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Rethinking Growth Strategies

The Energy and Resources Institute

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FOREWORD BY EDITOR-IN-CHIEF

I am happy to see that this second in the series of the Green Growth and Development publication, which TERI has launched, is published. One of the important innovations in this issue is the contribution from the private sector, which is significant. Any implementation of an approach or strategy, which has the characteristics of greater efficiency of use of energy and other resources, and therefore, qualifies as a green strategy, would be applied in practice only if the business is part of such action. It is significant that in the UN Conference on Sustainable Development, popularly known as the Rio+20 held in Rio de Janeiro in 2012, the visible presence of the private sector, in several cases at a very high level, was a significant feature that stood out. The document finalized at Rio de Janeiro with the title "The Future We Want" emphasizes a number of issues and advocates a number of initiatives which if implemented would lead global society towards a green and sustainable future.

Coming to grips with actions that would characterize a green economy represents a complex challenge, because a transition in this direction cannot take place overnight. Countries have major investments in infrastructure, production processes and equipment as well as a range of physical assets where wholesale change can only take place over an extended period of time, and with significant reallocation of resources. Another important aspect that would define the extent to which a green economy could be established is linked directly with lifestyles. It was in the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) that a statement was made, highlighting the fact that "changes in lifestyles and behaviour patterns can contribute to climate change mitigation across all sectors. Management practices can also have a positive role." If stabilizing the earth's climate is accepted as an important component of the thrust towards a green economy, then lifestyle changes become an important means to achieve this end.

A green economy necessarily uses resources efficiently, minimizes negative impacts on society and reduces pressure on the earth's ecosystems. Meeting the challenge of climate change and ensuring that emissions of greenhouse gases are mitigated is clearly an important prerequisite for establishing a green economy, to the extent

that lifestyle changes help in this direction. In a country like India, where society has maintained a reverential attitude to nature and all its manifestations, the current trend towards greater consumption and production of goods and services, often with very poor levels of resource use efficiency, would be an important part of a movement in the direction of a green economy. I am sure just as this issue of Green Growth and Development has expanded its coverage to some new aspects, a future issue will also focus on the subject of lifestyle changes.

R K Pachauri
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INTERVIEW

Dr Pronab Sen is former Principal Advisor of Planning Commission, Government of India

Dr Pronab Sen on inclusive green growth

The publication team interviewed Dr Sen on inclusive green growth.

TERI: *As someone who has seen the planning and growth process in India, what is your perception on greening of various sectors to realize the goal of sustainable development?*
Pronab Sen: When we think about green growth in India, two aspects of economic growth become relevant — patterns of production and patterns of consumption. In the Indian context, we are a large exporter of services and importers of manufactured goods. Our economy being largely service-oriented is green in many ways. However, greening of the consumption is required. The key question is where on the consumption front can we gradually transition to becoming green and at what cost? In many sectors, there are efficiency gains attached, if we are able to leapfrog because at present we are consuming polluting things.

TERI: *Measures such as Gross Domestic Product (GDP) or Human Development Index (HDI) focus on the short-term and macro-level intra-generational equity issues. What metrics, in your opinion are a better reflection of both inter-generational and intra-generational equity and sustainability?*
Pronab Sen: Intra-generational equity can be captured by looking at income distribution, wealth distribution, and human development measures. Intra-generational measures should capture our human capital and also the environmental assets. But, inter-generational equity is not easy to capture. An important issue of inter-generational equity has a lot to do with the human assets including skills. The distributional aspects

of the future generation or the intra-generational aspects of the future are difficult to determine today. Inter-generational metrics will also depend on intra-generational aspects of present and future.

TERI: *You are on the board of the committee which is expected to put in place Green GDP for India. Any views of the committee?*
Pronab Sen: I would say that the study on Green GDP is still at a conceptual stage. The committee mainly followed the System of Environmental-Economic Accounting (SEEA) that the UN Statistics Division has prescribed. The real challenge will be to translate the concepts on the ground. Strengthening of institutional arrangements linked to Ministry of Environment and Forest (MoEF) and Ministry of Statistical Planning and Implementation (MoSPI) is required to bring the concept of Green GDP in practice.

TERI: *Food inflation has remained above 6 per cent in the past years. High food inflation acts as a barrier to economic welfare, especially for vulnerable sections of society. In your view, how can this issue be tackled and how has the planning process in India dealt with the issue of food inflation?*
Pronab Sen: Traditionally food inflation in the country was linked to external factors such as weather. In the past decade, the food inflation has been close to 8 per cent. But, here we need to understand that there is a different structural aspect involved. Recent high growth of the economy has led to a change in the food baskets of the consumers including rural consumers resulting in increasing demand and the agriculture sector has not been able to meet the increasing demand.

The ability of the supply side is constrained by three key factors. First, subsistence agriculture continues to be dominant. Indian farmers are also risk-averse and often see a risk in increasing their production quantities. Second, we have a poor marketing system for food produce in India; at present, there are only localized markets. Third, even for large farmers, diversification of crops is a problem because of inadequacy of proper technologies and right marketing systems.

TERI: *Can private players play a role in addressing food supply and market issues?*
Pronab Sen: There have been some successful cases where private players like ITC Limited and Pepsi have demonstrated initiatives linked to the agricultural sector. However, the problem is that of scaling up of such initiatives. Also, the private sector may not necessarily see these initiatives as being profitable.

TERI: *You chaired the Pronab Sen Committee for Slums which highlighted problems related to urbanization including poorly built tenements with inadequate access to basic services such as sanitary facilities and drinking water supply. While India is still largely rural, in view of increasing urbanization, how can we tackle the challenge of providing essential services for the urban poor?*

Pronab Sen: Our system responds to urban problems only after urban agglomerations have developed. We need to start early and identify the upcoming urban areas, so that provisioning of urban services is done in a more systematic manner.

TERI: *You also chaired a committee that identified parameters for designating ecologically sensitive areas in India based on species, ecosystem, and geo-morphological features. For a country with four biodiversity hotspots, what do you think is the thin line for interventions related to 'conservation' and 'sustainable development'? What are the best possible ways to balance the two, and conserve biodiversity and ensure human well-being?*

Pronab Sen: Only reacting in cases involving development and ecologically sensitive areas does not help. What is required is that we must put the information about these ecologically fragile spots in public domain, so that any economic activity, prior to being planned, should take into consideration these sites. It has been almost a decade, since we came out with criteria for ecologically sensitive areas. Since then, only mapping of the Western Ghats has been done. Whereas in a decade's time, ecological assessments of substantial part of the country could have been carried out.

TERI: *In a recent article, you mentioned that the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) has had an enormous potential of unleashing entrepreneurial spirits in rural India. How, in your view, can such rural development programmes be strengthened, so that the country also moves towards a skilled work-force and higher employment levels?*

Pronab Sen: We certainly need to create supporting institutions to promote entrepreneurship. There needs to be a system that informs and supports people in carrying out their entrepreneurial ventures. This has happened to some extent by way of Self Help Groups (SHGs); but this is just one of the models, more of such kind of models need to be initiated. Entrepreneurship depends on the individual entrepreneur who need supporting ecosystems such as financial support and markets. In India, currently our banking sector has to also ensure financial inclusion in rural areas.

While we have a system in place, what is required is an ecosystem for innovators and entrepreneurs and India has a long way to go in this regard.

TERI: *Any other comments?*
Pronab Sen: We have to also appreciate that we have come far in the last decade with respect to environmental issues. Planning in India has always emphasized on environmental sustainability. We have to continue to make progress on that path.

Dr Pronab Sen is former Principal Advisor of Planning Commission, Government of India. He has served and is serving on number of government constituted committee on topics related to growth and development

INTERNATIONAL CASE STUDY

Japan's recent policies to promote green growth

International Cooperation Office
Ministry of Environment, Japan

The Government of Japan formulated the 'Comprehensive Strategy for the Rebirth of Japan' in July 2012. This Strategy aims to overcome the Great East Japan Earthquake and the nuclear power plant accident and identify the direction that Japan should proceed in as a "country facing frontiers of emerging challenges" (including aging society and energy issues). The strategy prioritizes four key policy areas relevant to green growth for the next three years. These include green energy and the environment; life (health and life sciences); agriculture, forestry, and fisheries; and Small and Medium Enterprises (SMEs).

The Ministry of the Environment of Japan (MOEJ) developed the "Initiative toward Realization of Green Growth and Dramatic Installation of Renewable Energy" in August 2012 in order to contribute the implementation of the strategies for rebirth of Japan.

The initiative articulates three major objectives to promote green growth in Japan.

Objective 1 To apply green growth for the recovery from the Great East Japan Earthquake that occurred in March 2011 through realization of 'green community' which will be formulated by actualizing coexistence with nature, and establishing a low carbon society and cyclical society in the affected areas.

Objective 2 To maintain Japan's position as one of the leading world economies based on the emphasis gained from the Rio+20 deliberations around green economy.

Objective 3 To involve every sector in Japan for revitalizing Japanese economy through promotion of green growth.

Under the initiative, MOEJ will make effort to promote innovations in the following six areas.

1 **Renewable energy**: The various policies to promote solar power, onshore wind power, and hydro-power have already been introduced; the further promotion of these technologies will be done. On the other hand, offshore wind power, geothermal power, biomass energy, and ocean energy still needs to be developed and promoted. However, they will contribute on a large scale in future because as per estimates of MOEJ, they have huge potential in Japanese natural conditions. MOEJ will promote research, development, and model projects till 2020, followed by expansion of these energies dramatically.
   - Offshore wind-power: The type of generator installed on the bottom of the sea is already commercialized and will be promoted. The type of generator installed on the float, which has larger potential in Japan, needs experimental proof for practical use.
   - Geothermal: MOEJ will survey the potential of geothermal resources and develop good practices for utilization of geothermal sources such as hot springs.
   - Biomass: It still faces difficulties such as high cost, instability of provision, and insufficient development of collection and transportation of the biomass resources. MOEJ will coordinate with relevant ministries such as agriculture, forestry, sewage and transportation, and introduce model projects.
   - Ocean energy: MOEJ will support R&D on wave power and tidal power.
   - Common issues: MOEJ will support distributed energy systems including battery technologies and renewable energy systems that will also strengthen electricity network.

2 **Water**: Support the development of businesses on water management and water treatment by Japanese companies in the foreign countries.

3 **Local development**: Establish a fund for local governments to introduce renewable energies and improve energy efficiency, and support local government's actions such as the installation of the technology on saving energy in the public facilities and the promotion of light emitting diode (LED) lights in the local area.

4 **Establish energy-efficient buildings**: Support huge promotion on LED lights into houses, and promote the technology development and model projects of home energy management system (HEMS), building and energy management system (BEMS), and improvement of energy efficiency of data centres which have many servers.

5. **Expansion to global markets**: Support promotion of the application of Japanese environment and energy technologies under its proposed Bilateral/Joint Offset Credit Mechanism.
6. **Foundation of green growth**: Provide ecosystem for operationalizing green growth:
   - Green finance: Development of mechanisms to promote funding for eco-friendly business and climate change related technologies.
   - Green regulation: Promotion and development of model projects with advanced technology which are in alignment with future regulations and eventually introduce restrictions on the carbon inefficient products.
   - Green human resources: Promote green jobs that support green technologies and create awareness about the adverse impacts of climate change as indicated in the Intergovernmental Panel on Climate Change (IPCC) fifth assessment report.

Through these enhanced policies, the Government of Japan aims at a paradigm shift of qualitative economic growth and also sees international cooperation as playing an important role in this process.

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ARTICLES

Mainstreaming biofuels in the Indian energy mix

Prodipto Ghosh

Introduction

The current approach to the use of biofuels in India centres on two initiatives: First, a requirement of blending of petrol with ethanol (upto 5 per cent) in states which are major producers of sugar. The ethanol is produced from molasses, a by-product of sugar production. Second, encouragement to blending of diesel with a compatible biofuel sourced from Jatropha and Pongamia plantations.

There are inherent problems with both approaches. In case of ethanol from molasses, the aggregate supply to the market is limited by the quantity of sugar produced. Further, ethanol has a number of competing uses: industrial (such as in the paints industry, and in manufacture of chemicals including pharmaceuticals) and human consumption. Dedicated sugarcane plantations for ethanol production, as exist in Brazil, are infeasible in India owing to severe competition for agricultural land and water by food and other cash crops. In case of biodiesel from Jatropha or Pongamia, the problem is, in case of plantations from marginal lands unsuited to agriculture, the yields are too low to be remunerative. For higher yields, the plantations would also compete for land and water with food and cash crops.

However, the potential in India for scaling up the use of biofuels is not limited to molasses based ethanol, or biodiesel from plantations. By far the greater potential lies with cellulosic biomass — primarily from crop residues, and also from fuelwood plantations on wastelands, and urban municipal waste.

This paper discusses the potential for production of biofuels from cellulosic matter (mainly crop residues), the technology pathways, and possible policy interventions not involving direct fiscal subsidies, for mainstreaming biofuels in the Indian energy mix. There is a more detailed focus on one pathway — the production of methanol (and hydrogen) by catalytic conversion of syngas, being a mature technology.

Scale of crop residues in India

Figure 1 below indicates the annual yields of crop biomass in different districts in India. The aggregate annual yield is c. 500 million tonnes of dry biomass, about the same in terms of coal equivalent. However, owing to a complex pattern of use in rural areas (Figure 2), the currently available surplus biomass which, in principle, may be diverted to production of biofuels, is c. 140 million tonnes (or the same in mtce).

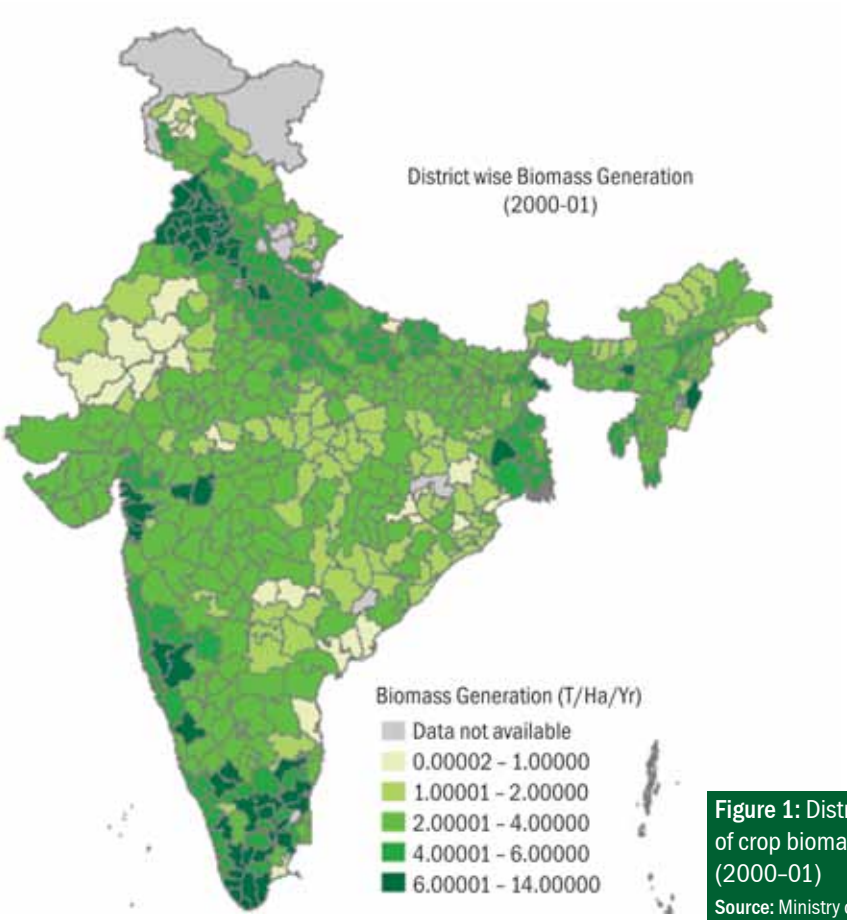

Figure 1: District-wise patterns of crop biomass generation (2000–01)

Source: Ministry of New and Renewable Energy, private communication

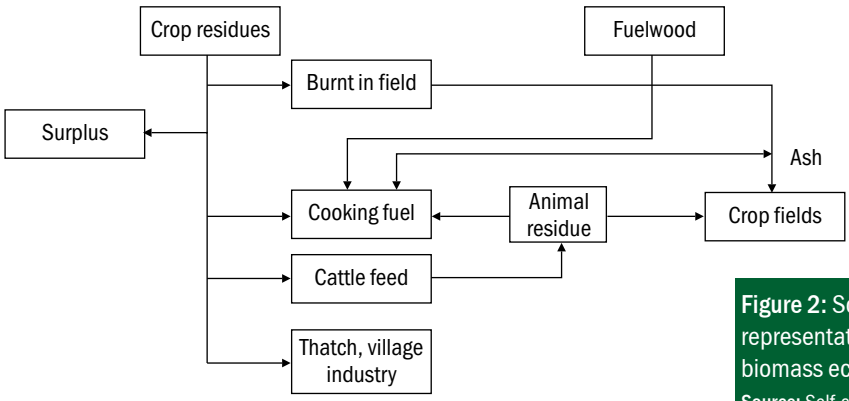

Figure 2: Schematic representation of rural biomass economy
Source: Self-compiled

Technology Pathways

There are several possible pathways for deriving transportation and industrial fuels (not being feedstocks where the chemical composition apart from energy content is a main consideration) from cellulosic biomass. Some of these are:

Derivation of fuel from cellulose biomass

(1) Biomass (Cellulose/Hemicellulose): From crop residues and energy plantations through:

- **Acid or enzyme hydrolysis, saccharification, and fermentation**: Yielding ethanol, butanol, and diesel
- **"Mixalco Process"**: Yielding mixed higher alcohols[1]
- **Microbial cultures** (anaerobic fermentation)[2] : Yielding methane
- **Pyrolysis/catalysis**: Yielding diesel fuel
- **Gasification**: Leading to Syngas, through:
  - *Fermentation*: Yields ethanol and butanol
  - *Catalytic conversion*: Yields methanol and hydrogen
  - *Fischer-Tropsch catalysis*: Yields biomass to liquid (BTL) diesel

(2) Algae/Water Hyacinth: Through hydrocracking, yielding biodiesel.

Various municipal/industrial wastes of biological origin may also be employed in the gasification route. At present, only biodiesel sourced from Jatropha or Pongamia

[1] Gasification of lignocellulose yields syngas, which, is cleaned and passed over a metal catalyst to give mixed alcohols.
[2] This is the process employed in biogas plants using animal or human wastes.

plantations, and bioethanol using spoilt[3] foodgrains are cost-effective in relation to petroleum-based fuels. While significant R&D is being carried out in several countries, including in India, in respect of technologies based on several of the above pathways, at present, the costs are not yet competitive with petroleum. However, it is probable that several biofuels technologies would eventually become competitive with petroleum and the policy/regulatory regime must enable them to be commercially deployed when that happens.

Catalysis of syngas to methanol and hydrogen

Of the different technology pathways, the most mature at present involve the catalysis of syngas to methanol and hydrogen. Both fuels can be used in present internal combustion (IC) engines, with little or no modification. In addition, both may be used in fuel cell vehicles that have efficiencies typically 2–3 times greater than conventional IC engines, on account of by-passing Carnot cycle limits. The syngas may be produced from almost any carbonaceous fuel — coal, refinery off-gases, biomass.

Methanol or hydrogen production facilities from biomass typically consist of the following basic steps: pre-treatment, gasification, gas cleaning, reforming of higher hydrocarbons, shift to obtain appropriate H_2:CO ratios, and gas separation for hydrogen production or methanol synthesis and purification. Optional are a gas turbine or boiler to employ the unconverted gas, and a steam turbine, resulting in electricity co-production. Many process configurations are possible. Gasification may be atmospheric or pressurized, direct or indirect, resulting in very different gas compositions; different options are available for gas cleaning, processing, and purification; also generation of power is optional. Altogether, in theory a very large number of concepts to produce methanol or hydrogen is possible. The feasibility of the technology (at least for methanol) has also been demonstrated at the small scale.

Feasibility of use of biofuels in internal combustion engines

Both methanol and ethanol burn at lower temperatures than petrol, and both are less volatile, making engine starting in cold weather more difficult. Methanol as a fuel in spark-ignition IC engines can offer increased thermal efficiency and power output as compared to petrol engines due to its high octane rating (114) and high heat of vaporization. However, its lower calorific content (19.7 MJ/kg) and stoichiometric air-fuel ratio (6.42:1) mean that fuel consumption (on volume or mass basis) will be higher than hydrocarbon fuels. The extra water vapour produced and the formation of acidic

[3] Those unfit for human or domestic animal consumption.

products during combustion — owing to soluble contaminants such as chloride ions — lead to greater corrosion of valves, valve seats, and cylinders. Certain additives in the fuel may neutralize these acids.

Methanol is hygroscopic, i.e., absorbs moisture directly from the atmosphere. Since this reduces the calorific value of the fuel, methanol containers must be kept tightly sealed.

In terms of toxicity, methanol is poisonous to humans in sufficient concentration. Moreover, it can be absorbed through the skin, and vapours through the lungs. The US standard for exposure (40 hr/week) is 1900 mg/m^3 for ethanol, 900 mg/m^3 for petrol, and 1260 mg/m^3 for methanol. Since it is much less volatile than petrol, it has lower evaporative emissions, producing a lower exposure risk for an equivalent spill. While the toxicity exposure pathways for methanol are somewhat different, the effective toxicity risk is no worse than for petrol or benzene, and is easier to treat successfully. Inhalation risk is also mitigated by a characteristic pungent odour. Unlike benzene family fuels, methanol rapidly and non-toxically degrades in the environment.

In terms of fire-safety, Methanol is more difficult to ignite than petrol and burns about 60 per cent slower. A methanol fire releases energy at around 20 per cent of the rate of a petrol fire. Unlike petrol, water is an effective and acceptable fire suppressant. These facts mean that as a vehicle fuel, methanol has considerable safety advantages. For these reasons, pure methanol is now mandated in United States Auto Club (USAC) Indy car competitions (after a 1964 seven-car crash in the Indianapolis 500).

Use of methanol in other countries

China

In 2007, China became the world's largest methanol producer and consumer. Currently, China consumes nearly one billion gallons (c. 4.5 billion litres) a year of methanol in transportation fuels for taxis and bus fleets, blended with petrol. The blends contain upto 85 per cent–100 per cent methanol, although lower blends (15 per cent methanol) are also available in retail petrol pumps in several parts of the country. China's overall production capacity for methanol was expected to be 37.4 million tonnes in 2010.

China is also developing production capacity for dimethyl ether (DME) using methanol as feedstock. This is to be blended with Liquefied Petroleum Gas (LPG) for domestic use, and as a diesel substitute in transportation. However, further R&D is considered necessary before this can be mainstreamed.

China's methanol production relies on coal as feedstock. The current prices of methanol sourced from coal are c. $350 per tonne, while petrol costs c. $ 965 per

tonne. *The lesson here is that methanol can be an economic petroleum substitute, even if it cannot be produced on large scale yet from biomass*. The annual growth rate of methanol use in transportation in China during the period 2008–12 is estimated at 16.6 per cent.

United States

California State operated an experimental programme from 1980 to 1990 that allowed anyone to convert a gasoline vehicle to 85 per cent methanol with 15 per cent additives of one's choice. Over 500 vehicles were converted to a dedicated ratio of 85:15 methanol: ethanol. The US automobile industry demanded subsidies for producing methanol or ethanol vehicles, and in 1982 the big three US automakers were each given $5 million for design, and contracts for 5000 vehicles to be purchased by the State of California. Such low compression, flexible fuel vehicles are still available today.

However, in 2005 California terminated the methanol programme in favour of ethanol sourced from corn owing to political compulsions for providing support to corn producers. Since then, a US Congressman, Eliot Engel, has introduced a Bill: "An Open Fuel Standard", requiring all automobile manufacturers to ensure that at least 80 per cent of vehicles manufactured by them can operate on fuel mixtures containing 85 per cent of ethanol or methanol or biodiesel.

European Union

The amended Fuel Quality Directive adopted in 2009 allows upto 3 per cent by volume blending of petrol with methanol.

Possible policy approaches in India

Any policy on transportation fuels in India has to contend with the overriding objective of reducing dependence on imported petroleum. This is immediately feasible, both technologically and economically, with methanol derived from coal or biomass. However, in the near term of 3–5 years, we may anticipate that several of the other technological pathways for conversion of cellulosic biomass or algae based may become technologically and economically mature. These may yield ethanol, methanol, DME, butanol, and other liquid fuels similar to various grades of petroleum-derived fuels, besides methane and hydrogen.

The current mandate on blending petrol with ethanol may thus be modified to enable blending with methanol or ethanol or other fuel from any source other than petroleum (coal or biomass or molasses) by any technological pathway, as long as specified technical characteristics related to engine performance and emissions are

adhered to. The limit of blending may also be raised to 85 per cent, and even 100 per cent methanol or ethanol or other fuel from any source may also be permitted, once again as long as the specified technical characteristics are met. While a 5 per cent blending limit with methanol may not require any lead time, since no modification in IC engines would be required, a time frame of (say) 3 years should be spelled out for introduction of 85 per cent blends, or 100 per cent methanol or ethanol. Such a time frame should suffice for automobile manufacturers to modify engines to operate on the higher blends.

Similarly, the policy on blending of diesel with biodiesel may be amended to permit the use of DME, itself sourced from methanol obtained from coal or biomass, or other non-petroleum-based fuel, as long as specified technical characteristics are met, apart from biodiesel.

Support may also be provided for R&D in modifying diesel engines to run on high blends (85 per cent) or 100 per cent DME, or other non-petroleum-based fuel. The feasibility of blending DME with LPG for domestic use should also be established with R&D support.

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Nationally appropriate mitigation actions: A vehicle for green economy

Manish Shrivastava

The 'economy' that needs to be 'green'

The 'economy' embodies those social and productive relations between humans and nature that define the character of material well-being of a society (Polyani 1944 [1957]). Humans' 'reproductive relationship with nature' is that of human subsistence in the form of extracting goods from nature necessary for human survival and well-being. The patterns of production (human–nature relationship) of goods necessary for human existence and their distribution (human–human relationship expressed through distribution of goods) together define how a society organizes its economic life. The origins of the concept of 'green economy' clearly indicate that modern industrial economies did not quite get the pattern of social and productive relations right (UNEP 2012). The character of economic progress during the 20th century has been that of undervaluing risks that the pursuit of rapid accumulation of capital and wealth can create for ecological health and social inclusiveness. The fact that economic growth, if inconsiderate of environmental impacts, can make lives of even wealthy people difficult, has forced re-examination of the thinking about economic growth. It demands putting constraints on the manner in which expansion of economic activities takes place.

The concepts of 'green economy', and subsequently that of 'green growth', have emerged as an approach to set the patterns of production and distribution right. It is not surprising that a green economy is plainly described "as an economic environment that achieves low carbon emissions, resource efficiency and at the same time is socially inclusive".[1] The concept of green economy does not undermine the importance of access to material wealth as fundamental to descent quality life. It rather engages with the question, how to produce that material wealth in an appropriate manner? In other

Note: Arguments presented in this article heavily draw from the ongoing research at TERI under the project "Developing country participation in addressing climate change: Analysing issues and options for implementing NAMAs and REDD Plus", supported by The Royal Norwegian Embassy in India.

[1] See http://www.unep.org/wed/greeneconomy

words, it asks: what are the right social and productive relations between humans and nature that we need to cultivate and promote if we want to avoid a range of crises (e.g., food security, energy poverty, biodiversity loss, poverty, degraded ecosystems, etc.) the world faces today?

Transition and its national context

Although the transition to green economy is needed at global level, and it is widely recognized; so the productive relationship of humans with nature is still grounded within the framework of national economy. Therefore, the correctness of relationships that should govern economy has to be assessed primarily in national context. The notion of nationally appropriate mitigation actions (NAMAs) may be conceived as a means to do the same, particularly in developing countries. Although the phrase 'nationally appropriate mitigation actions', as it has been used in the Bali Action Plan, can be applied to mitigation in developed as well as developing countries,[2] yet the abbreviation—NAMAs—exclusively denotes mitigation actions in developing countries.[3] The discussion on NAMAs in developing countries makes distinction between the mitigation actions which are undertaken with domestic resources and the actions which are partially or fully supported by developed countries (Linnér and Pahuja 2012).

By definition, mitigation is implicit in any path towards green economy. However, the adjective– 'nationally appropriate'—to mitigation actions reflects the fact, and the challenge, that although urgent mitigation actions are necessary to avoid climate change induced risks, mitigation alone cannot be the sole criterion to drive transition towards green economy. Nations have distinct production and distribution patterns and thus face peculiar challenges in transforming organization of their economic activities. Broadly, developing countries need to build an economic environment which provide basic services to a majority of their people with least environmental damage. Developed countries, however, need to reduce their carbon footprint while maintaining high living standards they have already achieved (Du Ploy 2012).[4] It may be argued that for developing countries the transition to green economy implies different sets of production and distribution relations whereas for developed countries it primarily means transformation of consumption patterns. Of course, the domains of production, distribution, and consumption are not independent of each other and

[2] See para 1b(i) and 1b(ii) of the Bali Action Plan; available at unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf

[3] A potential explanation could be the way the text referring to mitigation in developed countries was written in the Bali Action Plan. For developed countries, it reads, "nationally appropriate mitigation commitments or actions, including quantified emission limitation and reduction objectives", which are usually referred to as QELROs.

[4] Also see Global Footprint Network's Human Development Initiative; available at http://www.footprintnetwork.org/en/index.php/GFN/page/fighting_poverty_our_human_development_initiative/

change in any of the three domains of economy is likely to bring changes in other domains as well. Nonetheless, for different countries entry point to green economy is likely to be different.

NAMA discourse and strategies for green growth

The common economic wisdom of production patterns suggests that investment drives the direction and pace of economy. Hence, the current emphasis on pricing policies and regulatory changes translating environmental values into market incentives (Turner 2005) is in line with the economic logic of production relations. It is also imperative keeping in mind that green growth is the operational indicator of transition to green economy. It is also argued that social concerns of equity and poverty alleviation are also embedded in such investments through creation of green jobs. However, taking NAMAs as driver of transition to green economy opens up multiple dimensions of the comprehensive approach that is needed for transition towards green economy. The discourse on NAMAs, both in terms of defining the actions and designing the mechanism, points out that in addition to the economic logic of investment patterns, a pattern of social choice at national level and of political cooperation at international level is necessary for a quicker transformation towards 'green economy'.[5]

Social choice at national level

There is a serious lack of clear articulation as to what constitutes a NAMA. There are only a few ongoing research projects which have a systematic approach to codify what is nationally appropriate.[6] Most of the literature, and discussions, at best reflect an intuitive understanding with varying emphasis on a range of random parameters (Agarwal 2012a, 2012b). Nonetheless, what emerges as a common idea driving the thinking and research on NAMAs is a quest for a social choice function at national level, or at least a normative affirmation to comply with whatever social choice function a nation may have. In that, there is also a tendency to go beyond the common economic wisdom of investment decisions. While commercial viability and attractiveness of avenues for environment friendly investments is given due importance, a number of non-commercial qualitative criteria are also given equal weightage. Eventually, the intuition requires a political judgment through deliberative democratic processes in order to label an action as NAMA (Shrivastava 2012).

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[5] For more on how the social and political patterns ascertain sustenance and acceptance of a particular economic pattern, see Karl Polanyi (1944)[1957].

[6] For example, the project "Developing country participation in addressing climate change: analyzing issues and options for implementing NAMAs and REDD plus" hosted at The Energy and Resources Institute (TERI), New Delhi, supported by the Royal Norwegian Embassy in India.

This intuition for a social choice function has serious implications for the goal of green economy. Although, the definition of green economy includes important social and environmental concerns, seeing it through the lens of NAMAs brings forth the need to have a decision matrix that should govern the investment pattern in a country. Arguably, any investment choice now would need to be evaluated against the complex set of social and productive relationship between humans and nature. By extension, the concept of 'growth' no more remains an abstract measure of socio-economic development (Norgaard 1999, 2570–2574). Greening of this measure of material wealth indeed means unbundling of its social and environmental dimensions.

International political cooperation

As a mechanism whereby mitigation efforts in developing countries could be recorded and supported, the idea of NAMA is still ambiguous in terms of its governance structure. The categories such as 'domestic NAMA', 'supported NAMA', 'hybrid NAMA', 'credited NAMAs' are commonly used, yet a clear distinction as to how this labelling would work and who will decide these labels is yet to emerge. Simultaneously, a number of other related concepts have also emerged such as mutually appropriate mitigation actions (MAMAs) (Ethiopia 2011) and poverty alleviating mitigation actions (PAMAs) (Wlokas et al., undated). There is, however, a principled clarity regarding the nature of measurement, reporting, and verification (MRV) requirements for domestic and supported NAMAs.

The route of 'supported NAMAs' provides an additional impetus to fasten the pace of green growth within national economic boundaries. Although, the nature and meaning of 'support' remains politically contentious in international negotiations, the possibility of availability of support (technical, financial, capacity building) creates a hope for even higher investments in green economy (Tewari 2012). And as the economic wisdom tells us, higher investments are likely to bring transformations even sooner through 'multiplier' and 'accelerator' effects. However, there are two major hurdles in the way to agreement on supported NAMAs. First, is the absence of substantial commitment by the developed countries to provide for financial support through the Green Climate Fund. Second, is the issue of MRV of actions as well as of support. Clearly, an early resolution of pending political issues on supported NAMAs would give a strong push to the quest of green economy.

Credibility of 'green economy'

There is an element of 'doubt' among many thinkers and activists that the idea of 'green economy' or 'green growth' may dilute the goal of sustainable development.

These concepts do appear to give an impression of leaving out the social dimension of sustainable development. However, this doubt is consciously and categorically clarified by adding explanatory clauses to the definition of 'green economy' and 'green growth'. Moreover, the new concepts, particularly the idea of 'green growth', introduce an element of measurement and accountability of economic progress towards the goal of sustainable development. Nonetheless, it is important to have a credible unbundling of 'green growth' and a decision matrix for green investments. Arguably, NAMAs can enhance both the credibility as well as the pace of transition to green economy.

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IPR trends in renewable energy and issues in climate change

Krishna SD Dwivedi

Introduction

The road to acceptance of climate change impacts is fraught and frail with denial, inaction, and disbelief. This article adds another qualification, that it is now also burdened by intellectual disability.

The fate of technological know-how and hurdles in setting up a workable technology diffusion scenario (TDS) has long engaged the decision-making system as also the voicing-communities in a tug-of-war that grudgingly accepts inevitabilities of unmitigated climate change. This eventuality has been seen in the background of effervescent developments in the world economy. An era of liberalization, privatization, and globalization (LPG) and the World Bank mandated structural adjustment programs (SAP) that became the rule during much of 1990s saw economic consolidation which once complete, required for its existence a stable intellectual property (IP) regime that could safeguard diverse interests of the innovator and IP owner.

Various international treaties, World Intellectual Property Organisation (WIPO) treaties, Trade Related Intellectual Property Rights (TRIPS) agreement, and subsequent municipal legal changes were witnessed in the overall legal regime dominant in the world with the stated goal of setting an informal international working, acceptable and non-discriminative knowledge sharing arrangement (KSA).

At the thirteenth Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC), low-carbon technologies are discussed.[1] The Bali Action Plan introduced four pillars for long-term cooperative action including technology, financing, mitigation, and adaptation. Climate change as inevitability and moderating efforts by intelligentsia thereof sees Intellectual Property Rights (IPR) regime as short-circuiting access to existing knowledge on which climate change research could be built upon.

[1] COP 13, Decision: 4

This effort intends to examine recent trends in the global KSA. Under the assumption that intellectual property dimensions of climate friendly or green technologies are likely to find categorization in either trademarks or patents, a look at the recent and/or the current country spread of such patent/trademark (TM) applications brings no surprise to the expert or the laity.

Although climate friendly technologies are a broad classification with strict definitional lacunae, as an illustration, a peek into specific renewable energy related technologies shows that such technologies are still restrained from dispersal by invocations of rights violations by patent/trademark holder. Institutional mechanisms and procedural harmonization of conflicting interests continue to exist more in letter than spirit. While the galaxy of such institutional arrangements is massive and copious,[2] the net impact of various elements therein is enabling in the direction of haves rather than have-nots. An analysis of Patent Filing Reports, the source and origin of such applications and examination of collaboration between different countries shows status-quests or regressive trends. Relevant parts of the report has been analysed and some solutions are being suggested within the framework of workable IPR regime and needs of developing world in fighting climate change. It is also suggested at the end of the article as to the structure of the current pile-up of progressive and regressive existences in setting up an equitable and enabling environment for the chase of mitigated climate change as a goal of the scientific community and as an aspiration of developing societies. Some suggestions are also digested to lead the discussion forward on bringing the balance between extreme views on climate change on one hand and proponents of rights protection on the other.

Environmental Technology

In the area of environmental technology, the relative specialization index,[3] indicating the propensity of a country to file for patented technology in a given sector, the share continues to be higher from west European countries, Japan, and Canada (Figure 1). The index is negative for China, the manufacturing backyard of the global economy indicating that China may be less likely to file for patents in formal environmental technology, although it does have a presence in renewable energy (RE) space. Considering the fact that the manufacturing sector is one of the largest polluter amongst different sectors, this point needs to be specially taken note of. Also, apart from China, there is no other

[2] The cooperative and institutional structure therein includes the TRIPS agreement, WIPO treaties, WTO Disputes Settlement Forum (which inter alia setup the substantive regulations in IPR areas) and the procedural framework of Patent Cooperation Treaty (PCT) and other municipal nation states in the WTO agreement.

[3] The index is based on patent filings under the Patent Cooperation Treaty (PCT).

developing country that is digested in the list of countries within the boundaries of this index (0 to ±1).

As depicted in Figure 2, patent and trademark statistics also show[4] lean trends in terms of collaborative efforts and localization of environmental technology specialization

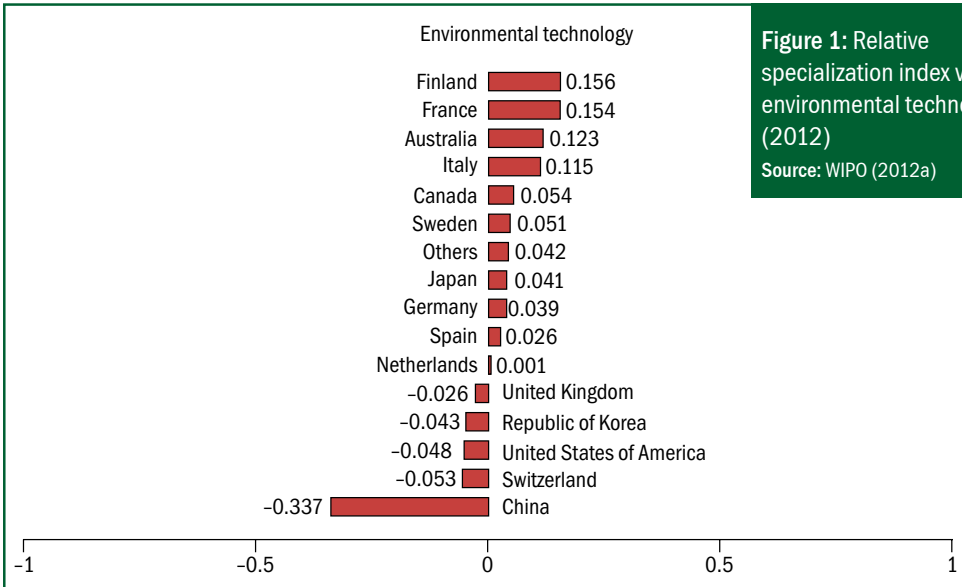

Figure 1: Relative specialization index value for environmental technology (2012)
Source: WIPO (2012a)

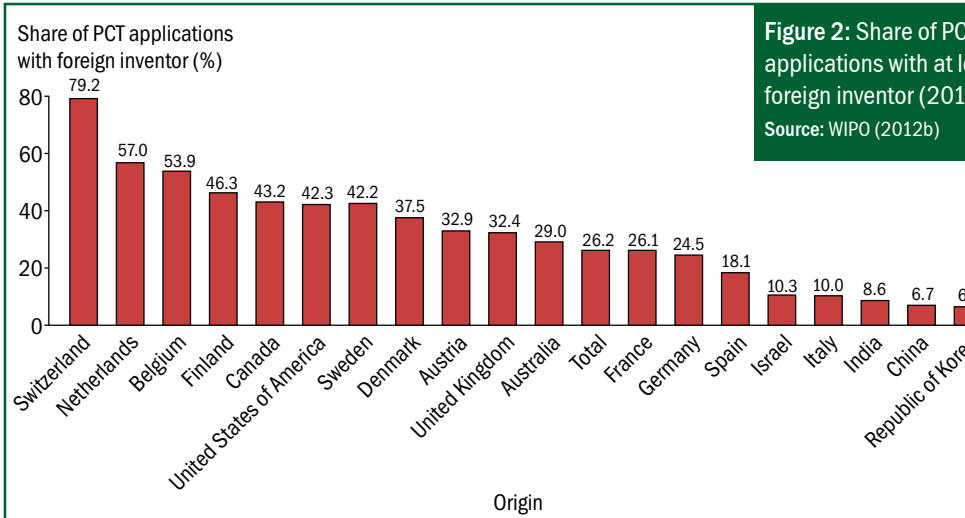

Figure 2: Share of PCT applications with at least one foreign inventor (2011)
Source: WIPO (2012b)

[4] Figure 2 shows that no country from the south, except India and China find place in top 20 countries which are applying for patents while having at least one foreign collaborator.

betraying the truth that there continue to be challenges to international cooperation and collaboration on clean technology research.

Climate Change Technologies in Renewable Energy Sector

A look at the trend in patents related to energy technologies (Figure 3) shows that post 1999, there has indeed been a substantial increase in patent-related activities with patents in solar technologies almost half of that of all other renewable energy related technologies in 2009.

In solar energy-related patents (Figure 4), Japan–US–Korea together constitute more than two-thirds of the patents, assuming application implies success in grant of patent. Thus, a large number of solar energy related patents continue to stay with the developed world. Japanese patent applications in fuel cell technology (Figure 4) were more than half of world's total in that field and only in cases of wind energy related patents is the situation more equitable, although the developing world, to the exception of China, is yet to make a mark in these fields.

Discussion

When the preceding figures and trends are analysed on the touchstone of the patent life cycle theory, it is interesting to pose the question whether the patent life cycle of

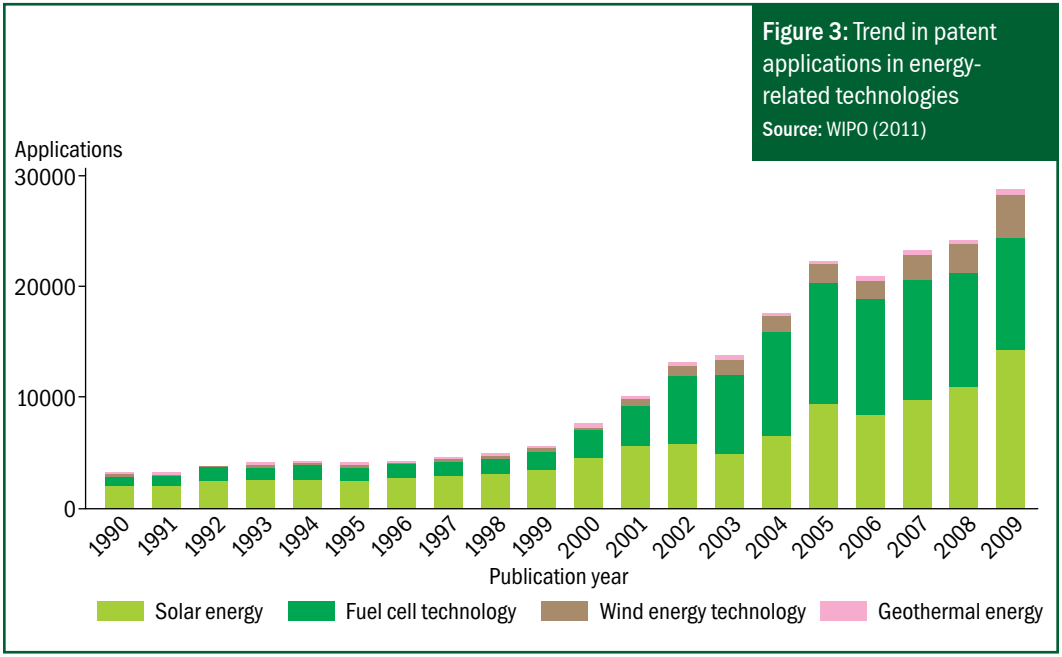

Figure 3: Trend in patent applications in energy-related technologies
Source: WIPO (2011)

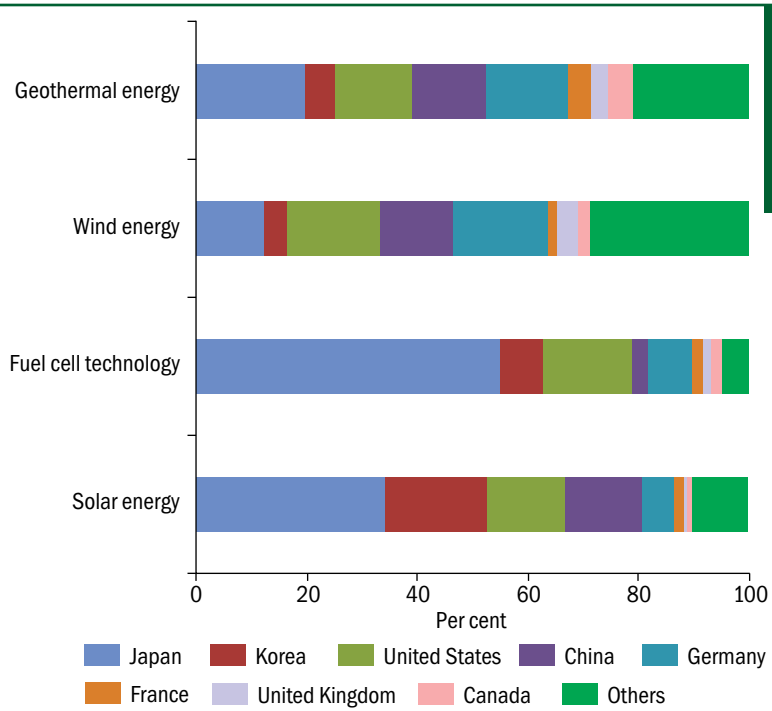

Figure 4: Distribution of patents by country origin in energy-related technologies (2005–2009)

Source: Based on WIPO (2011)

20 years when applied for technologies in the RE field is an enabler or an impediment in innovation in RE field. Technologies that solely lie with the patent holder for critical early years could enrich or contribute to development of green growth technologies. Tendencies such as utility patents or for that matter patent thickets, in fact amplify this 20-year period much beyond the numbers in terms of impact and scope. The innovative landscape becomes arduous and failure prone, robbing genuine scientific capabilities of exploiting existing knowledge into creating better or newer systems/processes. The current IPR regime is discriminative and ends up creating superstructures that are hard to surpass and difficult to work around. The patent life cycle is too long a timeline considering the urgent needs for a paradigm shift that is being sought in the energy field. Whilst seed time of patented technology is accepted to be long, for arguments' sake, the plough back needs of the inventor have to be balanced with the needs for climate-friendly technologies, specifically in the RE field.

Considering the enforcement related aspects to the IPR in climate change technologies, it is submitted that in absence of any universal-settled definition to climate change technologies, a legal examination of the same is difficult; more so because the definitions of such technologies are generic and only utility in climate change

mitigation can be a reliable litmus test in any judicial or quasi-judicial dispute resolution fora (supra-national/ municipal). This is particularly true, when in a possible litigation on compulsory licencing, absence of any settled definition of climate change technology (formal or informal) is likely to throw up challenges in issuing any compulsory licences. Not tied to a mere instrument or cog in an engineering edifice, such technologies could be the result of a combination of physical structures, whose efficiencies might be exemplified through/tweaked using a combination of superior processes.

Under this generic definitional classification of cleaner technologies, municipal sovereigns are expected to create regulatory frameworks that are harmonized with international obligations, and which ensure that the credits, financial yields, and plough-backs do cross-over to the source of origin of such a technology. Any sovereign mandate that does not deliver on these expectations is seen as vitiating the progressive march of rights enforcement, global world order, and rights of the global citizen. This debasing of rights of the global denizen, at the pretence of protecting the rights of the global citizen, lies at the heart of vexatious positions taken by interested parties in seeking harmony between needs of an effective IPR regime and the tearing need to address climate change.

Sitting ahead on the curve of technology, mature economies are now increasingly engaged in turf-protection and knowledge protection through instrumentation of intellectual property rights. At once, this IPR regime is a selective and discriminative veil which allows the luxury of denial and ignorance and yet eschews from the ignominy of common but differentiated responsibility. The former is evidenced from the statistics of patent filing available with the WIPO (WIPO 2012b), some of which have been analysed and digested previously. It is also submitted that the effectiveness of TRIPS-mandated changes in domestic municipal laws have brought down the use of enabling sections on compulsory licencing and created newer challenges in policy-related interventions in making such technologies accessible.

Yet another aspect that comes to the fore in any such discussion on IPR aspects to climate change is that of financing abilities present in market. Assuming that rights violations are going to be minimal and most IPR-related challenges to ownership of technology shall subside at the patent prosecution highway stage, the licencing or royalty issues to acquisition of fair use rights to these technologies needs to be understood in terms of financing based difficulties. Absence of climate change finance (CCF) based liquidity in the system, could then be a further hurdle in ease of availability of these technologies. It needs to be understood then, that transfer of technology, intellectual property rights and financing mechanism and institutional structures in-relation thereof, provide a curious mix to the dynamics of freer flow and equitable diffusion (multi-directional and many to many) of climate-mitigating technologies.

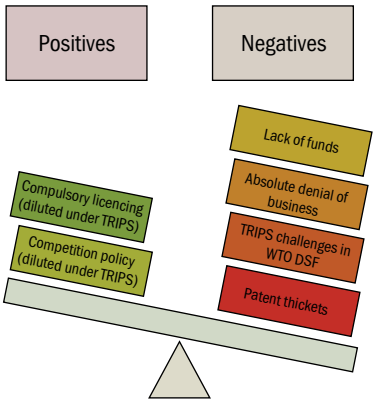

Figure 5: The disequilibrium of IPR Regime in diffusion of climate change technology
Source: Author's compilation

The opposition mechanism as mandated in different legal systems of the world, on ground of novelty, innovativeness and use in industry (NII), now creates a much harder choice for innovators, who have erstwhile used reverse engineering and duplicative imitation to advance global knowledge on clean technologies. Patent thickets are now effectively used by innovators in protecting their rights by creating proprietary nodes of knowledge in information flow systems. Even otherwise, the stated position of national trade offices such as United States Trade Representative (USTR) is that weak domestic/municipal regimes is one of the barriers to transfer of technologies that are climate friendly.

The disequilibrium observed in fair and equitable diffusion of climate friendly or climate change technology can be noticed through Figure 5, wherein the negatives outnumber the positives. Compulsory licencing and competition policy have been used much in domestic pharmaceutical industry in dismantling protective trumping of social utility. In an IP regulatory regime that is witnessing informal but complete tightening, remunerated and unimpeded exchange of climate friendly technology should not be made a victim.

Conclusion

The problem of climate change although universally acknowledged, needs to be universally approached as well. Whilst climate change efforts have been chased through multiple perspectives, the IPR regime has variedly been showcased as a barrier and an impediment in addressing this issue on an urgent basis. The solutions fishbone

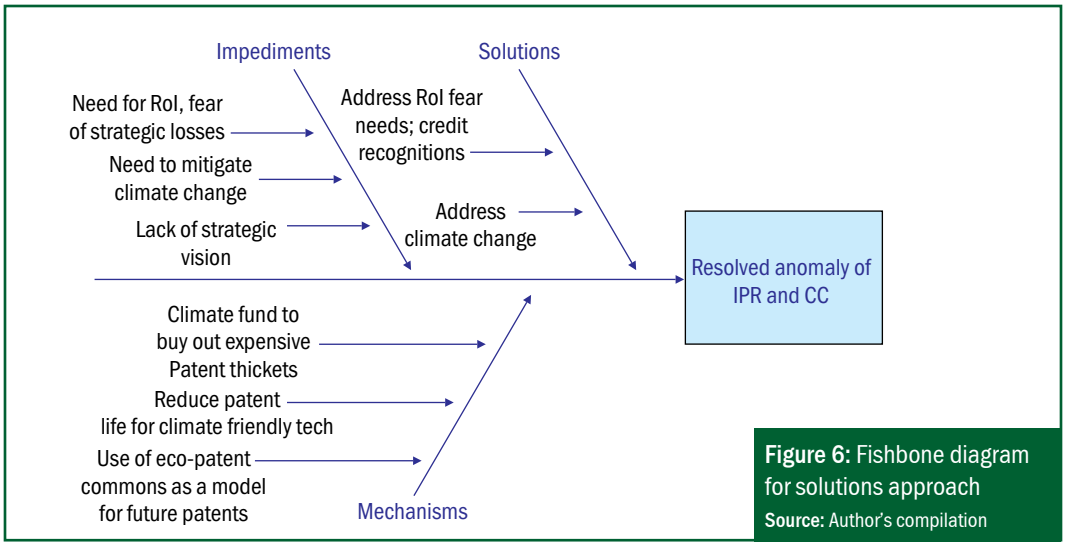

Figure 6: Fishbone diagram for solutions approach
Source: Author's compilation

(Figure 6) to this anomaly needs to approach the CC-IPR duo from an action-oriented perspective.

The lack of a definition of what climate-friendly technology shrouds absence of hard and encompassing data from which global trends and mega-trends can be gauged. In absence of such broad and reliable data, effective decision making is not possible. The need therefore is to identify every technology brought to be patented before the patenting authority, as to its nature in terms of climate friendliness, either as an improvement of existing technology or as a new innovation altogether. This shall help in building a body of raw data, from which definitions of climate change technology can be setup and which shall have a strong bearing on the subject of climate change.

Climate change finance needs to be looked into urgently, wherein a government mandated corpus, is likely to subsidize access to expensive technology which presently stays more as a showcase rather than genuine ameliorative access to the research pool. Such a corpus is also likely to do away with the needs for compulsory licencing, the usage of which is feared by the innovator and which is used by her to deny business altogether.

The concept of eco-patent commons can be expanded to create a patent pool that is universally accessed with sub-classification of critical/strategic technologies which might be accessed through the above-mentioned corpus.

What needs to be understood is that rights by themselves cannot be diluted and the intellectual property regime is likely to stay and progressively firm up in terms of its protection and safeguarding capabilities. Instead of proceeding on ways that by-pass such a regime, an action-solutions approach that addresses all concerns should be the way forward.

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GREEN ANALYSIS

Decadal future of the Strategic Plan for Biodiversity

Yogesh Gokhale

Biodiversity conservation is often seen to conflict with development goals and green growth strategies would have to address the issue of biodiversity conservation along with addressing poverty. The 11th meeting of Conference of Parties of Convention on Biological Diversity has brought into focus some of the commitments made by the member countries such as Aichi Biodiversity Targets, Strategic Plan for Biodiversity 2011–2020, and progress on Nagoya Protocol.

Aichi Biodiversity Targets are important on the backdrop of global failure on achieving 2010 Biodiversity Targets due to reasons such as measurability and funding mechanisms, and hence the Strategic Plan remains a key process for the success of Aichi Targets. Nagoya Protocol is only process to operationalize the equitable sharing of benefits from the commercial use of biodiversity.

The guidance provided on the Strategic Plan on the global financial requirements has estimates of financial resources based on several assumptions which could be mainly divided into field-level implementation, administrative, and opportunity costs with respect to the Aichi Biodiversity Targets. The focus of the potential sources of funding is leaning towards the entities, which are becoming the new or traditional users/exploiters of the biodiversity such as corporate sector and the national governments. The innovative ways of funding suggested based on concepts such as Payments for Ecosystem services, Wetland banking, and Green Development Initiative have so far demonstrated restricted success and long gestation periods to realize benefits.

The agreed decisions in CoP-11 on resource mobilization suggest: (a) doubling of total biodiversity-related international financial resource flows; (b) including biodiversity as a national priority and making appropriate financial provisions in at least 75 per cent of Parties by 2015; (c) providing adequate financial resources and reporting on domestic expenditures, funding needs, gaps and priorities in at least 75 per cent of Parties by 2015; and (d) assessing, by 2015, values of biodiversity by at least 30 per cent of Parties having financial plans for biodiversity.

The guidance over resource mobilization and the decisions suggest that there may not be new resources available in near future but the Parties would be required to re-design, refurbish, and to an extent reform the domestic approaches for biodiversity conservation, sustainable utilization, and equitable sharing of benefits (Table 1). At the

Table 1: Global guidance on Strategic Plan for Biodiversity 2011–2020

No.	Targets	Global requirements (US$ million)	Potential funding mechanisms suggested
1	Awareness raising	54	Focus on private sponsorships and joint initiatives
2	Biodiversity values	450–610	Governments, businesses, and international developmental agencies funding mainly for TEEB and WAVES initiatives
3	Incentives	1300–2000	Core funding for identifying negative incentives and options for positive incentives, cross-sectoral funding, innovative mechanisms like PES for positive incentives
4	Sustainable consumption and production	55–107	Soliciting investment from business sectors for developing research base for sustainable consumption
5	Reducing habitat loss	152300–288800	Innovative economic solutions to be developed such as Wetlands banking
6	Sustainable Fisheries	129900–292200	Based on the suggestions of UNEP's Green Economy Report such as Public, National, Regional and Private investments, PPPs
7	Sustainable Agriculture, Aquaculture and Forestry	20800–21700	Technology implementation supported by industry, GEF, and the World Bank assistance for rural livelihoods
8	Pollution control	77600–772700	Reduction in harmful subsidies, environmental taxes and non-compliance fees, liability payments
9	Invasive Alien Species	34100–43900	Domestic governments, external funding sources, GEF
10	Coral reefs	600–960	Donor driven and innovative market-based instruments
11	Protected Areas (terrestrial and marine)	66100–626400	Domestic government budgets, philanthropic foundations, PES, UN-REDD+
12	Species conservation*		National governments, international agencies, global foundations
13	Genetic diversity	550–1400	Multinational companies, national treasuries, PPPs, CGIAR Fund

Table 1: Contd...

No.	Targets	Global requirements (US$ million)	Potential funding mechanisms suggested
14	Ecosystem restoration	30000–299900	Reducing expenditure on unnecessary infrastructure such as Highways
15	Restoration of forests	100	Corporates, Domestic government budget
16	Nagoya protocol	55–313	Domestic governments, external funding sources, GEF
17	NBSAPs	114–1100	GEF
18	Traditional knowledge	210–340	Voluntary funds from donor countries, GEF, private sector
19	Science base	1800–4200	International agencies
20	Mobilization of financial resources	10–79	GEF

*The amount for species conservation is overlapping with protected area
Source: Adopted from report of the high-level panel on global assessment of resources for implementing the strategic plan for biodiversity 2011–2020

same time, the entire process till 2020 has several issues of capacities of the large number of Parties. Also with respect to Nagoya Protocol, out of 193 Parties of CBD about 40 Parties actually have legislation related to access and benefit sharing of biodiversity. So far, there are only 9 ratifications and 92 signatories of Nagoya Protocol. Thus, the onus of action is left with those who not only deserve support but also need to safeguard the livelihood interests of people substantially dependent on the biodiversity.

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GREEN SHOWCASE

A method for the assessment of corporate activities' impact on and contribution to biodiversity

Michinori Kutami

Introduction

In the 10th meeting of the Conference of the Parties (COP-10) to the Convention on Biological Diversity held in 2010, highlighted that participation of the private sector is essential for the conservation of biodiversity, and targets for 2020 were examined. The next decade will be important for biodiversity conservation around the world.

Private sector needs to contribute in the implementation of specific activities under the Convention on Biological Diversity. One of the factors contributing to this problem is the complexity of the biodiversity issue and the depth of the relationship with each affected region compared to the climate change issue, which makes it difficult to recognize that these are all parts of the same issue. In order to solve the current biodiversity issue in the next decade and achieve the Aichi Target declared in the COP-10, the private sector, which is most influential in this case, must promote more specific and effective measures.[1] To this end, it is essential that the impact of private sector activities on biodiversity be assessed quantitatively and that the effects of measures for reducing any possible impact on biodiversity also be assessed quantitatively. This paper describes an integrated index for quantitatively assessing the impact on and contributions to biodiversity, which will be necessary for companies to promote the above-mentioned activities (Kutami 2010).

Quantitative assessment of corporate activities' impact on and contribution to biodiversity

The foundation of the quantitative assessment method

Specific activities that the private sector and companies should implement to conserve biodiversity are those that are performed through their core businesses, in addition to voluntary activities relating to biodiversity, such as tree planting, ecosystem

[1] Aichi Target (Post 2010 Target): http://www.cbd.int/

conservation activities, and dissemination and public awareness activities. We believe that in order for companies to significantly contribute to biodiversity conservation, the following activities relating to companies' core business activities are important.

- Analyse the impact of corporate activities on biodiversity
- Set up adjustable and measurable targets that can be monitored on a regular basis
- Implement a plan–do–check–act (PDCA) cycle to reduce impact on biodiversity on a continued basis
- Link corporate targets and global targets and assess the degree of contribution

Integrated biodiversity assessment index

We have been examining a quantitative assessment index for the purpose of continuously reducing the impact of corporate activities on biodiversity, continuously increasing contribution to biodiversity by using technologies such as information and communication technology (ICT), and assessing the appropriateness of improvement levels and measures for biodiversity conservation (Kutami 2012). With this assessment index, we aim to be able to quantitatively assess each scope of assessment;, for example, all corporate activities, a single product, and a single solution, in a uniform framework as needed.

(1) Assessment process

We developed the following assessment steps based on the above idea:

1. Extract and identify corporate activities that affect biodiversity
2. Extract quantitative data items relating to the extracted corporate activities that affect biodiversity as impact factors
3. Assess corporate activities by weighting and integrating based on the extracted impact factors and compute the level of impact on biodiversity

Figure 1 shows the detailed steps of this quantitative assessment. "Corporate activities affecting biodiversity" are those activities that can be causes of changes in ecosystems and that affect the habitat of species.

(2) The biodiversity total index (BDTI)

The above assessment process can be expressed by the following formula:

$I_{total} = \sum w_k I_k$

where, the impact is I_k, weighting factor is w_k, corporate activity category is k, and BDTI is Itotal. If the relationship between three impact factors of corporate activities is focused on, Itotal can be expressed in the equation as follows:

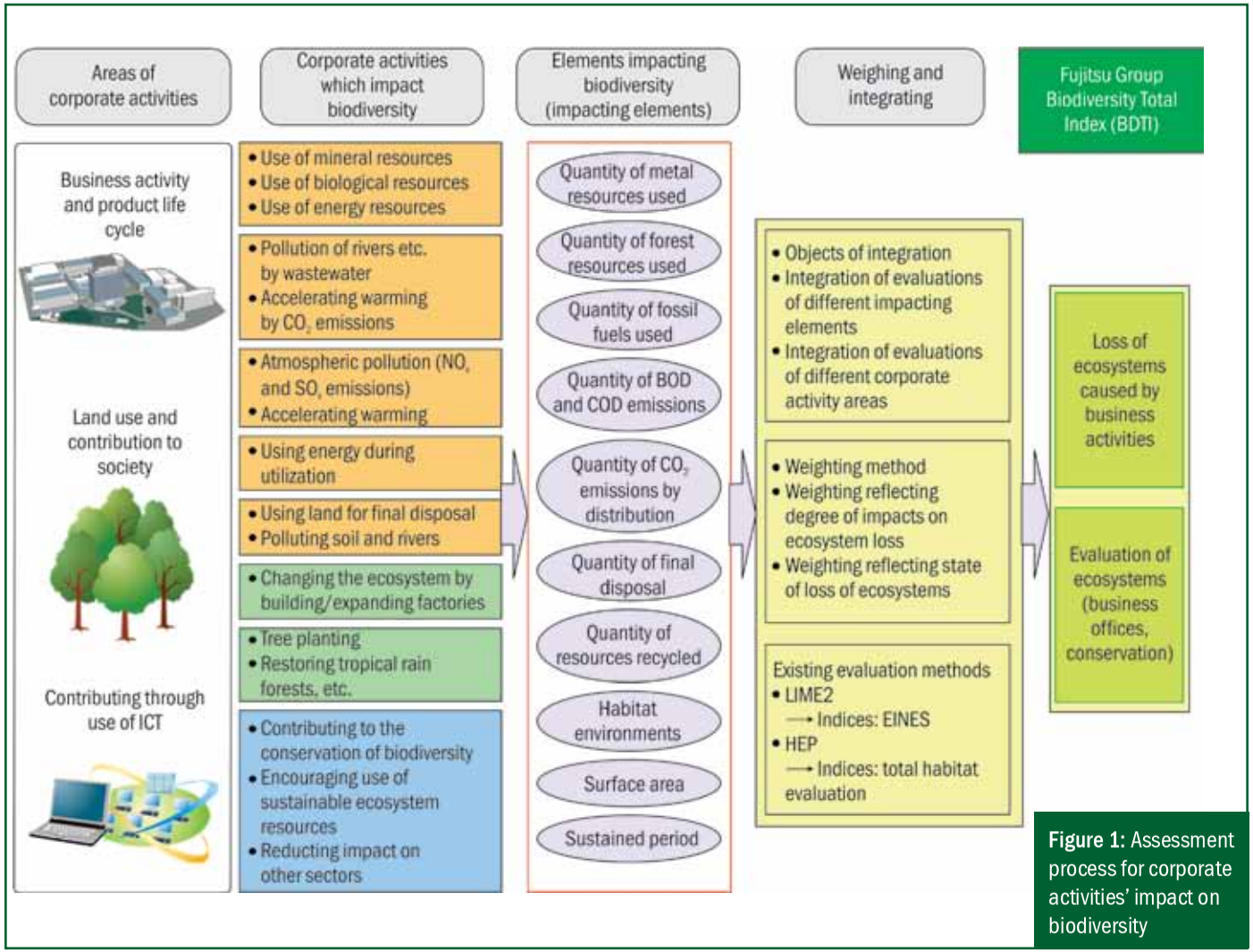

Figure 1: Assessment process for corporate activities' impact on biodiversity

$I_{total} = w_1 I_1 + w_2 I_2 + w_3 I_3$

where, the impact on biodiversity due to business activities (product and business lifecycle) is I_1, the impact due to land and space use is I_2, the impact due to nature conservation is I_3, and their relevant weighting factors are w_1, w_2, and w_3. In addition, each impact "I" can be expressed as follows:

$$I_1 = \sum w_{1n} G_{1n} (x_{1i})$$
$$I_2 = \sum w_{2n} G_{2n} (x_{2i})$$
$$I_3 = \sum w_{3n} G_{3n} (x_{3i})$$

where, the volumes of corporate activity factor i are x_1, x_2, and x_3, the impact functions that affect biodiversity are G_1, G_2, and G_3, and the relevant weighting factors are w_1, w_2, and w_3. Based on the relationship between them, the required integrated impact can be obtained by extracting, integrating, and weighting required factors and impacts. When the volume of important items that are currently monitored for the assessment of biodiversity status is selected, the population and distribution of species, habitat suitability, and the range and quality of ecosystems can be defined as G, and the weighting factor for the status of biodiversity, the existing number of species, and habitat suitability can be defined as w.

In addition, the change of impact due to changes in corporate activities, and the degree of contribution (effectiveness of measures) when some measures are taken can be obtained by the following formulas:

Change of impact for the year of corporate activities = $I_{\text{(year of assessment)}} - I_{\text{(reference year)}}$

Degree of contribution = $I_{before} - I_{after}$

where, I_{before} is the impact before the measures are taken, I_{after} is the impact after the measures have been taken. By assessing ΔItotal, the impact of corporate activities and the level of contribution by taking measures can be assessed.

(3) Environmental impact assessment

Many assessment methods are available for obtaining biodiversity impact values from impact factor data. As existing assessment methods, $LIME_2$ (Life cycle Impact assessment Method based on Endpoint modeling 2) and HEP (Habitat Evaluation and Certification Program) are available. By using $LIME_2$, indices concerning the extinction risk of species (EINES: Expected Increase in Number of Extinct Species) can be obtained. In the meantime, HEP is an ecosystem assessment method based on ecosystem survey, and indices concerning habitat suitability (Total habitat value) can be obtained. As for weighting, Global Biodiversity Outlook 3 (GBO3) and Japan Biodiversity Outlook (JBO)

can be used to add weight on the reduction of the number of species in biodiversity in a wide region or the status of regional biodiversity conservation.

Assessment examples

Although factors and functions of the integrated index, BDTI, can be examined in a number of ways, this section examines such factors and functions by providing assessment results of I_1, in relation to changes in the impact of Fujitsu's business activities, the effect of design improvement in PC products, and the effect of the reduction of biodiversity impact through the implementation of solutions, as an example. As the levels of impact, we extracted the extinction risk of species, EINES, as $G_{(x)}$ and the inventory related to environmental impact made throughout business and product lifecycle as x.

(1) Assessment of business activities

In this section, we calculated the impact due to business activities on a trial basis by using Fujitsu Group's material balance data. Figure 2(a) shows the result of assessment of impact due to business activities of Fujitsu Group for each fiscal year from 2005 to 2007. The vertical axis shows the impact for each year with reference to the impact for fiscal year 2006. This preliminary calculation indicates that the impact (loss) on the ecosystem due to business activities from fiscal years 2005 to 2007 changed in the range of 30 per cent.

(2) Assessment in terms of product lifecycle

Next example is applying this method to product improvement. Personal computers were selected as the product. We assessed the impact during the product lifecycle of personal computer. As a result, we found that the contribution of procurement and disposal in the product lifecycle to the ecosystem loss was relatively high. We further found that by reducing the final disposal volume in the disposal stage of the product lifecycle by about 50 per cent, loss due to the manufacture and use of notebook PCs will be reduced by approximately 30 per cent (Figure 2[b]).

Conclusion

In this study, we examined an assessment method that provides a direct link between various corporate activities and their impact on biodiversity on a quantitative basis, and identified a method to quantitatively assess the impact on and contributions to biodiversity of corporate activities. In addition, we presented the basic aim, idea, and

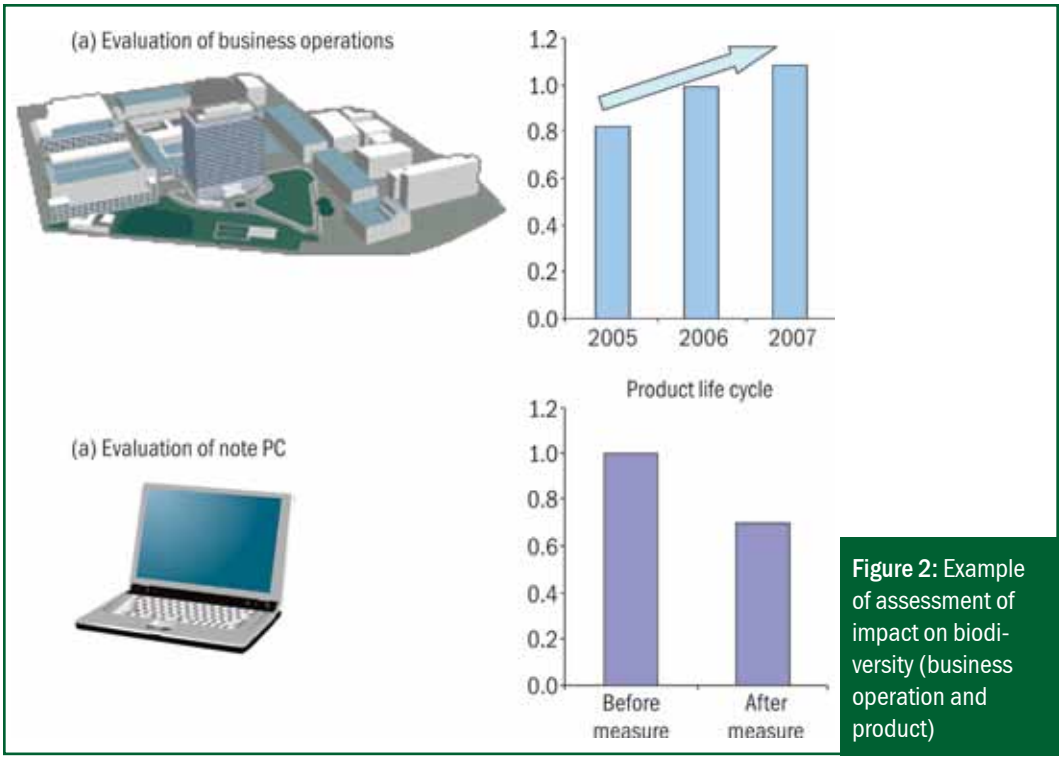

Figure 2: Example of assessment of impact on biodiversity (business operation and product)

concept of BDTI required for quantitative assessment. We used existing assessment method to assess the state (in terms of quality and amount) of biodiversity, which is currently a global issue, incorporating two-dimensional weighting, i.e., the level of impact on biodiversity loss and loss state of ecosystems. Furthermore, as an assessment example using this method, we provided the results of quantitative assessment of the impact of Fujitsu Group's business activities, the effect of product improvement, and impact reduction effects of implementing solutions.

In order for companies to make contributions to biodiversity conservation, it is necessary to thoroughly and quantitatively understand the impact of corporate activities on biodiversity and set quantitative targets, as well as make improvements through a PDCA cycle to the maximum extent possible, and it is important that such contributions are directly associated with data on issues faced by the world regarding the reduction of species and range in which biodiversity is conserved.

In the future, in addition to improving the reliability and effectiveness of the index, we will use the BDTI integrated index to assess and reduce the impact of a wide range

of corporate activities on biodiversity, and make contributions to the reduction of the negative impact on biodiversity brought about by society by using the company's core business, ICT.

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Controlling ground-level ozone pollution in India

Sumit Sharma

As India aims to maintain its economic growth, policies for improved air quality will increasingly play an important role. Pollution abatement is an essential co-benefit which needs to be factored in for formulating green growth strategies.

Air pollutants are of two types: primary and secondary. Primary air pollutants like many of Volatile Organic Compounds (VOC) and (oxides of nitrogen) NO_x are emitted directly into the air from different sources. Secondary pollutants form when primary pollutants react in the atmosphere under suitable meteorological conditions; for instance, Ozone, which is formed by reactions of primary pollutants like NO_x and VOCs. Though primary air pollutants can be managed with control of their immediate sources, secondary pollutants are a growing challenge and have proven to be difficult to control.

The presence of ozone at ground levels not only affects the human health but could also negatively impacts agricultural yields. Most parts of India are exposed to good amounts of sunlight and hence bound to have higher production rates of Ozone.

In India's context, there had been limited research carried out in understanding the sources responsible for formation of Ozone at the ground levels. Even on the monitoring fronts, there is extensive monitoring done for pollutants like SO_2, NO_x, and PM_{10}, whereas the monitoring of Ozone is very limited.

TERI with support from the Toyota Motor Corporation (TMC), Japan, initiated a project in 2008 with a view to reduce energy consumption and tackle ozone pollution in East and South Asia. This was a multi-institutional study with partners from Japan (Toyota Motor Corporation [TMC], Toyota Central Research and Development Laboratories, Inc. [TCRDL]), China (Tsinghua University), Austria (International Institute for Applied Systems Analysis [IIASA]), and India (The Energy and Resources Institute [TERI]).

The main objectives of the project were:

- To assess the energy consumption, emissions and air quality in the study domain

- To project future energy scenarios and predict air quality based on simulations for the year 2030
- To plan for reduction of energy consumption and improvement of air quality

One of the most challenging tasks in the project was to develop an emission inventory of the Ozone precursor species in India. Activity-level data were collected for various sectors including industries, power plants, transport, domestic, others, and non-energy sources. The energy and emissions scenarios for the year 2005 to 2030 were prepared for various states and union territories of India based on the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) Asia model.[1] Inventories of different precursor species were spatially and temporally allocated at the finest possible resolutions.

The analysis of the energy-mix of the country shows that following the growth patterns, mobility demands have grown manifolds in India. Growth in vehicular fleet, especially of the diesel-driven vehicles, has contributed significantly to the NOx emissions. Frequent power outages in many parts of the country have led to the installations of diesel-based generator sets which have only added to the total emissions of NOx in the atmosphere. VOCs on the other hand are mainly contributed by biomass burning in the domestic sector (58 per cent) followed by open burning (10 per cent) and transport sector (9 per cent). Then, there is a bunch of sources like oil storage and handling, personal products, paints, printing, etc., which contribute significantly to the overall inventory of VOCs. Precursor emissions for the base year 2010 were fed into state-of-the-art meteorological and air quality models like the Weather Research Forecasting (WRF) model, developed by the National Centre for Atmospheric Research (NCAR) and Community Multi-scale Air Quality (CMAQ), developed by United States Environmental Protection Agency (USEPA), to simulate the formation of Ozone at the ground levels in the Indian sub-domain.

Simulated results were validated with the actual observation of Ozone monitored by the Central Pollution Control Board, which shows good agreement. Simulated Ozone concentrations over the Indian sub-domain for different seasons are shown in Figure 1 which indicate very high concentrations in the Indo-Gangetic plains of India due to higher photo-chemical activity in summers.

The areas under heavy threat of Ozone concentrations are not only densely populated but also are hugely dependent on agricultural activities. Interestingly,

[1] An international team of researchers developed a scientific tool to guide policy makers through the complex process of air pollutant controls and greenhouse gas mitigation in China and India, known as GAINS (Greenhouse Gas and Air Pollution Interactions and Synergies).

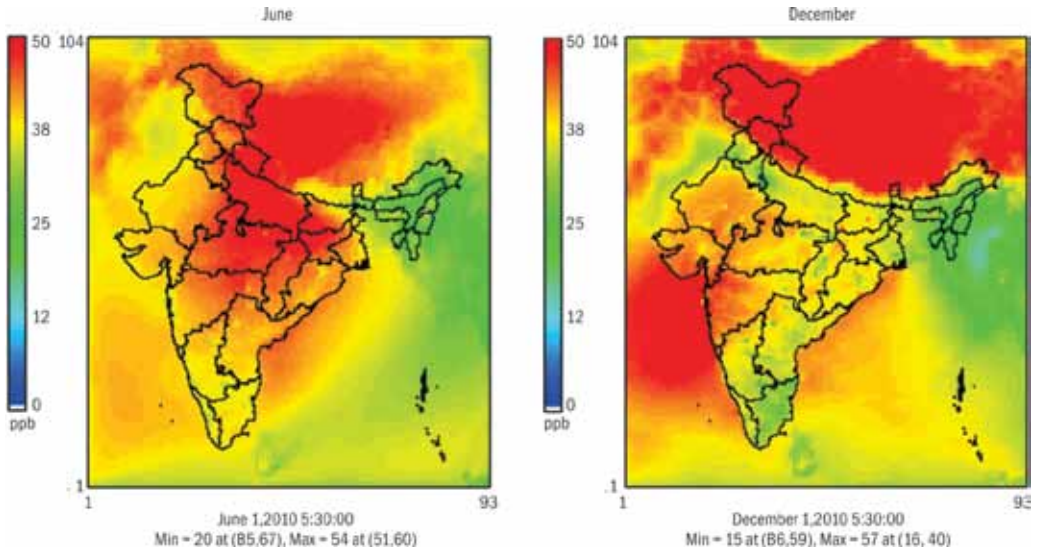

Figure 1: Simulated Ozone concentrations (ppb) across the Indian sub-domain in 2010 during the months of June (summers) and December (winters)

Source TERI study

Ozone concentrations were found to be lower in the urban centres because of titrating reactions of primary NOx with Ozone during night times.

Following the baseline assessment, future predictions of Ozone were made for different growth scenarios (Business As Usual – BAU, and Alternate – ALT) for the year 2030. While BAU was based on the current programmes and policies of the government, ALT scenario depicted the alternate path required to be followed for Ozone pollution control in India. As prescribed by the National Ambient Air Quality Standards (NAAQS), Ozone concentration in ambient air is 100 micrograms for eight-hour weighted average period and 180 micro-grams for one-hour weighted average period. As expected in the BAU scenario, Ozone concentrations increase tremendously and breach the standards at many locations. Very high concentrations of Ozone are likely to impact human health and crop productivity quite detrimentally.

On the other hand, the ALT scenario which considered aggressive renewable energy penetration improved energy efficiencies in various sectors; enhanced

public transport, cleaner fuels, and technologies etc.; and simulated lesser Ozone concentrations. However, even more efforts would be required to manage Ozone concentrations within the standards. While primary pollutants like PM could be tackled through straightforward source control based interventions, secondary pollutants like Ozone may require understanding of different roles played by various pre-cursors and meteorological conditions in their formation.

The study concluded that with economic growth, emission levels will rise manifolds but with a little lesser rate due to some interventions taken for their control. NOx and Ozone has clearly emerged out as important pollutants of concern for future. Significant amount of research including monitoring and modelling of NOx and Ozone pollution is required to draft policies for their control. The project is a step forward in the direction of evaluation of air quality with advanced and state of the art tools which not only improve the accuracy of prediction but are also able to present regional scale view of the problem.

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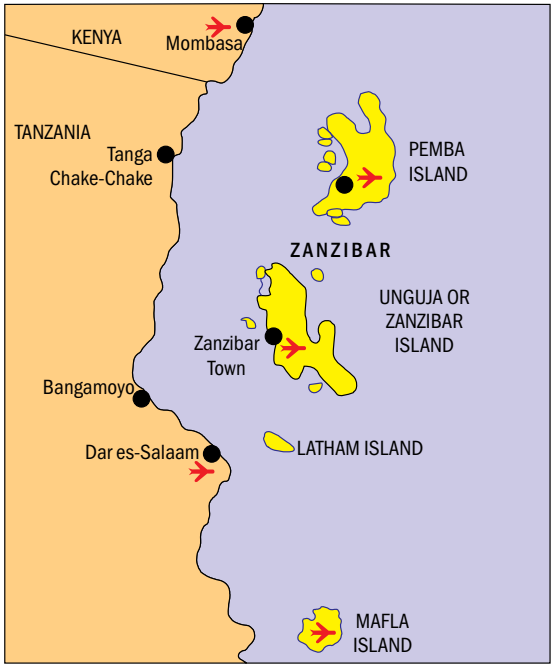
GREEN FROM THE GRASSROOTS

Improving livelihoods through tourism sector

Hamad Khamis Said

Zanzibar is an archipelago made up of Unguja and Pemba Islands, and several islets. It is located in the Indian Ocean, about 25 miles from the Tanzanian coast, and 6° south of the equator. Zanzibar is characterized by beautiful sandy beaches with fringing coral reefs, and the magic of the historical Stone Town said to be the only functioning ancient town in East Africa. This has made Zanzibar a perfect destinations for holiday makers.

Zanzibar economy is an island economy which is characterized by services and trade, tourism being the most in terms of its contribution to the GDP. The tourism sector has a significant share to the GDP of the country which has increased to 43.9 per cent in 2007 as compared to 43.5 per cent recorded in 2006. (Zanzibar Economic Bulletin, March 2009). In general, the growth rate of the sector is about 9–10 per cent, which is higher compared to that of agriculture. The tourism industry in Zanzibar has a considerable impact on the employment situation, wherein it employs around 10,500 people directly and over 40,000 indirectly.



The government of Zanzibar has come up with various initiatives to ensure that the local communities benefit from the sector. Most of the tourism activities take place in villages thus the government aims to provide

equal opportunities to all the people and consequently improve their livelihoods. This has helped in ensuring sustainable development along with poverty eradication.

The first initiative was to empower small and medium enterprises (SMEs) in which most of the local people, especially in the remote areas, are engaged for their livelihood. The aim of this initiative is to enable SMEs to manufacture products such as agricultural products (vegetables and spices), fishing products, and hand-craft products, which can be used by the tourism investors. Through public private partnership, the government of Zanzibar has managed to promote many SMEs. The government has collaborated with the Zanzibar National Chamber of Commerce, Industry and Agriculture to offer technical and financial capital to the entrepreneurs. The programme has been successful, and this can be seen in the various products that are available in the market with reasonable quality within Zanzibar.

The government has also put in significant effort to bring the element of sustainability in the branding of products. Again, the primary aim was to capture the tourism market. To start with, the government initiated the process by branding 'cloves'. For most of the decade, cloves have been produced without realizing its potential marketability and benefits. Most of the cloves being sold in Zanzibar are unprocessed while the same if processed could yield larger revenues. Now the process towards branding cloves is being carried out. The returns from branding will aid local producers to increase their earnings as they would have a ready market for their products. There are several merits of branding products for the market. Some of these are outlined below:

- Help in distinguishing Zanzibar local products from similar products
- Build goodwill and reputation of Zanzibar local products emanating from its intrinsic value
- Impart a message of distinctiveness to consumers and develop their understanding and association of the brand and local products
- Create and retain customer loyalty
- Maintain and enhance quality of local products to maintain brand promise
- Increase marketability and commercial value of Zanzibar local products
- Increase income earnings of producers and enhance foreign exchange earning of Zanzibar

Apart from these, some other measures have been taken by the government to promote sustainable development in the tourism sector. Now producers in Zanzibar have their own barcode for product identification, which helps them in selling to the international market. There are several on-going programmes which have been initiated by tourism investors, including building village schools, hospitals and other facilities.

Investors provide the opportunity to the villagers by imparting tourism and ICT training courses after which they are employed in different hotels.

The Zanzibar government has put in place an enabling environment to explore potential of tourism in generating higher growth and in reducing income poverty; the economy will continue to grow, as the tourism industry continues to grow.

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Landscape management approach for transforming livelihoods

Contributed by Grace Lhouvum and Sirisha Indukuri

The concept of treating landscapes as a whole instead of treating different land parcels in isolation while addressing the development needs of the local communities is gaining an important consideration in the development sector. TERI, as partner to International Union for Conservation of Nature (IUCN), has used this concept to restore forests and transform lives and livelihoods of four villages lying in the Shivalik foothills of Haryana. As a result of this, the villages of Thaska, Salehpur, Jhanda, and Pammuwala in the Yamunanagar district of Haryana are now on the path towards transition.

TERI has worked in Yamunanagar in the past also for improving the livelihoods of people through the Joint Forest Programme (JFM). Under JFM, TERI facilitated formation of village-level institutions, built capacities of forest department (FD) and local communities, reviewed and redrafted the usufruct sharing arrangements as per 1990 Guidelines, and helped in starting community enterprises.

In 2007, when the IUCN project started, it was found that the landscape and its institutions were facing second-generation problems related to improvement of resource management. The institutions formed for prudent management of natural resources were not functioning effectively as before mainly due to lack of periodic strengthening. The resultant effects were seen on the status of the resources.

Hence, an important component under the IUCN project was to strengthen the community institutions — the Joint Forest Management Committee (JFMC) and Self Help Groups (SHGs) — initiated under different natural resource management (NRM) projects in the area. In both cases, TERI acted as a facilitator in promoting activities that improve the day-to-day running and functioning of these local institutions and groups. Hence, specific activities included facilitation for holding regular meetings, encouraging proper means for communication and information about meetings in advance, and maintenance of records (including minutes of meetings, resolutions passed, accounts maintenance, etc.)

Integrated planning was another key activity under the project. The integrated planning was based on optimal use of various land resources of the landscape

by bringing together various actors and demonstrating linkages for holistic village landscape to tackle land use problem in landscape. The plan, thus prepared through intensive participatory process, is serving as a visionary guiding document for village development. For example, the gram panchayat of Pammuwala has proposed undertaking the distillation of a dam and construction of check dams in the forest area using funds from the Mahatama Gandhi National Rural Employment Guarantee Scheme (MGNREGS).

Efforts were made to empower communities from the marginalized caste categories and women with the aim to increase their participation in decision making. SHGs encouraged women's participation in various income-generation activities and became an important medium of collective voice for women in village meetings.

Leveraging funds from the existing funds of the government was an important component under the project. The focus of the activities was on linking the beneficiaries with the existing programmes of the government departments. Farmers and members of SHGs have been directly linked with block-level offices of the Horticulture Department, the State Seed Cooperative Society, and Agriculture Department for obtaining quality seeds of vegetables, planting material for horticulture plants besides providing fertilizers free of cost or at a subsidized rate.

Figure 1: Project team with women self-help-group at study site

The two important forest resources on which the communities were earlier dependent were bhabbhar grass and water. Dependency on bhabbhar grass had changed drastically mainly, due to easier availability of cheap substitutes. However, communities were still heavily dependent on water from dams constructed in the forests for irrigation. Hence, soil and water conservation works, plantation activities for forest catchment area treatment and increasing storage capacity of dams were done under the project mainly to increase water from forest catchments, which in turn result in increased agricultural production, thereby contributing to increased income of the communities in the landscape that are largely dependent on agriculture.

To establish more equitable benefit-sharing arrangements, work was aimed both at policy, as well as field level. At policy level, a revised policy framework was drafted which suggested greater share of benefits and control of funds to the local communities. This was done by undertaking intensive advocacy so that the key decision makers initiated the process for policy change. At field level continuous engagement with local institutions were undertaken to strengthen their daily functioning in order to make the existing distribution mechanism (especially of water) effective and also improve transparency in the activities of FD and local institutions. Although the policy recommends equal water rights to the landless household; however, this was not practiced in reality. The project facilitated change in the perception, and as a result the JFMC at Thaska has passed a resolution allowing landless to have their rightful share of water from the dams.

The goal of a project which focuses on improvement of the existing institutional arrangements for community-based forest management, in particular JFM, has thus rightly been achieved. The local people in the project villages have become more involved in deciding methods of restoration and protection of forests through strategies, which go beyond forest management and involve integrated livelihoods and landscape planning.

TERI's experiences gained from working over 15 years in the Yamunagar district of Haryana exemplifies how the interests, capacity and transparency of local institutions are critical to making a successful shift from livelihoods based on forest resources to those that are more diversified, resilient, and landscape based. It also underlines the importance of bringing together all relevant stakeholders to demonstrate better processes and delivery of services that can be scaled up in a common landscape.

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BOOK REVIEW

Golden Rules for a Golden Age of Gas

RK Batra

The International Energy Agency (IEA), representing 28 member countries, has brought out a book titled Golden rules for a golden age of gas. This is a timely publication because it not only highlights the increasing role that natural gas will play in the global energy space but also argues that this will be possible only if the world's vast resources of unconventional gas can be developed profitably and in an environmentally acceptable manner. Unconventional gas is defined as shale gas, coal bed methane, and tight gas. IEA brings together, in one volume, information on the three types of unconventional gases that is currently scattered in various reports and publications, some of which are not in the public domain.

The book defines shale gas as a gas that occurs in a rock classified as shale that due to its low permeability, requires a very different form of production compared to conventional gas. The main feature is the need to fracture the rock that contains shale gas in order to tap the gas. This requires not only conventional vertical drilling but also horizontal drilling at various depths. Injection of water, fine sand, and chemicals are required to open up the cracks in the rock, keep them open, and allow gas to rise to the surface. The downside is that the number of wells to be drilled is far more than for conventional gas. Also, large quantities of water are required, part of which remain underground, but a significant quantity rises to the surface as waste water and has to be disposed of in an environmentally friendly manner. The wastewater can also seep into aquifers, thereby contaminating clean water.

Coal bed methane, on the other hand is natural gas contained in coal beds and the technique for production is somewhat similar though drilling is not as extensive. Water is present in the coal seams. This wastewater rises to the surface along with the gas and needs to be disposed of, in a similar manner to shale gas production. Tight gas is a general term for natural gas found in low permeability formations and is a poorly defined category compared to the other two unconventional sources as well as conventional gas.

The book highlights in considerable detail the social and environmental concerns associated with the extraction of unconventional gas and emphasizes that companies will need 'a social license to operate'. It therefore sets out golden rules to address the environmental impacts of exploring and producing unconventional gas. It examines the current situation in the United States where shale gas has made a significant impact in natural gas availability and also Canada, Mexico, China, Australia, and Europe as a whole. The chapter on China is particularly interesting. It highlights that water availability may prove to be one of the biggest obstacles to unconventional gas development, particularly in the north and west of China where water is scarce and may be already strained by agricultural or urban needs. India also is a water-stressed country and although shale gas holds large promises, the water issue cannot be wished away and may prove to be the single biggest hindrance to shale gas exploration.

As India is currently exploring for coal bed methane and looking to shale gas as a promising addition to the diverse sources of gas, this book is a 'must read' for policy makers and all those who are in the energy business.

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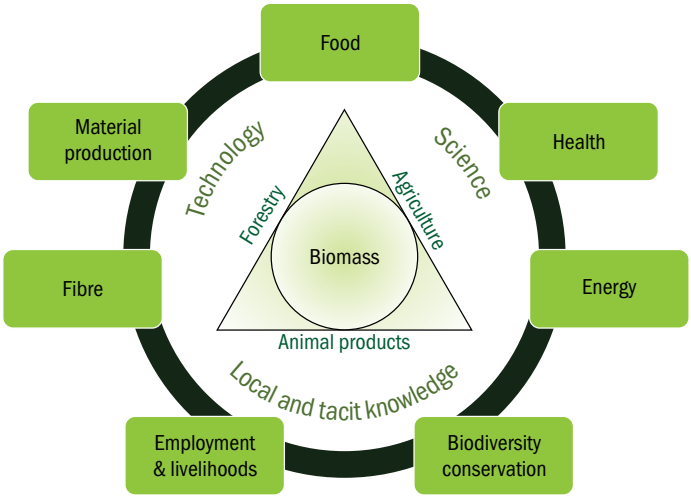
GREEN GLOSSARY

Innovation

An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations. (OECD 2005)

Innovation today is increasingly going beyond the confines of formal research and development (R&D) to redefine everything. Today innovation can mean new and unique applications of old technologies, using design to develop new products and services, new processes and structures to improve performance in diverse areas, organisational creativity, and public sector initiatives to enhance delivery of services. Innovation is being seen as a means of creating sustainable and cost effective solutions for people at the bottom of the pyramid, and is being viewed as an important strategy for inclusive growth in developing economies. (National Innovation Council)



Bioeconomy

Bioeconomy encompasses the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy. Its sectors and industries have strong

innovation potential due to their use of a wide range of sciences, enabling and industrial technologies, along with local and tacit knowledge. Bioeconomy is said to hold a potential to create economic growth and jobs in rural, coastal and industrial areas, reduce fossil fuel dependence and improve the economic and environmental sustainability of primary production and processing industries. (compiled from EC [2012])

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GREEN UPDATES

UN Climate Change Conference, Doha (November 26 to December 7, 2012)
The eighteenth session of the Conference of the Parties (COP 18) was held in Doha, Qatar from November 26 to December 7, 2012. The different themes discussed include climate change adaptation, finance, nationally appropriate mitigation actions by developing countries, and development and transfer of technologies and implementation of the technology mechanism.
More: http://unfccc.int/meetings/doha_nov_2012/meeting/6815.php

Government to develop 54 solar cities in India (December 17, 2012)
Dr. Farooq Abdullah, Minister of New and Renewable Energy (MNRE) informed the upper house of the Parliament of India that the government would develop 54 solar cities in India. The draft master plan has been prepared for 28 cities, of which eight has been approved by the MNRE for implementation.
More: http://pib.nic.in/newsite/pmreleases.aspx?mincode=28

Hawaii promotes green growth initiatives (17 October 2012)
Island nation of Hawaii has been pursuing several green growth initiatives with the objective of building sustainable and self-sufficient economy. Department of Land and Natural Resources (Hawaii), highlighted about the commitment of its leadership to promote green growth related measures in such as increased use of renewable energy, local food production, protection of natural resources and creation of green jobs.
More: http://hawaii.gov/dlnr/chair/pio/nr/2012/NR12-137.pdf

Convention on Biological Diversity, Hyderabad (October 1 to October 19, 2012)
India hosted the XI Conference of the Parties to the Convention on Biological Diversity in Hyderabad from October 1, 2012 to October 19, 2012. The different themes that were discussed at the Convention on include biodiversity and livelihoods, integration of value of biodiversity in national planning and accounting process, strategic resource mobilization and coastal and marine biodiversity.
More: http://www.cbd.int/cop11/
http://cbdcop11india.in/home.html

Mongolia's national strategy on green growth (February, 2013)
With the aim of balancing environmental sustainability alongwith economic growth, the Government of Mongolia established a new 'core' Ministry of Environment and Green Development (MEGD). This ministry would especially look into the challenges such as overexploitation of forests, loss of arable land, water and air pollution, loss of biodiversity, and environmental damage due to mining. This initiative highlights the country's eagerness to shift to patterns of clean energy and sustainable use of resources, in addition to poverty reduction and employment promotion.
More: http://www.undp.mn/dialogues/dd/dialogue4eng.pdf

Delhi Sustainable Development Summit to be held (31 January-2 February, 2013)
The 2013 Delhi Sustainable Development Summit will focus on the theme 'The Global Challenge of Resource Efficient Growth and Development'. It is expected that the articulation of issues related with this subject will set in motion a trend globally for resource efficient and low carbon development."
More: http://dsds.teriin.org

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Green Growth and Development Quarterly

Green Growth and Development Quarterly aims to understand the many facets of inclusive and green growth. It is a step towards a forward looking knowledge process for new opportunities linked with growth and sustainable development. Volume I (Issue 2) of the quarterly showcases new research and innovative practices through engaging with stakeholders from government, business & industry, and research & academia.

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