Green Growth Background Paper

Draft Final Report

Biodiversity and Green Growth in Punjab

Prepared for

Department of Science, Technology and Environment
Government of Punjab

Supported by

Global Green Growth Institute

The Energy and Resources Institute

...towards global sustainable development

Suggested format for citation

T E R I. 2015
Replace this line with the title of the report
New Delhi: The Energy and Resources Institute.

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Biodiversity and Green Growth in Punjab

1 Introduction

Punjab is one of the smaller states of India with an area of 50,362 sq. km located in the northwestern part of the country. The state comprises of 22 districts. Approximately 84% of its area is under agriculture. However, though Punjab has only 3.52% area under forests *(ISFR, 2013)* yet it supports a diversity of 1897 Angiosperms, 48 Pteridophytes, 34 Bryophytes, 948 Fungi and 397 Algae reported in the wild. Amongst faunal diversity, the state is especially rich in population of birds (428 species) and fishes (131 species). The domesticated agricultural faunal diversity includes three breeds each of cows, buffaloes and sheep and two breeds each of goats and poultry. Out of these Murrah & Nili Ravi breeds of buffaloes, Hariana & Sahiwal breeds of cattle, Lohi, Nali, & Desi breeds of sheep and Beetal breed of goat are indigenous. The Sahiwal breed of cattle, Nili Ravi of buffaloes, Lohi of sheep and Beetal breed of goat are threatened. Prior to the green revolution, 41 varieties of wheat, 37 varieties of rice, 4 varieties of maize, 3 varieties of bajra, 16 varieties of sugarcane, 19 species/varieties of pulses, 9 species/varieties of oil seeds and 10 varieties of cotton were reported to be in use in Punjab. Data indicates that out of 49 varieties of wheat, only 3 are widely used post green revolution as released by PAU, Similarly, out of 27 varieties of rice released, only 9 are currently in use. *Source: (Punjab Envis Newsletter, PBCST, 2012).*

Punjab comprising of 1.57 percent of the country's total geographic area has three major biogeographic zones which are as under:

- The central alluvial plains which comprise major cropland areas (besides some wetlands areas), wetlands (the state has three Ramsar sites) and small patches of natural forests in form of *birs*[1]and *rakhs* [2] .

- The northeastern Shivalik foothills which comprise 18 percent area in the state consisting of over 3 percent forest area, rest being rainfed and partially terraced fields wildlife sanctuaries and two communities reserves

- The southwestern dry zone with saline alkaline patches.

However, the major ecosystems with respect to biodiversity in the state are cropland ecosystems, and forest ecosystems. Various activities are undertaken for biodiversity conservation at *in-situ* and *ex-situ* sites (Jerath *et.al.,* 2002) as depicted in Figure 1.

[1] **Birs-** Patches of forest were set aside as hunting grounds (Shikargarh) by the erstwhile royals (e.g. Maharaja of Patiala) known as Bir forests and consist of small patches of semi-natural forest. Most of these are now incorporated into Punjab's network of PAs. Source: Sethi et al. (2002)

[2] **Rakhs-** Mostly wastelands or patches of thin forest with dwarf trees and brushwood that were used by the Britishers and Maharajas for various reasons like supplying wood and for cultivation.

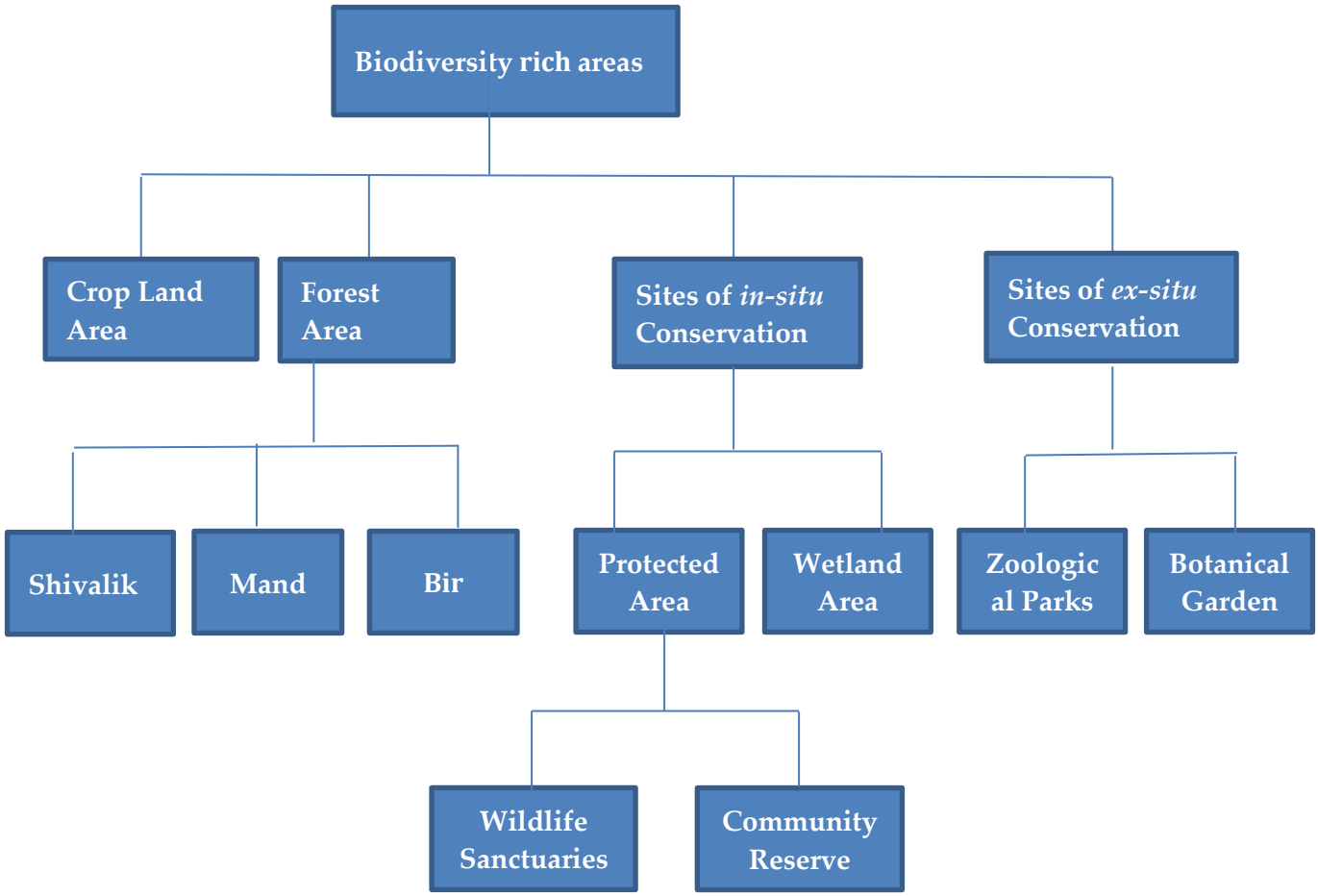

Figure 1: Major ecosystems with respect to biodiversity in Punjab

Source: (Punjab Envis Newsletter, PBCST, 2012)

As Punjab has 84 percent land area under agriculture so the cropland ecosystem forms the dominant ecosystem in the state. *Source: (Draft State Forest Policy & Strategic Plan*). The state was known to harbour great genetic variability in agri- and domesticated biodiversity however, over the years; it has reduced due to change in cropping pattern and higher dependence on certain high yielding varieties of crops. Due to denudation in the upper hills, water runoff and soil erosion is high and fertility is low and the cropping pattern is dominated by wheat in Rabi and rice–maize crop rotation in the Kharif season. The other crops grown are other cereals, pulses, potato and some oil seeds such as rapeseed. It is to be noted that production of rice, wheat and potato is growing continuously over the years, however, production of oil seeds, and pulses have declined considerably. The state has a very small area under forest cover (approximately 6 percent of the total geographical area).

The major forest area in the state is namely, Shivalik forests area, especially, in the districts of Ropar, Gurdaspur and Hoshiapur. The other forest areas are Bir Forests in Patiala district and Mand Forests in Amritsar & Kapurthala districts.

The state focuses on species conservation outside the natural habitat i.e. through *ex-situ* methods through zoological parks, botanical gardens, gene banks, and through captive breeding programs. Source: *(Punjab Envis Newsletter, PBCST, 2012)*

The major *ex-situ* conservation ecosystems in the state are: M.C. Zoological Park at Chaat bir, Tiger Safari at Phillaur and deer parks at; Bir Motibagh in Patiala, Bir Talab in Bathinda, Neelon in Ludhiana. Further, various mini zoos also exist in the state. Botanical Gardens an important means of *ex-situ* conservation are: Aam Khas Bagh in Fatehgarh Sahib, Rambagh in Amritsar, Shalimar Garden in Kapurthala, Banasar Garden in Sangrur and Company Bagh in Hoshiarpur.

2 Protected Areas, Biodiversity-rich Sites and Flagship Species

Protected Area (PA) Network in the state has twelve wildlife sanctuaries and two communities reserves covering 340.05 sq. km. area. Table 1 gives the list of protected areas with total area covered.

Table 1: Areas of Punjab

Protected Area	Name	Area covered (ha)
Wildlife Sanctuary	Bir MotiBagh Wildlife Sanctuary, Patiala	654
	Bir Bhunerheri Wildlife Sanctuary, Patiala	661.66
	Bir Dosanjh Wildlife Sanctuary, Patiala	517.59
	Bir Bhadson Wildlife Sanctuary, Patiala	1022.63
	Bir Bhadson Wildlife Sanctuary, Patiala	123.43
	Bir Gurdialpura Wildlife Sanctuary	620.53
	Bir Aishwan Wildlife Sanctuary, Sangrur	264.40
	Harike Wildlife Sanctuary, Firozepur, Amritsar, Kapurthala	8600.00
	Takhni-Rehmapur Wildlife Sanctuary, Hoshiarpur	382.00
	Abohar Wildlife Sanctuary, Firozepur	18650.00
	Jhajjar Bacholi Wildlife Sanctuary, Rupnagar	116.00
	Kathlaur-Kaushlian Wildlife Sanctuary, Gurdaspur	758.40
Zoological Park	Mohindra Chaudhary Zoological Park, Mohali	202.00
	Tiger Safari, Ludhiana	35.00
	Deer Park, Nilon, Ludhiana	4.00
	Deer Park, BirMotiBagh, Patiala	8.00
	Deer Park, BirTalab, Bathinda	20.00
Community Reserve	Lalwan Community Reserve, Hoshiarpur	1266.80
	Keshopur Chamb community Reserve, Gurdaspur	340.00

Source: Punjab State Action Plan on Climate Change,PSCST 2014

Along with PA network, the sites identified as biodiversity hotspots and heritage sites are also important in recognizing the biodiversity richness of the local sites in the states. Apart from the existing protected area network in Punjab, the Punjab Biodiversity Board has identified a number of hotspots in Shivaliks. These hotspots are as follows:-

1. Guru Gobind Singh Nature Reserve, Anandpur Sahib, Roopnagar
2. Chohal Forest, Hoshiarpur
3. Talwara Forest, Hoshiarpur
4. Dhar and Dunera Forest , Gurdaspur (Area-215 ha)
5. Sadavarat Forests and Ropar and Nangal Wetland, Roop Nagar
6. Kahanpur Khuhi Forest, Roop Nagar
7. Takhni-Rehampur Wildlife Sanctuary, Hoshiarpur
8. Manguwal Forest, Hoshiarpur
9. Siswan-Dulwan area in Roopnagar (Area-2044 ha)
10. Narangpur forests, in Roopnagar (Area- 422 ha)
11. Nara Forest in Hoshiarpur (Area- 3807 ha)
12. Dholbaha, Hoshiarpur (Area- 2083 ha)
13. Dada Forest area, Hoshiarpur (Area- 4700 ha)
14. Bindraban and Nandi Bir areas in Dayua (Area- 1462 ha)
15. Siali Dhar in Gurdaspur (Area- 1457 ha)
16. Nagdhar in Gurdaspur
17. Ranjit Sagar in Pathankot

2.1 Biodiversity Heritage Sites

Under the Biological Diversity Act, (2002) areas that are unique, ecologically fragile ecosystems - terrestrial, freshwater or marine having rich biodiversity can be declared as Biodiversity Heritage Sites. At national level, the National Biodiversity Authority and at state level, State Biodiversity Boards can identify and declare such areas. In case of Punjab, the State Biodiversity Board has identified 15 locations across the state as Biodiversity Heritage Sites. These sites cover the areas of agricultural, livestock and horticultural importance, community conservation sites and wetlands outside protected areas. (*Source: Punjab Envis Centre Newsletter, 2012)*

Declaration and Management of BHS

Under Section 37 of Biological Diversity Act, 2002, the State Government in consultation with local bodies may notify in the official gazette, areas of biodiversity importance as Biodiversity Heritage Sites (BHS). The State Government in consultation with the Central Government may frame rules for the management and conservation of BHS under sub section (2) of Section 37. Under sub section (3) of Section 37, the State Governments shall frame schemes for compensating or rehabilitating any person or section of people economically affected by such notification. Areas which have already been designated, identified or notified (for example as protected area, biosphere reserve, etc.) under other Acts or programmes may not be considered under this provision. The idea is to identify those areas important from Biodiversity point of view which do not enjoy protection/support under any other Act or programme.

The Punjab Biodiversity Board has identified a number of biodiversity Heritage Sites:-

- These include Inami Baag site in Hoshiarpur district with large diversity of mango species.
- Largest Banyan tree (Kaya Kalp Vriksh) site in Fatehgarh Sahib district.
- Chatpat Bani forest area (conserved by local community) in village Kataru Chak, on Pathankot-Amritsar National Highway.
- Areas falling outside Harike Wildlife Sanctuary from village Gagrewal to Goindwal Sahib on river Beas as dolphin heritage site for conservation of dolphins.
- Patti, Amritsar and Ferozepur area for native livestock species like Nili Ravi.
- Mand area for conservation of Hog Deer population.
- Sultanpur Lodhi area and area between Nangal and Ropar for conservation of fish biodiversity.
- Aam Khas Baag and Ram Baag in district Amritsar.
- Baradari Garden, Patiala for Simbal Tree & Banayan tree (which are about 120 years old) and Ferns.
- Shalimar Garden, Kapurthalaorthern parts of Shivaliks as biodiversity rich pockets.
- Dhar block in district Pathankot & Nurpur Bedi area in Rupnagar district for Vultures,
- Pandori (area between Keshopur Miani and Kahnuwan) in district Gurdaspur as a sacred grove
- Area falling outside Kathlaur Kalsian Sanctuary along Ranjit Sagar Dam.
- Keshopur Miani & Magamudian in district Gurdaspur for Sarus Cranes.

Source: (Punjab Envis Centre Newsletter, 2012)

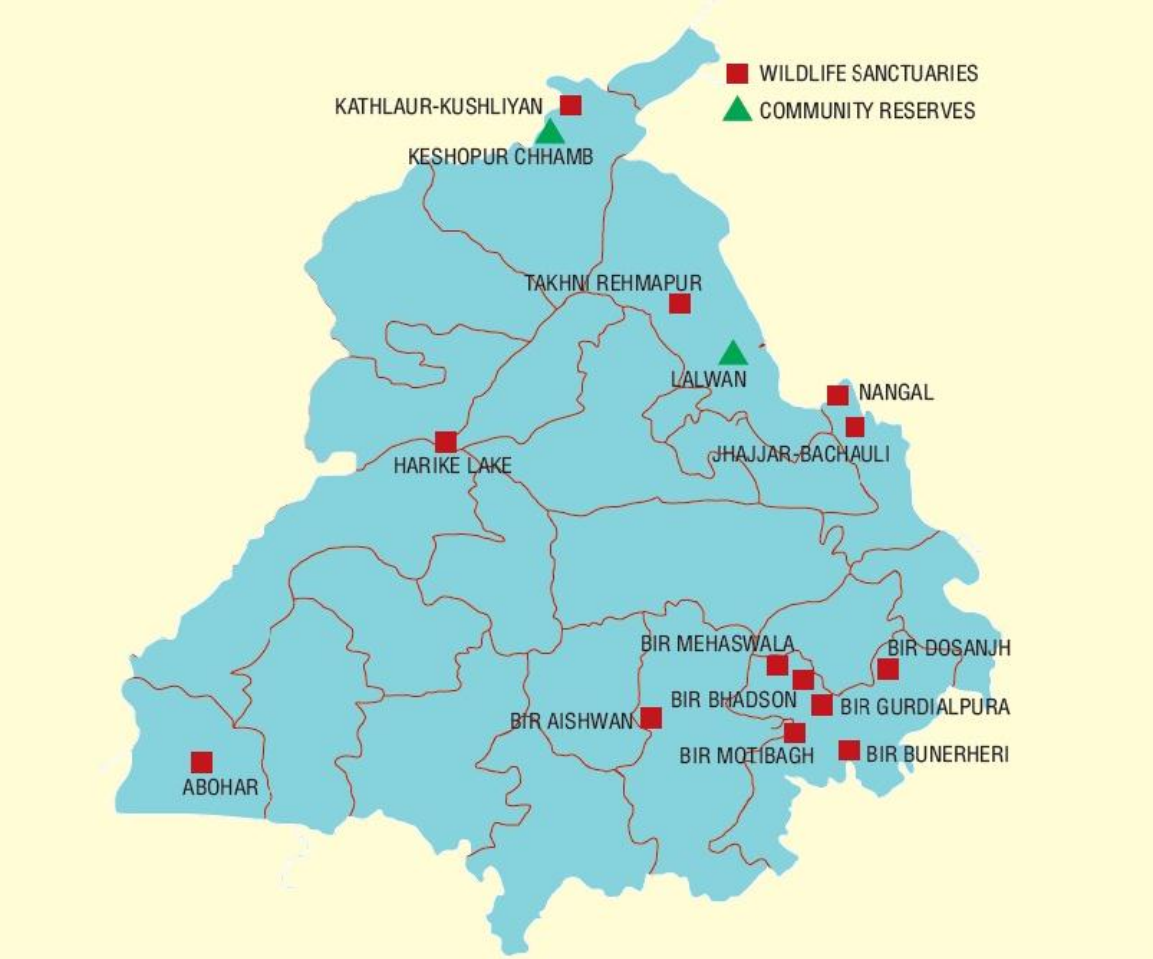

Figure 2: Protected Area Network of Punjab

Source: Adopted from ENVIS Centre, PSCST, 2010

2.2 Ramsar Sites

India has 26 Ramsar Wetland Sites which are recognized for their international importance. The state of Punjab is rich in natural wetlands. With construction of dams & barrages, several man-made wetlands have also emerged on the state's landscape. About 0.31% of the state's area is under natural and manmade wetlands. The state has 12 natural wetlands covering a total area of 8.39 square km and 9 man-made wetlands covering an area of 147.39 square km. Three wetlands namely Harike, Kanjali & Ropar are of international importance and designated Ramsar Sites. Though large scale biodiversity studies have not been carried out in the state, yet, a large number of flora & fauna has been recorded from the forest areas and wetlands. (*Source: Punjab Envis Centre Newsletter, 2012).* The wetland offers a variety of habitats to about 361 bird species out of which 59% are migratory birds. Further, 21 protozoan, 61 rotifers, 27 crustaceans, 34 insects, 9 annelids, 4 nematodes, 41 mollusks, 74 fishes, 7 turtles (out of which 4 are vulnerable as per Red Data book), 4 snakes, 2 amphibians and 12 mammal species have also been recorded.*(Source: Jerath et a.l, 1992; Ladhar et al., 1994; Dhilon et al., 1996 and Prakash et al., 1997)*

2.3 Important Bird Areas

An Important Bird Area (IBA) is an area recognized as being globally important habitat for the conservation of bird populations based on various criteria. Currently there are about 10,000 IBAs worldwide. In India, there are about 465 IBAs. In Punjab, three major wetlands Harike, Kanjali and Ropar are recognized as IBAs and they harbor several threatened and congregatory species of birds including vulnerable species like Ferruginous Duck (*Aythya nyroca)*, Pallas's Fishing Eagle (*Haliaeetus leucoryphus)*, Black-bellied Tern (*Sterna acuticauda)*, Greater Spotted Eagle (*Aquila clanga)* & Indian Skimmer (*Rynchops albicollis) and* near threatened avian species like Oriental Darter (*Anhinga melanogaster)*, Painted Stork *Mycteria leucocephala)*, Asian Openbill (*Anastomus oscitans)*, White-backed vulture (*Gyps bengalensis)*, Long-billed vulture (*Gyps indicus)*.

3 Ecosystems Services and Biodiversity in Punjab

Data indicates that out of the total 373 large/medium units (LMU) in Punjab, 310 units (83%) utilize bio-resources as major raw material. These include 142 units of food products & beverages (45%), 96 textile units of both, natural and synthetic fibre (31%) and 33 paper & paper products units (11%). The maximum bioresource based LMUs are located in district Ludhiana (77) followed by Patiala (59), and Mohali & Amritsar (32 each). Data also indicates that 13% (20,940) of the total Small Scale Units (SSU) are bioresource-based enterprises. These include food products & beverages (6081), leather & leather products (4263), textiles (1425 approx.), wood products (2783), furniture (2621), paper & paper products (754), rubber products (647), hosiery & garments 394), pharmaceuticals & botanicals (212) and tobacco products (7). Ludhiana (4292), Amritsar (2816), Sangrur (2803) and Jalandhar (1926) are leading districts for bioresources based SSUs in the state. *Source:* (*Jerath. N, 2012*).

There are 255 registered herbal units operating in Punjab, besides many unregistered herbal units utilizing botanicals to prepare various product formulations. For the data available for 121 units, these units use 919.9 MT/annum of raw plant materials. The most used medicinal plants are *Aloe barbadensis*, *Phyllanthus emblica* and *Terminalia chebula*. Two plant species namely *Tecomella undulata* and *Withania coagulans*, being used by herbal units have been identified as threatened species in the state. *Tecomella undulata* has been identified as an 'endangered species' and *Withania coagulans* as 'vulnerable species'. *Source: (Jerath N, 2012*).

About 500 unregistered tiny and cottage units based on biological resources exist in the state with a large percentage occurring in the Shivalik area alone due to higher availability of non-timber forest produce (NTFP) and wild medicinal plants. These units provide livelihood to local communities in about 300 villages in the Shivalik area falling in five forest divisions namely, Ropar, Garhshankar, Hoshiarpur, Dasuya and Pathankot. The local populations access these bio-resources, both from the forests and uncultivated areas as raw material. (*Source: Jerath. N, 2012).* The district wise quantity of botanicals used by herbal units in Punjab and the most used botanicals is given below in figure 3 and figure 4 respectively.

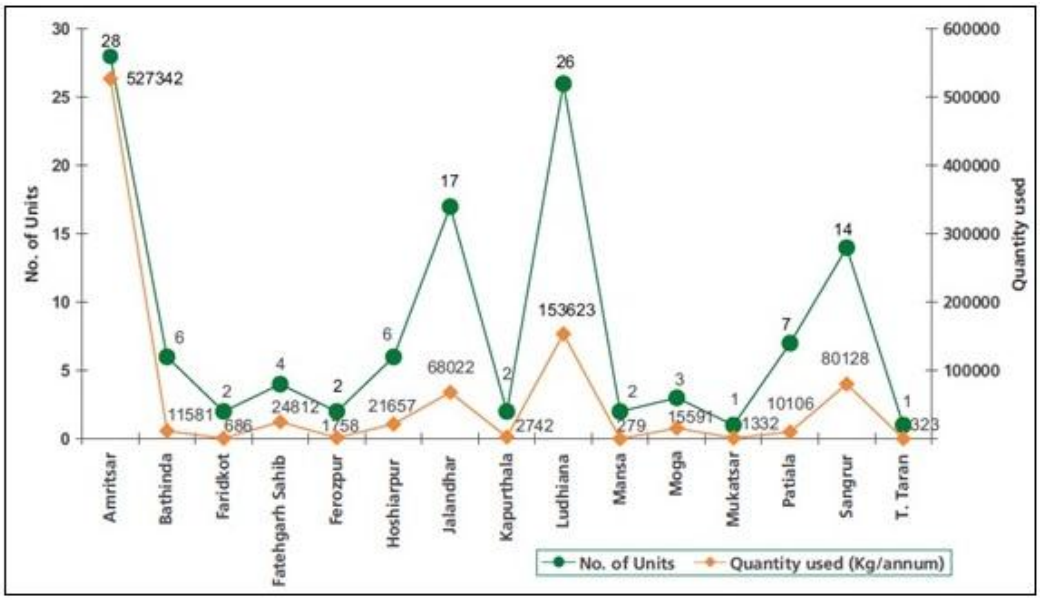

Figure 3: District wise quantity of botanicals used by herbal units (121) in Punjab

Source: Jerath (2012)

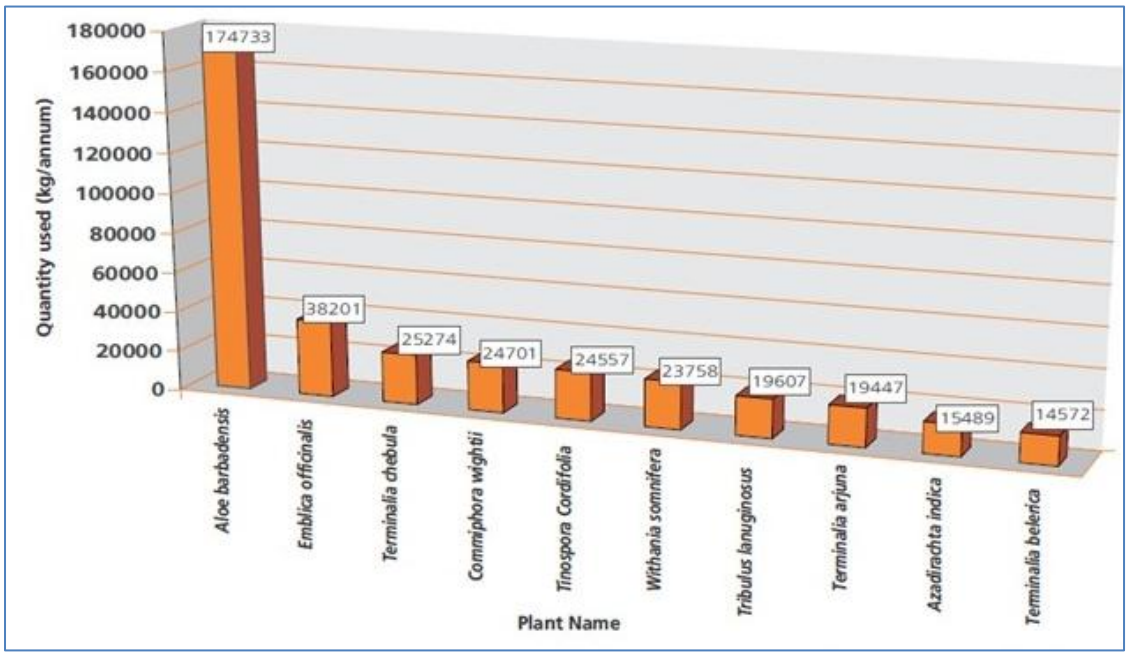

Figure 4: Most used botanicals in Punjab

Source: Jerath (2012)

The state of Punjab is bestowed with vast lotic and lentic aquatic resource. Aquaculture sector contributes more than 6 tonnes/ha/yr of fish with an annual growth of 10%. The existing sources are the rivers Sutlej (280 km), Beas (160 km), Ravi (150 km) and Gagger (39 km), 14500 kms of canals, 4370 hectare small reservoirs/ wetlands, and ponds. In Punjab, 10,856.60 hectare area is under fish culture and there are around 7500 fish farmers with fish farming units of 0.1 hectare to 5.0 hectare. (*Source: Vasudev, 2009*). Punjab fish farmers have made the concept of industrial fisheries a reality. Besides earning a net profit of more than Rs. 2.0 lakhs per hectare per year from fish farming, they are using their fish pond fertile

water as source of assured irrigation for the agricultural fields for cost effective agricultural produce. The major fish species which are being promoted for pisiculture in the state are *Labeo rohita* (Rohu), *Catla catla* (Katla), *Cyprinus carpio* (Common carp), *Ctenopharynx godonidella* (Grass carp) and *Hypophthalmichthys molitrix* (Silver carp*). [Source: Inputs for SAPCC from Dept. of Animal Husbandry, Dairying and Fisheries].*

Punjab has recorded tremendous growth in the fisheries sector in the last three decades. Fish production has increased from 28000 tons in 1980-81 to 122.86 000 tons in 2009-10, registering an increase of just over 58%. In 2010-11, the production however reduced to 97.04 000 tons. (Source: MoA 2012,)[3] At present, aquaculture productivity of the state is 6.04 t/ha/yr, which is more than double the national productivity of 2.60 t/ha/yr. *Source: (Vasudev, 2009).*

The percent utilizable ecosystem services within each forest type within the Shivalik hills is estimated and shown in Table 2.

Table 2: Percentage utilizable Ecosystem services derived from Shivalik Hills in Punjab

	Dry Deciduous Forests (In %)	Moist Deciduous Forests (In %)	Dry Deciduous Scrub (In %)	Pine Forests (In %)	Total (In %)
Food	11.15	12.7	10.05	0	33.9
Fuel	0.79	2.36	2.21	0	5.36
Fodder	9.09	6.94	9.06	8.56	33.65
Fibre	9.8	7.91	9.31	0	17.22
Timber	10.2	2.6	9.55	0	22.35
Medicinal Plants	31.66	32.1	31.61	20.78	116.15
Oil	5.02	0.65	6.37	0	12.04
Gums/Resin	3.5	0.86	3.18	0	7.54
Tannin	5.18	1.3	6.61	0	13.09
Others	9.83	8.45	8.09	2.35	28.72

Source: Jerath et al., 2006

4 Pressures on Biodiversity

4.1 Wetlands

In Punjab the pressures on biodiversity are of various kinds. The wetlands of Punjab are under pressure due to several reasons such as encroachment, land reclamation and soil erosion, silting and sedimentation, etc. The introduction of exotics is also affecting Punjab's natural fish populations. Four exotic fishes-*Cyprinus carpio, Ctenopharyngodon idella, Hypophthalm ichthys molitrix* and *Gambusia affinis* have become common in Punjab waters leading to a decline in the catch of Indian carps such as *Labeo rohita, Cirrhina mrigala, Catla catla and Labeo calbasu* (Johal and Tandon, 1984).

[3] Report, 2011-12; Department of Animal Husbandry, Dairy Development and Fisheries, MoA 2012, GoI

Dams and barrages act as a barrier for upstream movement of fish, a problem that is solved through the creation of fishways. Fishways have been constructed for some areas such as Ropar, Hussainiwala, Madhopur and Harike. However, others such as Talwara, Nangal and Pong lack them. Dams further, affect aquatic life by causing several ecological changes such as change in temperature regimes, salinity pattern in brackish water regions, altered water and air current velocities, inundation of spawning grounds and an increase in depth and siltation. The construction of numerous dams and barrages on Punjab's rivers is undoubtedly affecting fish populations (*Source: Sandhu and Toor, 1984*).

4.2 Forest cover change

In Punjab, studies carried out by Roy et al., (2001) indicate that dry deciduous scrub forests show high degree of fragmentation (around 40%).

Conservation of Shivalik Mountains Ranges – Shivalik hills form a connecting chain of mountains between Himachal Pradesh and Punjab. It also serves as an important watershed catchment for Punjab. But in both the states there have been number of developmental activities taking place in this region. The eco-fragile Shivalik hills are being leveled for building roads and for creating urban settlements as well as industrial establishments. There is a need to assess the impacts of these developmental pressures on the forest cover, incidences of land slides, and land degradation in the region.

4.3 Threatened, endangered flora and fauna

Punjab is bestowed with diverse flora and fauna. There are a number of risks to the biodiversity that have already been discussed in the chapter. There is a network of protected areas for the conservation of wild flora and fauna. But the wild flora and fauna are threatened due to loss of habitats and due to destructive harvesting of the species. There has been an increasing pressure on the commercially valuable biological resources such as timber and medicinal plants. Many medicinal plant species are threatened due to over harvesting.

Species occurring very rarely in the Punjab Shivaliks include 3 species of Algae, 2 species of Fungi, 5 species of Pteridophytes, and 44 species of Angiosperms (PSoER, 2005). Species like *Terminalia bellirica* and *T.chebula* seem to be the victims of overexploitation for medicinal purpose. Likewise *Grewia optiva* (leaves used as fodder), *Pueraria tuberosa* (edible tubers e) and *Bauhinia vahlii* (leaves used for making food plates) have suffered extensive damage because of the utilization of different parts for various purposes. The native and dominant flora of the semi-arid Punjab like *Prosopis cineraria* and *Tecomella undulata* find a prominent place under the 'threatened' category because of leveling of sand-dunes for agricultural purposes (Sharma, 2002). Amongst fauna the globally threatened species are 2 types of reptiles, namely, brown river turtle, Indian rock python; 6 species of birds – White-rumped vulture (*Gyps bengalensis*), Long-billed vulture or griffon (*Gyps indicus*), Oriental Darter (*Anhinga melanogaster*), Ferruginous Pochard (*Aythya nyroca*), Pallid Harrier (*Circus macrourus*) and Painted Stork (*Mycteria leucocephala*) ; and 2 species of mammals, Smooth coated Otter (*Lutrogale perspicillata*) and Indian Pangolin (*Manis crassicaudata*) *(Source: ZSI).*

5 Policy Framework, Regulations and Interventions related to Biodiversity in Punjab

Management of Punjab's natural resources is carried out under a broad umbrella of national, state and international laws and policies. In this chapter, relevant national and legislations pertaining to the management of the state's forests and biodiversity have been discussed. Table 3 provides a list of national and state policies and legislation for conservation of biodiversity values in the state.

Table 3: Biodiversity legislations and policies

National Conservation Policies
1. National Forest Policy
2. National Wildlife Action Plan
National Legislation
1. Indian Forest Act, 1927
2. The Wildlife (Protection) Act, 1972
3. Forest (Conservation) Act, 1980
4. Environment (Protection) Act, 1986
5. Biodiversity Bill, 2000
6. Biological Diversity Act, 2002
7. Biological Diversity rules, 2004
State Legislation, rules and notifications
1. Punjab Land Conservation Act, 1900
2. The Punjab apportionment of trees rules, 2000
3. The Wildlife (Protection) Punjab rules, 1975
4. Joint Forest Management notification
5. The Punjab Forest (Sale of timber) Act, 1913
6. The Punjab Public Premises and Land (Eviction and Rent Recovery) Act, 1973
7. The Cattle Tress Pass Act, 1871
8. Draft Punjab Forest Policy, 2008
9. Ecotourism Policy, 2009
10. Wetland Conservation & Management rules, 2010
1. Convention on the International Trade in Endangered Species of Fauna and Flora (CITES)
2. Convention on Biological Diversity (CBD)
3. Ramsar Convention

Source: Sethi P, 2002

The forty-second amendment of the Indian Constitution in 1976 transferred forests from the State list to the Concurrent list. This transfer empowered the Central Government to act directly in managing the forests. Since 1976, three major actions have been taken by the Central Government. The Forest (Conservation) Act was created in 1980 and amended in 1988, and the revised National Forest Policy was adopted in 1988. Wildlife' was also transferred to the concurrent list from the State list, increasing the role of the Central Government in wildlife protection.

The revised National Forest policy envisages a forest cover of 33%. However because of various reasons this has not been achieved so far. Keeping this in view, the Government of India formulated the National Forestry Action plan (NFPA), 1999, a comprehensive strategic plan to address the key issues underlying the major problems of the forestry sector. The objective of the NFPA is to evolve issue based programmes to dovetail with the provisions of the national forest policy of 1988. It is envisaged that the forestry programmes would be carried out within the framework of the national five year plans. The programme structure of NFPA is based on the forestry action programmes of the states of India and the recommendations of the regional and national and national workshops and forestry sector reviews.

Status of State Biodiversity Boards

Punjab has setup 22 Biodiversity Management Committees (BMC's) at District level, 33 at Village level in Shivalik area and one in potential heritage site. The 22 BMC's include Amritsar, Barnala, Bathinda, Faridkot, Fatehgarh Sahib,Firozepur, Fazilka, Pathankot, Gurdaspur, Hoshiarpur, Jalandhar, Kapurthala, Ludhiana, Moga, Muktsar, Mansa, Nawanshahr, Patiala, Roopnagar, S.A.S Nagar, Sangrur, Tarn Taran. Process to initiate Peoples Biodiversity Registers has been initiated in 11 districts out of 22 districts comprising of BMCs. They include Roopnagar, Hoshiarpur, Barnala, Tarntaran, Bathinda, Jalandhar, Muktsar, Faridkot, Gurdaspur, Fazilka and Pathankot. The National Biodiversity Authority, GoI has sanctioned Rs 26.45 lacs for preparation of 11 district level and 1 village level Peoples Biodiversity Registers for year 2013-14.

6 Biodiversity Governance

As a part of the Strategic Plan for Biodiversity (2011-2020) of Convention on Biological Diversity, twenty global targets have been agreed upon for the conservation and sustainable use of biodiversity. These 20 targets are referred as the Aichi Biodiversity Targets. These targets are the globally agreed responses to curtail the loss of biodiversity and countries are supposed to design national targets so as to achieve the Aichi Targets by 2020. These targets are designed to achieve five strategic goals by 2020. India has subsequently developed 12 National Targets corresponding to 20 Aichi Targets. Thus, achieving the National Biodiversity Targets by India would mean that nationally India is contributing to achieve the following 5 Strategic Goals –

Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society

Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use

Strategic Goal C: Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity

Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services.

Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity building

Table 4: Contribution of Punjab to the National Biodiversity Targets

Sr No	Aichi Target	National Target	Contribution of Punjab
1	**Target 1: By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.**	**Target 1:** By 2020, a significant proportion of the country's population, especially the youth, is aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.	**No. of Biodiversity Management Committees formed** - 22 BMCs at District level, 32 at Village level in Shivalik area and one in potential heritage site.
			Preparing Peoples Biodiversity Registers: Process initiated in 11 districts out of 22 districts.
2	**Target 2 - By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.**	**Target 2:** By 2020, values of biodiversity are integrated in National and State planning processes, development programmes and poverty alleviation strategies.	With regard to integration of Biodiversity in State Planning Process, development programmes and poverty alleviation strategies; the State Biodiversity Rules have been drafted and are under consideration of the Government for notification. As per Biodiversity Act; BMCs can charge collection fee as well as there is a provision of benefit sharing w.r.t. access which is an additional source of income for communities.
3	**Target 5 - By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.**	**Target 3:** Strategies for reducing rate of degradation, fragmentation and loss of all natural habitats are finalized and actions put in place by 2020 for environmental amelioration and human well-being.	The draft Forest Policy aims to extend the Forest cover in Punjab from 6% to 15% of its geographical area by 2015, i.e. to an area of 7554 sq km. The Green Punjab Mission aims at extending forest area in Punjab up to 10% of its geographical area by 2022.
	Target 15 - By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.		Out of total land area, 4.54% of total area is suffering from different kinds of soil problems. Only 2.33% (1172.84 sq km) of total area of the state is under various categories of wastelands. Mukatsar district has highest area (186.8 sq km) under waste lands, followed by Ferozpur (148.1 sq km), Bathinda (144.4 sq km) and Gurdaspur (94.5 sq km). The draft Forest Policy of Punjab brought out in 2008 states that it

Sr No	Aichi Target	National Target	Contribution of Punjab
			would aim to extend the Forest cover in Punjab from 6% to 15% with a special emphasis on degraded areas.
4	**Target 9 - By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.**	**Target 4:** By 2020, invasive alien species and pathways are identified and strategies to manage them developed so that populations of prioritized invasive alien species are managed.	The draft forest policy of 2008 states that strategies to remove invasive species must be mentioned in management plans. Eradication of weeds like *Lantana* and *Parthenium* and replacing them with more useful fodder and grasses and medicinal plants would help in improving the condition of the natural forests and availability of utilisable biomass for local people.
			The East Punjab Agricultural Pests, Diseases and Noxious Weeds Act, 1949 gives the power to declare noxious weeds and direct measures to eradicate or prevent them.
5	**Target 6 - By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.**	**Target 5:** By 2020, measures are adopted for sustainable management of agriculture, forestry and fisheries.	The Punjab Fisheries Act of 1914 envisages sustainable harvest of the fisheries. The Fisheries wing of the National Husbandry department suggest following actions for sustainable harvest of fishes:- i.Renovate/rehabilitation of village ponds and development of new ponds/tanks in saline affected waterlogged land in the south-west district of Punjab. ii. Develop Saline affected waterlogged area in the south-west districts of Punjab to make fisheries to grow there and become a major livelihood activity for the farmers.

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	Target 7 - By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.		iii. Assess impacts of climate change on fisheries in Punjab. iv. Determine the hydrological and physic-chemical characteristics of water bodies and correlate them with fish productivity. v. Supply of quality fish seed for table fish production. vi. Develop information and knowledge with respect to water conservation measures and increasing water use efficiency and disseminate the same amongst farmers. The total cost of implementing the actions for the Fishery sector is estimated to be Rs. 93 Cr for the two plan periods.
			The Agricultural Policy of Punjab aims at encouraging Organic farming and spreading awareness among the farmers and consumers about benefits of organic products. It also suggests issuing Soil health cards for every farmer in the State indicating the status of macro and micro nutrients as well as chemical properties of the soils for judicious & balanced application.
			Agricultural Policy provides for crop diversification. Currently diversification of agriculture to reduce area under paddy from 22.5 Lakh ha (2012-13) to 8.5 lakh ha in 2017-18 and promote cultivation of basmati, cotton, maize, sugarcane, pulses, fodder, fruit & vegetable and agroforestry is proposed. The State is also alive to the need of paddy straw utilization (the burning of which is a major environmental and climate change issue). Accordingly, a White Paper on Paddy Straw Management & Utilization has

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			been drafted which provides for sustainable economical use of this, presently unutilized, important bio-resource.
			The draft forest policy envisages to increase the tree cover in the State from existing 6.3% to 15% by 2017 under state forestry action programme by promoting social and agro-forestry activities.
			The State Biodiversity Strategy & Action Plan (SBSAP) is in place. The Shivalik biodiversity has also been extensively studied and taxanomic listing completed. It is hoped that awareness of BMCs and preparation of PBRs will help to improve the conservation status of diverse wild and cultivated/domesticated flora and fauna.
	Target 8 - By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.		Agricultural Policy provides for crop diversification. Currently diversification of agriculture to reduce area under paddy from 22.5 Lakh ha (2012-13) to 8.5 lakh ha in 2017-18 and promote cultivation of basmati, cotton, maize, sugarcane, pulses, fodder, fruit & vegetable and agroforestry is proposed. The State is also alive to the need of paddy straw utilization (the burning of which is a major environmental and climate change issue). Accordingly, a White Paper on Paddy Straw Management & Utilization has been drafted which provides for sustainable economical use of this, presently unutilized, important bio-resource.

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6	**Target 10 - By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.**	**Target 6:** Ecologically representative areas on land and in inland waters, as well as coastal and marine zones, especially those of particular importance for species, biodiversity and ecosystem services, are conserved effectively and equitably, on the basis of PA designation and management and other area-based conservation measures and are integrated into the wider landscapes and seascapes covering over 20% of the geographic area of the country, by 2020	Establishing Ramsar sites, important bird areas and other important wetlands and community reserves (two in case of Punjab). The Wetland Conservation and Management Rules of 2010 bans activities like withdrawal of water, impounding water, dredging, constructing jetty's, etc without permissions
	Target 11 - By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.		
	Target 12 - By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.		
7	**Target 13 - By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and**	**Target 7:** By 2020, genetic diversity of cultivated plants, farm livestock and their wild relatives, including other socioeconomically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic	The Punjab Agro Food grains Corporation limited (PAFC), is supporting Diversification of Agriculture through Contract Farming. The objective is to shift area under wheat and paddy crops to the crops requiring lesser irrigation to conserve water and to improve soil health for better productivity.

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	implemented for minimizing genetic erosion and safeguarding their genetic diversity.	diversity.	
8	**Target 14 - By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.**	**Target 8:** By 2020, ecosystem services, especially those relating to water, human health, livelihoods and wellbeing, are enumerated and measures to safeguard them are identified, taking into account the needs of women and local communities, particularly the poor and vulnerable sections.	
9	**Target 16 - By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.**	**Target 9:** By 2015, Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization as per the Nagoya Protocol are operational, consistent with national legislation.	Establishment of SBB and BMCs to execute Access and Benefit sharing of the commercially used biological resources as per National Guidelines.
10	**Target 3 - By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.**	**Target 10:** By 2020, an effective, participatory and updated national biodiversity action plan is made operational at different levels of governance.	The Punjab State Biodiversity Strategy & Action Plan is in place.

Sr No	Aichi Target	National Target	Contribution of Punjab
	Target 4 - By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.		
	Target 17 - By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.		
11	**Target 18 - By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.**	**Target 11:** By 2020, national initiatives using communities' traditional knowledge relating to biodiversity are strengthened, with a view to protecting this knowledge in accordance with national legislations and international obligations.	Preparation of People's Biodiversity Registers is under progress at selected sites.
12	Target 19 - By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss,	**Target 12:** By 2020, opportunities to increase the availability of financial, human and technical resources to facilitate effective implementation of the Strategic Plan for Biodiversity 2011–2020 and the national targets are	

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	are improved, widely shared and transferred, and applied.	identified and the Strategy for Resource Mobilization is adopted.	
	Target 20 - By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.		Total Financial allocation of Punjab for 12th and 13th Year Plan for various strategies to conserve biodiversity is Rs 262.6 crore. However, the Punjab Biodiversity Board has received a total of Rs 71.3 lacs for financial year 2013-14. The board has been mobilizing the funds in project mode from NBA, UNESCO and State Government for all its field level activities, manpower and office infrastructure.

The national targets set by India in tune with the Aichi Biodiversity Targets are aiming at aligning a number of forward looking policies so as to fulfill the strategic goals at national level. For most of the targets, India has a very comprehensive policy regime backed by institutional support on the ground. The indicators for monitoring the progress have also been developed and are assigned to the respective organisations for follow up. But at the operational level for implementing the respective targets dealing with the complexity of governance structure, policy regime along with complexity of bio-physical conditions in the country becomes a big challenge to understand the outcome.

The case study of states such as Punjab becomes illustrative to understand the progress and number of issues which still require attention for implementation. Based on the analysis of Table 4, several reforms could be suggested for not only achieving the National Biodiversity targets but also to have a sustained process of biodiversity conservation, sustainable and equitable utilization of the biological resources.

7 Ways Forward

7.1 Staff and Capacities

The state of Punjab has responded proactively to by formulating desired policies and setting targets to achieve the objectives. But there is a need to visualize and percolate the policy provisions at the implementation level. Presently, there are difficulties in having co-ordinated approach by these three entities to arrive at the larger objectives to be addressed by the state on medicinal plant conservation, sustainable harvesting, cultivation and developing equitable benefit sharing associated with the commercialization. Thus, there is a need of assessing the requirement of staff on the field so as to fulfill the objectives and also assess the capacities of the staff to undertake the desired activities. There are departments such as State Biodiversity Board which are poorly staffed but mandated with number of objectives as per the policy provisions. Thus, strengthening the required staff and the necessary capacities remain an important agenda for the state. One of the important recommendations could be strengthening of State Biodiversity Board by appointing a full time Chairman and a Member Secretary who would ensure smooth functioning of PBB and would facilitate meeting National and Aichi Targets and promoting Green Growth in the State.

7.2 New Legal Provisions

For implementation of policies, there is a need of formulating rules and road map for implementation. In case of Punjab, the agriculture policy emphasizes upon organic agriculture but possibly in absence of specific targets the outcome would be difficult to achieve. The Aichi targets and National targets thus become an opportunity to evolve such road maps.

7.3 Research Gaps

The state of Punjab is competent to evolve research programmes to tackle the gaps in information for implementation of number of policies provisions. There could be three major areas where the states can immediately develop a collaborative research programmes with national and international agencies by involving the state level research organizations as follows:

a) Valuation of ecosystem services – The neighboring state of Himachal Pradesh has successfully implemented Payment for Ecosystem Services (PES) policy. Similar policy can be adopted in state of Punjab but there is a need to generate the necessary knowledge as defined by the policy such as Identification of Ecosystem Services (ES) and Quantification of their flows, Identification of stakeholders and their institutions, process of engagement and Institutional arrangements, Determination of types and levels of payments, Regulatory and Legal Framework, Financial Arrangements, etc. Similarly in case of Punjab, such exercise in connection to the wetlands may be proposed considering the importance of the wetland ecosystem for livelihood and biodiversity conservation.

b) Threatened flora and fauna – With the help of State Biodiversity Board and State Forest Department of Punjab, state can develop a mechanism to assess the conservation status of the existing flora and fauna in a participatory way. It will involve process prioritization of species for monitoring, developing baseline and developing a monitoring mechanism. The information so generated can be fed for decision making process. The prioritization of species can be revisited periodically. The instruments such as People's Biodiversity Register would be important for this recording the presence of species.

c) Sustainable and equitable utilization of biodiversity: The trade of biological resources such as medicinal plants is of concern to the state. There are pharmaceutical units which are dependent upon the medicinal plant sourced from the wild. But lack of data on quantities from various locations in wild along with status of availability in the wild pose a major challenge for identifying sustainable limits of harvesting. At national level, India has guidelines for Access and Benefit sharing arising from the commercial utilization of biodiversity. Both the states need to understand how to make best use of policy regime for equitable sharing of benefits from the commercial use of biodiversity. In Punjab, there has been an established evidence of contribution of income from medicinal plant trade to the household economy. In this regard it is an important aspect for livelihoods of the local communities.

4) Fiscal gaps – The implementation of new programmes will not be possible unless adequate budgetary provisions are not made. In this regard, there is a need to first assess how much extra financial resources are needed for operationalizing institutions such as State Biodiversity Board, State Medicinal Plant Board, Forest Departments so as to undertake the suitable reforms in their ongoing activities. In case of Punjab, an exercise as mentioned in table 5 provides cost implications in the context of 12th 13th Five Year plans. But there is a need to have more clarity on additional budgetary requirements.

Table 5: Financial resources identified for climate change action and their linkage with National Biodiversity Targets in Punjab.

Strategy	Actions Proposed	National Biodiversity Target	Cost implications for 12th + 13th Plan
Sustaining Himalayan Ecosystem	To study Himalayan glaciers feeding the rivers flowing through Punjab and particularly to assess the trends glacier melt.	Target 3, 6, and 8	7 Crore
Protect, Preserve and Conserve Biodiversity of Shivalik Forests	1) Assessment of status of biodiversity of the Shivalik's through scientific studies and to generate mass awareness 2) Conserve existing forest resources & Plantations through natural and artificial regeneration in degraded areas and also conserve soil and moisture in these	Target 1, 2, 3, 5, 8 and 12	170 Crore

	areas. 3) Maintenance of Biodiversity registers by the communities and BMC		
Protect, Preserve and Conserve Wetlands in Punjab Biodiversity Mission	1) Rehabilitate natural wetlands by involving the communities 2) Continue conservation of manmade wetlands that include Ramasar sites and also nationally important wetlands	Target 1, 3, 4, 5, 6 and 8	39 Crore
Protect, Preserve and Conserve Wetlands in Punjab- Water Mission	1) Rehabilitate naturalwetlands by involving the communities 2) Continue conservation of manmade wetlands that include Ramasar sites and also nationally important wetlands	Target 1, 3, 4, 5, 6 and 8	82.1 Crore
Promote cropping of indigenous varieties in crop diversification programmes in the Shivaliks	1) Promote crop diversification in Kandi area by promoting indigenous crops having significant commercial value 2) Conduct research to upscale productivity of indigenous crops 3) Support soil and water conservation activities in these areas.	Target 1, 2, 4, 5, 7, 9 and 12	38.6 Crore
Protect and Preserve indigenous germ plasm of livestock animals- Livestock and Dairy Mission	Special thrust on preservation, development and popularization of superior indigenous germ plasm that would help to harness the gene pool of indigenous varieties of livestock (Sahiwal cow, Nil Ravi Buffalo and Beetal goat, and Punjab Brown poultry)	Target 1, 2, 7 9 and 11	41.95 Crore
To ensure ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced- Green Mission	Estimate base line of Carbon being sequestered by forests and tree cover in Punjab	Target 3	2.2 Crore
Total			**388.85 crore**

Source: Punjab State Acton Plan on Climate Change, PSCST, 2014

The international and national targets have a time line of 2020. It means there is a time of five years which can be efficiently used by the states to contribute to the national targets. But more important aspect of adhering to the national policy frameworks along with the national biodiversity targets is that the impacts of the interventions evolved till 2020 will sustain its impact beyond 2020.

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