, 2015).

In India, besides the Northeast India, until recently, the practice of shifting cultivation had been reported from some isolated pockets of Maharashtra, Madhya Pradesh, Chattisgarh, Andhra Pradesh and Odisha (Satapathy et al. 2003; Darlong, 2004; Kumar, 2017). Shifting cultivation in Northeast India, known as *Jhum,* remains a predominant agricultural practice in the upland areas of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. Extent of areas under shifting cultivation and the number of families practicing *Jhum* in Northeast India are debatable with different sources indicating different figures. However, it is estimated that at least 8,500 sq km of areas could be under shifting cultivation at any given time, and the number of families practicing *Jhum* would be at least 450,000 (MoSPI, 2014; NITI Aayog, 2018).

Keywords: soil fauna;*Jhum*;fallow; shifting cultivation;

In Northeast India the practice of shifting cultivation or *Jhum* is marked by the following stages: 1. Selection of a forested patch (October-November); 2. Slashing the vegetation therein and allowing the slash to dry; 3. Burning the dry slashed vegetation (January-February); 4. Worship and sacrifice; 5. Dibbling and sowing a variety of crops (February- August); 6. Weeding (several times during the growing season); 7. Harvesting as and when crops are ready (May-November); 8. Fallowing. However, in the higher elevations of Khasi hills, there is a modification of the steps outlined above. Here, the destruction of the forest is only partial. While slashing the vegetation, trees and advanced growth are retained, and only the undergrowth is cut. The slash is arranged in parallel ridges with intervening furrows, and a thin layer of soil is placed upon the heaped slash before burning. Soon after the burn, tuber crops like *Solanum tuberosum*, *Ipomoea batatas* and *Colocasia antiquorum* are planted on the ridges. This is followed by sowing of cereals like *Zea mays*, legumes (*Phaseolus vulgaris*) and cucurbits (*Cucurbita maxima, Cucumis sativus*) after the onset of the monsoons. A winter crop of *S. tuberosum* and *Brassica oleracea* is planted after the first harvest in July-August. The winter crop is harvested in November. The plots are left uncultivated between December and March, during which time, the plots are prepared following similar procedures (slashed vegetation is collected from adjoining forests) if a second year of cultivation is to be done; otherwise the plot/s are abandoned for regeneration of natural vegetation (Mishra and Ramakrishnan, 1981; Paul, 1991). The variety of crops grown in such plots is depicted in Table 1.

Table1: Diversity of *Jhum* crop germplasm

Jhum Crops	Germplasm Varieties
Upland Rice	298
Brinjal	37
Ginger	60
Chillis	68
Maize	674
Turmeric	60
Grain legumes	200
Sweet potato	5
Cucurbits	76
Taros	250
Yams	242

Source: NBPGR 2004

Biodiversity conservation under Shifting cultivation: Shifting cultivation or *Jhum* is an integrated agriculture and forest management system. In its traditional forms, *Jhum* has its short 1-2 years of agriculture phase and prolong fallow forest phase. Both the phases are inter-related and inter-dependent. Its agriculture phase of food crops production can best be done only when there is well-regenerated fallow forest. That is the reason why the underlying principles of *Jhum*, when closely seen through the socio-bio-cultural lens of the shifting cultivators, is to create, protect and manage fallow forests and not to destroy forest (Darlong 2004). Throughout the historical timeline, *Jhum* has been contributing to conservation of both food crops agro-biodiversity and fallow forest biodiversity. Traditional agro-biodiversity of *Jhum* fields had been combinations of cereals, legumes, fibre, dye, spices and aromatic plants, vegetables including roots & tuber crops. The National Bureau of Plant Genetic Resources at Umiam, Shillong (Table1) had documented the diverse germplasm varieties of various crops planted in the *Jhum* fields indicating the rich agro-biodiversity of shifting cultivation areas (Darlong 2004).There have been many studies from Northeast India and other parts of Asia on the contribution of shifting cultivation in biodiversity conservation. Kerkhoff and Sharma (2006) documented that shifting cultivation areas have more diverse agrobiodiversity than modern farming systems that are usually mono-cropping, and that wildlife conservation too benefits from fallow areas of shifting cultivation. Biodiversity values of *Jhum* fallow forests are significant from the community perspectives (Darlong et al. 2001; 2020). Shifting cultivation fallows have been shown to recover vegetation faster in terms of basal area, regeneration, and accumulation of species than other human-modified and subsequently abandoned lands such as pastures, agroforestry sites, and plantations (Teegalapalli et al. 2009). In northern Thailand and West Kalimantan, Rerkasem et al. (2009) had observed severe declines in plant diversity when swidden was replaced by permanent land use system. In the Philippines highland, Sajise (2015) reported that the swidden systems have plant species diversity as high as that of mid-mountain forest, though the faunal diversity reduced significantly in the agro-ecosystems as compared to adjoining forests. Other studies have documented that biodiversity in *Jhum* areas could be conserved by encouraging adoption and promotion of non-*Jhum* livelihoods through government programmes as demonstrated from the study in Tripura (Gupta, 2020). All of these are strong evidences that shifting cultivation has contributed to biodiversity conservation.

Terrace cultivation: The feasibility of *Jhum* in sloping terrain in the northeast India has always been a matter of debate and controversy, particularly because of the associated erosive topsoil losses and consequent fertility loss and soil degradation. Thus the soil conservation department, Govt. of Meghalaya prescribed terrace cultivation on slopy terrain as an alternative to *Jhum*. The slopy land is converted into benched terraces and cultivated for 6-8 years, after which it is left fallow for allowance for regeneration of natural vegetation (Paul, 1991). In contrast to the *Jhum* plots, terrace cultivation is characterized by heavy input (300 kg./ha.)of organic fertilizers (Mishra, 1981)

Valley cultivation: In the flat lands and valleys wet cultivation of Oriza sativa is practiced. However, where the water table is low and does offer submerged conditions, a cropping (mixed) pattern similar to the *Jhum* plots is followed. The fertility status of such valleys is comparatively high due to the inputs of nutrients and topsoil from higher terrain, negating or minimizing the use of fertilizers (Paul, 1991).

Soil faunal diversity : Soil as a habitat contains the most diverse assemblages of living organisms. Soil arthropods form an important component of the soil biota, and although small in size, compensate by their high densities. They are usually associated with decaying organic matter. They have varied food habits, with species being detritivores (feeding on dead organic matter), microbivores (feeding on microbes), coprovores (feeding on faecal matter), saprovores (sap sucking especially from fungal mycelia) and predators. Collembola and Acarina along with other soil arthropods such as Araneida, Diplura, Protura, Isopoda and Chelonethi (taxonomic orders of Phylum Arthropoda) constitute the important components of soil mesofauna in almost all terrestrial ecosystems. They are indispensable in the decomposition of organic matter, maintenance of soil physical structure, and efficient nutrient cycling. Although bulk of decomposition is attributed to microbial activities, soil fauna is important in, conditioning the litter and in stimulating microbial activities through grazing and mobilization of nutrients from standing microbial biomass, and spatial and vertical dispersion of microbial propagules. Such activities are vital in the functioning of ecosystems and maintenance of soil health and above ground productivity, both in natural (e.g. Forest) and human altered (e.g. Agriculture) ecosystems (Moore et al., 1988, 1993; Coulson & Whittaker, 1977; Peterson & Luxton, 1982; Bardgett, & Chan, 1999; Cole & Bardgett, 2006). Considering the important role of soil fauna in mobilization of nutrients and fertility status of soils, the present report documents the diversity and densities of soil fauna across different sedentary land use practices, and against different fallow periods of *Jhum* making allowances for recovery of the fauna after cessation of cropping in such fallows.

Objective of the Present Study: The present study examines the effect of shifting agriculture on the prevalence of soil mesofauna and also compares the same with other types of sedentary agricultural practices like terrace and valley cultivation. In doing so, the purpose of the study is to demonstrate that if the soil mesofaunal diversity and density are ecological indicators of soil health (as the soil mesofauna contribute to soil recuperation through litter decomposition and soil nutrient recycling), which of the three candidate systems (*Jhum*, terrace and valley cultivation) has minimal impacts on soil mesofaunal diversity and density, and hence might ecologically be a more sustainable system?.

Study Area

The present report deals with investigations on soil fauna carried out in Uppershillong, Shillong, Nongpoh and Byrnihat, Meghalaya, spanning three decades.

Physiography: Meghalaya is divisible into three hill sections viz. Western Meghalaya (Garo Hills), Central Meghalaya (Khasi Hills), and Eastern Meghalaya (Jaintia Hills). The study areas are located in Central Meghalaya (Khasi hills and Ri-Bhoi districts). The Khasi Hills along with portions of Eastern Meghalaya forms an imposing table land known as the Shillong Plateau. Towards the south, the plateau is characterized by deep gorges and precipice, falling abruptly into the plains of Bangladesh. The northern face however, exhibits a gradual altitudinal decrease through foothills, merging imperceptibly into the plains of Assam. The plateau is the remnant of the pre cambrial Indian Peninsular Shield consisting of exposed gneiss and schists and intruded by younger granites. The hills of Meghalaya are thus very old with a chequered evolutionary history of emergence, submergence, and re-emergence. The waters of the encroaching Tethy's sea submerged the plateau during the Mesozoic and Tertiary periods. The emergence of the Himalayas from the sea saw the upliftment of the plateau to its present position (Zimba, 1983). The Shillong and Uppershillong sites are representative of the plateau while the Nongpoh and Byrnihat sites represent the foothills to the north.

Study sites: Four sets of study sites are reported in the present discourse. The first set represents a study on the soil faunal status in *Jhum* fallows of 1, 5, 15 and 20 years (1978-1980) at Byrnihat. The second set represents faunal studies on Sacred grove (Forest) and cultivated *Jhum* plot (1980-1982) in Uppershillong (Laitkor); the third represents faunal studies on Pine forest, and cultivated plots of *Jhum*, terrace and valley at Uppershillong and Nongpoh (1983-84); and the fourth set represents faunal studies on Pine forest and sedentary agriculture (2008-2009) at Shillong.

Sampling: Soil samples measuring 5x5 cm^{-2} in area and 40 cm. depth (divided into four samples of 10 cm. each) were collected fortnightly in three replicates from each sampling site. Samples were collected during 0800-1100hrs. Samples were extracted using a modified Tullgren extraction apparatus for 72 hrs (Southwood, 1966; 1967). The principle of extraction involved exposing the soil (and faunal elements within) kept in a Berlese funnel to light and heat using a 40W electric bulb. Under the influence of light and heat, the fauna migrate away from the heat and light and are collected in a vial containing a preservative (ethyl alcohol & glycerene) kept below the funnel (Fig. 1).

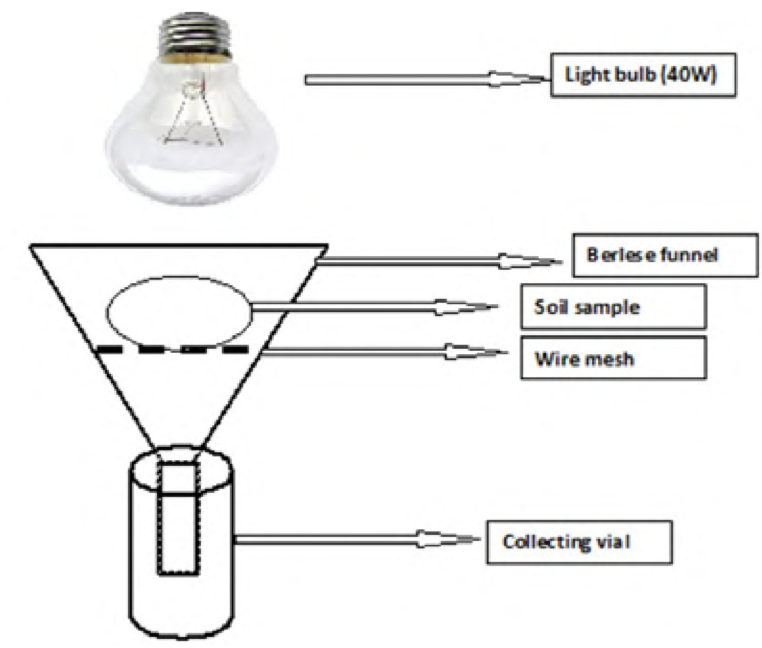


FIGURE 1: Diagrammatic view of Berlese funnel extraction apparatus

Results

The soil fauna encountered during the studies belong to the following classes, with the representative orders in parantheses:-

1. Insecta (Protura, Diplura, Collembola, Diptera, Coleoptera, Hymenoptera, Isoptera, Orthoptera, Dermaptera,Hemiptera, Homoptera, and insect larvae)
2. Myriapoda (Symphyla, Pauropoda, Chilopoda, and Diplopoda)
3. Arachnida (Acarina, Araneida, and Pseudoscorpionida)
4. Crustacea (Isopoda)

Jhum fallows (Byrnihat, 1978-1980):

Flora: The four different aged fallows (1yr, 5yrs, 10 yrs and 20 yrs) revealed a clear successional pattern of the resurgence of flora after cessation of agriculture and abandonment. The early successional species were gradually replaced through mid succession and ultimately resulted in the species of late succession taking roots in the 20 yr. old fallows (Table 2).

Table 2: Vegetation at the four study sites and their dominance

Species	Site A (1 yr fallow)	Site B (5 yr fallow)	Site C (10 yr fallow)	Site D (20 yr fallow)
Ageratum conyzoides Linn.	+++	-	-	-
Arundinella bengalensis (Spreng.) Druce	++	+++	-	-
Bauhinia variegata Linn.	++++	-	-	-
Borreria hispida (Linn) K. Schum	+	++	++++	-
Cyperus globosus Allioni	++	+++	++++	++++
Carex cruciata Nees	-	++	++++	++++
Careya arborea Rox.	++	-	++++	++++
Callicarpa toona Roxb.	+	++	+++	++++
Combretum decandrium Roxb.	+	+	++	++
Desmodium triguetrum DC.	++	++++	++++	++++
Dendrocalamus hamiltonii Nees & Arn.	++	++++	++++	++++
Dillenia indica Linn.	+	+++	-	++++
Eupatorium odoratum Linn.	++++	++++	++	++
Eugenia tetragona Wight	+	++	++	+++
Ficus hispida Linn.	++	-	++++	++++
Gregia elastica Royle	++	-	-	-
Litsala assmica H.R.F.	+	-	++	-

Contd...

Table 2: *Contd...*

Species	Site A (1 yr fallow)	Site B (5 yr fallow)	Site C (10 yr fallow)	Site D (20 yr fallow)
Mikania micrantha H.B. SK.	+	-	++	-
Imperata cylindrica (L.) Beaure	++++	++++	-	-
Macaranga denticulata Muell.	++	+++	-	++++
Melia azadirachta Linn.	-	+	+	-
Machillus Khasyana Meisnn.	+	-	-	++
Maesa indica Wall.	+	++	++	-
Osbeckia crinita Benth.	++	-	-	-
Panicum maximum Jacq.	++	+++	++++	++++
P. khasianum Munro	++	+++	-	-
Setaria tessellata Willd.	-	++	++++	++++
Schima wallichii Chois	++	-	++++	++++
Sapium buccatum Roxb.	+	-	++	+++
Thysanolaena maxima Kuntze	++	+++	-	-
Vitex peduncularis Wall	++	+++	++++	-
V. glabarta Br.	++	+++	++++	++++

Source: Vatsauliya & Alfred,1993

++++ = highly dominant ; +++ = dominant; ++ = poorly dominant + = present; - = absent

The primary factors determining such a change in the species is light, moisture and the presence of organic matter. The early colonizers are light tolerant and can survive under conditions of low moisture and soil organic matter. They are usually herbaceous annuals. As the semblance of a canopy develops and shaded conditions emerge, the mid and late successional species start to dominate. During this evolution, soil organic matter accrues, and moisture retention capacity of the soil also increases, resulting in more stable conditions and lesser diurnal and seasonal perturbations of the abiotic factors. Such a stability is crucial to the colonization and inhabitation by the faunal elements.

Mesofauna: In the 1 yr fallow, the mesofaunal density was high, probably due to the initial profusion of herbaceous species and also cessation of soil tillage (disturbance), triggering colonization by the faunal elements. However, in the immediate later stages the numbers declined, in tandem with the change in the floral elements and poor soil moisture and organic matter, and again build up to higher densities with the accrual of more stable soil conditions (Table 2). Such an initial population buildup has also been reported in earlier studies (Huhta, et.al., 1967,1969; Moritz, 1965), and has been attributed to Oribatid mites. However, Collembola numbers were reduced to half in such 1 year fallows Vatsauliya and Alfred, 1993). The immediate build-up of numbers with subsequent reduction and stabilization is also dependent on the soil development process which is crucial to habitation by soil fauna, and temporal maintenance of densities and diversity (Rosek, 1978).

Table 3: Total mesofauna in the *Jhum* fallows (± SD in parantheses).

Site	Total mesofauna
A 1yr fallow	13498 (65.72)
B 5 yr fallow	10756 (61.17)
C10 yr fallow	12108 (60.97)
D 20 yr fallow	13524 (60.25)

Source: Vatsauliya & Alfred,1993

Forest & *Jhum* (cultivated): The second set of study reports a comparative analysis of the faunal densities and diversity in a sacred grove (forest) and a *Jhum* plot under cultivation. Unlike the *Jhum* fallows described earlier, this study incorporates a forest site and more importantly the litter layer with its abundance of soil fauna, thus enabling a comparison of the degree of faunal depletion in a *Jhum* (disturbed) site to that of a forest (undisturbed) site.

Mesofauna: The total mesofauna count in the forest site was 22917x10-2m-2, and that in the *Jhum* site was 5712x10-2m-2. The litter layer of the forest alone accounted for 64% of the fauna, and this layer was absent in the *Jhum* site, causing a depletion of the fauna (Table 4).

Comparing the two systems in totality (including the litter layer of the forest), in the *Jhum* system, the total fauna was reduced by 75%; Collembola by 85%; Acarina by 74%; and other arthropods by 68%. Even when the litter layer of the forest is not considered and only the soil layers are compared, the *Jhum* system evidenced a reduction of 30% (total soil fauna); 50% (Collembola); 43% (Acarina); and 23% (other arthropods). It is thus evident that the faunal densities are drastically reduced in the *Jhum* system. The litter layer accounted for 35% and 22% of Collembola and Acarina respectively. These two groups inhabit the upper soil layers, being scanty in the 20-30 cm layer of the soil and were totally absent in the 30-40cm soil layer. These two groups have the highest densities in most soils, and in the present study, constituted more than 57% of total soil fauna in the litter layer. Apparently, the cultivation of the *Jhum* site creates disturbance by way of tilling and incorporation of the litter layer, resulting in poor habitat and biotic conditions, and is reflected in lowering the densities of Collembola and Acarina.

As for the species diversity of the two groups, 17 species of Collembola were recorded in the forest system, and this was reduced to 10 species in the *Jhum*. Similarly, 11 species of Oribatid mites (one of the four suborders of Acarina) were recorded in the forest and only 9 in the *Jhum*. It is evident that the reduction of species diversity of Acarina would be much higher if all the suborders are considered, although it was beyond the scope of the study.

Forest, *Jhum*, Terrace and Valley: The third set of studies investigated the soil faunal densities and diversity in plots of Forest, *Jhum*, Terrace and Valley at two different locations viz

Table 4: Faunal densities in the Forest and *Jhum* sites (Source: Darlong, 1984)

Site	Layers	Total Soil Fauna		Collembola		Acarina		Other Arthropods	
		a	b	a	b	a	b	a	b
Forest	LITTER	14831±559.5	64.8	8092 ± 129.16	35.31	5128±90.1	22.37	1644±205.16	7.2
	0-10 cm	6740 ±229.15	29.3	2100 ± 35.21	9.16	3802±142.5	16.5	826±74.8	3.56
	10-20cm	1188 ±78.28	5.1	342 ± 19.95	1.49	535±39.1	2.33	310±45.3	1.35
	20-30cm	158 ±15.5	0.7	22±3.02	0.09	10±1.67	0.04	106±18.4	0.54
	30-40cm	40 ± 9.21	0.17					40±9.1	0.17
	Total	**22957**		**10556**		**9475**		**2839**	
Jhum	0-10cm	3570 ±155.45	62.5	1604±42.38	17.5	2335±172.34		544±56.34	7.52
	10-20cm	1858±42.5	32.5	224±1156	3.92	467±9.34		338±43.33	5.91
	20-30cm	116± 13.48	2.04	16±1.23	0.28	18±1.33		82±16.13	1.43
	30-40cm	168±10.76	2.95					84±10.33	1.47
	Total	**5712**		**1844**		**2820**		**1048**	

a: numbers ±SD; b: percentage of total soil fauna

Uppershillong and Nongpoh. In the present case, to arrive at a true comparison among the forest and agroecosystems, the litter layer of the forest was not considered. Thus the faunal densities of the four soil layers were accounted for.

Mesofauna: The total soil fauna densities of the forests at Uppershillong and Nongpoh were of a similar range (516.36 and 477.88 respectively). However, the densities in the terrace and *Jhum* were depleted by about 50% at Upper Shillong *Jhum* site (163.84) and 70% in the terrace (95.84) while the valley site had a reduction of about 24%. At the Nongpoh site, the depletion was 28% for the *Jhum* site; 54% for the terrace; and 10% for the valley. Thus, the reduction of fauna in the Uppershillong agroecosystem sites were more severe than that of the Nongpoh sites (Table 5). The primary reason for such a difference lies in the quality of litter and the operating temperature regimes. The Uppershillong forest has conifers and other cold tolerant species (winter temperatures reaching 2-4°C) as the dominant contributor of litter. Such acidic litter with high polyphenol content undergo decomposition at slower rates, accumulate over time, and harbor fungi and a vast spectrum of soil fauna. In contrast, the Nongpoh site had broad leaved species contributing to the litter which is less acidic and devoid of polyphenols. This, coupled with a higher temperature regime (winter temperatures reaching 14-18°C) encourages faster decomposition and negligible accumulation of litter. Thus, the spatial and vertical distribution of the fauna is somewhat more even as compared to the former, where the bulk of fauna prefer to inhabit the accumulated litter (often 2-3 years of slowly decomposing litter gets accumulated).

Table 5: Faunal densities in the Forest and agroecosystem sites (Source: Paul, 1991)

Soil Depth	Forests		Agroecosystems					
	Uppershillong	Nongpoh	Uppershillong			Nongpoh		
			Jhum	Terrace	Valley	*Jhum*	Terrace	Valley
0-10 cm.	229.07 ± 57.92	246.91 ±51.65	163.84 ±48.8	95.84 ±48.24	228.31 ±58.09	178.4 ±49.9	114.59 ±40.12	223.41 ±55.14
10-20 cm.	173.99 ± 33.69	186.58 ±39.04	127.38 ±38.0	82.34 ±41.44	131.66 ±33.5	136.07 ±38.06	95.83 ±41.08	151.66 ±37.43
20-30 cm.	38.57 ± 7.4	34.65 ±7.25	23.74 ±7.08	13.67 ±6.88	26.83 ±6.83	29.08 ±8.13	15.25 ±6.54	31.55 ±5.32
30-40 cm.	4.75 ±0.92	9.28 ±2.05	20.5 ±6.11	6.88 ±3.44	6.24 ±1.59	14.0 ±3.91	7.59 ±3.25	8.5 ±2.0
Total	516.36	477.88	335.2	198.68	393.04	357.55	233.26	415.12

Numbers ±SD

Collembola constituted 28% of total soil fauna in the Uppershillong forest and 23% in the Nongpoh forest. Generally, more than 50% of the population was limited to the top soil layer and 31-46% in the 10-20cm soil layer. The 30-40cm layer did not harbour any Collembola The Uppershillong forest harboured 11 species while Nongpoh forest had 13 species representing the order. Of the agroecosystems, the terrace had the lowest representation , harbouring 4 species at Uppershillong and 9 species at Nongpoh. The valley at Uppershillong harboured 10 species and that at Nongpoh had 13 species.

Total Acarina densities were similar for both the forests (284x10 for Uppershillong and 274x 10for Nongpoh). This group contributed 57.5% to total soil fauna at Uppershillong and 55% at Nongpoh. They were present in all the soil layers. However, the 0-10cm layer accounted for 50% or more of the population. Of the Acarina, the suborder Cryptostigmata was represented by 15 species in the Uppershillong forest and 26 species in the Nongpoh forest. The terraces had the poorest representation of the group (6 species at Uppershillong and 9 species at Nongpoh) while the valleys consistently had the highest representation among the agroecosystems (12species at Uppershillong and 15 secies at Nongpoh).

Forest and Agroecosystem: The fourth investigation centered around a Pine forest and an agroecosystem (sedentary) at Mawlai (Shillong). This study estimated the soil fauna of only the 0-10cm soil layer. Although not directly comparable to the studies discussed earlier, total faunal counts of the litter and 0-10 cm layer and the percentage contributions of Collembola (28%) and Acarina (51%) are of a similar range as the others.

Discussion

Soil fauna: The trends in soil faunal diversity and density in the present study showed similar results from the earlier studies from the region (Darlong & Alfred, 1982: Hattar & Alfred, 1984; Alfred *et al.*, 1991; Hattar et al., 1992, 1998, 2008; Zodinpuii et al., 2019). The length of the fallow period in *Jhum* is crucial to the resurgence of soil fauna. Earlier, the fallow period was 20-30years, making allowances for the recovery of faunal elements to their original status. However, the reduction of this fallow period to 3-6 years is a deterrent to the development of faunal elements. The studies on the *Jhum* fallows clearly indicate that even in the 20 year fallow, the densities fall short of that of an undisturbed system. Similarly, in comparison to forests, there is a considerable reduction in the faunal densities. Further, the litter layer of the forest offers excellent habitat and microclimatic conditions for successful inhabitation on a sustained basis. The absence of this layer in the agroecosystems is a further constraint for the inhabitation and sustenance of fauna. It is evident that most of the fauna inhabit the upper soil layers, and cultivation practices like tillage disturb these layers. The reduction of fauna by 40-50% in the different agroecosystems is indicative of such disturbance. Among the agroecosystems, the terraces harbored the lowest densities. Such terraces had two sections (horizontal and vertical) of the soil exposed, a have poor moisture retention capacities under upland cultivation, and also exhibited poor physico-chemical mileu (Paul, 1991) resulting in poor habitat conditions.

The importance of soil fauna relates to the decomposition of the organic matter resident in the soil. Although microorganisms are credited with a bulk of the decomposition process, detritivorus soil fauna help in the reduction of particle size of organic matter, making it more accessible to the microflora, and thus hastening the decomposition process. Further, microbivorus communities like Collembola and Acarina help in releasing the immobilized nutrients in microbial biomass through grazing. Moreover, they also help disperse microbial propagules spatially and vertically in the soil profile effecting more efficient colonization by the microbial community (Wallwork, 1967; Visser, 1977; Visser et al., 1981).

Governance of *Jhum* Cultivation Adapting to Changing Socio-economic Circumstances

Interventions aimed at stopping shifting cultivation go as far back as pre-British rule. The Ahom rulers in Assam encouraged wet-rice cultivation in place of shifting cultivation. During the colonial period too, shifting cultivation was seen as primitive, and efforts were made to ban the practice and wean away farmers from the practice. Post-independence , the government's overall policy remained more or less the same with a number of programmes promoting settled cultivation. In recent years, efforts to replace *Jhum* with horticulture and cash crops plantations including rubber, tea, arecanut, pineapple, litchis, bananas and allied crops have yielded mixed results.

Thus, the outcome has been a changing socio-economic landscape with many shifting cultivators adopting to settled farming. This has also resulted in changes in the governance systems of *Jhum* land. With the replacement of *Jhum* with perennial cash / horticulture crops plantations, community land or commonly held *Jhum* land started fragmenting and has been transformed into private individual land. Other changes include the emergence of a number of modified *Jhum* or development of *Jhum* sub-systems, such as home garden, livestock sub-system, agro-forestry sub-system and agro-horticulture sub-system, again resulting into transformation of community land to private land. Crop diversity too has reduced from traditional mixed crops to mainly commercial crops such as ginger and other crops having higher market demand.

Consequently, in a given village, the number of families exclusively dependent on *Jhum* has reduced significantly, so also community-based fire management strategies and practices weakened. Food systems of many families too started changing, and the traditional knowledge on *Jhum* and crop practices and varieties started dissipating. Festivals associated with the agricultural cycle of *Jhum* became mostly symbolic and modernized.

Such a changing socio-economic scenario due to intensive government programmes infused through the Rubber Board, Tea Board, National Horticulture Mission, National Bamboo Mission, etc. have other consequences. With the promotion of these plantations in the areas under shifting cultivation, overall available land for shifting cultivation has significantly reduced. The traditional land ownership systems where every household had equitable access to land had been altered. There is now skewed land ownership pattern among the shifting cultivation communities. In Mizoram, the government introduced the New Land Use Policy (NLUP) to address *Jhum* and promote permanent horticulture-livestock based livelihoods. Elsewhere, *Jhum* farmers are leading the adaptation to changing *Jhum* governance due to changing socio-economic landscape by modifying their *Jhum* practices based on market demands.

***Jhum* cultivation for a sustainable society and environment:** Despite numerous *Jhum* control programmes and discouragements by the government, *Jhum* cultivation continues in many pockets of NE India among various tribal communities. Limited extension outreach by the government agencies, lack of viable alternatives for adoption by the *Jhum* farmers, topographical challenges that are conducive mainly for *Jhum* cultivation (slash and burn), typical prevailing community land tenure system among many communities, physical isolation of the communities that allows them to use their traditional knowledge and available tools primarily for *Jhum*, are some of the often cited reasons for the continuance of *Jhum* in NE Region. Of course, for many rural tribal communities, shifting cultivation is not only a means of livelihood based on their foods and crops systems alone, but also deeply rooted in their culture and a way of life through their festivals, songs, dances and tales that are intimately connected with the *Jhum* farming cycles.

In his edited book on *Shifting Cultivation Policies: Balancing Environmental and Social Sustainability*, Cairns (2017) argued that shifting cultivation can play a crucial role in sustainable society and environment. He and many authors in the book have suggested that the role of the government and local institutions in regulating shifting cultivation over time should be done with sensitivity, through the lens of the shifting cultivators, considering their local values, practices, intimate understanding of indigenous vocabularies with their underlying meanings and indigenous knowledge systems. How *Jhum* can play a role in the balance of society and environment could be understood by appreciating the three key socio-economic-environmental characteristics of the shifting cultivation communities (Pandey et al. 2019).

The first is that the shifting cultivation communities have the traditional community and institutional social bonding. They are intimately associated and attached to their communities, their traditions and their institutions that govern their socio-cultural-economic life. Such social bonding could be expressed through their festivals and celebrations around their *Jhum* agricultural cycle with all their songs and dances being done as a community.

The second is their economic bonding as demonstrated by their attachment to their traditional livelihoods and economic activities around shifting cultivation. Given that many of the shifting cultivator communities continue to live in remote areas with hilly or mountainous locations, and access to markets remain challenging, understandably, many of them continue to have economic sense of security only through shifting cultivation. As farming in the hill landscape is often arduous , economic bonding of the communities could be seen through their community activities. Clearing of land for *Jhum*, burning of *Jhum* slash, preparation of fire line for *Jhum* burning, seeds sowing, weeding and harvesting are all done as community activity where a few neighbouring families coming together for the shared tasks of *Jhum* cultivation. The seeds system of the communities are also integrated with the traditional practices of seed exchanges among the families to ensure on-farm cross-breeding of crops for best yield. By practicing *Jhum* cultivation, the preservation of indigenous crops and cultivars have been ensured, many of which are considered useful in the context of climate change as well as food and nutrition security.

The third dimension is the bonding of the shifting cultivation communities with their natural world. This is demonstrated by their community ownership of forest and *Jhum* land, as well as protection of natural landscapes as sacred groves for their traditional rituals and/or burial grounds. This traditional bonding with their natural environment enables the communities to continue to have community forests, many of which are linked to traditional water sources or natural springs. The forests around the shifting cultivation communities provide their livelihoods requirements including their needs for their households' construction, foods, medicines, dyes, handicrafts, etc..

Another way of looking at the role that *Jhum* cultivation can play for a sustainable society and environment would be in supporting the shifting cultivators and the government to fully implement the various *Jhum* Control Regulations enacted by the government or autonomous district councils in NE India (Darlong 2004). For example, effective implementation of the various provisions of the Garo Hills District (*Jhum*) Regulation, 1954 such as prohibition of *Jhum* in the radius of 400 meters of any water source or a distance of 50 meters on either side of state PWD roads, fixation of *Jhum* cycles, precaution against fire, recuperation of soil in the *Jhum* area, etc. could go a long way in securing social and environmental sustainability.

Recent initiative of the Govt of India in NITI Aayog is also an indication of the new role that *Jhum* cultivation can play, and which will pave the way for a sustainable society and environment. NITI Aayog is working towards supporting the practice of *Jhum* in a way that they can access credits and subsidies, besides defining the *Jhum* land as agricultural land. Recent documentation of NITI Aayog also has encouraging outlook towards shifting cultivation emphasizing on the transformational approaches (NITI Aayog, 2018).

Conclusion

From the soil mesofaunal diversity and density perspectives, shifting cultivation or *Jhum* systems appear to harbour much higher diversity and density as compared to sedentary farming systems of terrace. The higher densities in valley cultivation is indicative of the relocation (transport) of fauna from adjoining higher terrain, and consequent upon erosive losses. As soil fauna contribute to the ecological processes of soil health restoration, the higher the diversity and densities, the more is their functional effectiveness, and therefore, it may be concluded that shifting cultivation looks more promising to ecological sustainability as an agricultural system, as compared to other forms sedentary farming systems including terrace cultivation. Valley cultivation is benefited from the inputs of topsoil and faunal entities through erosive losses from higher terrain and are thus sustainable .

Further, *Jhum* has to be viewed from the traditional farmers' perspectives. For them, *Jhum* is an integrated activity of both agriculture and fallow forest management. In several case studies of IFAD-funded NERCORMP project in Northeast India, it was observed that about 60% of family food requirements come from current *Jhum*, while nearly 40% requirements are sourced from fallow forests of different ages comprising of wild edible vegetables and fruits including small fish, crabs and snails from the fallow forest streams (NERCORMP, 2017). However, when the community needs were computed in the forms of fuelwood, fodder, construction materials and Non timber forest products (NTFPs) for handicrafts including cultural requirements sourced from fallow forests, the livelihoood dependency of the communities on fallow forests were significant as part of their integrated *Jhum* system (*Ibid*). In many typical *Jhum* communities, the current *Jhum* plots are generally in proximity with the fallow forest landscape. This proximity perhaps provides avenues for many of the soil faunal groups, particularly the ants, to quickly colonise the adjoining 'new environment' following burning and cultivation, and thereby, *Jhum* harbouring higher soil mesofaunal diversity and densities.

From the biodiversity conservation perspectives, shifting cultivation too has its own historical and contemporary roles. In comparison with terrace or valley cultivation, where mainly paddy is cultivated, *Jhum* on the other hand is biodiversity conservation in practice. *Jhum* essentially maintains, nurtures and sustains much higher biodiversity in all forms such as below ground biodiversity (of soil mesofauna and rich root biomass for regeneration), as well as maintaining above ground rich agrobiodiversity in the current *Jhum* fields, and forest biodiversity in the fallow forest of different ages. In essence, high crop diversity is a characteristic of most traditional shifting cultivation systems.

Building on their traditional knowledge, the *Jhum* farmers are well aware that the longer the fallow forest phase, the more is the productivity of soil for the next *Jhum* cycle. In recent years, *Jhum* has received much attention, both globally and in India, as one of the major causes of degrading processes in tropical forest areas due to increasing population pressure inevitably leading to competition for arable land and resulting in shortages in fallow periods with consequent loss of soil fertility. Studies have documented that if fallow is less than 5–7 years, land degradation occurs and species diversity may be greatly reduced (Berkes *et al*., 1995). However, if adequate fallowing is allowed for, shifting cultivation may be highly sustainable (e.g., Posey, 1985).

From the aforementioned accounts, it is evident that *Jhum* cultivation can continue to play an important role for a sustainable society and environment in Northeast India along with appropriate *Jhum* governance issues being addressed by the communities and authorites. *Jhum* ensures conservation of diverse traditional food crops, many of which could be promising species in the era of climate change, besides ensuring food and nutrition security for communities living in remote areas. *Jhum* cultivation ensures equitable access to land for all families in a village, thereby, ensuring social harmony in terms of land access as the *Jhum* land among many comminities remain under the community ownership or common property resource. On the other hand, sedenterization of farming in the form of terrace and valley cultivation lead to privatisation of land to particular individuals.

Land governance through the traditional village or community institutions remains is key to enabling the practice of *Jhum* to remain socially and environmentally relevant. There are now competing land use changes due to expanding horticulture and cash crop plantations (following government policies of promoting horticulture/cash crops plantations) over the same limited land resources that are/were traditionally used for *Jhum* or shifting cultivation. It is the strong land governance system by the village institutions that can ensure balance between the need to continue *Jhum* as well as the need to have cash crops plantations. The fact is that as soon as *Jhum* land is converted into horticulture or cash crops plantations, such plots transform into invidual ownership. Therefore, the land governance aspects would require ensuring equitable privatisation of common land while promoting farming sedetirization by perennial horticulture or cash crops plantation. Only then will there be social justice and harmony among the communities.

Another important dimension of *Jhum* is revealed when viewed through the lens of Gender. Over 70% labour requirement for *Jhum* is invested by the women in most typical communities in North East India (Darlong et al. 2012). This means that *Jhum* provides productive occupation for women. `Consequently, the women farmers are the 'custodian farmers' in typical *Jhum* farming system. They are also the traditional knowledge holders with respect to *Jhum* agobiodiversity including the seeds system.

From environmental sustainability perspectives, *Jhum* could be considered as reflective of its historical role in biodiversity conservation, particularly agrobiodiversity, many of which today could be climate-adaptive species in the era of climate change. Strengthening the existing governance of *Jhum* land and *Jhum* practices through the traditional village institutions could be the vehicle for attaining environmentally sustainable *Jhum* practices. Measures in practice among many communities which could be adopted by for ecological sustainability of *Jhum* could be:

» Revival or enforcement of traditional *Jhum* block system by demarcating the entire *Jhum* areas into 10 to 12 blocks , each block cultivated in each year irrespective of the number of *Jhum* families, that will automatically ensure at least 10-12 years of *Jhum* cycle, as being practiced by the Ao Nagas in Mokokchung district of Nagaland (Jamir (2015).

» Harmonizing *Jhum* with PGS (participatory guaranteed standards) that proposes at least 10 or more years *Jhum* cycle (Darlong et al. 2008).

» Reviving or strengthening community-based fire management practices to manage firelines in the *Jhum* fields during *Jhum* burning could greatly prevent escape of any fire to nearby forest thereby ensuring more sustainable environment (Darlong, 2002).

» Agroforesty such as alder-based *Jhum* system could greatly ensure ecological sustainability of *Jhum* system as described in NEPED (2007); NEPED & IIRR (1999).

References

Alfred, J. R. B., Darlong, V. T., Hattar, S. J. S. and Paul, D. (1991). Microarthropods and their conservation in some North-East Indian soil. Advances in management and conservation of soil fauna, Oxford and IBH Publishing Company Private Limited, New Delhi, pp 309-319.

Bardgett, R D & Chan, K F (1999) Experimental evidence that soil fauna enhance nutrient mineralization and plant nutrient uptake in montane grassland ecosystem. Soil Biology & Biochemistry, 31: 1007-1014

Berkes, F., C. Folke, and M. Gadgil, (1995). Traditional ecological knowledge, biodiversity, resilience, and sustainability. *In* C.A. Perrings, K,, G. Maler, C. Folke, C.S. Holling, and B.O. Jansson (Eds) *Biodiversity Conservation: Problems and Policies*. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Cairns, M. (2017). Shifting Cultivation Policies: Balancing Environmental and Social Sustainability. CABI, UK.

Cole, L and Bardgett, R.D. (2006) Animal: Microbial interactions and nutrient cycling. In *Encyclopedia of Soil Science*. (Ed. R. Lal) Taylor & Francis pp 113-116

Coulson, J. C & Whittaker, J.B (1977) The ecology of moorland animals . In *The Ecology of British Moors and Montane Grasslands* (Eds. O. W. Heal & F. Perkins) Springer, Berlin

Darlong, V.T.(2002). "Traditional CommunityBased Fire Management Among the Mizo Shifting Cultivators of Mizoram in Northeast India" in Communities in Flames: Proceedings of an International Conference on Community Involvement in Fire Management, edited by Peter Moore, David Ganz, Lay Cheng Tan, Thomas Enters and Patrick B. Durst, http:// www.fao. org/docrep/005/AC798E/ac798e0j.htm.

Darlong, V.T. (2004). To *Jhum* or Not To *Jhum*: Policy Perspectives on Shifting Cultivation. The Missing Link – Society for Environment & Communication, Guwahati.Darlong, V. T. and Alfred, J. R. B. (1982). Differences in arthropod population structure in soils of forest and *Jhum* sites of North-East India. Pedobiologia, 23, 112-219.

Darlong, V., Hore, D.K. and Deb Barma, S. (2012). Gender, food security and rice farming in Tripura. In Sumi Krishna (Ed) Agriculture and a Changing Environment in Northeastern India. Routledge India, New Delhi.

Darlong, V.T., Dollo, M., Hmar, M. and Marbaniang, A. (2020). *Jhum* sub-systems as continuity and change: Innovation in shifting cultivation by the *Jhum* farmers in Assam and Manipur, Northeast India. In *Farmers Innovations and Best Practices in Shifting Cultivation in Asia-Pacific*, Edited by Malcolm Cairns (In Press).

Darlong, V.T., Tiwari, B.K., Singh, J. and Prasad, K.G. (2001). Biodiversity values in fallow areas of Northeast India. In Shifting Cultivation: Towards Sustainability and Resource Conservation in Asia, pp. 93-97, IIRR, Philippines.

Darlong, V., Jamir, A., Barik, S.K., Tiwari, B.K., Choudhury, D. and Nakro, V. (2008). Harmonizing *Jhum* in Northeast India with PGS Organic Standards – Ways Forward. North Eastern Region Community Resource Management Project (NERCORMP), Shillong.

Erni, C. (2015). Shifting cultivation, Livelihood and Food Security: New and Old Challenges for Indigenous Peoples in Asia. FAO, IWGIA & AIPP, Bangkok. Evans, G. D., J. G. Sheats & D. Macfarlane. 1961. *Terrestrial Acari of the British Isles*. I. Introduction and biology. British Museum, London, 219 pp.

Gupta, A.K. (2020). Shifting cultivation and conservation of biological diversity in Tripura, Northeast India. Human Ecology, 28 (4): 605-629.

Hattar, S. J. S. and Alfred, J. R. B. (1984). A population study and community analysis of Collembola in pine forest soils of Meghalaya. NE India-III Oriental Entomology Symposium, pp 203-209.

Hattar, S. J. S., Alfred, J. R. B. and Darlong, V. T. (1998). Animal diversity in some managed and protected forests of North-East India with particular reference to soil fauna. Agro Botanica, 11, 108-118.

Hattar, S. J. S., Alfred, J. R. B. and Darlong, V. T. (1992). Soil acarina and collembola in forest and cultivated land of Khasi Hills, Meghalaya. Record of Zoological Survey of India, 92, 89-97.

Hattar, S. J. S., Darlong, V. T. and Alfred, J. R. B. (2008). Soil fauna diversity and shifting cultivation: an observation from north-east India. Annals of Forest, 16(2), 340-357.

Huhta, V., E. Karppincn, M. Nurminen & A. Valpar. (1967). Effect of silvicultural practices upon arthropod, annelid and nematode populations in coniferous forest soil. *Ann. Zool. Fennici.* 4 : 87-143.

Huhta, V., E. Karppinen, M. Nurminen & A. Valpar. (1969). Further notes on the effect of silvicultural practices upon the fauna of coniferous forest. sol. *Ann. Zool. Fenn.* 6 : 327-334.

Kerkhoff, E. and Sharma, E. (2006). Debating on Shifting Cultivation in the Eastern Himalayas. Farmers' innovations as Lessons for Policy. ICIMOD, Kathamandu.

Jamir, A. (2015). Shifting options: a case study of shifting cultivation in Mokokchung District in Nagaland, India. In C. Erni (Ed) *Shifting Cultivation, Livelihood and Food Security New and Old Challenges for Indigenous Peoples in Asia*, pp. 159-202. FAO, IWGIA & AIPP, Bangkok.

Kumar, K. (2017). State land policies and shifting cultivation in Odisha, India. In Malcolm Cairns (Ed) Shifting Cultivation Policies : Balanding Environmental and Social Sustianability, pp. 414-440. CABI, UK.

Mishra, B.K. (1981). Studies on *Jhum* (slash and burn cultivation) at higher elevations of Meghalaya. Ph.D. Thesis, North-Eastern Hill University, p.176.

Mishra, B.K. & P.S. Ramakrishnan. (1981). The economic yield and energy efficiency of hill agro-ecosystems at higher elevations of Meghalaya in Northeastern India. *Oecol. Applic.* 2, 369-389.

Moore, J C , Walter, D E, & Hunt, H W. (1988) Arthropod regulation of micro- and mesobiota in below ground detrital foodwebs. Annual Review of Entomology, 33: 419-439

Moore, J C, de Ruiter, P C & Hunt, H W (1993) Influence of productivity on the stability of real and model ecosystems. Science, 261:906-908

MoSPI (2014). Ministry of Statistics and Programme Implementation Year Book, 2014. Govt of India, New Delhi.NEPED (Nagaland Environmental Protection & Economic Development), 2007. Adding Value to Shifting Cultivation in Nagaland, India. NEPED, Govt of Nagaland, Kohima

NEPED (Nagaland Environmental Protection and Economic Development) and IIRR (International Institute of Rural Reconstruction) (1999). *Building Upon Traditional Agriculture in Nagaland, India*. Silang, Cavite, Philippines: IIRR

NERCORMP (2017). Project Completion Review Report of North Eastern Region Community Resource Management Project for Upland Areas (NERCORMP). NERCORMP, Shillong.

NITI Aayog (2018). Report of the Working Group III - Shifting Cultivation: Towards a Transformational Approach. NITI Aayog, Govt of India, New Delhi.

Nongmaithem, A., (2013) Study on biodiversity of soil arthropods in Forests and Agroeciosystems of Meghalaya. Ph.D. Thesis, North-Eastern Hill University, p. 283.

Pandey, D. K., Himansu, K. B., Shantanu, K. D., Bagish, K., Shivani, D., & Adhiguru, P. (2019). Indigenous people's attachment to shifting cultivation in the Eastern Himalayas, India: A cross-sectional evidence. *Forest Policy and Economics*, Vol. 111, 102046. Doi: https://doi.org/10.1016/j.forpol.2019.102046

Paul, D. (1991). Ecological studies on soil arthropods in forests and agroecosystems of Meghalaya. Ph.D. Thesis, North-Eastern Hill University, p. 514.

Paul, D. Nongmaithem, A. and Jha, L.K. (2011). Collembolan Density and Diversity in a Forest and an Agroecosystem. Open Journal of Soil Science, 1: 54-60.

Peterson, H & Luxton, M A (1982) Comparative analysis of soil fauna populations and their role in decomposition process. Oikos, 39(3):288-308

Poole, T.B. 1961. An ecological study of the Collembola in a coniferous forest soil. *Pedobiologia*. 1: 113-137.

Posey, D.A. (1985). Indigenous management of tropical forest ecosystems: the case of the Kayapó indians of the Brazilian Amazon. *Agroforestry Systems*, 3:139–158

Price, D.W. (1975). Vertical distribution of small arthropods in a California pine forest soil. *Ann. Entomol. Soc. Am*. 68: 174-180.

Rerkasem, K., Lawrence, Dl, Padoch, C., Schmidt-Vogt, D., Ziegler, A.D. and Brunn, T.B. (2009). Consequences of swidden transitions for crop and fallow biodiversity in Southeast Asia. Hum. Ecol. 37: 347-360.

Rosek, J. (1978). Pedozootische Sukzessionen wahrend der Entwicklung Von Okosystemen. *Pedobiologia*. 18: 426-433.

Sajise, P.E. (2015). Biodiversity and swidden agroecosystem: An analysis and some implications. In Shifting Cultivation and Environmental Change: Indigenous People, Agriculture & Forest Conservation (Malcolm, F. Cairns, ed.), Routledge, London, pp. 401-418.

Satapathy, K.K., Sarma, B.K., Goswami, S.N. and Verma, N.D. 2003. Developing Lands Affected by Shifting Cultivation. Department of Land Resources, Ministry of Rural Development, Government of India, New Delhi.

Sharma, T.C. (1976). The prehistoric background of shifting cultivation. In: Shifting Cultivation in North-East India (B. Pakem et. al., eds.), NEICSSR, Shillong. pp. 1-4.

Solheim, W.G. (1967). Southeast Asia and the West. *Science*. 157, 896-902.

Southwood, T.R.E. (1977). Habitat, the template for ecological strategies. J. Anim. Ecol. 46: 337-365.

Southwood, T.R.E. (1978). Ecological Methods with particular reference to the study of insect populations. Chapman & Hall

Teegalapalli, K., Veeraswami, G.G. and Samal, P.K. (2009). Forest recovery following shifting cultivation: an overview of existing research. Tropical Conservation Science, 2(4):374-387.

Vatsauliya, P.K. & J.R.B. Alfred. (1993). Ecological studies on *Jhum* Fallows (Meghalaya) with particular reference to soil fauna. Records Of The Zoological Survey Of India. Occasional Paper No. 149, p120.

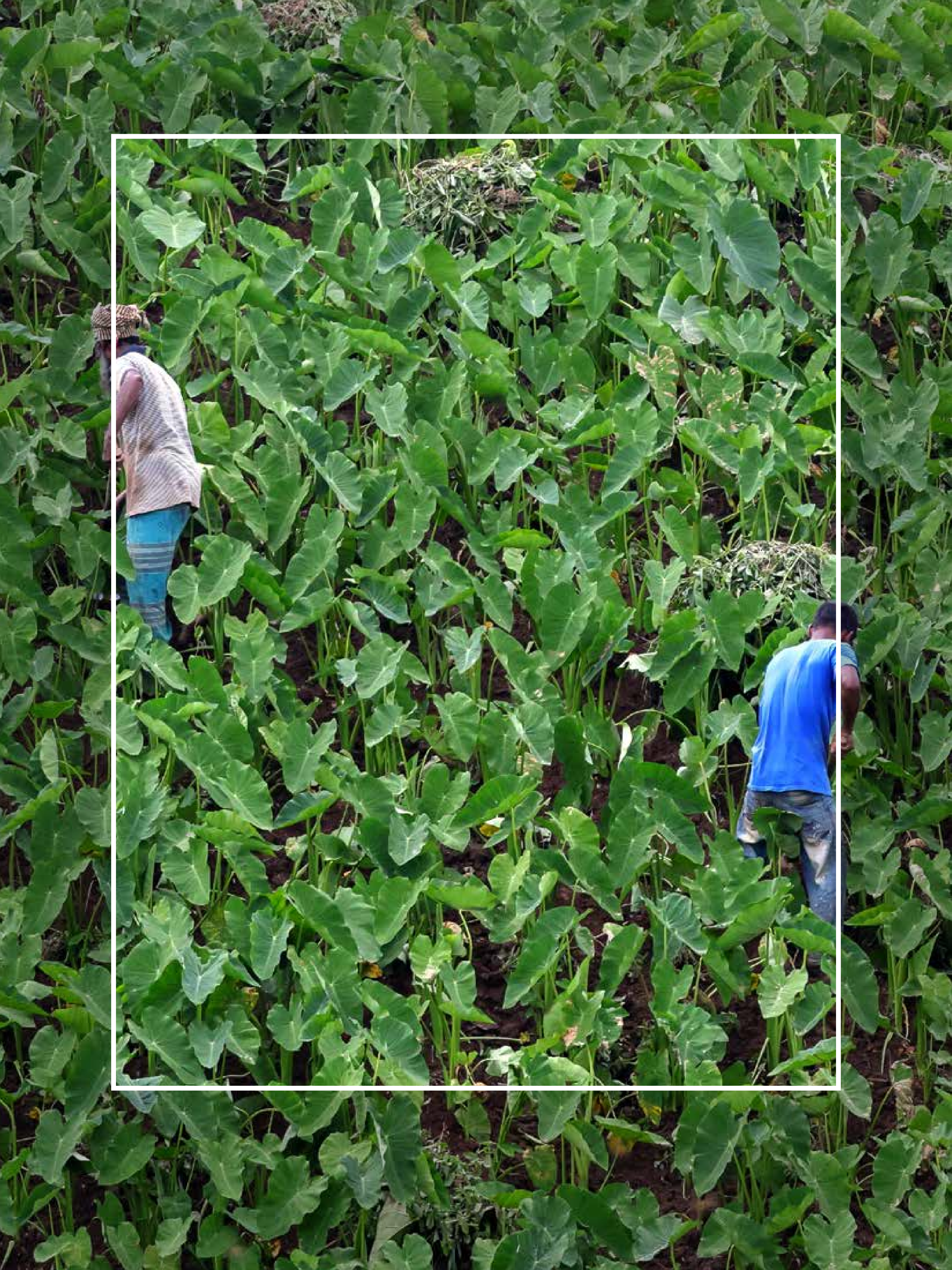
Visser, S. and Whittaker, J.B. (1977). Feeding preferences for certain litter fungi by Onychiurus subtennuis (Collembola). Oikos,29:320-325

Visser, S., Whittaker, J.B. and Parkinson, D. (1981). Effects of collembolan grazing on nutrient release and respiration of a leaf litter inhabiting fungus. Soil Biology and Biochemistry, 13:215-218

Wallwork,J.A. (1967). Acari. In:Burges, N. A. and raw, F (eds) Soil biology 363-398

Zimba, D.T. (1978). Geography of Meghalaya. Standard Printing Press, Gauhati, India.136p

Zodinpuii, B. ., Lalnuntluanga, & Lalthanzara, H. (2019). Diversity of soil macroarthropods in shifting cultivation and forest ecosystem of Mizoram, Northeast India. *Journal of Applied and Natural Science*, *11*(3), 601-611. https://doi.org/10.31018/jans.v11i3.2122



CHAPTER-10

RELIABLE OR NOT? RETHINKING SHIFTING CULTIVATION ESTIMATES TO INFORM LAND-USE POLICY

Amit John Kurien*

Abstract

Shifting cultivation landscapes are mosaics of farms, fallows, forests, and other non-forest land uses. Official forest cover estimates from such landscapes in the northeast Indian states are among the highest in the country. Curiously, agriculture department reports and other official and popular impressions of changes in the landscape paint a picture of plantation expansion and large-scale deforestation due to shifting cultivation. On the contrary, existing estimates of shifting cultivation suggest that it is a land use that is almost negligible in presence.

This chapter investigates the above puzzle in policy discourse by asking why maps showcase such drastically different views and what might be going wrong in the way they are created. Without this basic information, progress towards understanding the contribution of shifting cultivation landscapes for biodiversity and sustainable development will remain ambiguous.

Using a comparative understanding of different studies set against a rigorous mapping framework for shifting cultivation landscapes, the chapter argues that the large variations in land uses noticed in different maps are because of the way shifting cultivation is understood, defined, and measured, which is chiefly attributable to ambiguous normative framings. Using West Garo Hills, as an example, the chapter compares a well-conducted mapping exercise with estimates observed from other mapping surveys such as Wastelands Atlas of India, state government statistics, Forest Survey of India, and other studies. The comparison underscores fundamental issues in mapping such as poorly defined land categories and insufficient understanding of factors that constitute shifting cultivation, forest, and non-forest. The chapter also points out that shifting cultivation is certainly the most widespread land use in West Garo Hills and is quite likely a significant land use for the entire northeast India. However, this is not reflected in mapping studies because of

* Visiting Faculty, Institute of Public Policy, National Law School of India University, Bengaluru – 560072, India | Email: amitkurien@gmail.com

poor definitions and methodology. Along with it, plantations too are found to be a major land use. These ideas upend popular interpretations of these landscapes as 'forested' or as entirely shifting cultivation-only landscapes. The study further suggests reasons why plantation expansion and population increase are relevant factors to consider in the examination of questions of changes in shifting cultivation intensities (that is, fallow periods) and deforestation. Without detailed multi-causal approaches to examine these questions, policy prescriptions to manage shifting cultivation will be unscientific. The chapter points out that scientists and policy experts need to be attentive to the socially defined character of land categories. It is crucial to choose socially relevant land categories during mapping and not those ones for which there is implicit global preference or others that are easily separable. The lack of field-level understanding of shifting cultivation and its sub-components (cultivated fields and fallows) and farm management, and other land uses such as tree plantations and forests hamper in defining and mapping the landscape, undertaking mapping and establishing accuracy of estimates that are relevant for both environmental decision-making and ensuring people's livelihoods. From a policy and land management perspective, the chapter calls for a careful revision of India's official land-use mapping protocols and has significance for mapping of similar shifting cultivation landscapes.

Introduction

Shifting cultivation is a widespread and simultaneously contentious agricultural practice in the tropical countries in the world (Heinimann, *et al*. 2017). Many experts think of it as useful for maintaining forest cover, biodiversity, soil and water conservation and climate mitigation, and a vital ingredient for ensuring nutritive health and livelihood for millions of people in the hilly tropics where access to roads and development is poor (Bruun, *et al*. 2009; Ziegler, *et al*. 2009; van Vliet, *et al*. 2012; Ickowitz, *et al*. 2016). Others, including policy makers and researchers, however, criticise it for being environmentally destructive, consider it a 'wasteland' in need of development and outright eradication (FAO 1957; Greenland 1975; Myers 1992). The northeast India, where shifting cultivation is practised widely, has witnessed it being both celebrated for its share to safeguard livelihoods (Ramakrishnan 1992; Kerkhoff and Sharma 2006) and reviled as the cause of deforestation (Ranjan and Upadhyay 1999; Manhas, *et al*. 2006). Both national and state governments have preferred to curtail it and continue to encourage cash crop plantations, the most recent being the plan to expand oil palm under the National Mission on Oil-Oil palm (NMEO-OP) (MoA-GoI; NLUP; SWC-GoM 2017).

Transitions introduced to the shifting cultivation pose fundamental problems. Despite decades of debate, the extent of shifting cultivation, how much it is intensifying, and whether it actually causes deforestation, and so on have largely remained unresolved (Schmidt-Vogt, *et al*. 2009). In South Asia, even though estimations of the extent of shifting cultivation and its trends are observed given widespread use of remote-sensing technology, large discrepancies in data abound in the literature. For instance, Talukdar, *et al*. (2004) claims the extent of shifting cultivation in

Keywords: *Jhum*, mapping, remote sensing, land use, Forest Survey of India, Wasteland Atlas of India, Directorate of Economics and Statistics

small region of Garo Hills to be 500 km^2 in 2000, while Behera, *et al*. (2017) identified no class at all as shifting cultivation but maps fallows and identified 281 km^2 as 'wasteland' in 2005 for the entire region of northeast India. Even when estimates of forest from the Forest Survey of India (FSI) and of shifting cultivation by the Wasteland Atlas of India are included, the confusion only increases. Not surprisingly, NITI Aayog, India's top planning body, recently emphasised the need for resolution of this problem in order to move ahead with mapping and understanding of issues in shifting cultivation landscapes to further policy (NITI Aayog 2018).

This chapter engages with the research-cum-policy concern: Why is there such variance, even errors, in the basic data on land uses from shifting cultivation landscapes? This analysis will go on to substantiate that such discrepancies are rooted in differences in understanding of shifting cultivation and forest and other land uses and their corresponding land covers, and inadequacies in image interpretation and verification. A precise understanding of the issues involved in mapping is reviewed in this chapter. The results of a well-undertaken case study based on a socially specific understanding of the land uses on the landscape are first briefly provided to identify both the extent of shifting cultivation and forests. A comparison with other similar estimates is also made to understand how serious the issue of mis-estimation of shifting cultivation really is. The chapter also discusses how the choice of classes and methods can make 'out-of-mind' land uses such as shifting cultivation altogether invisible on a landscape and its implications for both agriculture and forest policy and consequently those oriented towards shifting cultivation. Furthermore, the chapter furnishes reasons why a well-conducted mapping exercise has the potential to also unearth finer understanding of landscape patterns such as fallow periods and how they correlate with the land-use mapping results, and especially if combined with socio-economic data, something that is generally ignored, and can potentially throw light on questions about shifting cultivation-led agricultural intensification and deforestation.

Research Questions

1. Why do shifting cultivation estimates from India show so much variation and what is the probable cause of this mapping conundrum? What elements constitute a good mapping framework for shifting cultivation landscapes?
2. What do current estimates about shifting cultivation and other land uses suggest about the reliability of existing frameworks for mapping shifting cultivation landscapes?
3. Given concerns about deforestation and agricultural intensification, are there relevant emergent landscape patterns that we can grasp from reliable land-use maps and what could be their implications for biodiversity conservation and agricultural productiveness?

A Framework for Mapping Shifting Cultivation Landscapes

To understand the nature of reliability of mapping practices in India, this chapter first establishes the main features to be noted while mapping shifting cultivation landscapes. Key features in a shifting cultivation landscapes are first identified based on what is already known about these landscapes and based on significant fieldwork with the help of local informants and the characteristics of land uses and land covers examined to set out a frame that has the essential ingredients for proper mapping of shifting cultivation landscapes. This framework is then used to compare existing studies.

As a preface to this section, it is important to highlight that societal concerns related to shifting cultivation landscapes have generally been focused around two central concerns: (i) deforestation and biodiversity conservation and (ii) agriculture production and sustainability (Laurance, *et al*. 2006; Lawrence, *et al*. 2010; Ziegler, *et al*. 2011). In order to suitably address these concerns, maps of shifting cultivation landscapes need to define shifting cultivation and forests clearly. Furthermore, it is important that other classes on the landscape are not confused with these two. For this study, shifting cultivation is defined as including both the actively cultivated fields and the fallow fields since they together form the cyclical agricultural practice. It is worth mentioning, clarification and definition are foundational in setting the boundaries of a mapping framework.

A Social–Scientific Land-use Classification for Analysing Land Uses/ Land Covers

Map classification schemes and land-use categories are often based on well-established land covers and land uses that subscribe to standardised national or international classification schemes (Herold, *et al*. 2006; Gong, *et al*. 2016) or others that make for easier class separability using remote-sensing algorithms. The field of critical geography, however, points out that map classification schemes are necessarily social constructs, reflecting categories and distinctions based on the values placed by the researchers (Robbins 2001; Comber, *et al*. 2007). Since different groups in society ascribe different values to dissimilar land uses, these distinctions should not be combined, but maintained, in order to showcase the different values the landscape that is classified are being attributed to. For example, maps that represent land covers and land uses that maximise different values such as biodiversity conservation, agricultural productiveness, carbon sequestration, and so on for the same study area would look different from each other. Maps made using land cover-based classifications that are agnostic about land-use differences and use arbitrary cut-offs between classes (for example, using NDVI values) would look very different but more importantly also end up serving no useful social purpose to inform policy. This is important since the purpose of a land-use map is to aid different stakeholders. Therefore, the first step in a socially-sensitive land-use classification should be to determine which classes are the most pertinent to a particular set of social or policy concerns in a given context.

For instance, mapping 'forests' to characterise high-biodiversity areas in shifting cultivation landscapes would mean that all low-biodiversity land uses should be excluded from the 'forest' category and identified as 'non-forest' . This would mean that tree plantations should not be considered 'forests'. Similarly, fallows should also be kept out of the 'forest' class simply because they are lower in biodiversity even though often it is found to have more than plantations (Mandal and Raman 2016). However, if the mapping concern and identification of forest are to map high-carbon content areas, mapping plantations and old fallows into the 'high-carbon' class would be appropriate. If the same land-use map has to address different audiences that might be interested in conservation, agricultural productiveness, carbon sequestration potential and/or sustainability questions in shifting cultivation, the map must make adequate distinctions between all these classes: high-/low-biodiversity uses, young/old fallow, and high-/low-carbon uses (intermediate gradation can be used), and so on.

Many studies on shifting cultivation, to some degrees, have imbibed this concept. For example, majority of the studies distinguish active shifting cultivation fields from wet rice cultivation (Leisz and Rasmussen 2012; Hurni, *et al*. 2013) while many separate old shifting cultivation fallows and different forms of forest (Fox, *et al*. 2000; Inoue, *et al*. 2010). Some studies distinguish between old growth forests from single-species tree plantations (Meyfroidt, *et al*. 2013; Ornetsmüller, *et al*. 2018), however, others that use NDVI approaches to segregate vegetation stages in fallows are ambiguous about discriminating tree plantations (Yamamoto, *et al*. 2009).

Mapping Shifting Cultivation, Forests, and Forest-like Land-uses

The generic challenge of translating land covers into land uses gets protracted while mapping shifting cultivation landscapes because shifting cultivation transitions through a spectrum of land-cover classes—cleared land, burned land, land with crops—fallows that start as abandoned fields after harvest with grass, to bush, and end up in being a part of secondary forest. Thus, for example, land-cover classes such as 'shrub', 'scrub' or 'bush' that may be interpreted as 'degraded forest' in a context where shifting cultivation does not exist (for example, deciduous vegetation landscapes, arid zones), might get interpreted as regenerating fallows in shifting cultivation landscapes. Similarly, well-fertilised fields with successive years of cultivation will contain more vegetative cover and at best will only go through clearing, drying and/or mulching and so will contain grass. These too need to be identified separately as actively cultivated fields. The transitioning of very early fallows may resemble such fields, and so will need to be identified separately. Thus, when mapping the extent of shifting cultivation in a large landscape, a precise understanding of the average number of years of cultivation along with accurate ground data on it and on fallows is needed to separate them. The former varies across regions and even from village-to-village. One has to also be careful of the kind of shifting cultivation practices prevalent as those with simply only mulching of soils for cultivation will imply that identifying active shifting cultivation sites would be harder than if there are areas with clearing and burning of fallows for cultivation.

In this review, the focus is maintained on the South Asian studies, much of which comes from India. Indian studies have by and large lagged behind on several fronts, starting with both map-making and causal attribution of land-use changes. They show three main problems: First is a problem of definition. State agencies such as the FSI have maintained their forest cover definition as all tree cover above 10% tree canopy density, thereby including forest-like horticultural plantations or tree-shaded crops like coffee in their estimates of forest cover (FSI 2015). Many researchers have followed this approach without distinguishing shifting cultivation, plantations, and forests (Lele and Joshi 2008; Yadav, *et al*. 2012). Such forest-focused studies ignore shifting cultivation as a land use, thereby incorrectly including cultivation and fallow phases into different forest or non-forest classes. The FSI reports simply aggregate everything under non-forest, but their canopy density-focused definition implies that the older fallows (which resemble secondary forest) will most likely get counted as 'open forest'. Behera, *et al*. (2017) define both a fallow class and a 'wasteland' class without clarifying what they contain; but in the absence of a shifting cultivation class, active cultivation areas will likely end up in this class. Thus, claims about shifting cultivation as the cause of deforestation in northeast India based on studies that only map forest cover and not shifting cultivation are simply unfounded (Lele, *et al*. 2008). Yet other studies include numerous forest classes following floristic land cover-oriented stratification, but forget to do the same with shifting cultivation or the large variety of plantations classes—together this leads to an exaggerated area estimates for forest (Joshi, *et al*. 2006).

Second, where shifting cultivation is explicitly part of the classes being mapped, a confusing multiplicity of classes are often found (Roy, *et al*. 2015, who use 'current *Jhum*', 'abandoned *Jhum*' and 'shifting cultivation'). The Wasteland Atlas of India (NRSC-MRD 2011), the only official source that maps shifting cultivation, estimates only the burned and cleared area figures excluding the multiple cultivation years. However, the official denotation as 'wasteland' makes the bias against a legitimate agricultural land use for the entire northeast Indian region amply visible.

Third, the confusion between land cover and land use and a poor choice of classes is often compounded by limited ground truth and post-classification accuracy assessment. For instance, in mapping land cover for the whole state of Meghalaya in northeast India, an area of 22,429 km^2, Roy and Tomar (2001) use only 69 pixels for accuracy assessment for a total of 10 classes, while others provide no details on ground truth used (Talukdar, *et al*. 2004; Sarma, *et al*. 2015). Singh, *et al*. (2013) and Roy and Joshi (2002) have conducted fairly relevant mapping and include *Jhum* and 'abandoned *Jhum*', but it is unclear if even they covered all land covers within shifting cultivation and plantations given inadequate methodological clarity. Using decision tree-based methods, Das, *et al*. (2021) identify shifting cultivation areas but it appears that their emphasis is only on the cleared and burned areas without clarifying nature of land covers. It is incorrect to assume that all shifting cultivation areas will necessarily have a burning phase and thus have visible burn signatures that can be captured on the imagery. If there are multiple years of cropping they may not undergo burning. Moreover, the fallow areas are missed out entirely. Two methodological issues arise out of this. First, a silvicultural and tree-based focus is being employed in landscape classification convention in many studies, excluding other equally valid ways of perceiving forest and non-forest landscapes. Second, most studies rely heavily on visual classification and/or some form of automatic rule-based classification thus missing ground realities of the many land uses and how they may overlap in these landscapes.

Overall, land-use mapping that intends to address issues of biodiversity conservation and agricultural sustainability in a shifting cultivation context therefore needs to clearly define and identify the following on the landscape:

1. Active shifting cultivation fields (multiple years of cultivation and the land covers within ensuring careful inclusion of cleared, burned, harvested fields depending on the number of image layers used for classification)
2. Distinguish active cultivation fields from fallow fields
3. Distinguish fallows from forests
4. Distinguish non-forests and land uses other than shifting cultivation and forests

Furthermore, depending on the goal of the mapping, that is, whether to speak to biodiversity concerns, agriculture viability, carbon sequestration potential, timber availability, or a mix of these goals, and so on, fallow, forest, and non-forest classes such as tree plantations need to be appropriately categorised.

Identifying Spatial Patterns in Fallow Periods/ Land-use Intensity of Shifting Cultivation

An expansion in the total area under the shifting cultivation cycle leads to 'deforestation' (defined as a net reduction in old-growth forest area). However, if additional area is unavailable, shifting cultivation intensifies by shortening of the fallow period, possibly leading to unsustainable production. Hence, estimation of fallow periods or land-use intensity of shifting cultivation, trends in them, and the drivers of these trends are of interest to policy-makers. Internationally, remote-sensing-based analyses of fallow periods are limited, but researchers have made headway to answer this question (Hett, *et al*. 2012; Dutrieux, *et al*. 2016; Jakovac, *et al*. 2017). However, despite the concern about intensification, the South Asian literature has not published any relevant material so far to reliably demonstrate intensification or deforestation in shifting cultivation landscapes. Meta-analysis of studies indicate shortening of fallow periods in most parts of the world (van Vliet, *et al*. 2012). The drivers of declining fallow periods have been debated extensively, ranging from population to multiple drivers and complex pathways (Lambin, *et al*. 2001). It is worth mentioning, in many locations plantations are seen to play a major role in 'eating up' land available for shifting cultivation, thus intensifying it. But it needs to be seen as multiple factors may affect intensification.

In order to compare and contrast studies that have provided estimates of shifting cultivation, forests, and other land uses, this chapter focuses on the methods and results of studies from West Garo Hills district. An overview of the study area, the land uses and prominent land covers found, and overall methodological approaches of the studies under consideration are provided in brief in the ensuing section. This is followed by the comparison and discussion of these estimates to understand the issues in mapping frameworks and significance of shifting cultivation landscape, in the present context, for biodiversity conservation and agricultural sustainability, based on one reliable study.

Study Area and Methods

The West Garo Hills district in the state of Meghalaya, northeast India lies between 25°47´–26°10´ N latitude and 89°45´–92°47´ E longitude (Figure 1) and is characterised by an undulating terrain (up to 1400 m above sea level). The climate is mostly humid sub-tropical with average annual rainfall of 2000–4500 mm. The district has an overall population density of 175 persons per km^2 (CoI 2011).

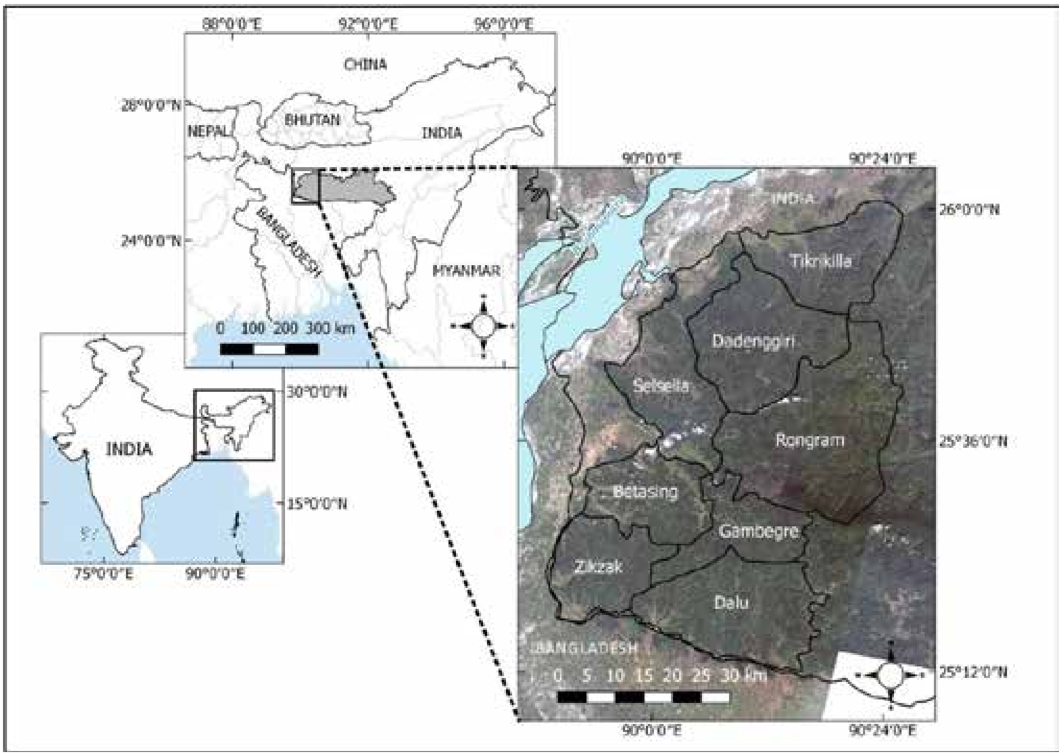


FIGURE 1: The West Garo Hills district (before bifurcation) in the state of Meghalaya in northeast India showing its eight community and rural development (CRD) blocks

In classification, the natural vegetation of this region is divided amongst semi-evergreen and wet evergreen forest vegetation types. Shifting cultivation is widespread with crops such as hill rice (*Oryza sativa*), maize (*Zea mays*), along with millets and a variety of vegetables, tubers, and leafy greens. The land is typically cultivated for two years before fallowing based on fieldwork conducted during 2013–14. The first-year fields are created by clearing (Figure 2a) and burning (Figure 2b) a fallow in the month of March or April, and sown soon after (Figure 2c). The field is harvested at the end of the first year in November (Figure 2d) to prepare it for another year of cultivation. These land covers in the active shifting cultivation fields showcase how differentiated the landscape can be and how careful one needs to be when undertaking mapping.

FIGURE 2: Land covers within the active shifting cultivation in Garo Hills in 2013–14

The main land uses of relevance in a shifting cultivation landscape in the Garo Hills context in general and those used from the study site in particular are provided in Table 1.

Table 1: Land use and land covers found in West Garo Hills district

Land uses Found in Shifting Cultivation Landscapes	Land covers in West Garo Hills	Class Definition
Active shifting cultivation (ASC)	1st year ASC (cleared)	1st year cultivation fields
	1st year ASC (burned)	
	1st year ASC (harvested)	
	2nd year ASC (cleared)	2nd year cultivation fields
	2nd year ASC (burned)	
	2nd year ASC (harvested)	
Young fallow		1–10 years fallow period
Old fallow		11–20 years fallow period
Old growth forest		≥ 20 years fallow period
Cashew plantation		Cash crop tree plantations' land uses
Areca plantation		
Rubber plantation		
Wet rice cultivation		Irrigated paddy cultivation
Other cultivation		Mixed orchards/ home garden
Water bodies		Rivers, streams, tanks

The chapter compares results of a few key studies from the study area. Most of the studies used remote sensing as their basis for mapping except the Directorate of Economics and Statistics (DES) of the Ministry of Agriculture and Farmer Welfare, Government of India which relied on ground-up surveys. The studies were undertaken in two ways: there were those that exclusively focused on mapping the extent of shifting cultivation alone and others that mapped the different land-use categories on the entire landscape. Among the studies examined, Kurien, *et al*. (2019) defined and characterised the land uses and land covers based on the above-mentioned social-scientific land-use classification and a clear normative framing. The next section is therefore based on a comparative examination of other studies against the findings of this study to understand the issues facing estimation of shifting cultivation and also its social implications. The comparison also covers some of the latest research that came after NITI Aayog expressed its concerns about mis-estimation of shifting cultivation. The chapter also provides some new data on population that indicates its relevance in examining causal relationships with fallow period decline and with land-use change.

The estimates of the extent of shifting cultivation are compared with those from several other sources. A comparable data has been developed from six sources (given below) for roughly the same region (district or at least a 3-district regional cluster) as the study area:

1. The Wastelands Atlas of India (2011)
2. Talukdar, *et al*. (2004)
3. Sarma, *et al*. (2015)
4. Yadav and Sarma (2014)
5. Riahtam, *et al*. (2018)
6. A conventional bottom-up administrative reporting to the Directorate of Economics and Statistics (DES) of the Ministry of Agriculture (DES 2016).

Of these, first five are based on remote sensing. Among the remote-sensing studies, decision tree modelling techniques (Talukdar, *et al*. 2004), object-oriented classification (Yadav and Sarma 2014; Riahtam, *et al*. 2018) and a detailed two-season land-use classification (Kurien, *et al*. 2019) are used. The Wasteland Atlas, being a national mapping exercise, uses a wall-to-wall mapping using Resourcesat LISS III image of 2008–09, wasteland vector layer based on pre-defined national-level definitions of land-use and land-cover categories. The FSI too conducts a national mapping exercise but with different land-use categories and definitions.

Results and Discussion

Land-use Extents

A brief overview of the land-use statistics of West Garo Hills for 2013–14 by Kurien, *et al*. (2019) is necessary before a comparison is made (Table 2). The study highlighted two significant departures from regular understanding of shifting cultivation that this chapter utilises while providing the comparison. Firstly, both shifting cultivation and horticulture tree plantations are ubiquitous in the district where the former covers a total of 39% (1306 km^2) and the latter nearly 30% of the landscape. Secondly, old growth forests occupy only 9.7% of the district and are largely restricted mostly to high elevations.

Table 2 Land-use statistics for West Garo Hills district (Kurien, *et al*. 2019)

Class name	Area (km²)	Area (%)
Active shifting cultivation	612	18.2
Young fallow	483	14.3
Old fallow	211	6.3
Old growth forest	327	9.7
Rubber plantation	114	3.4
Areca palm plantation	446	13.2
Cashew plantation	443	13.1
Wet rice cultivation	287	8.5
Other cultivation	248	7.4
Water	168	5.0
Cloud	32	0.9
Total	**3371**	**100**

The results of the different studies from West Garo Hills district are now compared to showcase the variance in estimates of shifting cultivation from the study site, also taking into account their individual approaches to mapping to identify the key issues that crop up. The section also discusses some advantages of a proper mapping in identifying fallow periods and also causal factors of land-use change if necessary socio-economic data are combined.

'Invisible' Farms

To understand the relevance of shifting cultivation and to manage it, one has to first 'see' its prevalence (or the lack of it) on maps and identify where it is found/not found. The comparison of studies, shown in Table 3, highlights several issues and discrepancies that can be observed. To begin with, Kurien, *et al*. (2019) provide an estimate of 612 km^2 (18%) of West Garo Hills landscape as under active shifting cultivation, followed by 694 km^2 (21%) under fallows, totaling 39% as shifting cultivation on the landscape thus making it the single largest land use in the district. The study identifies with clear definitions what land covers constitute these land uses also. It also provides a clear normative framing since it focuses on biodiversity conservation and agriculture sustainability goals. Therefore, it also separately identifies active shifting cultivation (including all its land covers), two levels of fallows, old growth forests, plantation categories and other non-forest categories with adequate ground truth and fieldwork based on detailed local information.

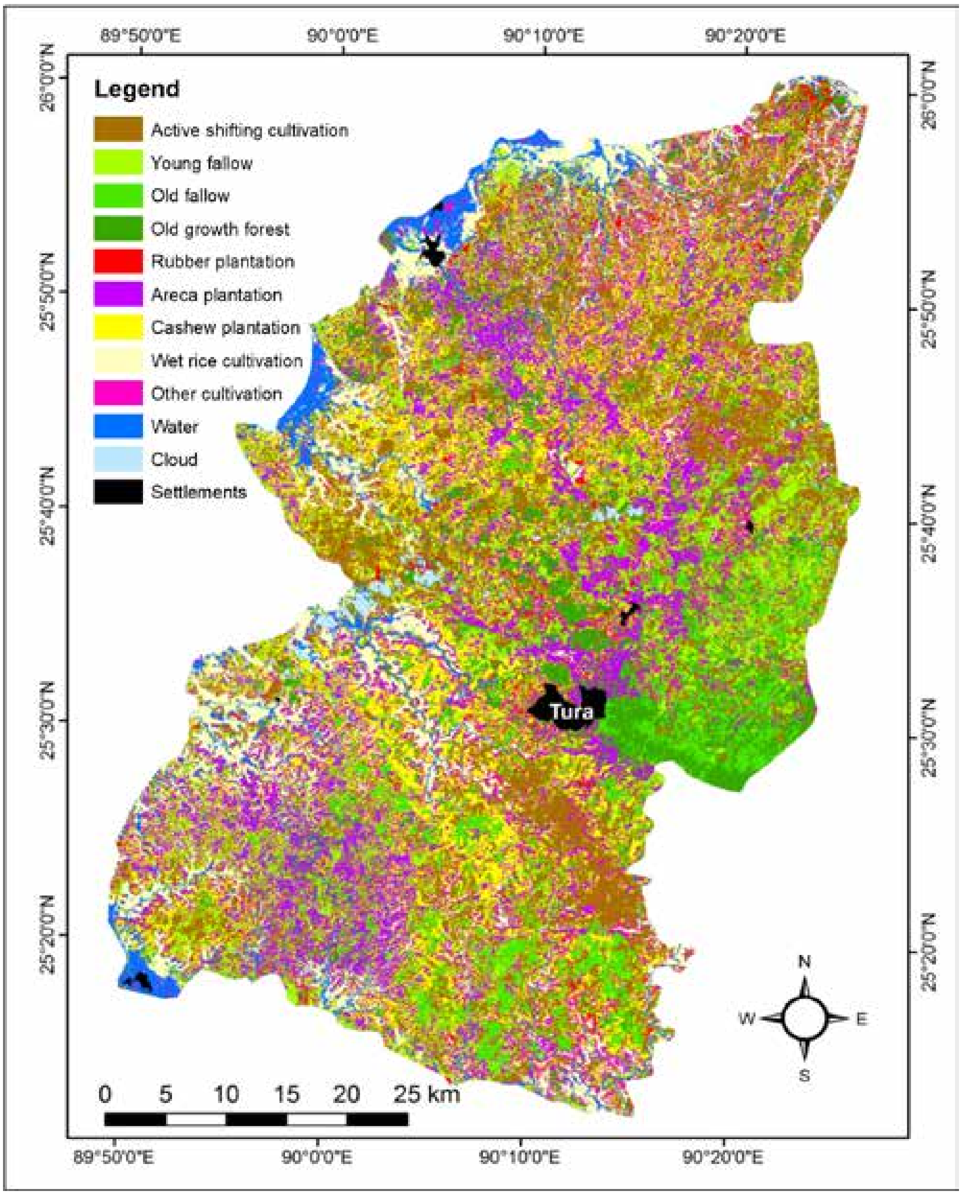


FIGURE 3: Land-use map of West Garo Hills district for 2013–14 (Kurien, *et al*. 2019)

The comparison of estimates of the extent of shifting cultivation as found by other studies is laid out in Table 3. Several discrepancies could be observed. The first issue is the problem of definition. Instead of a well-separated class for active shifting cultivation, it is being referenced using a multiplicity of terms such as 'barren and uncultivable land' (DES) or 'current *Jhum*' and 'abandoned *Jhum*' (Talukdar, *et al*. 2004), 'slash-and-burn land' without clarifying what land covers they contain (Yadav and Sarma 2014). Riahtam, *et al*. (2018) defined shifting cultivation areas using the split-categorisation of 'current *Jhum*' defined, as all cultivated areas and 'regenerating

TABLE 3: Comparative extent of shifting cultivation and all agriculture land uses (in km2)

Source		Kurien, et al. 2019	DES, Department of Agriculture, Government of India 2013–14	The Wastelands Atlas of India 2011	Riahtam, et al. 2018	Talukdar, et al. 2004	Sarma, et al. 2015	Yadav and Sarma 2014
Year of data collection		2013–14	2013–14	2008–09	2010	2000	2013	2010
Spatial scale		West Garo Hills district			East Garo Hills district	All 3 Garo Hills districts		
Cultivation	Wet rice cultivation	287 (9%)				745 (9%)		
	Active shifting cultivation	612 (18%)	72 (2%)1	115 (3%)	25 (1%)	500 (6%)4	159 (2%)	421 (5%)
Fallow agricultural land	Fallow (young and old)	694 (21%)	606 (16%)2	463 (13%)3	23 (1%)	4112 (50%)	43 (0.5%)	4307 (53%)
Tree-like agriculture	Plantations	1003 (30%)	Areca = 167 (5%)					2846 (35%)
	Other cultivation	248 (7%)						
Total district area (km2)		3371	3677	3714	2603	8167	8167	8167

Jhum' (defined as fallows <5 years) but without clear details of land covers included or nature of fieldwork or the rationale for choosing 5 years as the upper cut-off mark for fallows. Yadav and Sarma (2014), on the other hand, use a composite classification scheme of FSI classes and separate identification of 'slash-and-burn' areas without clarifying whether it includes fallows or if 'open forest' contain them. Otherwise, shifting cultivation is found in the Wastelands Atlas as a category of 'wasteland', pointing to a clearly pejorative perspective about shifting cultivation without understanding its role in society. Other studies also use such discrediting nomenclature while mapping land cover/land use of the northeast Indian landscape (Behera, *et al*. 2017). Therefore, one observes the problem of definition emanating, arising from the lack of understanding of the shifting cultivation land use among researchers and government agencies. A significant problem noticed in the inability to overcome this problem is the continued adherence of Indian researchers to collect data using 'at-home' or 'lab-based' visual identification techniques or even automated methods alone without significant fieldwork. Early researchers pointed out the inadequacy of such methods in mapping complex tropical forest and horticulture landscape and so notably highlighted the need for more fieldwork in avoiding inaccurate mapping practices (Conant 1994; Wilkie 1994). Furthermore, it does not help that the colonial bias about shifting cultivation as a 'primitive' and 'wasteful' practice gets reflected in modern-day mapping terminology.

Note: Area figures are rounded off to the closest whole number. The district area estimated in our study is smaller than that quoted in The Wastelands Atlas of India 2011 and Directorate of Economics and Statistics 2012–13 due to variations in boundaries that could not be sorted out. The difference in total area, however, does not explain the variation in individual land-use estimates. [1] DES class barren and uncultivable land comes nearest to active shifting cultivation. [2] Includes DES categories 'current fallows', 'fallow lands other than current fallows', 'cultivable wasteland', and 'land with open scrub'. Additional data gathered from DES office in Meghalaya. [3] The standard terminology for fallow category is 'abandoned *Jhum*' in the Atlas. [4] Classified as 'current *Jhum*' but unclear which land covers this class contains.

Secondly, regardless of the definitions used and because of the confusion about understanding land covers that constitute active shifting cultivation, the area under it ranges from only 2%–6% (Talukdar, *et al*. 2004; NRSC-MRD 2011) as against 18.2% as found by Kurien, *et al*. (2019). Although the estimates do not pertain to the same year, this cannot explain the large underestimation. NRSC-MRD (2011) estimates are based on satellite image analysis and they have mapped both cleared and burned fields (but not 2nd year active shifting cultivation fields). One would expect their estimate of active shifting cultivation to be near half of the results from this study (that is, 336 km^2) but instead is only 115 km^2, casting serious doubt on their methodology and quality of interpretation. Similarly, estimates of both cultivation and fallow by Sarma, *et al*. (2015) are simply too low, possibly because of a weak methodology. Given that neighbouring districts of East Garo Hills are equally, if not more, dependent on shifting cultivation, a similar issue is observed since only 48 km^2 (2%) of the landscape is both active cultivation and fallows (Riahtam, *et al*. 2018). As pert Talukdar, *et al* (2004) estimates are not for the same period or district as this study but covers the three districts of Garo Hills region; but their total estimate of active shifting cultivation of 500 km^2 (6%) is smaller than what is observed for a single district alone (Kurien, *et al.* 2019). The underestimation reinforces policy blindness to and the bias against shifting cultivation.

Thirdly, DES' bottom-up estimates are also unreliable, but for a different reason. While administratively assembled land-use data are known to be somewhat inaccurate globally, the larger issue here is that DES imposes a uniform classification across the country, which fits regions with settled agriculture (where categories such as 'current fallows', 'fallow lands other than current fallows' and 'cultivable wasteland' may be more relevant). However, this classification does not suit shifting cultivation landscapes. When combined with the bias visible in its categorisation as a type of wasteland, it appears that the main problem is not estimation or mapping methods, but a refusal to acknowledge it as a distinct and legitimate agricultural land use relevant for people's livelihoods.

Finally, in the context of Garo Hills, neither government reports nor remote-sensing studies identify or systematically estimate the area under plantations, in spite of their significant share in the landscape. Other than that, only Roy, *et al.* (2015) and Kurien, *et al.* (2019) clearly mapped plantations. However, the definition of fallow land based on standardised IGBP land-use categories in the former study makes the national map by the former somewhat unsuitable for local-level policy making. Unfortunately, in most remote-sensing studies it appears plantations have most likely got merged with forest or fallow. However, in DES data, which are supposedly collected bottom-up, only areca is reported, while cashew (which is equally pervasive in Garo Hills , especially in West Garo Hills) and new entrants like rubber are omitted. The area under areca plantations is itself grossly underestimated. The absence of horticultural plantations in the mapping exercises and its underestimation in government statistics is more than just oversight. It is a serious flaw considering the importance of tree plantations like cashew, rubber, and areca for rural livelihoods (Viswanathan 2008) and for understanding environmental outcomes of land-use change (Rerkasem, *et al.* 2009; Ziegler, *et al.* 2009). By focusing only on image quality and mapping algorithms combined with inadequate fieldwork, geographers seem to miss the interpretations that mapping practices and the map products give to map readers. For instance, when plantations are glossed over as some 'fallow' and/or 'forest' the message the map reader (that is, policy makers, concerned citizens) takes home is the reinforcing of an impression of static agricultural practices, when in reality the region is undergoing dynamic changes.

Paper Forests and Invalid Deforestation Claims

Once shifting cultivation and plantations are identified as occupying a total of 2309 km^2 (69%) of the landscape in the study area, it naturally raises questions about the extended forest cover which is purported to be widespread. A comparison of the estimates for natural or old-growth forest from Kurien, *et al.* (2019) with other estimates tells us that compared to the estimate of about 10% old- growth forest, other estimates range from 45% (DES 2016) and 58% by Roy, *et al.* (2015) to 79% by FSI (2015) from the same West Garo Hills district. Thus, shifting cultivation and even horticulture are rendered invisible with overestimation of forest cover. Clearly, the forest representation in the study area is a case of 'paper forests' that only misleads land managers and policy makers.

The reasons for this overestimation are two-fold. Once again, the issue of definition arises. Kurien, *et al*. (2019) defines 'old-growth forest' as those areas with vegetative growth more than 20 years of age, based on published studies that show biodiversity approaching maximum only in such areas. This is a measure than maximises biodiversity and excludes non-forest land uses such as plantations. However, FSI's definition of forest (any area with a tree canopy density >10%) subsumes all forest-like classes such as horticultural plantations and even older shifting cultivation fallows. DES' definition is even more problematic: "any legal enactment dealing with forest or administered as forest whether state-owned or private, and whether wooden or maintained as potential forest land. The area of crops raised in the forest and grazing lands or areas open for grazing within forests should remain included under forest area." DES, therefore, does not report actual land use or land cover but only its legal status. The last two approaches provide a misleading picture of the status of old growth forest in the region. Roy, *et al*. (2015) use better definitions but their land-use map data is too coarse-grained for a highly fragmented farm landscape, casting doubt on the quality of data collection.

The second issue is the quality of interpretation. Even if the area under all tree-like classes (old-growth, horticultural plantations, and old fallows) are summed up, the total is only 46% (Kurien, *et al*. 2019) as against FSI's 79%. Since FSI does not provide details of their ground data collection and validation strategy, it is not clear whether this could be due to inadequate ground truth or uncertainties in particular classes. In the case of Roy, *et al*. (2015), although their classification is for the year 2005, field visits suggest that the forest landscape has not changed dramatically in the 2005–15 period. While the presence of a separate plantation class means that there is no definitional issue, they nevertheless overestimate the area under natural forest: 58% as against 16% (including old fallows).

The estimates of the land uses from this shifting cultivation landscape from one district call into question claims about the northeast Indian region housing a quarter of India's forest cover (FSI 2015). Several studies also infer that deforestation is taking place and attribute it to shifting cultivation in the Garo Hills. However, those that have used time-series data on forest cover (Lele and Joshi 2008; Roy, *et al*. 2015; Behera, *et al*. 2017) do not have shifting cultivation as a class, so it is not clear how the causality is inferred.

Overall, the widespread nature of shifting cultivation is a serious change in understanding of the landscape. The extent of major land uses, such as areca, cashew, and rubber plantations occupy almost one-third of the total landscape. By conflating horticultural plantations with forests (FSI) or largely overlooking them (DES), state agencies are clearly doing a dis-service to policy makers and anyone who seeks to understand the conservation or development imperatives of the region. Accurately, defining and delineating the different plantation crops is essential for land-use mapping not only to avoid conflation of other annual/perennial crop area or old-growth forest with tree plantations, but also because the type of tree plantation could have different repercussions for livelihoods, biodiversity, carbon sequestration, hydrological services, and their trade-offs (Ahrends, *et al*. 2015; Mandal and Raman 2016; Pirard, *et al*. 2017). Encapsulating this multi-dimensionality is what provides land-use mapping its public value. Similarly, overlooking the fact that secondary forest is integral to the shifting cultivation cycle and not separately defining and mapping shifting cultivation fallows prevents a nuanced understanding of the complex mosaic of vegetation that exists on this landscape and its implications for biodiversity, carbon, and livelihoods.

Identifying Correlates of Land-use Intensity Using Land-use Statistics and Socio-economic Data

A good mapping exercise, if combined with land-use metric measures and socio-economic variables, can also throw light not only on patterns of distribution of fallow periods but also correlates of it. The separation of fallows from active shifting cultivation and from old-growth forest enables the estimation of average duration of the fallow period. The average fallow period for the entire district is found to be 2.4 years (range =1.4–4 years) and so usually short in most villages of West Garo Hills (Kurien, *et al*. 2019) and matches global trends (van Vliet, *et al*. 2012).

The expansion of horticultural plantations is a significant driver of this transformation, as already highlighted using land-use statistics disaggregated to the taluk/block-level (Kurien, *et al*. 2019). Farmers are known to plant saplings of cashew, areca, and rubber directly into the active cultivation fields along with shifting cultivation crops. However, in the context of West Garo Hills and Northeast India, generally speaking, population is a key variable that deserves to be examined as a potential correlate of land-use intensity. Population trends from the districts in Meghalaya show a steep rise in population for the latter part of the 20th century. The last three decades, in particular, have consistently seen more than 25%–30% rise in population in all districts in Meghalaya (Figure 4). Field visits to more than 17 villages across West Garo Hills and East Garo

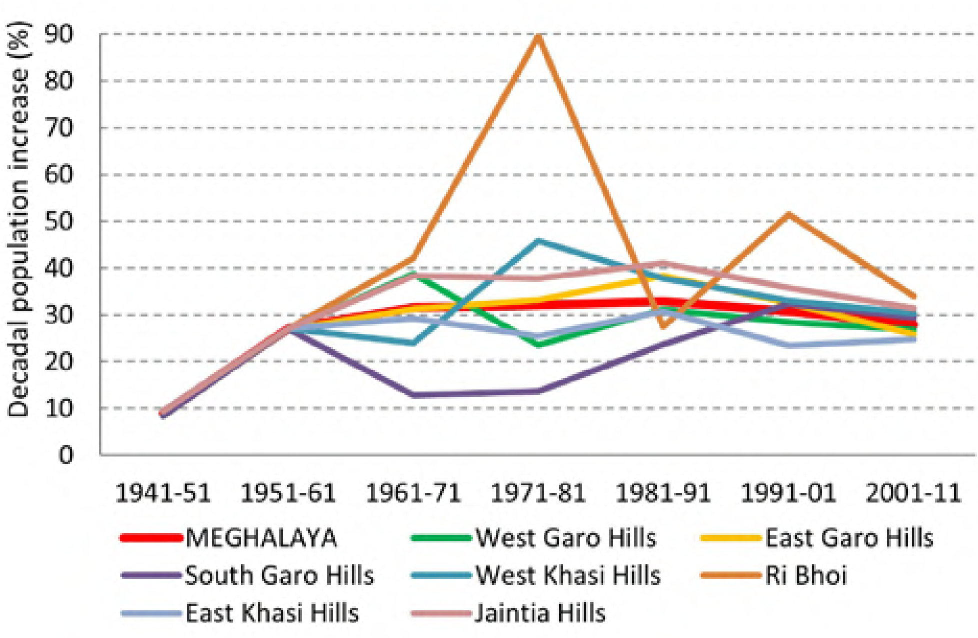


FIGURE 4: District-level trend in decadal change in population between 1901 and 2011 in Meghalaya

Hills have also provided evidence that this period saw a sharp drop in fallow periods across all of them. Moreover, a detailed village-level case study of causes of land-use change in West Garo Hills district showed that demographic rise and plantation expansion were major proximate determinants of shifting cultivation intensification (Kurien 2021b). Furthermore, outmigration tendencies that can ease the pressure on land have not been significant from the Garo Hills region unlike many other parts of Northeast India or the world, all of which point to the need to consider the relationship of population to fallow period changes and overall land-use change seriously. However, it needs to be done cautiously since a gamut of other economic, cultural, social, and ecological reasons could be contributing to the decline in fallow periods and intensification of shifting cultivation and agro-ecological sustainability.

How Much Shifting Cultivation Could There Be in Northeast India?

Using the land-use mapping framework and careful field data collection, the estimate of shifting cultivation in only 1 of the 121 districts is as much as 1306 km^2. It is widely known that shifting cultivation is fairly widespread in all states in northeast India. Thus, at this stage of policy paralysis with regard to shifting cultivation estimates in India, providing a ballpark estimate of shifting cultivation for northeast India may not be altogether unwelcome for researchers and policy makers since it might reveal the work that may have to be done for the future.

Focusing exclusively on mapping shifting cultivation and using a combination of NDVI and NBR (normalised burned-area ratios) approach, Pasha, *et al*. (2020) identified a total of 5955 km^2 (2.3%) as 'shifting cultivation fallows' in all of northeast India for the year 2014. The study reproduces the issues discussed in this chapter regarding lack of clear definitions of land uses. A 'back-of-the-envelope' calculation based on terrain and overall distribution of the land use in the different states, I propose a likely figure between 65,000 and 90,000 km^2, that is, roughly one-third of the approximately 262,200 km^2 area in the eight states of northeast India to be under shifting cultivation (active cultivation and fallows combined), pointing to a 10-fold underestimate by MoSPI (2014). This will naturally also include 'non-traditional' forms such as those typologies of shifting cultivation without a burn phase and thus harder to locate using satellite imagery alone (Singh, *et al*.). Consequently, area under old-growth forest could be much lower than estimates provided by FSI and other studies. Furthermore, a clear assessment of plantations is also needed given that governments have promoted it and farmers have taken to it in northeast India for the last three decades at least. Indeed, the Director General, FSI, has admitted that up to 28% of the total forest cover is plantations, but one cannot rule out the possibility of this figure being much more (Nandi 2022). Clearly, the field of mapping of shifting cultivation landscapes in India has only just begun.

Implications for Agriculture Productiveness, Biodiversity Conservation and Sustainability

Based on interviews with villagers across the district, it is clear that the district mostly had only shifting cultivation and wet-rice cultivation (and no plantations) until the 1970s or so. Two things had certainly happened: 1) overall shifting cultivation acreage has declined and active shifting cultivation field sizes have declined too (Kurien 2021b); 2) plantation land uses of cashew, areca, and rubber observed on the map arrived only after the 1960s and until a few decades ago were restricted to merely small patches. Thus, the expansion of plantation has overall fragmented the shifting cultivation forest landscape and can have an impact on agricultural production within shifting cultivation as well as biodiversity conservation, but contrastingly can also have positive effects on overall livelihoods.

Short fallow periods in a fragmented landscape could mean decline in biomass accumulation during succession that affects crop productivity (Lawrence, *et al*. 2010) unless actively aided by communities using agricultural innovation or active restoration and management (Cairns and Brookfield 2011). West Garo Hills district is representational of the dynamics that are occurring in many parts of the world, and especially in other parts of northeast India where tree plantation expansion are reducing land available for shifting cultivation. Despite the short fallow periods, communities continue to rely on shifting cultivation for food security and ensuring resilience and because of their cultural affinity to it (Pandey, *et al*. 2020; Kurien 2021b). The governments in northeast India (and elsewhere), having assumed that shifting cultivation is harmful, have initiated a variety of *Jhum* control schemes, prominent among which is the introduction of horticultural plantations to replace shifting cultivation (MoA-GoI). However, it is not clear how horticulture will meet food and more importantly nutritional needs, and whether dependence upon markets or public distribution systems for these needs (and the consequent reduced self-sufficiency) is desirable.

From the viewpoint of biodiversity conservation, this scenario presents a challenge. The inclusion of plantations has meant loss of forest-fallow habitat complex, combined with fragmentation effects in a short fallow shifting cultivation landscape, these together do pose a big challenge to biodiversity conservation, especially for large mammals (the comparison being longer fallow areas with secondary forests) (Fletcher Jr, *et al*. 2018). However, given that the other land uses that exist on the landscape are worse candidates as biodiversity source or sink populations, shifting cultivation (along with other land uses) probably continues to be the best possible option to ensure that both aims of biodiversity conservation and farm-based livelihoods (including the propagation of agricultural genetic diversity) can be managed. This calls for new research into the effectiveness of these landscapes as forest biodiversity areas.

Investing in a more nuanced understanding of the reasons for both the adoption of horticultural crops, the continued attachment to shifting cultivation, a serious examination of the question of deforestation, intensification, soil erosion, hydrological effects; which types of shifting cultivation might be relevant for the region and why, and so on would be preferable to an exclusive policy orientation on removing shifting cultivation and expanding plantations as has thus far been attempted in northeast India. Land managers and policy makers also need to recognise that shifting cultivation continues to play a significant role in livelihoods (as the agrarian downturn after COVID-19 pandemic has shown us) and is culturally and technologically appropriate for the landscape (Ramakrishnan 1992; Pandey, *et al*. 2020; Kurien 2021a). Any modification to shifting cultivation might have to work around it and not by replacing it.

Conclusion

This chapter provides a social-scientific mapping framework for delineating land uses in a shifting cultivation landscape and uses existing studies to compare the reliability of estimates of shifting cultivation and other land uses. It underscores that the causes of lack of reliability of estimates emanate from a lack of understanding of the shifting cultivation itself, the lack of proper delineation of land-use and land-cover categories in a shifting cultivation landscape by way of normative framing, ambiguous/inappropriate definitions, and finally poor interpretation by way of significant fieldwork. Therefore, overcoming these issues constitute the basic features of a good mapping framework for such landscapes. The emphasis is laid on the importance of explicitly choosing socially relevant land-use classes as the focus of mapping, rather than classes for which one may have some implicit preference or (land cover) classes that are easily separable since the intention of mapping is invariably to aid land management and policy. The challenge of mapping shifting cultivation epitomises the challenge of distinguishing land use from land cover that confronts all satellite imagery-based mapping efforts. The complex set of land covers that make up different phases of shifting cultivation demand a contextual understanding of the practice and the vegetation forms it creates, which can only come from extensive fieldwork that is becoming more, not less important for such complex landscapes (Conant 1994). They also require a clearer definition of what one is trying to map: newly burned fields, or active shifting cultivation, or total cultivation including fallows, and so on for which a clear understanding of the system is warranted. Clearer definition and discrimination will also enable getting at the important question of shifting cultivation intensity or fallow period and its dynamics in space and time, and contribute to our broader understanding of this complex and dynamic land-use form by being able to link it with other socio-economic data.

The significant extent of shifting cultivation and horticultural plantations in West Garo Hills as provides empirical evidence that counter existing government statistics and reports that portray this region as heavily forested, with shifting cultivation variously seen as being insignificant, simply a wasteland, and being a major cause of deforestation. These findings speak directly to the concerns raised recently by the NITI Aayog report on shifting cultivation that pointed out the inconsistencies in estimates of the extent of shifting (NITI Aayog 2018). The study contains the essential framework required for creating a plan for mapping other shifting cultivation landscapes too and it is hoped that it will pave the way for more accurate information on shifting cultivation that the NITI Aayog demands at the national level.

In the absence of such information, policies that governments will push for towards increasing monoculture plantations or other land uses will be based on fundamentally incorrect notions about West Garo Hills district and even other parts of the region. Although this study is limited to one district, it is widely known among experts that shifting cultivation is a major land use across northeast India, and plantations of cashew, areca, rubber, and oil palm have also expanded across the region. Policy makers and mapping agencies in India need to recognise this reality that is significantly transforming not only landscapes but societies as well (Chakraborty, *et al*. 2018; Bose 2019; Kurien 2021b). Policy decision cannot be made without a clear delineation of these land uses on the maps that directly influence biodiversity conservation efforts as well as concerns of agriculture sustainability, among other goals of the society.

References

Ahrends A, Hollingsworth PM, Ziegler AD, Fox JM, Chen H, Su Y, and Xu J. 2015. Current trends of rubber plantation expansion may threaten biodiversity and livelihoods. Global Environmental Change **34**: 48–58

Behera MD, *et al*. 2017. Remote sensing-based deforestation analysis in Mahanadi and Brahmaputra river basin in India since 1985. Journal of Environmental Management: 1–12

Bose P. 2019. Oil palm plantations vs shifting cultivation for indigenous peoples: analyzing Mizoram's New Land Use Policy. Land Use Policy **81**: 115–123

Bruun TB, Neergaard Ad, Lawrence D, and Ziegler AD. 2009. Environmental consequences of the demise in swidden cultivation in Southeast Asia: carbon storage and soil quality. Human Ecology **37**: 375–388

Cairns M and Brookfield H. 2011. Composite farming systems in an era of change: Nagaland, northeast India. Asia Pacific Viewpoint **52**: 56–84

Chakraborty K, Sudhakar S, Sarma KK, Raju PLN, and Das AK. 2018. Recognizing the rapid expansion of rubber plantation: a threat to native forest in parts of northeast India. Current Science

CoI. 2011. District Census Handbook Part XII: A and B, West Garo Hills District: village and town directory. Census of India Directorate, Shillong, Meghalaya

Comber AJ, Fisher PF, and Wadsworth RA. 2007. Land cover: to standardise or not to standardise? Comment on 'evolving standards in land cover characterization' by Herold, *et al*. Journal of Land Use Science **2**: 283–287

Conant FP. 1994. Human ecology and space age technology: some predictions. Human Ecology **22**: 405–413

Das P, Mudi S, Behera MD, Barik SK, Mishra DR, Roy PS. 2021. Automated mapping for long-term analysis of shifting cultivation in northeast India. Remote Sensing **13**: 1066

DES. 2016. The Statistical Abstract of Meghalaya 2016. Directorate of Economics and Statistics GoM, p. 124, editor, Shillong

Dutrieux LP, Jakovac CC, Latifah SH, and Kooistra L. 2016. Reconstructing land use history from Landsat time-series: case study of a swidden agriculture system in Brazil. International Journal of Applied Earth Observation and Geoinformation **47**: 112–124

FAO. 1957. Shifting cultivation. Unasylva **11**: 9–11

Fletcher Jr RJ, *et al*. 2018. Is habitat fragmentation good for biodiversity? Biological Conservation **226**: 9–5

Fox J, Truong DM, Terry Rambo A, Tuyen NP, Le Trong C, and Leisz S. 2000. Shifting cultivation: a new old paradigm for managing tropical forests. BioScience **50**: 521–528

FSI. 2015. The State of Forest Report. Forest Survey of India (Ministry of Environment and Forest), Goverment of India, Dehradun, India

Gong P, Yu L, Li C, Wang J, Liang L, Li X, Ji L, Bai Y, Cheng Y, and Zhu Z. 2016. A new research paradigm for global land cover mapping. Annals of GIS **22**: 87–102

Greenland DJ. 1975. Bringing the green revolution to the shifting cultivator. Science **190**: 841–844

Heinimann A, Mertz O, Frolking S, Egelund Christensen A, Hurni K, Sedano F, Parsons Chini L, Sahajpal R, Hansen M, and Hurtt G. 2017. A global view of shifting cultivation: recent, current, and future extent. PLOS ONE **12**: e0184479

Herold M, Latham JS, Gregorio AD, and Schmullius CC. 2006. Evolving standards in land cover characterization. Journal of Land Use Science **1**: 157–168

Hett C, Castella J-C, Heinimann A, Messerli P, and Pfund J-L. 2012. A landscape mosaics approach for characterizing swidden systems from a REDD+ perspective. Applied Geography **32**: 608–618

Hurni K, Hett C, Epprecht M, Messerli P, and Heinimann A. 2013. A texture-based land cover classification for the delineation of a shifting cultivation landscape in the Lao PDR using landscape metrics. Remote Sensing **5**: 3377–3396

Ickowitz A, Rowland D, Powell B, Salim MA, and Sunderland T. 2016. Forests, trees, and micronutrient-rich food consumption in Indonesia. PLOS ONE **11**: e0154139

Inoue Y, Kiyono Y, Asai H, Ochiai Y, Qi J, Olioso A, Shiraiwa T, Horie T, Saito K, and Dounagsavanh L. 2010. Assessing land-use and carbon stock in slashand-burn ecosystems in tropical mountain of Laos based on time-series satellite images. International Journal of Applied Earth Observation and Geoinformation **12**: 287–297

Jakovac CC, Dutrieux LP, Siti L, Peña-Claros M, and Bongers F. 2017. Spatial and temporal dynamics of shifting cultivation in the middle-Amazonas river: expansion and intensification. PLoS ONE **12**: e0181092

Joshi PKK, Roy PS, Singh S, Agrawal S, and Yadav D. 2006. Vegetation cover mapping in India using multi-temporal IRS wide field sensor (WiFS) data. Remote Sensing of Environment **103**: 190–202

Kerkhoff E, and Sharma E 2006. Debating shifting cultivation in the eastern Himalayas: farmers' innovations as lessons for policy. ICIMOD, Kathmandu

Kurien AJ. 2021a. Facing the crisis: effects of COVID-19 pandemic in Garo Hills, Meghalaya. Seminar **748**: 65–69

Kurien AJ. 2021b. Shifting cultivation, land use change, and livelihood sustainability: causes and consequences of forest-agricultural transformations in Garo Hills, Meghalaya in northeast India, p. 243. Academy of Conservation Science and Sustainability Studies, ATREE. Manipal Academy of Higher Education (MAHE), Manipal, Bengaluru

Kurien AJ, Lele S, and Nagendra H. 2019. Farms or forests? Understanding and mapping shifting cultivation using the case study of West Garo Hills, India. Land **8**: 133

Lambin EF, *et al*. 2001. The causes of land-use and land-cover change: moving beyond the myths. Global Environmental Change **11**: 261–269

Laurance WF, Alonso A, Lee M, and Campbell P. 2006. Challenges for forest conservation in Gabon, Central Africa. Futures **38**: 454–470

Lawrence D, Radel C, Tully K, Schmook B, and Schneider L. 2010. Untangling a decline in tropical forest resilience: constraints on the sustainability of shifting cultivation across the globe. Biotropica **42**: 21–30

Leisz SJ and Rasmussen MS. 2012. Mapping fallow lands in Vietnam's north-central mountains using yearly Landsat imagery and a landcover succession model. International Journal of Remote Sensing **33**: 6281–6303

Lele N and Joshi PK. 2008. Analyzing deforestation rates, spatial forest cover changes and identifying critical areas of forest cover changes in northeast India during 1972–1999. Environmental Monitoring Assessment **156**: 159–170

Lele N, Joshi PK, and Agrawal SP. 2008. Assessing forest fragmentation in northeastern region (NER) of India using landscape matrices. Ecological Indicators **8**: 657–663

Mandal J, and Raman TRS. 2016. Shifting agriculture supports more tropical forest birds than oil palm or teak plantations in Mizoram, northeast India. The Condor **118**: 345–359

Manhas RK, Negi JDS, Kumar R, and Chauhan PS. 2006. Temporal assessment of growing stock, biomass and carbon stock of Indian Forests. Climatic Change **74**: 191–221

Meyfroidt P, Vu TP, and Hoang VA. 2013. Trajectories of deforestation, coffee expansion and displacement of shifting cultivation in the Central Highlands of Vietnam. Global Environmental Change **23**: 1187–1198

MoA-GoI. Watershed Development project in shifting cultivation areas (WDPSCA), p. 27. Ministry of Agriculture DoAC, Natural Resource Management Division, Government of India

MoSPI. 2014. Statistical Year Book India 2014 in Ministry of Statistics and Programme Implementation Government of India. New Delhi.

Myers N. 1992. Tropical forests: the policy challenge. Environmentalist **12**: 15–27

Nandi J. 2022. Plantations count for 28% forest cover: FSI DG. Hindustan Times, New Delhi

NITI Aayog. 2018. Report of Working Group III: shifting cultivation: towards a transformational approach. NITI Aayog, New Delhi

NLUP. 2019. New Land Use Policy (NLUP). Details available at <https://nlup.mizoram.gov.in/>, last accessed on 30 March 2019

NRSC-MRD. 2011. Wastelands Atlas of India 2011: change analysis based on temporal satellite data of 2005–06 and 2008–09 in National Remote Sensing Centre and Department of Land Resources MoRD. Government of India, Hyderabad

Ornetsmüller C, Heinimann A, and Verburg PH. 2018. Operationalizing a land systems classification for Laos. Landscape and Urban Planning **169**: 229–240

Pandey DK, Kumar De H, Dubey SK, Kumar B, Dobhal S, and Adhiguru P. 2020. Indigenous people's attachment to shifting cultivation in the Eastern Himalayas, India: a cross-sectional evidence. Forest Policy and Economics **111**: 102046

Pasha SV, Behera MD, Mahawar SK, Barik SK, and Joshi SR. 2020. Assessment of shifting cultivation fallows in Northeastern India using Landsat imageries. Tropical Ecology

Pirard R, Petit H, and Baral H. 2017. Local impacts of industrial tree plantations: an empirical analysis in Indonesia across plantation types. Land Use Policy **60**: 242–253

Ramakrishnan PS 1992. Shifting agriculture and sustainable development: an interdisciplinary study from northeastern India. UNESCO/ the Parthenon Publishing Group, Paris

Ranjan R, and Upadhyay VP. 1999. Ecological problems due to shifting cultivation. Current Science **77**: 1246–1250

Rerkasem K, Lawrence D, Padoch C, Schmidt-Vogt D, Ziegler A, and Bruun T. 2009. Consequences of swidden transitions for crop and fallow biodiversity in Southeast Asia. Human Ecology **37**: 347–360

Riahtam NB, Nongkynrih JM, Sarma KK, Raju PLN, Mishra AR, Lal D, Kharsahnoh AM, and Sahkhar DJ. 2018. Assessment of shifting cultivation dynamics in East Garo Hills District, Meghalaya, India. IOP Conf. Series: earth and environmental science **169**: 012104

Robbins P. 2001. Fixed categories in a portable landscape: the causes and consequences of land-cover categorization. Environment and Planning A: economy and space **33**: 161–179

Roy P, Tomar S. 2001. Landscape cover dynamics pattern in Meghalaya. International Journal of Remote Sensing **22**: 3813–3825

Roy PS, and Joshi PK. 2002. Forest cover assessment in northeast India: the potential of temporal wide swath satellite sensor data (IRS-1C WiFS). International Journal of Remote Sensing **23**: 4881–4896

Roy PS, *et al*. 2015. Development of decadal (1985–1995–2005): land use and land cover database for India. Remote Sensing **7**

Sarma PK, HudaE A, Baruah B, Mipun BS, and Talukdar BK. 2015. Assessment of changing trends of shifting cultivation in Garo Hills Landscape of Meghalaya: a geo-spatial approach. International Research Journal of Environment Sciences **4**:1–7

Schmidt-Vogt D, *et al.* 2009. An assessment of trends in the extent of swidden in Southeast Asia. Human Ecology **37**: 269–280

Singh LJ, Lungharwo T, and Choudhury D. In press. Fireless shifting cultivation: a lesser-known form of swiddening practised by Tangkhuls in parts of Ukhrul district, Manipur, India in Cairns M, editor. Farmer Innovations and Best Practices by Shifting Cultivators in Asia-Pacific. CABI Publishing

Singh TP, Singh S, and Tiwari SC. 2013. Assessment of digital image classification algorithms for forest and land-use classification in the eastern Himalayas using the IRS LISS III sensor. International Journal of Remote Sensing **34**: 4105–4126

SWC-GoM. 2017. Shifting Cultivation. Details available at <http://megsoil.gov.in/shifting_cul.html>, last accessed on 28 August 2019

Talukdar G, Ghosh S, and Roy PS. 2004. Landscape dynamics in northeast region of India (Meghalaya state) using spatial decision tree model. Geocarto International **19**: 11–18

van Vliet N, *et al*. 2012. Trends, drivers and impacts of changes in swidden cultivation in tropical forest-agriculture frontiers: a global assessment. Global Environmental Change **22**: 418–429

Viswanathan PK. 2008. Co-operatives and collective action: case of a rubber grower co-operative in East Garo Hills in Meghalaya, North East India. Ahmedabad

Wilkie DS. 1994. Remote sensing imagery for resource inventories in Central Africa: the importance of detailed field data. Human Ecology **22**: 379–403

Yadav PK, Kapoor M, and Sarma K. 2012. Impact of alash-and-burn agriculture on forest ecosystem in Garo Hills landscape of Meghalaya, northeast India. Journal of Biodiversity Management and Forestry **1**

Yadav PK and Sarma K. 2014. Application of geoinformatics for assessment of tropical deforestation, slash-and burn land and their impact on climate change in Garo Hills, northeast India. Expert Opin. Environ. Biol. **3**

Yamamoto Y, Oberthür T, and Lefroy R. 2009. Spatial identification by satellite imagery of the crop–fallow rotation cycle in northern Laos. Environment, Development and Sustainability **11**: 639-–654

Ziegler A, Bruun TB, Guardiola-Claramonte M, Giambelluca TW, Lawrence D, and Lam NT. 2009. Environmental consequences of the demise in swidden cultivation in Montane Mainland Southeast Asia: hydrology and geomorphology. Human Ecology **37**:361–373

Ziegler AD, Fox JM, Webb EL, Padoch C, Leisz SJ, Cramb RA, Mertz O, Bruun TB, and Vien TD. 2011. Recognizing contemporary roles of swidden agriculture in transforming landscapes of Southeast Asia. Conservation Biology **25**: 846–848

CHAPTER-11

SHIFTING TO SETTLED AGRICULTURE: EXPERIENCES FROM DZONGU VALLEY, NORTH SIKKIM, INDIA

Sarala Khaling and Pema Yangden Lepcha*

Abstract

Dzongu, the land of the indigenous Lepcha ethnic group, is located in the North district of Sikkim. It is an area rich in biodiversity, culture, and traditions. Agriculture is the key occupation of majority of people in Dzongu. As part of a study to understand the impacts of changing agriculture patterns and their impact on food systems, we assessed the transition of shifting cultivation to settled cultivation of cash crop and market-based agriculture. Primary data were collected through (i) focus group discussions, (ii) key informant interviews, and (iii) online questionnaires. Twenty-seven focused group discussions were conducted with over 250 participants in 27 different sites. Sixty key informants were involved in in-depth interviews (at least 1 h long) with pre-prepared key questions using a snowball sampling method. Transitions in shifting cultivation began in Dzongu towards the middle of the 19th century and this was mainly driven by politics of the monarchy, the British colonial authority, and the advent of Nepali migrants who were brought into Sikkim for building infrastructure and agriculture expansion. Some of the key drivers of change identified during our surveys included (i) government policies and programmes such as prohibition of burning and clearing areas, ban on grazing, subsidies on key staples, (ii) infrastructure development and access to markets leading to more cash crop agriculture, off-farm employment, and access to more skills and tools for adopting settled cultivation, (iii) food to cash crop shifts where cardamom, mandarin orange, and ginger augmented the household income and supported food security, (iv) improved farming practices – capacity and skills developed for settled agriculture, access to efficient tools and implements, and (v) youth engaged in pursuing higher education, off-farm employment, and their migration to larger cities, thus creating a severe dearth of human resources. Until 2000, many villages in Dzongu valley were reported to practise

* 1. Sarala Khaling, Regional Director | 2. Pema Yangden Lepcha: Research Associate
Ashoka Trust for Research in Ecology and the Environment, Regional Office Eastern Himalaya – Northeast India, NH 10 Tadong, Gangtok 737101, Sikkim, India | Corresponding author: Sarala Khaling, sarala.khaling@atree.org

shifting cultivation, but we observed this in only four villages. This remnant practice was in small patches of land for customary reasons. Agrobiodiversity, local food and diets, nutrition, food consumption patterns, and agriculture patterns were identified to be impacted by this transition. Despite this transition, agriculture in Dzongu valley is family managed, integrated, and dependent on natural resources. Communities in Dzongu advocate for agricultural practice that is a mix of food crops and cash crops so that agricultural products are diversified and communities have the opportunity of food and financial security.

Keywords: Shifting cultivation, settled agriculture, transitions, drivers, Dzongu, Sikkim

Background

Dzongu Valley

Dzongu valley (27°28′–27°38′ N and 88°23′–88°38′ E longitude) is located about 70 km north of Gangtok, the state capital of Sikkim (Figure 1). The word Dzongu is a Bhutia derived name meaning 'a place with nine districts' (Gowloog, 1992). The landscape is triangular in shape covering an area of about 78 km^2 with an altitude range of 700–6000 m (Pradhan and Badola, 2008).

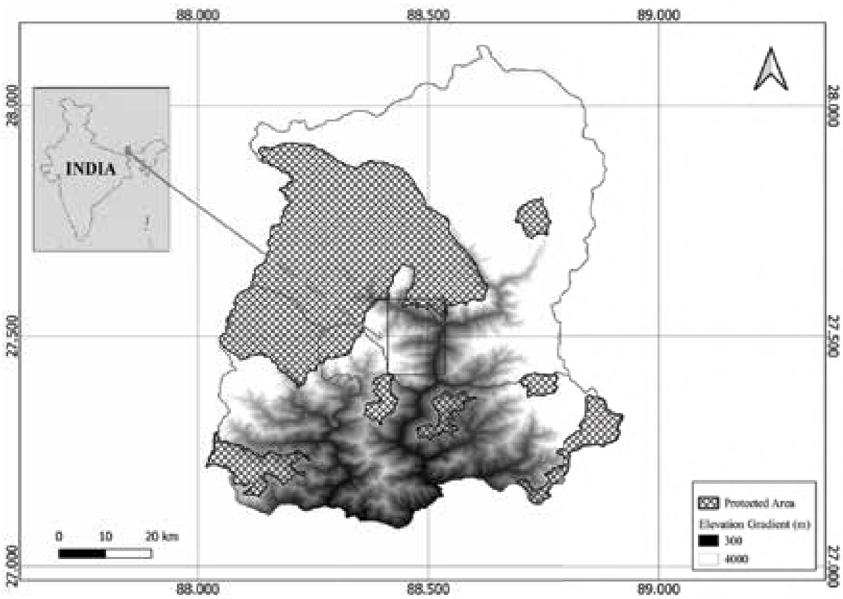


FIGURE 1: Location map of Dzongu

The land under settlements (Figure 2) and agriculture is located on a relatively narrow band above Teesta River and Tholung River towards the northeast between 1000 and 2300 m.

FIGURE 2: Sakyong, one of Dzongu's most remote villages, at an elevation of 1700 m

Photo credit: Pema Yangden Lepcha

Beyond the cultivable land, the area is covered by forest extending to the snow line with alpine pastures and wetlands. Dzongu valley borders the Khangchendzonga National Park and Khangchendzonga Biosphere Reserve. Dzongu was officially declared a reserve area for the Lepcha community in 1958 by the then ruling monarch of Sikkim (Lepcha, 2021) to acknowledge the community's sacred land and to prohibit non-Lepcha people from residing in the area. The reserve area proclamation remains in existence even after Sikkim's merger with India, and land rights in Dzongu are still reserved for Lepchas. Non-indigenous persons are permitted entry to Dzongu with a formal permit. Even Lepchas from other parts of Sikkim are not permitted to settle in Dzongu. Additionally, the Government of Sikkim declared the Lepchas of Dzongu as a Primitive Tribe. The Lepcha people are believed to be the original inhabitants of the state of Sikkim in India (Plaisier, 2005). Dzongu comprises almost 100% of people belonging to the Lepcha tribe. In ancient times, the group was reported to adopt hunter-gatherer practices (Little, 2008) and slash and burn agriculture. During the mid-19th century, they began practising settled agriculture (Das, 1978). The Lepchas call themselves *Mutanchi Rong Cup* (beloved children of Mother Nature) (Little, 2009) and *Rong* (people of the ravines) (Mainwaring, 1876).

FIGURE 3: Land use under different types of farming methods, such as wet terrace farming, terrace farming, and polyhouse, in Gnon-Sangdong village in Lower Dzongu in 2020

Photo credit: Pema Yangden Lepcha

Dzongu is known to be a region of rich cultural heritage because of the practices and traditions of its people. The lives and livelihoods of Lepchas are known to be inextricably linked to nature in all aspects and their rich and diverse traditional knowledge and practices are seen even today (Biswas and Chopra, 1982; Little, 2008; Pradhan and Badola, 2008). In Dzongu, the Lepchas practise both Shamanism and Buddhism into which they converted at the beginning of the 18th century (Pradhan and Badola, 2008). According to Bhasin (2011), the land use of Dzongu includes forests, agricultural land (dry, irrigated, and fallow), and pastureland (Figure 3). There are no recent figures to update this in the literature. However, communal land (*khas*) and pastureland may have been reclassified in the later years as per the different government policies in the state. More categories of land use were presented by Lepcha, Lepcha, and Das (2012) (Figure 4).

The Dzongu area represents three distinct climatic zones, namely, subtropical, temperate, and alpine (Bhasin, 2011). The plant diversity of Dzongu is rich as the area has a very wide altitudinal zone and high rainfall. Floristically, it is very rich in medicinal plants, wild edibles, bamboos, and canes (Jana and Chauhan, 2000; Jha, Rao, Jha, *et al*., 2004; Pradhan and Badola, 2008; Sharma, Dahal, and Borthakur, 2014; Lepcha, 2020). Faunistically, it is equally rich and diverse with 287 species of birds (Important Bird Area), many of the 44 species of amphibians (Subba, Aravind, and Ravikanth, 2017), and about 312 species of butterflies (Lepcha and Lepcha, 2006).

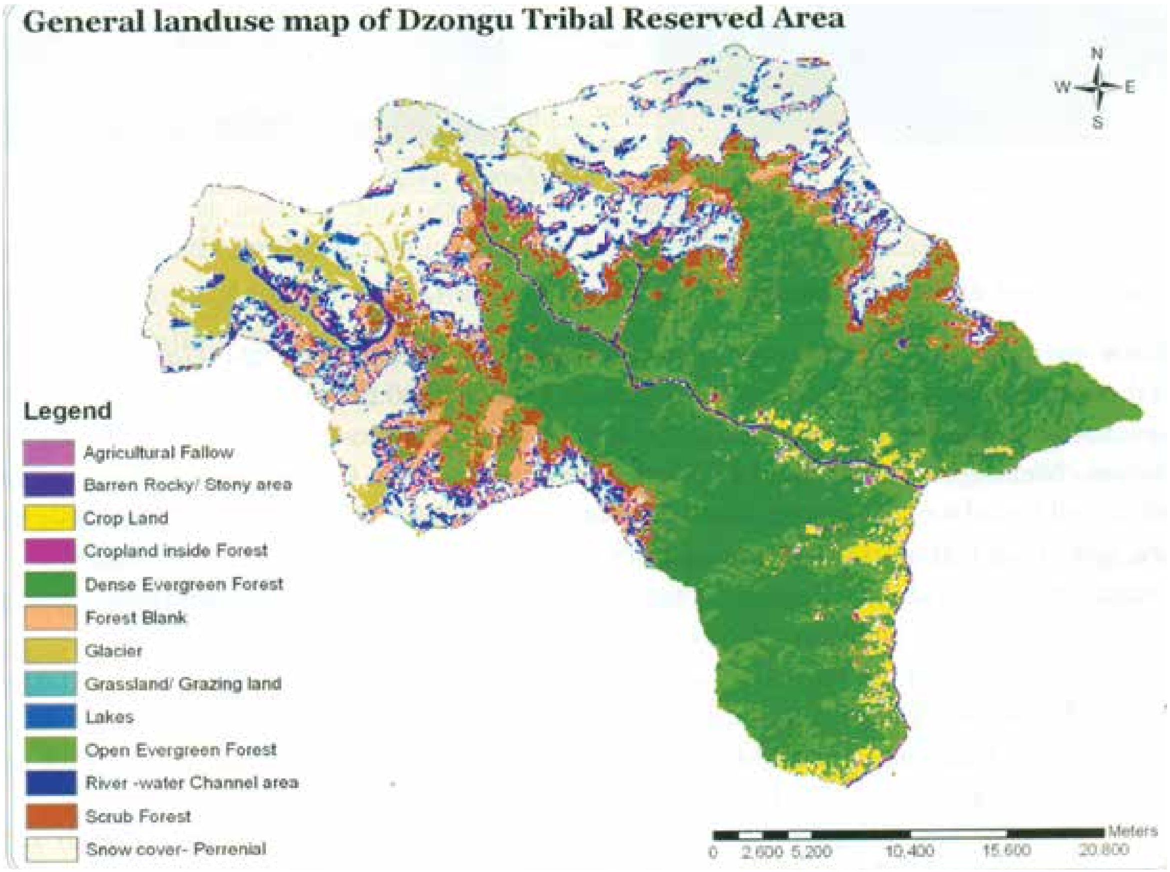


FIGURE 4: Land use map of Dzongu

Source: Lepcha, Lepcha, and Das (2012)

Agriculture is the key occupation of the majority of people in Dzongu. The current farming system is a settled terrace farming system growing fruits, vegetables, cash crops, and some local cereal crops. The farming system also includes domestication of livestock, which plays a vital role in both agriculture and the food system of the communities. Traditional food crops such as paddy, buckwheat, foxtail millets, barnyard millets, and legumes grown in shifting agriculture areas are cultivated on a much smaller scale. Cultivation of local landraces is confined to small patches of homestead gardens for local consumption or for rituals during different festivals. High yielding varieties of food crops provided by the government are cultivated in the larger parcels of land. Monoculture of cash crops has replaced large areas of food crop cultivation to enhance the income of farmers.

Changing Practices of Shifting Cultivation

The farming system of the Lepchas was termed 'primitive' by Campbell (Campbell, 1840). They were not permanent settlers as they rarely remained longer than 3 years in one place and after which they moved to new parts of the forest nearby or often to distant places. Thereafter they cleared the forest area, built temporary houses, and prepared the ground for crop cultivation. This type of farming practice involved cutting down trees, threshing, burning, and scratching soil with traditional tools followed by sowing seeds into the ground. The British colonial authority began a significant process of economic development in the Himalayan area of Sikkim and North Bengal in the early 18th century (Bhattarai, 2015). People mainly from Nepal started moving in as labourers to Dzongu to be involved in the agriculture sector and for working in infrastructure development projects such as road construction.

Lepchas of Dzongu slowly transitioned from hunter-gatherers and shifting cultivation to settled agriculture (Bhasin, 2007). The predominant reasons for the transition from shifting cultivation may be attributed to lack of technical knowledge, low productivity, unavailability of improved seeds or planting materials, ineffective soil conservation measures, lack of value addition and processing facilities water harvesting, and storage (Shukla, Kumar, Mohanty, *et al*., 2017). By the mid-19th century, out of a very crude form of shifting cultivation, Dzongu witnessed the transition to more intensive subsistence agriculture (Bhasin, 2011). Here, a semi-shifting type of cultivation was practised where the cultivated farm remained fixed, but the farmers changed their fields throughout the area, abandoning the fields for regenerating back to wild vegetation after a few years of cropping. With the arrival of Nepali labour force, wet rice farming was introduced in Dzongu towards the beginning of the 19th century. Large cardamom was also introduced at the same time as a cash crop and agriculture transitioned from being subsistence farming to also encompassing commercial farming (Bhasin, 2011). Thus, the transition from shifting cultivation to settled cultivation was initiated although some remnants of shifting cultivation can still be observed in some remote villages.

Currently there has been a paradigm shift from traditional farming practices of mainly food crops for subsistence towards market-oriented agriculture. This is aimed at creating a diversified farming system, growing high value crops such as large cardamom, mandarin orange, ginger, off-season exotic vegetables, kiwi, ground apple, quinoa, cherry peppers augmented by floriculture, and apiculture. This is accompanied by providing government inputs such as manure, seeds, saplings/seedlings, pest repellents, materials for polyhouses, and implements. Agriculture-based institutions such as farmers' groups, farmer producer organizations, and cooperatives have also been formed to support the market linkages of farmers.

Methodology

Sampling Design

Villages for the survey were selected to represent the altitudinal gradient so that all agroclimatic zones would be represented in surveys (Figure 5). Proximity to the market was also considered as the agriculture and food consumed by communities were linked with this factor. All seven administrative blocks of Dzongu were represented by the sampling design.

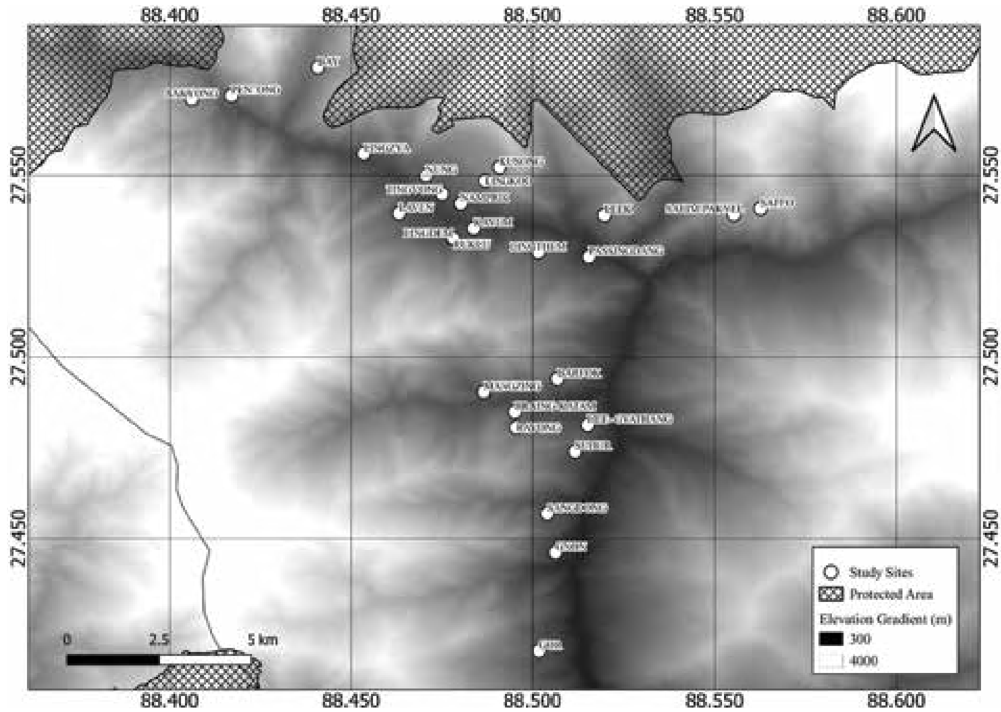


FIGURE 5: Map of the study area showing surveyed villages

Field Data Collection

Primary data were collected through focused group discussions, key informant interviews, and online questionnaires. Twenty-seven focused group discussions were conducted with over 250 participants in 27 different sites. Sixty key informants were involved in in-depth interviews (at least 1 h long) with pre-prepared key questions using a snowball sampling method. These included farmers, shamans, members of self-help groups, and social workers. Care was taken to ensure that women and senior citizens of the society were involved in all these interviews. Recordings of these interviews were made with the consent of the interviewee. An online survey was conducted for the youth using Google Forms. Twenty-four respondents of the 18–40 age group who were comfortable with this survey method were included in the survey. A pre-informed consent was taken from all the interviewees before participation in any of these interactions. The main data collected from these methods included people's perspective on the change in local agricultural patterns over the past 50+ years in Dzongu and the key drivers causing these shifts in the agriculture practices. Data were also collected from secondary sources that included journals, books, reports, grey literature, photographs, and audio recordings. For the data collection, the fieldwork period was from September 2019 to July 2021.

Analysis

Following the fieldwork, primary data collected through these interactions were collated and arranged in MS Excel. From the key informant interviews, we were able to get 46 h and 22 min of recording, which was then transcribed in MS Excel and directly used for analysis. Most of the information was qualitatively analysed and presented in this chapter.

Results

The History

Political History

Before 1890, the people of Sikkim practised shifting agriculture and were not allowed permanent settlement and settled agriculture by the chiefdoms that ruled the state under the auspices of the monarchy (Subba, 2009). According to Subba (2009), one of the main reasons for shifting cultivation to thrive for many centuries was the existing policy of land taxation. Communities did not inhabit the same site due to increased taxes every year and thus cleared new areas for agriculture (Hooker, 1849). Besides this the remoteness, economic, ecological, and cultural factors were also responsible for this. Literature reveals that the steps of shifting cultivation practised in that period included: selection of sites, clearing of sites, burning, planting by dibbling, abandoning or surrendering of the land to administration to avoid heavy taxation after cultivation for two cycles, and shifting to new sites and never returning to the same site as it would be rented to another farmer (Subba, 2009). Settled agriculture to replace shifting cultivation in Sikkim was introduced by the political administrator of the erstwhile British Administration in 1897 as shifting cultivation was considered a problem for tax/rent collection (Subba, 1999).

Historical Aspects of Transitions of Shifting Agriculture to Settled Agriculture

The British administration initiated the settlement of a large number of Nepalese migrants from Nepal in the 1860s and soon they became the largest group in the demography of Sikkim (Vandenhelsken, 2021). Besides all the sociopolitical implications to the demographic tapestry of Sikkim, one of the consequences of this demographic shift was the introduction of agriculture production for economic gains and not just subsistence. Wet rice terrace and large cardamom cultivation became the key land use in Dzongu and the existing land tenure system evolved (Kharel and Bhutia, 2013) along with terracing, ploughing, irrigation, etc. Large cardamom replaced many of the sites where communities practiced shifting cultivation of food crops. With the improvement in infrastructure, people in Dzongu got exposed to other food crops never grown in the valley. Thus, shifting cultivation traditionally practised till then all over Sikkim including Dzongu valley slowly gave way first to semi-shifting cultivation and then to a completely settled agriculture (Bhasin, 2011).

Now settled agriculture (cash crop and food crops mixed, orchards, horticulture), animal husbandry, and agricultural entrepreneurship are the most important strategies for livelihoods in Sikkim (Ali, 2017). Agriculture of Sikkim is still essentially characterized by family farming and women play a critical role in all aspects of farming. Currently hybrid seeds distributed by the Department of Agriculture and Horticulture have replaced the traditional varieties that were adapted to the region.

The Practice

Practice of Shifting Agriculture

According to some elders and key informants, shifting cultivation or *Sudyom prek shyon*/'*Sudyom hong shyong*' was practised extensively in Dzongu till early 2000 (Lepcha and Khaling, 2020). The process of shifting cultivation started with clearing a large patch in the private forest in December and after which the cleared forest debris was dried and burnt from mid-February to mid-March. The ash from the burnt debris was considered a good fertilizer. Crops were sown at the beginning of monsoon. A particular site was used for one or two seasons and then left fallow and new sites were cleared for cultivation. The cycle of rotation was about 10 years. These sites were the primary source of food for the communities and therefore were monitored laboriously. This system of agriculture was labour intensive and involved all the family members. However, this was supported by a traditional system of pooled labour or *Lobu*, which played a significant role. The participation of men and women was equal with clear distribution of work. The men were involved in clearing the land, cutting down trees, ploughing, levelling the land, and burning, which were physically challenging, while the women cleared debris, selected and sowed seeds, and harvested crops. Staple food crops primarily grown in the shifting cultivation included (i) Upland dry paddy (*Tukmorzo*), (ii) Foxtail millet (*Kumdak*), (iii) Barnyard millet (*Kudo*), (iv) proso Millet (*Nuho*), (v) Sweet buckwheat (*Kushrot*), (vi) Bitter buckwheat (*Kushru*), (vii) varieties of Maize (*Kuchung nok*, *Kuchung dari*, *Kuchung tingkyel*, etc.), (viii) Sorghum (*Kuchung kong)*, (ix) Perilla (*Nohum)*, (x) Amaranthus (*Kutnim*), (xi) Yams (*Singbuk*), (xii) Taro (*Singti*), and (xiii) Tapioca (*Tunglubuk*). Traditional landraces were selected by farmers during the first harvest for keeping seeds for the next season. This was a distinctive approach to select a particular crop for cultivation and storage because it was done by women who were the keepers of the seeds.

Thus, Lepchas of Dzongu hunted, fished, foraged for wild edibles, and practised shifting cultivation. Besides agriculture, in combination with other subsistence and productive activities, Dzongu seems to have been sufficiently productive to account for the small permanent hamlets, a chiefdom level of social organization, and the *Mandal* as the village chief to deal with external settlers. Lepchas also had a well-organized structure in place that allowed for the allocation of their territories for various resources and goods to be used by the communities.

Productivity

Key informants reveal that currently one of the key Government inputs in agriculture is the supply of seeds of non-local high yielding varieties of food crops to replace local landraces that some believed have become obsolete and less productive. Productivity according to them was reduced because of the lack of organic matter for the soil. Earlier when grazing was legal each farmer had a large herd of free grazing livestock, which provided the critical input to the soil. According to some of the respondents in the survey, people aspire for higher yield without having to spend too much on required inputs. The perception of very poor yield and productivity of local varieties of food crops is widespread all across Dzongu.

In Sikkim, agriculture with related activities accounts for 16% of the land (Chakrabarti, 2010). The state's diverse agro-climatic zones combined with its varied elevation and intense monsoons have resulted in significant diversity in agricultural operation. However, a large portion of the land has also become unsuitable for traditional agricultural practices. Since 2000, food grain production, agriculture productivity or yield, and agricultural expansion have all slowed down. In addition, the gross sown area is decreasing as more productive land is being sold for various development projects (hydropower, infrastructure, pharmaceutical companies, urbanization, tourism infrastructure) that have had a negative impact on food grain yield.

Food Systems Shifts

Production systems of Dzongu are more focused on cash crops of high yielding varieties and include large cardamom, ginger, mandarin oranges, exotic fruits, and vegetables. Maize, millet, rice, legumes, local vegetables, tubers, yams, and fruits are grown for their own consumption. Self-sufficiency in animal sourced food is a challenge due to a lesser number of people rearing livestock and poultry for meat and milk. Proximity to local markets and entrepreneurship have made it easier to buy and consume rather than rear. Staples like rice and wheat are available cheaply through the Public Distribution System (PDS) and do not require labour intensive activities that were part of the shifting cultivation. Other traditional food crops such as paddy, buckwheat, foxtail millets, barnyard millets, and legumes which were grown as main food crops in shifting cultivation are cultivated in a much smaller scale. Dzongu is surrounded by privately owned forests which are contiguous with the government owned protected area forests. Wild edibles from the forests form a significant part of the diet of local communities. These include fruits, nuts, vegetables, roots, shoots, tubers, and fibre for eating directly or preparing various traditional cuisines. There is a high dependence on both local/informal and formal markets for food. Access and availability have been facilitated with the construction of roads and bridges, particularly in Lower and Middle Dzongu. However, in upper Dzongu availability and access to food from external sources are limited seasonally. In the monsoons when the roads are inaccessible by vehicles and bridges are swept away, people travel long distances to markets for buying food and carry it back as headloads for the major part of the route to their villages. With limited livestock rearing and access to forests and the shift from food production to cash crop economy, the food and diets are less diverse and increasingly there is reliance on distant markets and government subsidies for food (Gupta, Haider, and Österblom, 2020).

Agrobiodiversity Impacts

Dzongu is known to be a region of extremely rich agrobiodiversity in terms of cereals, legumes/pulses, vegetables, roots and tubers, fruits, oilseeds, spices, and livestock. One of the impacts of the change from shifting to settled agriculture perhaps is the drastic loss of local agrobiodiversity-local varieties, heirloom crops which were indigenous to the land. Farmers are dependent on seeds from external sources, even for non-traditional crops that they have been growing for quite some time now. Climate change related factors like change in local weather patterns are likely to have more impacts on these 'new varieties' compared to the traditional crops, which are considered more resilient. Along with the loss of agrobiodiversity, there is a dearth of documentation of the traditional knowledge and practices, which are the most invaluable resources of Dzongu and need to be documented and preserved for the future generation. There is no published literature to compare the agrobiodiversity in shifting cultivation, settled cultivation primarily of food crops, and the current form of more cash crop farming. These inferences are drawn from our interviews and interactions with the people from Dzongu.

The Transitions

Shifting to Settled Cultivation

Shifting cultivation used to be the dominant type of agricultural practice in the hills and mountains of South and Southeast Asia. In countries like Nepal, it has been completely replaced by productive and sedentary agriculture (Rasul and Thapa, 2003). The rise in agricultural demand along with population growth, urbanization, and rising per capita incomes will require perpetual increase in agricultural productivity in most countries. Currently, there is a wealth of work indicating that agricultural yield and productivity is decreasing and the possibility of bringing more land under agriculture and irrigation is becoming unlikely (Wood, Sebastian, and Scherr, 2000). Agriculture development is vital to the progress of Sikkim, because more than 64% of the population are dependent on agriculture for their livelihoods. The agriculture strategy of Sikkim hinges on high yielding and improved varieties that play a vital role in achieving augmented productivity and production.

Shifting cultivation was the food basket of communities in Dzongu valley where large swathes of forest land were cleared for cultivation in one site for 2 years before being abandoned for a decade to allow the cleared forest area to regenerate into a healthy forest. Buckwheat was the most productive crop and was grown twice a year in a site where the productivity of maize seemed to be relatively low. The diet then consisted of several cereal crops grown in these patches and was not predominantly rice like it is today. In the transition from shifting to settled cultivation during the past 50 years, each farmer had two types of cultivable land: (i) *Singmo* or terrace farming near houses and (ii) *Sudyom* or shifting cultivation site, which was at a distance from the homestead and inside the surrounding forest. To address the challenge of labour, the Lepchas in Dzongu had a system of pooled labour for cooperation and collaboration known as *Lobu kyop nun*. Large cardamom slowly replaced food crop cultivation in shifting cultivation sites with the advent of the Nepalese. The shared crop system or 'Adya' was initiated and the migrant labourers performed all the work required in cultivation and received 50% of the yield of large cardamom. The migrants also assisted farmers in a variety of agriculture activities and were instrumental in introducing terrace farming and wet rice cultivation (Figure 6) in Dzongu.

FIGURE 6: Wet paddy cultivation in Gnon-Sangdong village, Lower Dzongu in 2021

Photo credit: Pema Yangden Lepcha

Along with shifting cultivation for food security, the people in Dzongu relied on forest resources for food, medicines, and ritualistic activities. Communities in Dzongu valley also reared large herds of cattle, which grazed in the surrounding forest and provided animal sourced food for their diets, manure, and most importantly the draught power needed for the transitioning settled terrace fields adopted by communities. Until the advent of education in the form of schools, women were expected to stay at home and one of the main tasks they undertook was agriculture where they had equal roles to that of men in shifting and semi-shifting cultivation.

Remnants of Shifting Agriculture

There are remnants of shifting cultivation practised in the Dzongu valley and it is perhaps the only place in Sikkim where this practice can still be observed in a very small scale. We observed some shifting cultivation practices in 2020–2021 in Kusong, Mangzing, Sakyong, Leek, and Pentong villages (Figure 7). In this practice, communities now grow buckwheat, foxtail millet, and dry paddy in a small amount. Some of these food crops are used to make certain food items used during religious and cultural festivals. The communities thus felt that this practice is now limited to only keeping this alive like an old custom or tradition practised by their forefathers.

FIGURE 7: Remnant shifting cultivation in Pentong village in Upper Dzongu in 2019

Photo credit: Passang Lepcha

Key Drivers of Transition from Shifting to Settled Cultivation

Shifting cultivation, which was once a widespread farming system in slop y forests, has been denounced by most governments as it has been associated with deforestation, degradation of soil, and water resources (Fox, Fujita, Ngidang, *et al*., 2009). Many of these bans have led to resettling of communities and practising settled agriculture (Fox, Fujita, Ngidang, *et al*., 2009). In Southeast Asia, land uses that have replaced shifting cultivation usually include extensive, long-term cultivation of annual crops, cultivation of monoculture tree plantations, cultivation of horticultural plants in greenhouses, and livestock grazing (Schmidt-Vogt, Leisz, Mertz, *et al*., 2009). It has been observed that in forest–agriculture interface in the tropics, the conversion of shifting agricultural landscapes into more intensive land uses such as annual crops, monoculture cultivation, and tree plantations has benefitted communities with income but has negatively impacted soil, water, biodiversity, and ecosystem health (Van Vliet, Mertz, Heinimann, *et al*., 2012).

Similar transitions have already been experienced in Dzongu valley. Our surveys tried to capture the perspectives of the farmers in Dzongu about some of the drivers of transition from shifting to settled agriculture (Figure 8).

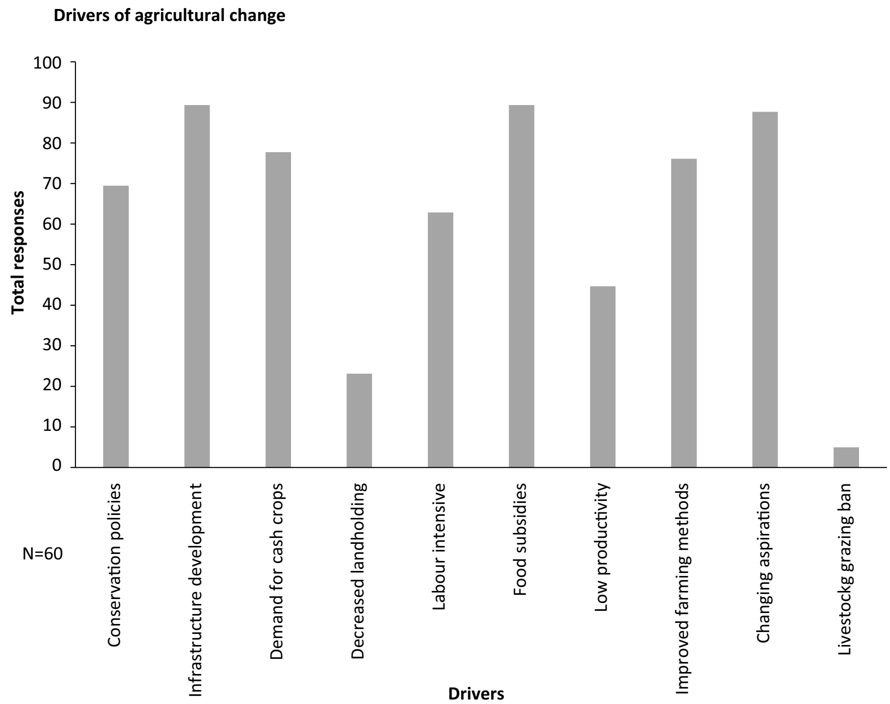


FIGURE 8: Drivers of change

Government Policies and Programmes

Policies like the Wildlife (Protection) Act, 1972 of India, which governs the setting up of the protected areas for conservation of wildlife species, was identified as a driver of prohibiting the practice of shifting cultivation in Dzongu valley. Shifting cultivation was considered a risk factor for forest fires, especially in the protected and reserved forest areas that adjoin the community's land. Additionally, it was also considered to cause deforestation and land degradation (Gupta, Haider, and Österblom, 2020). Although Sikkim was still not part of India when this Act came into force, shifting cultivation had started transitioning into terrace farming and cardamom plantation with the arrival of migrant labourers in the region. After Sikkim became a part of India, these legal prohibitions with the scope of penalization further accelerated the expansion of settled agriculture and even the semi-shifting cultivation practices slowly disappeared from most of the places in the valley.

Another policy instrument that communities perceive was a disincentive for practising shifting cultivation was the government subsidies on food, particularly for the staples. During the British colonial control of India in the 1940s, the PDS system was established and several revisions were implemented after India's independence (Maikhuri, Rao, and Semwal, 2001). The Sikkim Cooperative Movement was started during the days of monarchy with the enactment of Sikkim Cooperative Society Act, 1955. The Act was replaced in 1978 and 1981 after Sikkim became a part of India. One of the drivers of changing food production from shifting cultivation to settled agriculture is also the PDS. Staples like rice and wheat were now cheaply available and farmers did not have the incentive to be involved in time and labour intensive activities that shifting cultivation requires. Although this provided a much needed food security, especially for people who were at the lower rungs of the economic ladder, it led to the erosion in the agrobiodiversity, traditional knowledge, and practices. Many of the local landraces of food crops, mostly grown in shifting cultivation spaces, also disappeared in Dzongu and this impact of PDS has also been observed in the Central Himalayas (Maikhuri, Rao, and Semwal, 2001).

The other policy instrument that indirectly impacted shifting cultivation practices prevalent in Dzongu was the ban of grazing livestock. The Forest Environment and Wildlife Management Department of Sikkim declared a blanket ban on livestock grazing in 1998 (Forest Department, 2010). According to the farming community of Dzongu valley, livestock was one of the most important assets for shifting cultivation as free grazing cattle provided manure for patches and also helped to clear the land by grazing once trees had been removed. Prior to the state government's initiative in outlawing grazing in the state in 1998, farmers had large herds of livestock that were subsequently significantly reduced and this trend remains even to this day (Lepcha, 2020). This was a further disincentive for the already declining shifting cultivation in Dzongu.

Infrastructure Development and Access to Markets

Another key driver that incentivized settled agriculture in Dzongu was the construction of roads and bridges that linked the farming community to the outside world and to the local and distant markets. Supply chains for cash crops were established, which enhanced the household economy and also made access and affordability of food possible directly from these markets. Shifting cultivators were totally dependent on their patches of land for food produced collaboratively by family members or on foraging for parts of their diet from the forest seasonally. Improved access to market and increased demand for fruits also enhanced the profitability of some cash crops, which motivated many shifting cultivators to convert their food crop sites into orchards (Rai, 2017). With exposure to markets, outdated tools used in shifting cultivation were replaced with advanced implements that were more efficient to use for farming although they were not mechanized. There was a perception of self-sufficiency of food but easy access to markets provided communities with a wider range of food options. With the construction of roads, bridges, and other infrastructure, off-farm employment became available and young people left their villages for education and employment. Thus, cash incentives from access to markets/economic gains through settled cash crop cultivation and diminishing human resources also paved the way for a shift to settled cultivation. Similar experiences of dearth of human resources impacting shifting cultivation have been observed in Arunachal Pradesh, where the prevalence of this practice is still widespread (Teegalapalli and Datta, 2016).

Food to Cash Crop Shifts

The monarchy in Sikkim granted a lease to Nepali immigrants in 1867 and this marked the beginning of settled agriculture and cultivation of large cardamom in Sikkim. The Lepcha people of the region were generally poor, self-sufficient farmers until they began farming cardamom as a cash crop for export to India and other parts of the world (Bhattarai, 2015). The shift to cash crops began with the introduction of wet rice cultivation in terrace fields along steep mountain slopes as well as in the river valleys across Dzongu. Plantation of large cardamom, the high value, minimally labour intensive, and non-perishable perennial crop, with Himalayan alder (*Alnus nepalensis*) and other forest tree species (Uma, Ghanashyam, Gurung, *et al*., 2014) became one of the key land uses in Dzongu valley. With the increased demand of cardamom over the years, many of the shifting cultivation patches were converted to large swathes of monoculture of cardamom agroforestry land use. In the 1930s, the value of cardamom began to soar. With their new-found wealth, Lepcha farmers were able to recruit Nepalese labourers to work on their lands, especially in the cardamom fields, and send their children to school. Improvement in infrastructure and access to distant markets (Siliguri 150 km from Dzongu) in the plains of the neighbouring state of West Bengal further enhanced cash crop cultivation. Thus, cropping pattern changes included the shift in cereal-dominated subsistence agriculture to high value cash crop based commercial agriculture, with increased production of pulses, oilseeds, fruits, vegetables, and cash crops such as cardamom, ginger, and mandarin oranges (Sharma, Sharma, Singh, *et al*., 2000). Although this transformation was radical after Sikkim's merger with India in 1975, the process of transformation had already begun more than a century ago. Similar changes from food crops to cash crops settled agriculture have also been observed in Meghalaya, a state with extensive shifting cultivation even today (Behera *et al*., 2015).

Improved Farming Practices

In shifting cultivation, no livestock or large tools and implements were used. The only implements used were a chopping knife (*Bamphok/Mudenphe/Pheja*), the dibbling stick, and a small hoe for weeding. The system was low on external inputs although it was immensely time and labour intensive. The men usually cleared the land and guarded crops from wildlife, while the women carried out all the farming activities in shifting cultivation fields (Subba, 2008). With the arrival of settled agriculture and rice terraces, there was an improvement in farming input methods and tools. Modern inputs included fertilizers, herbicides and pesticides, high yielding variety of seeds, efficient implements, ploughing using animal draught power, channelling water for irrigation, and so on. When Sikkim became a part of India, shifting cultivation was restricted but farmers were introduced to new horticulture, modern and efficient tools and implements, and cash-oriented crops for income generation. New forms of cultivation replaced dry paddy cultivation and seeding millets in shifting cultivation and high yielding hybrid seeds replaced most of the local landraces. Workshops, training, and exposure to other farming methods and cultivation of new crops became regular events through various institutions of the government. Farmers who adopted these practices were recognized as 'progressive farmers'. People began to perceive local food crops grown in shifting cultivation patches as 'obsolete' and with 'low productivity'. Further agriculture income was augmented by fishery, poultry, piggery, and floriculture. Population growth in Dzongu valley also compelled farmers to shift from extensive to intensive types of land-use systems and to adopt new technologies in pursuit of increasing crop yields. Crops were diversified and high-input cash crops such as fruits and vegetables replaced traditional low-input crops such as maize and upland rice. Moreover, fruit trees and livestock raising were integrated into the farming systems and farm produce such as vegetables and fruits was commercialized. The government actors described the reasons for this shift to be land and labour shortage, increasing cash crop demand, and an increasing need for generating income for better education (Gupta, Haider, and Österblom, 2020). The implementation of subsidized schemes that promoted commercial agriculture led to replacement of locally adapted seasonal seeds. It transformed subsistence farmers into commercial farmers who responded according to changes and demand price, market, institution, and policies. Mountain farmers, in recent years, are planting high value commodities such as tomato, tea, cardamom, ginger, and turmeric replacing traditional cereal crops (Rai, Zhang, Paudel, *et al*., 2018). A significant proportion of traditional agricultural land has been brought under cash crops or off-season vegetables. The reduction in crop diversity is partly because of the introduction of high yielding varieties of seeds and partly because of increased emphasis on cultivation of cash crops. The evolution of these changes is basically to increase yield and economic returns (Maikhuri, Rao, and Semwal, 2001).

Changing Youth Aspirations

Education in Sikkim was mainly monastic/monastery based. The modern or formal education system in Sikkim began in the late 19th century with the arrival of Christian missionaries (already present in adjacent Darjeeling and Kalimpong) and both government and private schools were on the rise. By the time Sikkim merged with India, there were 264 schools providing formal education (Gurung and Balakrishnan, 2015). Thereafter institutions of higher learning such as colleges, universities, and technical institutes were established in Sikkim from 1972, and as a result youth from rural areas like Dzongu were able to engage in education and training of different forms. The children of farmers in Dzongu valley also got exposed to education with the setting up of primary/elementary and high schools in the valley or in nearby areas such as Mangan and Dikchu. On completion of any level of education, the aspiration was to be able to get government employment. According to communities, shifting cultivation demanded continuous toil with no guarantee of lucrative benefits, and so even the intergenerational aspiration did not reflect farming as a priority. Another opinion of key informants was that the majority of younger members of the community also lost their skill and acumen of farming after having spent most parts of their lives outside farming. With most of the younger generation not engaged in shifting cultivation, there was a severe dearth of human resources required for this labour intensive practice. Another study in Sikkim revealed that the majority (62.5%, N = 259) of youth preferred to opt for government employment and a meagre 3.9% opted for agriculture (Ghimiray and Mohapatra, 2020). This trend continues even today in many places with smallholders. Opportunities like off-farm employment (construction and infrastructure building labour, tourism, and other government schemes) also became popular and young people were exposed to multiple options and did not have to choose farming only.

Key Impacts of Transition from Shifting to Settled Cultivation

Agrobiodiversity Loss

One of the impacts of transitioning into settled agriculture was the loss of agrobiodiversity. Diversity of food crops that were grown has reduced and most of the agricultural products are targeted at the markets. Cash crops such as cardamom, orange, ginger, off-season high value vegetables, and exotic fruits have brought the much needed household income to farmers to augment their livelihoods and food security. Even in the case of staples like cereals (e.g., rice and maize), farmers have adapted new high yielding hybrid varieties of seeds, and thus the landraces of these crops have either disappeared or remain with only a few progressive farmers (Figure 9). Owing to unavailability of the forest resources, it was difficult for farmers to cultivate traditional crops, which require forest resources like leaf litter and organic manure (Maikhuri, Rao, and Semwal, 2001). With the loss of agrobiodiversity, there is the collateral loss in traditional knowledge and practices.

FIGURE 9 Varieties of upland paddy cultivated in shifting cultivation patches in Pentong, Upper Dzongu, in 2020

Photo credit: Nima Tshering Lepcha

Change in Food and Consumption Patterns

In shifting cultivation, Lepcha communities of Dzongu subsisted on the variety of food crops produced in these patches throughout the year. However, the productivity was low and wildlife from the surrounding forests depredated crops. So as the population grew, the size of land ownership decreased and food security became a challenge to most families in the region. Settled agriculture with wet rice cultivation changed the food from a multi-cereal-based diet to a more dominantly rice-based diet, while cash crops brought in income to buy food from markets. In addition, subsidies in rice through PDS facilitated in meeting the target of the required daily caloric intake. Foods from the varieties of millets, barley, indigenous varieties of rice, and buckwheat are rarely prepared and they are confined for occasions such as festivals and rituals when prepared. Thus, the dietary diversity seems to have decreased. Dependence on external local shops and distant markets for food grew over the years and now most of the food is purchased externally. In recent years, food and taste are showing increasing homogenization and a trend towards using packaged and processed food. Younger members of the community are said to be increasingly unfamiliar with the taste of local cuisine and are highly influenced by popular external cuisines. There is also a void in the transmission of traditional local culinary preparation knowledge with adoption of new food and taste.

Cash Crop-Based Economy

Dearth of human resources was also one of the drivers of decline in shifting cultivation in Dzongu, with the younger generation engaged in education, off-farm activities, and employment. Much of this land was converted to cardamom agroforestry systems with Himalayan Alder (*Alnus nepalensis*) and the abandoned fallows are now secondary forests. The cardamom-based agroforestry systems found in Dzongu are considered more sustainable than the rainfed agriculture systems. They contribute to carbon sequestration, conserve and rejuvenate soil, support nutrient cycling, and are the natural habitats of many species of plants and animals (Sharma and Sharma, 2017; Negi, Joshi, and Pandey, 2018). These contribute substantially to the household income of farmers and have low-input costs, thus increasing the margins of profitability. Research in Sikkim (Sharma, Partap, Dahal, *et al*., 2016) shows that the productivity of cardamom has been declining in Sikkim since 2004 and some of the drivers identified by this study are: change in seasons, erratic rainfall patterns with long dry periods, temperature increase, soil moisture loss, and increasing infestation of diseases and pests attributed to climate change.

Nutrition Impacts

We did not get any concrete responses regarding the impacts on nutrition through changing food and diets as a result of changing agriculture practices in Dzongu (shifting to settled). Even in the current settled agriculture practices, the diet of the Lepcha community is supplemented with foraged wild edibles such as plants and mushrooms, tubers, and rhizomes and it has the potential to ensure easy availability and access to micronutrients and proteins (Romanelli, Cooper, Campbell-Lendrum, *et al*., 2015; Ray, Ray, and Sreevidya, 2020). Other foods grown in small homestead gardens such as pumpkin, chillies, beans, cucumber, garlic, sweet potatoes, yams, and sugarcane are also an important component of their diets and ensure food security and diversity (Pradhan and Badola, 2008; Jha, Jha, Sherap, *et al*., 2020). Animal sourced food is also a key component in their diets. Foods high in nutrients derived from biodiversity are being slowly replaced by processed and packaged foods high in energy but lacking in nutrition. Surveys in 2016 revealed that over a quarter of adult men and over a third of adult women in the state are overweight or obese. Noncommunicable diseases such as overweight, high blood pressure, and high blood sugar are all emerging as health challenges in the state. The study recommended that even though Sikkim exceeds or is at par with the national averages on nutritional indicators, measures have to be taken to address undernutrition and noncommunicable diseases (George, Nguyen, Avula, *et al*., 2017). Key impacts mentioned by communities through interactions are depicted by the graph (Figure 10).

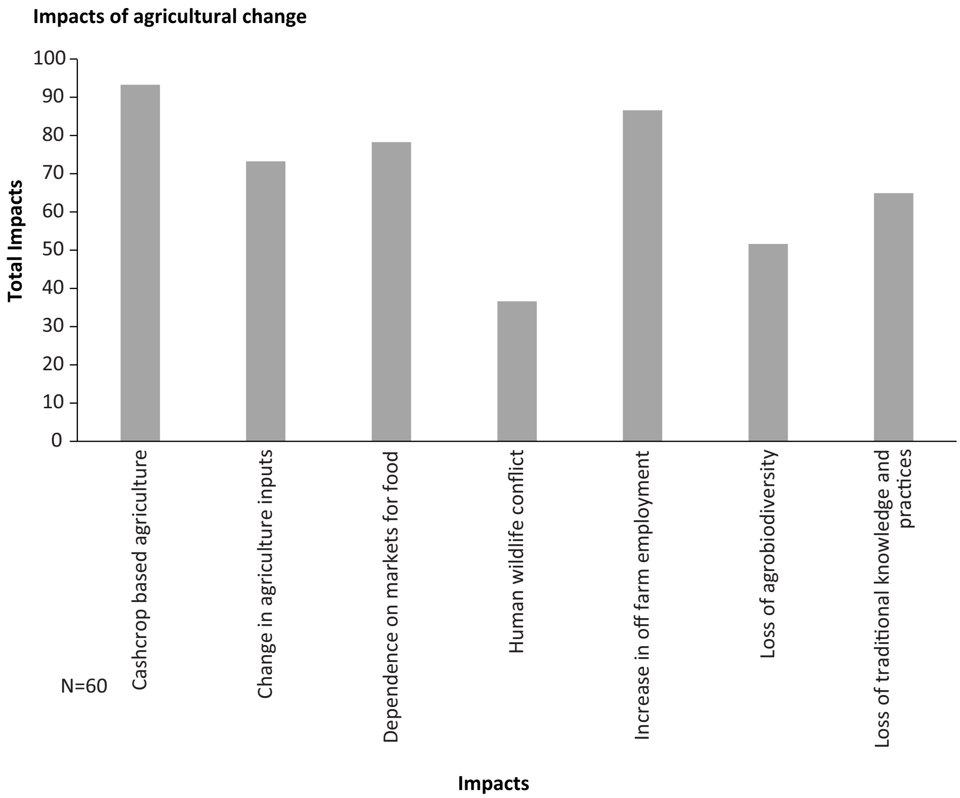


Figure 10: Key impacts of agricultural changes

Conclusion

In Northeast India, shifting cultivation is still a dominant mode of farming, whereas in Dzongu the transition to settled agriculture was completed in about 140 years. Assuming that settled agriculture started with wet rice terraces and cardamom agroforestry after the arrival of Nepali migrants from 1860 onwards, by 2000 there were only a few villages in Upper Dzongu that continued with this practice and currently there are remnants of shifting cultivation practice in very small patches that is more cultural and customary. Policies and socio-economic changes were the main drivers for transitioning to settled agriculture. Globally shifting cultivation has been on the decline or transforming into other permanent land uses (Van Vliet, Mertz, and Birch-Thomsen, 2013), and this has been attributed to similar drivers as observed in Dzongu, that is, policies, agricultural intensification, and access to markets. Introduction of cash crops such as cardamom, mandarin orange, and ginger and their links to market have benefitted communities in Dzongu with enhancement of household income and these transformed their farming into settled agriculture systems. Agriculture product diversification, access to education, off-farm employment, and entrepreneurship activities have helped communities transition to alternative livelihoods, making them less dependent on agriculture and foraging for forest resources. The transformation of shifting to settled cultivation in Dzongu was well supported by the cardamom agroforestry land use. Cardamom, an indigenous spice plant of Sikkim, was quickly adopted by communities and this plant brought much needed economic benefits to communities at the household level. There are also reports of low productivity, food insecurity, and dependence on foraged wild edibles and for all these some cash-based incentives that cardamom brought in seem to have helped in this critical process of transformation. Even though conservation-related policies played a critical role in transformation of agriculture in Dzongu, the cardamom agroforestry system perhaps prevented the segregation of agricultural land and forested land observed in other shifting cultivation sites (Castella Lestrelin, Hett, *et al*., 2013). This agroforestry system was an interface between the protected area forests and the agriculture land and communities had access to their own forests to use the natural resources needed for their livelihoods (food, fodder, fuelwood, medicine, etc). Apart from its high income value, cardamom agroforestry is not labour intensive and low-input farming. The agroforestry also supports soil nutrition, water flow, carbon sequestration, and biodiversity values (Sharma, Sharma, Singh, *et al*., 2000). In the remnant shifting cultivation patches still maintained by communities in some villages in Dzongu valley, local landraces of upland paddy, millets, buckwheat, tapioca, tubers, oilseeds, and so on are still grown. These are the last remaining patches of traditional food crops. Loss of agrobiodiversity, especially of food crops, has been described as one of the key impacts of transitioning to settled agriculture from our surveys. There is still an opportunity to conserve these and revive their cultivation in the settled agriculture patches. Through these experiences of transitions, communities in Dzongu advocate for agricultural practice that is a mix of food crops and cash crops so that agriculture products are diversified and communities have the opportunity of food and financial security. Agriculture in Dzongu valley like many other sites in the Himalayas is family managed, integrated, dependent on natural resources, and unmechanized. With the government's organic farming policy, agriculture in Dzongu has the potential to be an exemplary area of sustainable farming that benefits the environment and provides livelihood to the communities using agro-ecological principles in their mixed-farming practices.

Acknowledgements

This research is part of the SHEFS - an interdisciplinary research partnership forming part of the Wellcome Trust's funded Our Planet, Our Health programme, with the overall objective to provide novel evidence to define future food systems policies to deliver nutritious and healthy foods in an environmentally sustainable and socially equitable manner. This research was funded by the Wellcome Trust through the Sustainable and Healthy Food Systems (SHEFS) Project (Grant number- 205200/Z/16/Z).

The authors are grateful to the communities, homestay entrepreneurs, Panchayat members of Dzongu, Sikkim. Aditya Pradhan, ATREE is acknowledged for his help with the data analysis and maps and Rohit George, ATREE for building a database for the research work.

References

Ali, B. 2017. A review of agrarian relations and changes in state Sikkim, India. *International Research Journal of Social Sciences,* **6**(8): 59–62

Behera, R. N., D. K. Nayak, P. Andersen, and I. E. Måren. 2016. From jhum to broom: agricultural land-use change and food security implications on the Meghalaya Plateau, India. *Ambio*, **45**(1): 63–77

Bhasin, M. K., V. Kumar, and A. Sehgal. 1984. Impact of human activities on the ecosystem and vice-versa with reference to the Sikkim-Himalaya MAB (Man and Biosphere) Programme, UNESCO. *Mountain Research and Development*, **4**: 267–271

Bhasin, V. 2007. Medical anthropology: healing practices in contemporary Sikkim. *Anthropology Today: Trends, Scope and Applications*, **3**: 59–94

Bhasin, V. 2011. Settlements and land-use patterns in the Lepcha Reserve-Dzongu zone in the Sikkim Himalaya, India. *Journal of Biodiversity*, **2**(1): 41–66

Bhattarai, B. 2015. Socio-economic impact of hydropower projects in Dzongu region of North Sikkim. *Global Journal of Sociology: Current Issues*, **5**(1): 14–27

Biswas, K. and R. N. Chopra. 1982. *Common Medicinal Plants of Darjeeling and Sikkim Himalayas*. Periodical Experts Book Agency, Delhi, India

Campbell, A. 1840. Note on the Lepchas of Sikkim, with a vocabulary of their language. *Journal of the Asiatic Society of Bengal*, **9**: 379–393

Castella, J. C., G. Lestrelin, C. Hett, J. Bourgoin, Y. R. Fitriana, A. Heinimann, and J. L. Pfund. 2013. Effects of landscape segregation on livelihood vulnerability: moving from extensive shifting cultivation to rotational agriculture and natural forests in northern Laos. *Human Ecology*, **41**(1): 63–76

Chakrabarti, A. 2010. A critical review of agrarian reforms in Sikkim. *Economic and Political Weekly*, 23–26.

Dame, J. and M. Nüsser. 2011. Food security in high mountain regions: agricultural production and the impact of food subsidies in Ladakh, Northern India. *Food Security*, **3**(2): 179–194.

Das, A. K. 1978. The Lepchas of West Bengal. Editions Indian, Calcutta

Forest Department. 2010. Schemes and Policies Implemented from 1996 till 2010. Chapter II. Forests. Environment & Wildlife Management Department, Government of Sikkim.

Fox, J., Y. Fujita, D. Ngidang, N. Peluso, L. Potter, N. Sakuntaladewi, J. Sturgeon, and D. Thomas. 2009. Policies, political-economy, and swidden in Southeast Asia. *Human Ecology*, **37**(3): 305-322.

George, N. R., P. H. Nguyen, R. Avula, and P. Menon. 2017. Improving nutrition in Sikkim: insights from examining trends in outcomes, determinants and interventions between 2006 and 2016. POSHAN Policy Note 31. New Delhi: International Food Policy Research Institute

Ghimiray, S. and R. Mohapatra. 2020. Factors affecting youth involvement in agriculture in Sikkim. *Journal of Agroecology and Natural Resource Management,* **7**(1): 16–20

Gowloog, R. 1992. Lingthem after Fifty Years: A Diachronic Study of a Lepcha Village in Dzongu, North Sikkim. Unpublished PhD Dissertation, Centre for Himalayan Studies, North Bengal University, West Bengal

Gupta, R., Haider, L. J. Haider, and H. Österblom. 2020. The theory of cross-scale interactions: an illustration from remote villages in Sikkim, India. *Environment, Development and Sustainability*, **22**(4), 3777–3804.

Gurung, K. and R. Balakrishnan. 2015. Educational development and social mobility in Sikkim: a critical study. Doctoral dissertation, Assam University, Assam.

Hajer, M. A., H. Westhoek, J. Ingram, S. van Berkum, and L. Özay. 2016. Food systems and natural resources. United Nations Environmental Programme

Hooker, J. D. 1849. Notes of naturalist, *Himalayan J*, **1**: 123–124

Jana, S. K. and A. S. Chauhan. 2000. Ethnobiological studies on Lepchas of Dzongu, North Sikkim, India. *Annals of Forestry*, **8**(1): 131–144.

Jha, A., A. Rao, S. Jha, and V. Suhag. 2004. A preliminary survey of plants used as food by Lepchas of Dzongu area in Sikkim, India. *Crop Research*, **28**(1/3), 135–137

Jha, A., S. Jha, S. Sherap, R. Mallik, and A. Jha. 2020. Nutrition-based benefits of kitchen gardens: an investigation of gender differences. *Ecology, Environment and Conservation*, **26**: S104–S108

Kharel, S. and W. J. Bhutia. 2013. *Gazetteer of Sikkim*. Home Department, Government of Sikkim

Lepcha, T. and G. Lepcha. 2006. Undermining cultural values: an indigenous perspective on the Khanchendzonga nomination. World Heritage Watch Report 2018, p. 52. World Heritage Watch

Lepcha, K. C., S. R. Lepcha, and A. P. Das. 2012. Sikkim Biodiversity Significance and Sustainability 2012, pp. 187–192. Sikkim State Council of Science and Technology

Lepcha, P. Y and S. Khaling. 2020. Agriculture and Food Systems of Dzongu: From 'We Eat What We Grow' to 'We Eat What We Buy'. The Confluence Collective. Details available at https://www.theconfluencecollective.com/blog/agriculture-and-food-systems-of-dzongu-from-we-eat-what-we-grow-to-we-eat-what-we-buy

Lepcha, S. R. 2020. Ethno-veterinary practices by the Lepcha Primitive Tribe living in the Dzongu Tribal Reserve Area (DTRA) in North-Sikkim, India. *Pleione*, **14**(1): 71–82

Lepcha, R. 2021. Hydro power projects induced conflict: a study of Lepcha community of Dzongu. International Journal of Research in Engineering, Science and Management, **4**(1): 72–81

Little, K. 2008. Lepcha narratives of their threatened sacred landscapes. *Transforming Cultures eJournal*, **3**(1)

Little, K. 2009. Deep ecology, dams, and Dzonguland. *The Trumpeter*, **25**(1): 34–64

Maikhuri, R. K., K. S. Rao, and R. L. Semwal. 2001. Changing scenario of Himalayan agroecosystems: loss of agrobiodiversity, an indicator of environmental change in Central Himalaya, India. *Environmentalist*, **21**(1): 23–39

Mainwaring, G. B. 1876. *A Grammar of the Rong (Lepcha) Language as it Exists in the Dorjeling and Sikkim Hills*, p. XX. Calcutta: Baptist Mission Press |

Myllyntaus, T. (2002). Sustainability in danger? Slash-and-burn cultivation in nineteenth-century Finland and twentieth-century Southeast Asia. *Environmental History*, **7**(2): 267–302

Negi, B. K., R. K. Joshi, and A. Pandey. 2018. Status of large cardamom (*Amomum subulatum* roxb.) farming systems in the changing scenario of modern economics of Sikkim, Himalaya. *Global Journal of Bioscience and Biotechnology*, **7:** 189–199

Plaisier, H. 2005. A brief introduction to Lepcha orthography and literature. *Bulletin of Tibetology*, **41**(1): 7–24

Pradhan, B. K. and H. K. Badola. 2008. Ethnomedicinal plant use by Lepcha tribe of Dzongu valley, bordering Khangchendzonga Biosphere Reserve, in north Sikkim, India. *Journal of Ethnobiology and Ethnomedicine*, **4**(1): 1–18

Rai, B. 2017. Socio-Economic Impact of Hydro-Power Projects: A Study on Lepcha Community in Dzongu Block in Sikkim, 2001-2015. Doctoral dissertation

Rai, R., Y. Zhang, B. Paudel, B. K. Acharya, and L. Basnet. 2018. Land use and land cover dynamics and assessing the ecosystem service values in the trans-boundary Gandaki River Basin, Central Himalayas. *Sustainability*, **10**(9): 3052

Rai, B. and S. Goswami. 2019. Urbanization and tourism induced challenges in waste management in hill towns: case of Gangtok. In *Waste Management and Resource Efficiency*, pp. 393–407. Singapore: Springer

Rasul, G. and G. B. Thapa. 2003. Shifting cultivation in the mountains of South and Southeast Asia: regional patterns and factors influencing the change. *Land Degradation & Development*, **14**(5): 495–508

Ray, A., R. Ray, and E. A. Sreevidya. 2020. How many wild edible plants do we eat—their diversity, use, and implications for sustainable food system: an exploratory analysis in India. *Frontiers in Sustainable Food Systems*, **4**: 56

Romanelli, C., D. Cooper, D. Campbell-Lendrum, M. Maiero, W. B. Karesh, D. Hunter, and C. D. Golden. 2015. Connecting global priorities: biodiversity and human health: a state of knowledge review. World Health Organisation/Secretariat of the UN Convention on Biological Diversity

Sarkar, S., N. Gurung, D. Nayak, R. Meena, and B. Singh. 2017. Large cardamom cultivation—a review. *Journal of Agricultural Engineering and Food Technology*, **4**(1): 78–81.

Schmidt-Vogt, D., S. J. Leisz, O. Mertz, A. Heinimann, T. Thiha, P. Messerli, *et al*. 2009. An assessment of trends in the extent of swidden in Southeast Asia. *Human Ecology*, **37**(3): 269

Sharma, E., R. Sharma, K. K. Singh, and Sharma, G., 2000. A boon for mountain populations. *Mountain Research and Development*, **20**(2): 108–111

Sharma, T. P., S. Dahal, and S. K. Borthakur. 2014. Bamboos diversity and its utilization among the Lepcha tribe of Dzongu valley, Sikkim, India. *Journal of Non-Timber Forest Products*, **21**(3): 163–166

Sharma, G., U. Partap, D. R. Dahal, D. P. Sharma, and E. Sharma. 2016. Declining large-cardamom production systems in the Sikkim Himalayas: climate change impacts, agroeconomic potential, and revival strategies. *Mountain Research and Development*, **36**(3): 286–298

Sharma, G. and E. Sharma. 2017. Agroforestry systems as adaptation measures for sustainable livelihoods and socio-economic development in the Sikkim Himalaya. In *Agroforestry*, pp. 217–243. Springer, Singapore

Shukla, G., A. Kumar, A. K. Mohanty, and R. K. Avasthe. 2017. Constraints analysis in adoption of homestead farming: a case study among lepcha community of Indo-Himalayan region. Indian Council of Agricultural Research

Subba, J. R. 1999. *Limboos of the Eastern Himalayas: With Special Reference to Sikkim*. Sikkim Yakthung Mundhum Saplopa, Gangtok, Sikkim

Subba, J. R. 2008. *History, Culture and Customs of Sikkim*. Gyan Publishing House

Subba, J. R. 2009. Indigenous knowledge on bio-resources management for livelihood of the people of Sikkim. *Indian Journal of Traditional Knowledge*, **8**(1): 56–64

Subba, B. 2015. *Understanding Food Security in Sikkim: A Case Study of Tathanchen Shyari Ward*. New Delhi: Scholars World.

Subba, B., N. A. Aravind, and G. Ravikanth. 2017. Amphibians of the Sikkim Himalaya, India: an annotated checklist. *Check List*, **13**(1): 2033

Tambe, S. and G. S. Rawat. 2009. Ecology, economics, and equity of the pastoral systems in the Khangchendzonga National Park, Sikkim Himalaya, India. *Ambio*, **38**: 95–100

Teegalapalli, K. and A. Datta. 2016. Shifting to settled cultivation: changing practices among the Adis in Central Arunachal Pradesh, north-east India. *Ambio*, **45**(5): 602–612

Tiwari, P. C. and B. Joshi. 2012. Natural and socio-economic factors affecting food security in the Himalayas. *Food Security*, **4**(2): 195–207

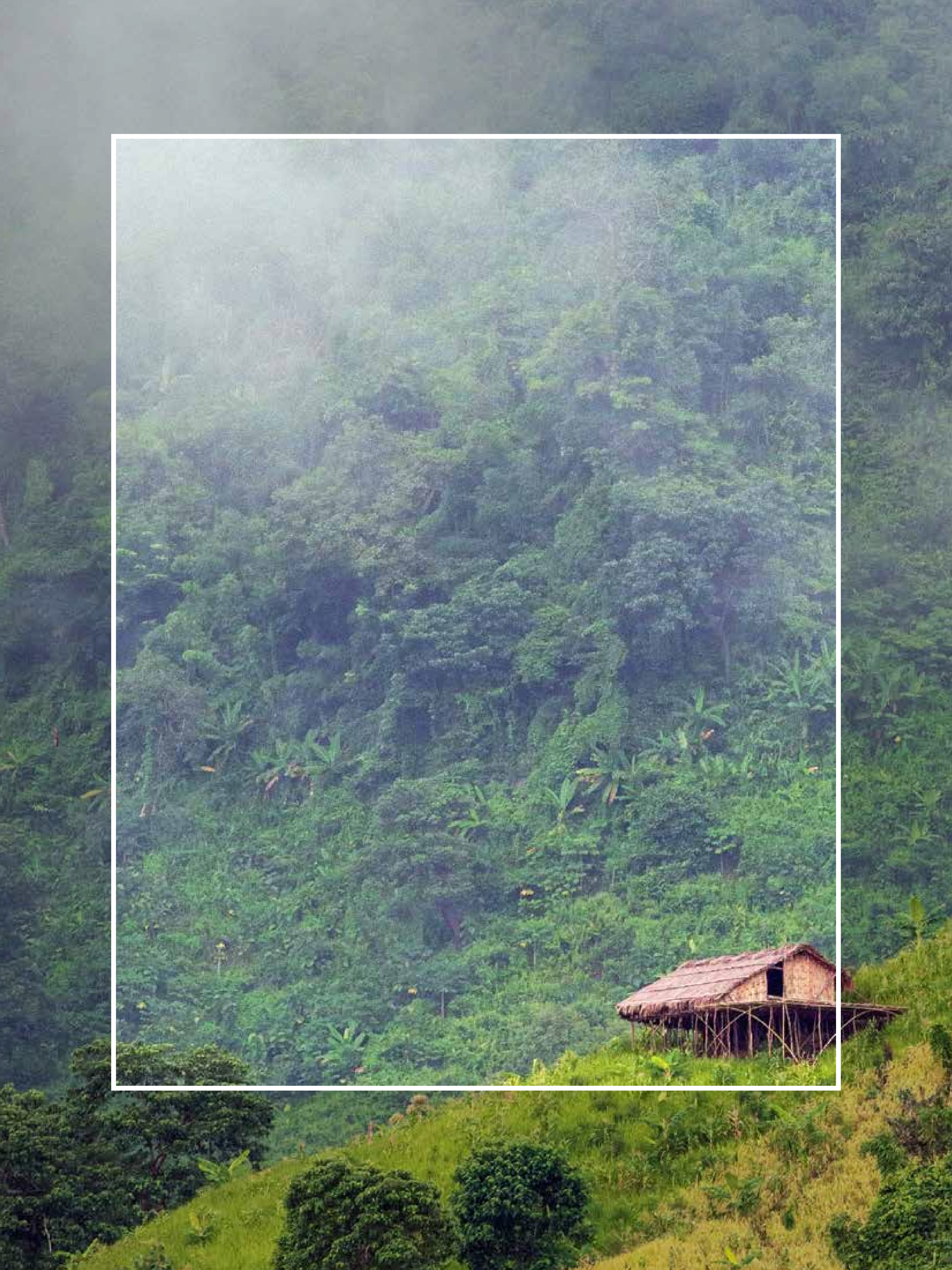
Uma, P., S. Ghanashyam, M. B. Gurung, C. Nakul, and S. Eklabya. 2014. Large cardamom farming in changing climatic and socioeconomic conditions in the Sikkim Himalayas. ICIMOD Working Paper, 2014/2.

Vandenhelsken, M. 2021. Ancestrality, migration, rights and exclusion: citizenship in the Indian state of Sikkim. *Asian Ethnicity*, **22**(2): 213–234. Doi: 10.1080/14631369.2020.1802575

Van Vliet, N., O. Mertz, A. Heinimann, T. Langanke, U. Pascual, B. Schmook, *et al*. 2012. Trends, drivers and impacts of changes in swidden cultivation in tropical forest-agriculture frontiers: a global assessment. *Global Environmental Change*, **22**(2): 418–429

Van Vliet, N., O. Mertz, T. Birch-Thomsen, and B. Schmook. 2013. Is there a continuing rationale for swidden cultivation in the 21st century? *Human Ecology*, **41**(1), 1–5

Wood, S., K. Sebastian, and S. J. Scherr. 2000. *Pilot analysis of global ecosystems: agroecosystems*. World Resources Institute



CHAPTER-12
A SYNTHESIS OF UNDERSTANDING THE ROLE OF SHIFTING CULTIVATION FOR SUSTAINABLE DEVELOPMENT OF NORTHEAST INDIA

Lead Authors: **Siddharth Edake,** Senior Manager, Sustainable Landscapes and Restoration Program, World Resources Institute India**, Yoji Natori,** Associate Professor, Global Studies Program, Akita International University, **Aniket Kumar Shaw,** Research Associate, The Energy and Resources Institute**, Brajesh Kumar Tiwari,** Formerly Professor, Department of Environmental Studies, North-Eastern Hill University, Shillong**, Uttam Kumar Sahoo,** Dean, School of Earth Sciences & Natural Resource Management & Former Head, Department of Forestry Mizoram University, Aizawl**, Ayyanadar Arunachalam,** ICAR-Central Agroforestry Research Institute, Jhansi

Contributing Authors: **Dietrich Schmidt-Vogt,** Chair of Silviculture, Faculty of Environment and Natural Resources, Freiburg University, Freiburg, Germany**, Kuang-Chung Lee,** Professor, National Dong Hwa University, **Maiko Nishi**, Redearch Fellow, United Nations University Institute for the Advanced Study of Sustainability, **Paulina G. Karimova,** National Dong Hwa University (Hualien, Taiwan)**, Devon Dublin,** Governance Coordinator, World Wildlife Fund Guianas**, Alka Michael,** Associate Professor, Department of History, Gargi College, University of Delhi**, Kasturi Chakraborty,** Scientist 'SF', North Eastern Space Applications Centre (NESAC), Umiam, Meghalaya**, Angshuman Sarma,** PhD Research Scholar at Centre for Informal Sector and Labour Studies, Jawaharlal Nehru University New Delhi**, Tarujyoti Buragohain,** Associate Fellow at National Council of Applied Economic Research (NCAER), 11 Indraprastha Estate, Parisila Bhawan, New Delhi**, Srijani Bhattacharjee,** Assistant Professor (History), Amity Institute of Social Sciences, Amity University, Kolkata, West Bengal**, Naveen Pandey,** The Corbett Foundation, Tamenglong, Manipur, India B. Centre for Indian Knowledge Systems, IIT Guwahati**, Anirban Datta Roy,** Foundation for Ecological Security, Guwahati**, Karthik Teegalapalli,** 447, Els Riviera, Candolim, Goa**, Kankana Trivedi,** Member of Kalpavriksh, **Dibyendu Paul,** Head, Department of Environmental Studies, North Eastern Hill University**, Amit Kurien,** Independent Environmental Social Scientist, Bengaluru**, Sarala Khaling,** Regional Director, Ashoka Trust for Research in Ecology and the Environment, Regional Office Eastern Himalaya – Northeast India

Introduction

Shifting cultivation, locally known as *Jhum* in northeast India (NE India), is a practice that involves management of arable land resources at a landscape scale, which has been undertaken for centuries (Ramakrishnan & Patnaik 1992). In NE India, customary institutions such as village councils have been successfully managing land and other resources at the communal level, although this does not necessarily mean that all land and resources are communally owned. This has enabled sustainable use of resources and ensured equitable access to them, thus guaranteeing livelihood and food security for the communities. However, these institutions are faced with challenges owing to the pressure on or dispossession of land, or when government policies along with market integration favour individual private land ownership. The existing narrative of shifting cultivation projects it to be less a productive and ecologically devastating practice. As a result of this, many state governments have encouraged cash crops, monoculture or plantation-style agriculture, which are less biodiverse and more economically risk-prone land uses than traditional shifting cultivation that they replace.

The modus operandi for weaning people from shifting cultivation varied from state to state in NE India. The establishment of *Jhumias* Rehabilitation Colonies in Tripura, *Jhum* Control Schemes of Assam and later in Meghalaya, *Jhum* Control Act of Nagaland and Arunachal Pradesh, and the New Land Use Policy of Mizoram were some of the policies that tried to formulate a structural shift in the traditional land-holding, which paved the way for commercialization of agriculture.

The promotion of cash crops, such as areca nut, rubber and oil palm, resulted in conversion of unused fallow lands, which in turn, caused social stratification, and privatization of many *Jhum* lands. As the cash economy establishes itself among upland communities, subsistence cultivators are also drawn into a money-oriented economy. Citing the example of Arunachal Pradesh, Buragohain (2022 [Chapter 4]) highlights how the Schemes, incorporated in the 11th and 12th five-year plan for *Jhum* improvement, have endowed the farmers with bigger land holdings to grow commercial crops, which further encouraged the small scale farmers, thereby improving their income and livelihood.

Findings of various remote sensing studies (Chakraborty, *et al*. 2015; Thong, *et al*. 2018a, 2019a; Chakraborty, *et al*. 2022 [Chapter 2]; Kurien 2022 [Chapter 10)]) suggest that the decline in shifting cultivation brought about a transformation of the tropical highlands across NE India. The transitions and transformations of hill landscapes probably have not been ecologically and economically sustainable and many farmers who had adopted new farming methods have reverted back to shifting cultivation (Karlsson 2011). However, Khaling and Lepcha (2022 [Chapter 11]) recorded a contrary situation in Dzongu Valley of Sikkim. The transition from shifting cultivation to settled agriculture in Dzongu Valley has been able to ensure both financial and food security, as the farmers advocate a farming practice, combining both food and cash crops (Khaling and Lepcha 2022 [Chapter 11]).

Against this background, chapters in this volume attempted to address the following questions from the perspectives of environment, society, economy, and policy in NE Indian states (Figure 1).

1. How is the governance of shifting cultivation adapting to changing socio-economic circumstances?
2. Does or can shifting cultivation contribute to biodiversity?
3. How does shifting cultivation support community livelihoods?
4. What is the new role for shifting cultivation to play that can lead to a sustainable future?

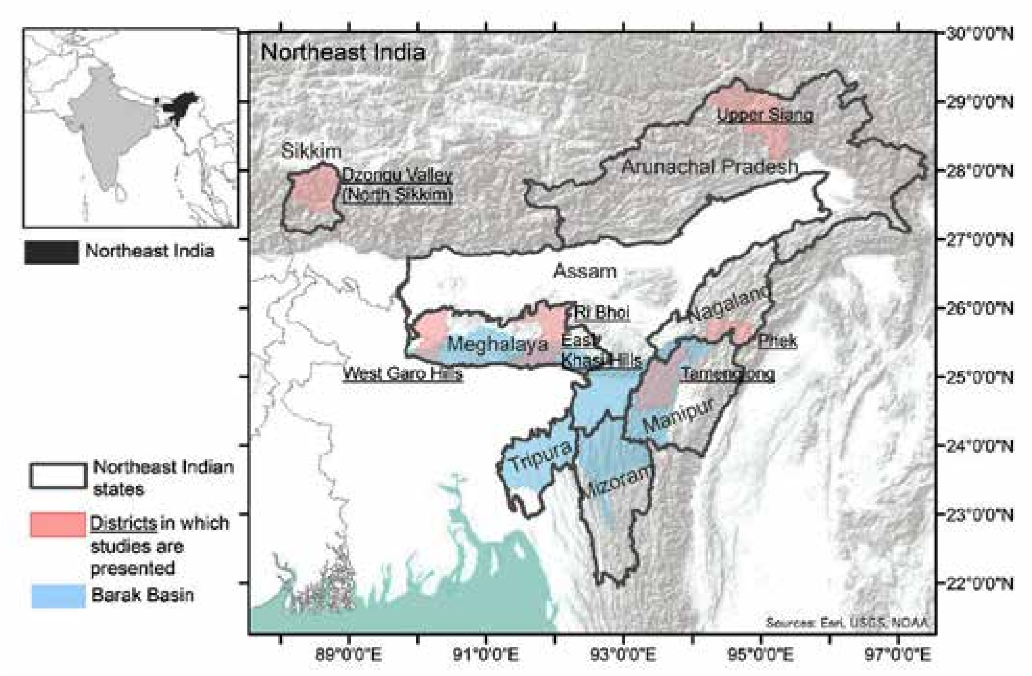


FIGURE 1: Adaptation of shifting cultivation under changing socio-economic circumstances

Adaptation of Shifting Cultivation under Changing Socio-economic Circumstances

Shifting cultivation is a highly dynamic and complex socio-ecological system that has evolved over centuries of experiential learning by traditional societies (Cairns 2015). This system of food production was considered to be highly appropriate in upland and undulating hills of humid tropics where population density was low, and there were limited alternatives owing to remoteness and poor market access (Tran 2007). However, growing population pressure, introduction of plantation crops, better market linkages, infrastructural developments and expanding state control over forest resources in the region have led to the reduction in the area under *Jhum* cultivation, thereby leading to shortening of the period for which the land can remain as fallow (Bhattacharjee 2022 [Chapter 5]; Pandey, *et al*. 2022 [Chapter 6]). This has been the primary reason for decline in productivity and depletion of soil fertility of *Jhum* fields (Ovung, *et al*. 2021), leading to the belief by most government agencies that this system is unsustainable, ignoring the fact that the return per unit of land labour was much higher in *Jhum* as compared to wet rice cultivation (Tran 2007). Shifting cultivation involves a diverse array of stakeholders, including farmers, village level socio-political institutions, an array of government departments, foresters, academia and non-governmental agencies, and each one of these have different management objectives, agenda and interest. This has led to conflicts between conservation and economic development priorities in the NE India where *Jhum* is still quite widespread. In this situation, the policymakers and planners introduced land-use policies that have often failed in the past and have also faced some degree of resistance in the region.

The practice of shifting cultivation has remained centered around the village institutions and traditionally it was done in a most participatory way by incorporating the socio-ecological-cultural ethos as well as issues of equity in overall governance of the shifting cultivation. Every household of the village had a right to practice *Jhum* on the community land, which was controlled by the village councils or traditional chiefs. As the practice of growing tree-based cash crops, such as areca nut, cashew, and oil palm, has become popular, the availability of land for *Jhum* has considerably reduced (Kurien 2022 [Chapter 10]). One of the reasons for continuance of *Jhum* in NE India, despite all the prevailing narratives against it, is the community ownership of land and forests on which *Jhum* was practiced. This system of land tenure is changing with time and large areas of community lands are being privatized thereby resulting into *Jhum* being practiced on private or rented lands. For example, the Khasi and Karbi tribes of Meghalaya practice *Jhum* on private lands and in such cases the traditional institutions have very little role to play (Deb, *et al*. 2013). The power and functions of the traditional institutions are also being curtailed through government regulations and creation of new institutions like Autonomous District Councils in Meghalaya under Sixth Schedule of Indian Constitution and by promulgation of The Nagaland Village and Area Council Act (1978) in Nagaland. Besides, there is also no clarity on the number of shifting cultivation farmers and the actual area under shifting cultivation, much needed for developing any concrete alternative/transformational approach to shifting cultivation (NITI Aayog 2018).

During past couple of decades, the *Jhum* farmers have modified their cultivation practices by introducing cash crops which has sufficiently increased the average income of every household. This has been possible due to development of roads and availability of transport networks, linking the remote villages with the markets. Over the years, a large number of erstwhile *Jhum* farmers have been producing cash crops, which have considerably improved their livelihoods. A number of *Jhum* farmers have opted for other occupations outside their villages thereby lowering the population residing in the villages, which in turn has caused a shortage of labour for *Jhum*. This transformation in *jhumscape* has become prevalent throughout NE India and market forces are playing a pivotal role in this transformation. Thus, shifting cultivation is changing rapidly and the *Jhum* farmers are adapting to the changing socio-economic circumstances.

Governance of Shifting Cultivation Landscapes

Different states in NE India have been addressing and maneuvering shifting cultivation in different ways, but the general pattern is that market-based labour system is changing or undermining community-based activities of the traditional farming system (Sarma 2022 [Chapter 3]). There is a gradual fading of the self-sustaining system of food resources leading to lower food sovereignty. As a result, local food sovereignty has to be linked to national food sovereignty and community knowledge plays important roles in its operationalization (Sarma 2022 [Chapter 3]).

Buragohain (2022 [Chapter 4]) argues that northeastern states can improve their socio-economic status by reducing dependency on shifting cultivation, and provides evidence that former *Jhumias* who have adopted settled agriculture with the support of various agricultural development programmes have been able to increase their revenues significantly. This success can be traced back to various factors, such as accessibility to market and education, which many communities that are dependent on *Jhum* do not necessarily have (Bhattacharjee 2022 [Chapter 5]). Bhattacharjee (2022 [Chapter 5]) argues for government support of providing better transportation infrastructure and communication networks for better access to internal and external markets and improved land-titles systems that enable *Jhumias* to have access to financial services and subsidies available to settled farmers. However, this form of development that is expressly or inherently linked to market may undermine the agrobiodiversity and local sovereign food system associated with *Jhum* (Sarma 2022 [Chapter 3]).

It is possible that the conversion to settled, market-based farming with ready access to markets, has enhanced the income of the *Jhumias*, however, it is not necessarily true for the people living in remote locations with rugged topography. The agricultural conversion programs may have harvested the "low-hanging fruits" so far where there was a set of conditions favorable to such conversions, but the same cannot be expected from a sweeping application of the successful conversion cases to all the remaining areas where *Jhum* is still prevalent and conditions may be different. Geographic analysis of the relations between physical features (e.g., the slope, elevation, and distance from population concentrations) and the locations where *Jhum* is persisting and where it transitioned to other form of agriculture has a great potential in resolving the apparent disagreement and confusion about the trend of *Jhum* extent and future prospect for its conversion. Inability of existing land-use classification schemes for mapping areas under shifting cultivation system, which is temporally dynamic between a cropping phase and a fallow phase in different stages of ecological succession, leads to the false understanding that *Jhum* is insignificant in area coverage and that it is a major cause of deforestation. Kurien (2022 [Chapter 10]) demonstrates using his case study of West Garo Hills district in Meghalaya that *Jhum* is the most widespread land-use, which is in stark discrepancy with government statistics, and calls for the adoption of a land-use classification system that acknowledges the more socially defined nature of land categories. A global mapping of socio-ecological production landscapes (of which *Jhum* is an example) similarly pointed out that the way the land-use and land-cover classification system is defined could influence the result of mapping such landscapes (Natori and Hino 2021).

Contribution of Shifting Cultivation to Biodiversity Conservation

In contrast to the previously held view that shifting cultivation is a cause of biodiversity loss, this land use is now believed to be an agent for biodiversity conservation (NITI Aayog 2018). As such, it has been observed that shifting cultivation can support agro-biodiversity in polyculture and other elements of biodiversity through ecological succession during the fallow phase and through complementing ecosystem protection.

Rich Agrobiodiversity and Conservation of Germplasm

Jhumias maintain high levels of agrobiodiversity in their farms (Ramakrishnan, *et al*. 1998; Rerkasem, *et al*. 2009). They practice intercropping and sequential cropping to produce a wide variety of crops within the limits of available resources. They introduce a high variety of crop species on a single plot, based on the biophysical features and their requirements. That is how the historical value of shifting cultivation also lies in *in-situ* conservation of many varieties of edible foods. The National Bureau of Plant Genetic Research (NBPGR) has recorded 674 varieties of maize, 298 varieties of upland rice, 200 varieties of grain legumes, 37 varieties of eggplant, 60 varieties of ginger, 250 varieties of taro, and 242 varieties of yam, among other crops, in shifting cultivation sites in NE India (Pradheeb, *et al*. 2011). In the Upper Siang District of Arunachal Pradesh, it has been observed that more than 30 species and 75 varieties of crops are cultivated in *Jhum* fields and are used for subsistence purposes by the Adi tribe. The Adi farmers grow a total of 72 crops in the West Siang district, and 74 indigenous varieties of crops in the East Siang district (Yumnam, *et al*. 2011; Saravanan 2010). As many as 10 varieties of foxtail millet are grown by the Chizami and Sumi tribes in Phek District in Nagaland (Trivedi 2022 [Chapter 8]). Although rice is the staple diet, millet and other crops area also grown, including beans, gourds, cucumbers, spinach, legumes, spices, and oilseeds. The additional advantages of polycropping practiced in *Jhum* include 1) pest management and 2) erosion control and weed suppression by covering the soil during the cropping phase.

The practice of shifting cultivation depicts an evident linkage between conservation of genetic diversity and farmers' livelihood and food security (Datta-Roy & Teegalapalli 2022 [Chapter 7]). The indigenous varieties of seeds are possibly more resilient to the environmental changes as compared to the newly introduced hybrid varieties (Michael 2022 [Chapter 1]). *Jhumias* actively preserve local germplasm in the form of farm-based conservation as well as conservation of seed stock. They aim to produce a wide variety of foods that are nutritious and are available throughout the year. To control the loss of crop seeds, the community members take effective measures such as exchanging seeds among themselves and with neighboring villages through an extensive network (Thong, *et al*. 2018b). However, various studies (FAO 2021; Mylliemngap 2021; Sarma 2022 [Chapter 1]) have highlighted that the introduction of new seeds and breeds in the *Jhum* fields over the years has resulted in a loss of local varieties. For example, it has led to the loss of eight varieties of potatoes and equal number of sweet potatoes in Meghalaya (FAO 2021). Furthermore, through the transition of shifting cultivation to settled agriculture, as in Dzongu Valley in Sikkim (Khaling & Lepcha 2022 [Chapter 11]), the diversity of food crops that was grown has reduced significantly with a collateral loss of traditional knowledge and practices. Sikkim is the only state in NE India where shifting cultivation has transitioned to settled system of agriculture. The drivers and impacts of this transition especially through policy and governance-related processes can be a lesson to the other sites.

Ecosystem Conservation and Restoration

Ecological succession takes place in *Jhum* fallows. Studies from NE India have reported that the percent recovery of tree species from a 5-year fallow to a 20-year fallow ranges from 35% to 62% (Gogoi, *et al*. 2020; Thong, *et al*. 2016; Thong, *et al*. 2020). Effective *Jhum* plot management can help in retaining the biodiversity of the area, as can be found in the *Jhum* system of the Konyak people, where approximately 3000 saplings of 42 species, such as *Macaranga denticulata*, *Sapium baccatum*, *Grewia* spp., *Quercus* spp., *Schima wallichii*, and *Alnus nepalensis*, were recorded from 1 ha of *Jhum* land (Chakraborty *et al*, 2022 [Chapter 2]). Additionally, *Jhum* fallows also provide multiple non-timber forest products, which are an essential source of rural livelihood (Trivedi, 2022 [Chapter 8]). The result is a mosaic of secondary forests with a primarily native species composition on a landscape level, which provides diverse habitat conditions needed by both wildlife and people.

From the perspectives of soil meso-faunal diversity and density as well, *Jhum* systems appear to harbour much higher diversity and density as compared to sedentary farming systems, such as terrace cultivation (Paul et. al, 2022 [Chapter 9]). As soil fauna contributes to the ecological processes of soil health restoration, the higher their diversity and density, the greater is their functional effectiveness (Paul et. al, 2022 [Chapter 9]).

This system can provide a mosaic of land uses that complements conservation activities either in protected areas, buffer zones or biodiversity corridors between protected areas. This contrasts with the more intensive land use of oil palm and teak plantations, such as those that have been established in the buffer zones of Dampa Tiger Reserve, Mizoram, where the bird diversity has declined significantly (Chakraborty, *et al*. 2022 [Chapter 2]).

Therefore, it may be concluded that shifting cultivation has an advantage over other forms of sedentary farming systems, including terrace and valley cultivation in regard to conservation and sustainable use of biodiversity, through maintaining diversity in the crop, wild species soil flora and fauna and their habitats.

Contribution of Shifting Cultivation to Supporting Community Livelihoods

The practice of *Jhum* is not merely exercised by the *Jhumias* for their sustenance, but is also a source of income. Two promising directions are 1) improving income from *Jhum* itself, thus improving biodiversity and livelihoods (Trivedi 2022 [Chapter 8]); and 2) tapping into marketing potential of local crops (Datta-Roy & Teegalapalli, 2022 [Chapter 7]). The local products and techniques have evolved to their present stage as a result of the interaction of the cultural and environmental conditions of the region, and thus deeply embedded in the identity of indigenous communities of the region. At the same time, the needs for cash income (e.g., for education) exist in communities practicing *Jhum* for various new aspirations. Thus, to maintain their livelihoods, the farmers are required to balance food production and income generation. Different crops can be harvested sequentially from *Jhum* lands and fallow lands, and there is a high demand in the local market for seasonal and annual cash crops from *Jhum*, such as ginger, turmeric, chili, and cucumber (Trivedi 2022 [Chapter 8]).The revival of millets in the *Jhum* field in Nagaland, has led to the enhancement of the livelihood of the community, particularly women. The average annual incomes of 5,008 households have increased by 15-20 percent through access to credit facilities, agriculture revolving funds, and sales from an increased yield of *Jhum* fields (Trivedi 2022 [Chapter 8]). In Arunachal Pradesh, tribe's famous *bhut jolokia* or *mithun marcha* (the ghost pepper, which is a hybrid of *Capsicum chinense* and *C. frutescens*) is grown by the Adi tribe for local consumption in the village and is in high demand in city centres, including the district capital Yingkiong. Large cardamom is also being grown in some of the *Jhum* fields for sale (Datta-Roy & Teegalapalli 2022 [Chapter 7]).

The primary workforce employed in every *Jhum* field comprises of the number of family members and labourers. However, it has been observed that there has been a lack of workforce in *Jhum* fields in recent times, due to a declining interest amongst the younger generation, thereby affecting the practice of *Jhum* to a great extent, as observed in the Tamenglong district of Manipur and Dzongu Valley in Sikkim (Pandey *et. al*, 2022 [Chapter 6]; Khaling and Lepcha, 2022 [Chapter 11]). Area under *Jhum* and number of family members involved in the *Jhum* had a significant positive relationship with the livelihood status in Tripura (Datta, *et al*. 2014). A positive correlation was found in Mizoram between the increase in income and field maintenance, presumably as a consequence of the higher capacity to hire labourers for weeding the field (Thong, *et al*. 2018b; Thong, *et al*. 2019b). However, in the Tamenglong District, Pandey *et al.*, (2022 [Chapter 6]) highlight that about three-fourths of the educated youth respondents, although being unemployed, are reluctant to contribute to *Jhum*. One of the major reasons of this disinterest, as cited by Pandey *et al.* (2022 [Chapter 6]), is the net return from the *Jhum* fields, as the average income from daily wages lies somewhere between INR 300-500 per day, whereas the average income from selling of the agricultural products grown in the *Jhum* fields is about INR 200 per day. Similarly, Khaling and Lepcha (2022 [Chapter 11]) point out that the youth community residing in the Dzongu Valley are of the opinion that *Jhuming* is a continuous toil, without any guaranteed lucrative benefits. Hence, they prefer indulging more in off-farm labour such as construction, eco-tourism, and other various governmental plans. Both Khaling and Lepcha (2022 [Chapter 11]) and Pandey, *et al.* (2022 [Chapter 6]) have highlighted the fact that the declining interest amongst the youth is leading to the loss of cultural identity. Hence, as Pandey, *et al.* (2022 [Chapter 6]) suggest that it is imperative to also explore alternative livelihood options that are associated with *Jhum*, such as eco-tourism, as implemented in Nagaland, in order to retain the interest of the *Jhumia* community, particularly the educated youths.

New Role that Shifting Cultivation can Play towards a Sustainable Society and Environment

Shifting cultivation can thus play a new role in achieving a sustainable society and environment as international agencies and governments reconsider it, based on new scientific insights related to

Jhum practices and dynamics, and an enhanced understanding of the impacts of sedentarization on communities and the environment.

Environmental: *Jhumias* contribute to biodiversity because their high level of livelihood dependency creates incentives for conservation; they have abundant skill in mixed cropping, seed development, and *in-situ* gene pool conservation; they create habitats in different successional stages through rotation; and they have rich indigenous knowledge (particularly traditional ecological knowledge) and cultural practices.

Jhum fallows contribute to conservation, restoration and enhancement of biodiversity and carbon stocks; protection of the forest from the consequence of land-use intensification, biological nitrogen fixation and nutrient cycling; mitigation of soil erosion; and maintenance of the soil fertility (Kessler, *et al*. 2012; Coelho 2017; Villa, *et al*. 2018). Further, the dibbling method of seeding used by the farmers causes less soil erosion compared to conventional agriculture on slopes up to 20-degrees where *Jhum* is typically practiced. The use of bamboo poles and log remnants from forest clearing as breaks on field edges also helps in preventing soil erosion (Deb, *et al*. 2013). The *Jhumias* further prevent soil erosion and help in soil moisture conservation by timing the sowing of crops such as tubers before the rains, paddy and other crops after rain, as well as with weed grading and mulching with mowed grasses.

Traditionally, *Jhumias* farm organically through sustainable crop and soil management. It provides multiple ecosystem services including soil retention, carbon sequestration and thus also helps in mitigating climate change (Folke and Colding 2001; Berkes, *et al*. 1995; Gogoi, *et al*. 2020; Thong, *et al*. 2020). *Jhumias* have a large repository of indigenous germplasm, which they maintain as per their culture and tradition. The wild relatives of crops and landraces maintained by indigenous communities have been considered to be essential to ensure future viability of global food production irrespective of climate change (Dempewolf, *et al*. 2014). Thus, these evidences negate the narrative that shifting cultivation causes environmental degradation. The steep tropical highlands with high rainfall could not have supported any other forms of agriculture as useful and productive as this (Ramakrishnan, *et al*. 1992). The resilient nature of mountain communities across the world is well known (Choudhury, *et al*. 2021; Datta-Roy and Teegalapalli, 2022 [Chapter 7]) and the *Jhumias* have been practicing this form of agriculture since time immemorial with the best demonstrations of innovation and adaptation, such as zero tillage, mulching, graded weeding, sequential cropping/harvesting, adjusting crop timing, retaining tree stumps and laying logs across slopes for mitigating erosion, crop mixture, integrated farming with livestock, and efficient resource management. Proper acknowledgement of *Jhum* provides the scope to return to the regenerative fallows for gaining several ecological benefits, such as biodiversity conservation, carbon storage, and use of traditional knowledge (Chakraborty, *et al*. 2022 [Chapter 2]).

Social: Shifting cultivation has remained central to the social, cultural, and economic life of farming communities in mountainous regions. *Jhum* practice is intricately linked to the socio-cultural ethos of the tribes in the region. It brings community harmony and promotes social bonding as the *Jhumias* work together, share the indigenous landraces, and adopt culturally imbibed practices, such as festivals that are observed throughout the agricultural cycle. The entire *Jhum* cycle is associated with various festivals and marriages and has a strong bonding with the cultural identity of many ethnic groups in the region. For example, with the revival of millets in Phek district of Nagaland, the role of women has been strengthened as they help in retaining the cultural aspect of farming that avoids farming to be practiced in isolation (Trivedi 2022 [Chapter 8]). In the Tamenglong district of Manipur, loss of cultural identity has been identified as one of the major consequences that may occur if the community decides to discontinue *Jhum* cultivation (Pandey, *et al*. 2022 [Chapter 6]). The transition has adversely affected the tenurial rights and customary laws of the *Jhumias*, and has jeopardized the unique annual land distribution practice followed in the region (Sarma, 2022 [Chapter 1]). The policymakers often consider fallow lands to be abandoned, thereby free of encumbrances, which henceforth can be converted to other forms of land-use such as settled farming or tree plantation. This is contrary to the customary norms governing the indigenous practice of shifting cultivation. Such conversions encourage private property arrangement, countering the common property framework under which shifting cultivation practice functions. Thus, promotion of settled farming in shifting cultivation fallow lands results in breakdown of land tenurial arrangements, thereby diluting the functioning of traditional village institutions, which govern customary land management.

Economic: Though there have been a few cases that depict that shifting cultivation results in low productivity and may not be economically viable in comparison to other forms of agriculture (Thrupp, *et al*. 1997; Darlong 2009; Das and Das 2014), these studies do not take into account the difference in inputs (such as planting materials, fertilizers, equipment). Besides, these studies also do not take into account the benefits of mixed or sequential cropping, which provides yield throughout the *Jhum* rotational cycle as per the needs of the family. The sale of organic farm produce (*bhut jolokia* or *mithun marcha*, large cardamom, varieties of millets) from *Jhum* fields provides livelihoods of the *Jhumias* (Datta-Roy & Teegalapalli, 2022 [Chapter 7]; Trivedi 2022 [Chapter 8]). Even the fallow lands continue to provide diverse resources, such as fuel wood, medicinal plants, leafy vegetables, broom grass, and other non-timber forest products, as well as bush meats to supplement the dietary needs and income of the *Jhumias* (Trivedi 2022 [Chapter 8]). A comparison has shown that long fallow shifting cultivation is nevertheless profitable and is the most efficient domestic resource use in the prevailing conditions (Toky and Ramakrishnan 1981; Tawnenga, *et al*. 1997).

Political: Since the 1950s many state governments in NE India have tried to replace shifting cultivation with alternative forms of land uses by providing cash incentives to the farmers to take up cash crops, and plantations without much success (Malik 2003). The conversion of land uses in mountainous fragile landscapes from shifting cultivation to commercial monocultures (without adequate care for people's attachment to nature and targeting a specific land use only for profitability purpose) has resulted in depletion of agrobiodiversity and food and nutritional insecurity (Pradheep, *et al*. 2017). Many of the indigenous landraces and their ecological services are lost by the inclusion of cash crops, which are remotely advantageous in the context of addressing climate change and other uncertainties. The popular notion held by various state officials and other agencies that shifting cultivation does not provide sustainable means of livelihood and food security is slowly changing with awareness on improved/innovative *Jhum* practices conducted in states like Nagaland and Meghalaya. The uses of alder by the Angamis in Khonoma and of paan (the betel leaf) by the Khasias in Barak valley are examples of sustainable traditional practice of

Jhum (Chakraborty, *et al*. 2022 [Chapter 2]). Therefore, a careful recommendation of a cropping mixture that can safeguard sustainability, optimize socio-ecological, and cultural systems could ensure ecological and economic security.

Conclusions

Shifting cultivation has been a subject of intense debate and discussion for governments, policy planners, and academics. For years, it has been viewed as an anachronistic, inferior, outdated, and destructive method of land use. As a result, this practice is going through a transition, manifested in crop changes, land allocation, absence of rituals, and socio-ecological shifts. From the researches conducted across the region and included in this volume, it has emerged that the traditional long cycle *Jhum* is an effective form of land use in which the agro-biodiversity of native crops and other elements of biodiversity are conserved and limited space is utilized for optimum production in a specific time. In addition, the polyculture system is a reliable and protective mechanism for food and economic security of the indigenous population. *Jhum* also promotes social cohesion and equitable sharing of natural resources. The discussion here brings out a deeper understanding of the current scenario of *Jhum* in NE India and demonstrates with examples, how the *jhumescape* of NE India is being transformed by the farmers themselves and by the market forces and also through intervention of external agencies in order to meet changing needs of the *Jhumias*. These researches highlight that the 'tradition is in transition' and underline the definite need to manage the transition in order to make it sustainable in every context—ecological, economic, and social.

References

Berkes, F., Folke, C, Gadgil M.1995. Traditional ecological knowledge, biodiversity, resilience, and sustainability.In C.A. Perrings, K. G. Maler, C. Folke, C.S. Holling, and B.O. Jansson (Eds) *Biodiversity Conservation: Problems and Policies*. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Cairns MF. 2015. Shifting Cultivation and Environmental Change: Indigenous People, Agriculture and Forest Conservation;Routledge: Abingdon, UK.

Chakraborty K, Sarma KK, Kundu SS, Das AK. 2015. Shifting cultivation dynamics in Barak basin of North East India – A geospatial approach. International Journal of Advancement in Earth and Environmental Sciences 3(2): 21-29.

Choudhary D, Bhuchar S, Thomas S. 2021. Transitioning shifting cultivation to resilient farming systems in south and southeast Asia. Resource Book, ICIMOD, Kathmandu, Nepal.

Coelho GC. 2017. Ecosystem services in Brazilian's southern agroforestry systems. Tropical and Subtropical Agroecosystems 20**:**475–492.

Darlong VT. 2009. Shifting paradigm on shifting cultivation: Revisiting challenges and options for transforming "Lives, Landscape and Livelihoods" in Tripura from experiences of NERCORMP-IFAD in North-East India.

Das S, Das M. 2014. Shifting cultivation in Tripura-A critical analysis. Journal of Agriculture and Life Sciences 1(1): 48-54.

Datta J, Gangadharappa NR, Debnath, A. 2014. Sustainability of jhum cultivation as perceived by the tribal people of Tripura. International Journal of Social Sciences 3(2): 179–190.

Deb S, Lynrah MM, Tiwari BK. 2013. Technological innovations in shifting agricultural practices by three tribal farming communities of Meghalaya, northeast India. Tropical Ecology 54(2): 133-148.

Dempewolf H, Eastwood RJ, Guarino L, Khoury CK, Müller JV, Toll J. 2014. Adapting agriculture to climate change: A global initiative to collect, conserve and use Crop Wild Relatives. Agroecology and Sustainable Food Systems 38(4): 369-377.

FAO. 2021. *Indigenous People's Food System: Insights on sustainability and resilience from the front line of climate change*. Rome: FAO and Alliance of Bioversity International and CIAT. DOI:https://doi.org/10.4060/cb5131en

Folke C, Colding J. 2001. Traditional conservation practices. Encyclopedia of Biodiversity, Volume 5, Academic Press, 681-694.

Gogoi A, Sahoo UK, Saikia H. 2020. Vegetation and ecosystem carbon recovery following shifting cultivation in Mizoram-Manipur-Kachin rainforest eco-region, Southern Asia. Ecological Processes 9 DOI:10.1186/s13717-020-00225-w.

Karlsson BG. 2011. Unrully hills: A political ecology of India's northeast. Berghahn Publishers, New York, 333 p.

Kessler M, Hertel D, Jungkunst HF, Kluge J, Abrahamczyk S, Bos M, Buchori D, Gerold G, Gradstein SR, Kohler S, et al. 2012. Can joint carbon and biodiversity management in tropical agroforestry landscapes be optimized? PLoS One 7 DOI: 10.1371/journal.pone.0047192.

Malik, B. (2003). The "Problem" of Shifting Cultivation in the Garo Hills of North-East India, 1860–1970. *Conservation and Society*, *1*(2), 287–315. http://www.jstor.org/stable/26396409

Mylliemngap W. 2021. Agrobiodiversity and Natural Resource Management in Traditional Agricultural Systems of Northeast India. Agrobiodiversity & Agroecology 1(1): 1-23, https://doi.org/10.33002/aa010101

Mertz O. Leisz SJ, Heinimann A, Rerkasem K, Dressler W, Pham VC, Vu KC, Schmidt-Vogt D, Colfer CJ, Epprecht M et al. 2009. Who counts? Demography of swidden cultivators in Southeast Asia. Human .Ecology 37: 281–289.

NITI Aayog 2018 Report of Working Group III. Shifting Cultivation: Towards a Transformational Approach. NITI Aayog, Government of India, New Delhi

Ovung, E., Upadhyay, K. K., & Tripathi, S. K. (2021). Soil fertility and rice productivity in shifting cultivation: impact of fallow lengths and soil amendments in Lengpui, Mizoram northeast India. Heliyon, 7(4), e06834.

Pradheep K, Ahlawat SP, Bhandari SP. 2011. Report on special drive to North-Eastern India for the collection of Plant Genetic Resources (2011-16). ICAR-National Bureau of Plant Genetic Resources, New Delhi, 116 p.

Ramakrishnan PS, Patnaik S. 1992. Jhum: Slash and burn cultivation. India International Centre Quarterly 19: 215-220.

Ramakrishnan PS, Saxena KG, Rao RS, Maikhuri RK, Das AK. 1998. Contributions of ethnic diversity to the evolution of diverse coexisting mountain agroecosystems: A study of the North East Indian Himalayan Region. Pages 33-40 in Partap T, Sthapit B, editors. Managing agrobiodiversity: Farmers' changing perspective and institutional responses in the Hindu Kush-Himalayas. Kathmandu, ICIMOD.

Rerkasem K, Lawrence D, Padoch C, Schmidt-Vogt D, Ziegler AD, Bruun TB. 2009. Consequences of swidden transitions for crop and fallow biodiversity in Southeast Asia. Human Ecology. 37: 347–360. doi:10.1007/s10745-009-9250-5.

Tawnenga, Shankar U, Tripathi RS. 2007. Evaluating second year cropping on jhum fallows in Mizoram, north-eastern India: Energy and economic efficiencies. Journal of Biosciences 22(5): 605-613, https://doi.org/10.1007/BF02703398

Thong P, Pebam R, Sahoo UK. 2016. Recovery pattern of vegetation during succession following slash and burn agriculture in Mizoram, North-East India. Journal of Plant Biology and Soil Health 3(2): 1-8

Thong P, Pebam R, Sahoo UK. 2018a. A geospatial approach to understand the dynamics of shifting cultivation in Champhai district of Mizoram, North-East India. Journal of the Indian society of Remote Sensing 46(10): 1713-1723.

Thong P, Sahoo UK, Pebam R. 2018b. Influence of socio-economic factors on the dynamic nature of shifting cultivation in Champhai district of Mizoram, India. Journal of Hill Agriculture 9(3): 325-330.

Thong P, Sahoo UK, Pebam R, Thangjam U. 2019a. Spatial and temporal dynamics of shifting cultivation in Manipur, Northeast India based on time-series satellite data. Remote Sensing Applications: Society and Environment 14: 126-137.

Thong P, Sahoo UK, Pebam R, Thangjam U. 2019b. Changing trends of shifting cultivation and its drivers in Champhai, Northeast India. Indian Journal of Hill farming 32: 1-4.

Thong P, Sahoo UK, Thangjam U, Pebam R. 2020. Pattern of forest recovery and carbon stock following shifting cultivation in Manipur, North-East India. PLOS One 15(10) DOI: 10.1371/journal.pone.0239906.

Thrupp LA, Hecht S, Browder J. 1997. The diversity and dynamics of shifting cultivation: Myths, Realities and Policy Implications. World Resources Institute, 53p.

Toky OP, Ramakrishnan PS. 1981. Cropping and yields in agricultural systems of the northeastern hill region of India. Agro-Ecosystems 7:11–25.

Villa P, Martins S, Neto S, Rodrigues A, Martorano L, Monsanto L, Cancio N, Gastauer M. 2018. Intensification of shifting cultivation reduces forest resilience in the northern Amazon. Forest Ecology and Management 430: 312-320.