GOVERNMENT OF KERALA

THIRTEENTH FIVE-YEAR PLAN
(2017-2022)

WORKING GROUP ON

BIODIVERSITY

REPORT

AGRICULTURE DIVISION
STATE PLANNING BOARD
THIRUVANANTHAPURAM
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EXECUTIVE SUMMARY

In summary the focus of 13th plan should be on empowering people to ensure participation and good governance of natural resources whether terrestrial or marine. Improving environmental governance at all levels will strengthen the resilience of ecosystems that support life on earth. The schemes to be taken up during the next five years should strive to promote a participatory, bottom-up approach to conservation and sustainable development with equitable sharing of benefits.

The critical gaps to be addressed during the 13th plan and action points are summarized below

State Biodiversity Strategies and Action Plan

1. The 13th plan should work to develop a comprehensive Biodiversity Strategies and Action Plan, and a Kerala ABS Policy and Guidelines, in alignment with India's commitments.

2. Measurable indicators and responsible agencies along with time frame and frequency of monitoring, major threats to Biodiversity conservation and strategies for mitigating them are to be identified on priority basis.

3. Estimating financial requirement for Biodiversity conservation and funding sources during the next five years should also be part of this. A scheme for revisiting of total budget expenditure for Biodiversity including core funding, non-core (indirect) of state government institutions and external funding during 12th plan and financial outlay on Biodiversity in Kerala under various schemes of State and Central Government is essential.

Conservation of Biodiversity

Floral and Faunal Biodiversity

1. The 13th plan should make it a priority to complete the inventory of all recorded plant and vertebrate species terrestrial, inland and marine in Kerala within the plan period.
2. It should invest in increasing the number of trained taxonomist through a network of institutions to complete this task.
3. A coordinated project on cataloguing and characterization of all the lower groups of species, especially the less studied groups like fungi, algae and bryophytes and invertebrates to be initiated.
4. An initial intervention on compilation of the present information and expertise available in the state on the below ground biodiversity (BGBD), ex-situ conservation facilities and Introduction of Research Fellowships to enhance knowledge of BGBD.
5. A scheme for assessment of conservation status of threatened species and updation of species on the verge of extinction as mandated by section 38 of Biological Diversity Act and their notification.
6. A coordinated scheme for assessment, monitoring and conservation of notified threatened taxa and habitats. This scheme may be implemented by a network of institutions who have the competence to study the different taxa and develop propagation protocols for priority species.
7. Inventory, assessment, monitoring and conservation of landraces/ farmers varieties/indigenous breeds/ endemic species at LSG level in community seed banks and authorized repositories.

8. Notification of authorized state repositories for safe deposit of genetic resources of different groups as flora (Angiosperms, Gymnosperms, Pteriodophytes, Bryophytes, Lichens, etc) fauna, genetic resources of cultivated plants and their wild relatives, marine flora and fauna etc.

Urban Biodiversity

1. Development of city biodiversity index for Trivandrum, Kochi and Kozhikode.
2. Ensure local community participation through BMC, for promotion and conservation of private green spaces/ afforestation in public land in urban and peri-urban areas.
3. Eco-restoration of urban ponds and natural aquifers in association with residents association and BMC.
4. Establishment of Biodiversity parks/ Shanthisthal in urban educational institutions and organizations through Biodiversity clubs.

Coastal Ecosystem

1. The first step to conserve marine biodiversity would be to identify areas of significant marine biodiversity in Kerala, record the threats they face, and undertake long-term surveys to document species diversity and trends in populations. Development of marine biodiversity register at LSG level can be completed during this plan period including assessing marine fisheries resource use and by catch at landing centres and traditional knowledge of artisanal fishermen.
2. Estimate maximum sustainable yield at different depth zones and develop strategies and policies for sustainable utilization of marine resources.
3. Schemes for monitoring of unexplored marine biodiversity of lower groups in association with government institutions.
4. Conservation of mangroves and implementation of schemes for natural protection of shoreline with community participation.

Wetland Ecosystems

1. Land use mapping at LSG level with support of relevant departments. Important layers would be vegetation types, water bodies, wetlands, land uses, public lands area, protected areas with core and buffer zones, revenue land etc. The database at local level can be integrated in a state level database
2. Biodiversity assessment and monitoring of rivers of Kerala.
3. Support development of inland fisheries, value addition and storage facilities at local level to reduce pressure on native inland biodiversity.
4. Promoting sustainable utilization of inland bio resources and awareness of unsustainable activities as monsoon floodplain fishery through BMC.

Agro Ecosystem

1. Inventory of landraces/farmers varieties/indigenous breeds/ endemic species from PBR and digital documentation of agro-biodiversity.
2. Schemes for *in situ* conservation of landraces of priority species as Rice, Tuber, Mango, Jack through respective BMC.

3. Promotion of under-utilised species as tubers, green leafy vegetables etc on which considerable genetic diversity already exists in the home gardens.
4. Development of village level community seed bank and a seed management committee with representatives of farming community and BMC for conservation of local landraces.
5. Ex situ conservation of Agro biodiversity in notified seed banks.
6. Reviving the food diversity and thereby nutritional security by focussing on promotion of Agro-diversity and diversifying food crops through exhibitions and awareness programmes at educational institutions and at LSG level.
7. Promotion of studies on diversity of natural pollinators and predators in Agroecosystem.
8. Ensuring food safety by Good agricultural practises, Participatory Guarantee Scheme (PGS) of the central government for organic certification (for field crops, species, condiments, vegetables etc.).
9. Promote agroprocessing industries and market for local produce and underutilized species through support for certification/ GI registration etc and Organic fairs at local level.
10. Promotion of local breeds as Vechur cow, Poultry, Attapady goat etc and integrated farming.
11. A tropical home garden initiative to conserve and sustain tropical homegardens in the state may be considered, implemented through BMC with technical support of Agriculture department focusing on promotion of multipurpose tree planting on farmlands such as establishing experimental tree islands in the agricultural landscape, e.g., boundary/bund planting in paddy fields, rubber and coconut plantations, intercropping with nitrogen fixing trees in forest plantations etc.), etc. to enhance on farm agro biodiversity conservation.
12. The state may also consider formulating an agroforestry policy on the lines of the National Agroforestry Policy.

Non-Wood Forest Resources (NWFR)

1. Establish a state level task force on NWFR , their status, conservation and use.
2. During the plan period a complete inventory of the Nonwood forest resources of Kerala with relevant details on resource availability, rare, endangered and threatened species shall be developed.
3. The 13th plan should focus on an exploration of underutilised resources having potential to contribute to the food security, health, income generation and environmental services including plants that provide edible fruits, grains, leaves, nuts, oils, roots and tubers, fibres, medicines, spices, stimulants and other products based on traditional knowledge.

Eco Restoration of Unique and Degraded Ecosystems

The next five year plan can concentrate on increasing society-science-policy interface for biodiversity monitoring through

1. Mapping and protection of the fragile ecosystems such as hills and mountains, shola forests, laterite hills, mangroves, riparian habitats, etc through participatory ecosystem management at LSG level.
2. Mapping and biodiversity assessment of sacred groves at LSG level.
3. Ecosystem mapping of sacred groves, ponds, tree cover etc at micro level through Biodiversity clubs using mobile apps and Crowd sourcing. Resources should be allocated for Education and Training, Access to appropriate technologies and Facilities for Data quality assurance.
4. Conservation of biodiversity rich areas outside forest as Biodiversity heritage sites.
5. Eco-restoration of degraded areas as quarries by LSG/BMC and participatory afforestation.

6. Site specific approach, can address isolated, local biodiversity conservation hence a landscape based approach for hotspots of biodiversity as Western Ghats is more appropriate to promote conservation-compatible livelihoods. Joint BMC can function as a very important component of local level participation in biodiversity use and conservation for an integrated approach in the management of extended landscapes. A coordinated scheme for conservation of biodiversity of Western Ghats through landscape approach and Integration of databases to form a baseline for management of biodiversity from the local to the state level can be taken up with technical expertise form relevant institutes during the plan period.

Invasive Species Management at LSG Level

1. Training to MGNRES workers for identification of invasive species through LSG/BMC.
2. Invasive species monitoring and control for high risk species at local level by linking with MGNRES schemes.
3. Development of a state wide invasive species database with identification, their distributions, their mode of introduction, risk category and control measures.

Biodiversity Information System and Data Sharing

1. The13th plan should prioritize setting up a Kerala Biodiversity Information System (KBIS), which can be developed as an ENVIS centre based on the wealth of existing information on biodiversity, as well as the information generated from preparation of PB Rs KBIS will be a single-window source for Biodiversity of Kerala. Modern technologies such as 'cloud computing' could also be incorporated.

2. A well-crafted data sharing policy is of paramount importance to facilitate this. A number of issues should be included such as: frequency of updation of status, trends and threats to Biodiversity, maintaining confidentiality ownership, custodianship etc.

3. A Biodiversity cell can be set up to function as a State wide local knowledge- science-policy interface including Government departments, Technical support groups, etc. It will enable Data sharing -developing linkages with state departments for data sharing and management.

Strengthening Capacities of Local Biodiversity Governance

The Biodiversity Act was aimed at devolving biodiversity management to communities through the Biodiversity Management Communities from the State Biodiversity Board down and to build up scientific and participatory models of management.

KSBB has established BMC at all LSG and 13th plan should focus on developing 100 BMC as Model BMC yearly. This will be targeted through

Capacity Development of BMC

1. Inclusion of Natural resource management and sustainable development in the generic training module on local plan formulation for all the stakeholders of local governance.
2. Training of key resource persons at the state level and district resource persons who will be responsible for capacity development at LSG level.
3. KSBB will be responsible for preparation of the training tool kits.

4. Training institutes as Kerala Institute of Local Administration (KILA) can be identified as the nodal institution for capacity building at district level and local level.
5. Skill development programmes for stakeholders including exposure visits and Panchayat to Panchayat training programmes.
6. Training module for village botanists/zoologists/marine ecologists.

Institutional and Policy Support to BMC

As part of 13th plan a detailed work plan should be formulated in association with experts in the field for empowering BMC through appropriate policy support. Ministry of Panchayati Raj has already given necessary directions to LSGD to declare BMC as statutory bodies under Panchayati Raj Act/ Rules. Some of the major suggestions are

1. Inclusion of environment protection and Biodiversity conservation as a mandatory function of the panchayat.
2. Establishment of Standing committee of Biodiversity of elected member.
3. Constitution of a working group of Biodiversity and Environment including Experts to provide support for developing plan projects.
4. Cross representation of members of Environment/Biodiversity Standing committee/BMC/Working group in other committees for cross linkages.
5. Holding of Environmental/Biodiversity gramasabhas.
6. All developmental activities having an effect on Biodiversity/Environment as quarrying, sand mining, wetland conversion shall be with approval of Environmental gramasabha/BMC.

BMC and Biodiversity Conservation

1. The BMC can develop Environmental/ Biodiversity status Report based on Biodiversity gramasabhas. Based on this the Working group can formulate Local Biodiversity Action Plan and formulate projects for inclusion in Plan funding. The KSBB can prepare broad guidelines for the preparation of the local plans and model projects.
2. Revenue generation options for BMCs need to be elucidated. KSBB will provide training for enhancing negotiations skills for ABS.
3. For effective natural resources management a digitally searchable data base of identified species or checklist can be made available to BMCs.
4. A dedicated web platform interlinked with Kerala Biodiversity Information System needs to be developed with updates regarding activities of the BMCs.
5. Funds may be allocated for developing basic infrastructure facilities for BMC/ holding of BMC meeting etc and office space for BMC.

Model 100 BMC

1. During the 13th plan 100 model BMC can be established in a phased manner. The activities envisaged to be implemented by model BMC can include
2. Capacity development of 100 BMC through training and policy support.
3. BMC can prepare model development Projects and present them in the Working Group on Agriculture/ Environment. The suggested activities which can be taken up by BMC includes Development of City Biodiversity Index by Corporations, Greening of urban areas, Maintain data of plants/ resources/ local vaidyas/ bioresources of economic potential, Help LSG for identification, prioritization and eradication of invasive alien species; Prepare map of local

land use and analyse trends in land-use change , Eco-restoration of degraded areas, abandoned quarries, degraded ponds etc, Identify areas for notification as BHS, function as Environmental watch groups, Support biodiversity-compatible production practices in agriculture, aquaculture, agro-forestry, forestry and fisheries, Implement access and benefit sharing mechanisms etc.

4. Involve in activities of institutions, departments, LSGs and NGOs engaged in implementing projects that contribute to Sustainable Development / Green economy.
5. Joint BMC in Western Ghats area for landscape approach to biodiversity conservation and sustainable utilization.

People's Biodiversity Register- Decentralized Planning

1. The PBR exercise attempted by KSBB is an initial step and should be a continuing endeavour and the list of focal issues based on priority set by different user groups should form the basis of the next phase of the PBR exercise. Periodic updation of PBR for participatory biodiversity monitoring and reporting after identification of major gaps in knowledge in the following areas can be taken up during 13th plan
2. PBR in forest areas and documentation of traditional knowledge.
3. PBR in 13 Agroecological zones.
4. Marine Biodiversity Register.
5. Crowd sourcing and citizen science for landscape monitoring at micro level in PBR.
6. PBR digitization for data management and analysis: The 13th Plan should focus on improving upon the PBR database for accurate retrieval of data and data analysis. The digital recording of PBR can be completed in a time bound manner in two years. The gaps identified are to be addressed at the institute level and at field level.
7. PBR as a text book and panchayat as a classroom: The project can be introduced as part of education in a phased manner in the educational institutions of Kerala.
8. The recorded traditional knowledge of history of the panchayat, local festivals and folksongs and myths related to agricultural harvesting etc in PBR can be incorporated in the website of LSG.

Youth and Biodiversity Conservation

1. Strengthening Biodiversity clubs/ eco clubs etc.
2. Ecosystem mapping of sacred groves, ponds, tree cover etc at micro level through Biodiversity clubs/eco clubs using mobile apps.
3. Involvement of Biodiversity club volunteers in Navakeralam missions of Kerala Govt.
4. Setting up of Biodiversity gardens in educational institutions.

Biodiversity and Livelihood Enhancement

The 13th plan should focus on

1. Livelihood enhancement schemes through value addition of medicinal plants, agricultural produce, fisheries at LSG level: on pilot basis this can be done in model BMC with technical support by concerned departments.
2. Development of new entrepreneurial units based on handicrafts, bamboo crafts etc to be set up in Panchayat, jointly with LSG, Kudumbasree, Ecodevelopment committee etc. They can be provided with mentor support in the initial years and marketing support through Govt institutions.

3. Integration of biodiversity and agroproduction system.
4. Promotion of cluster development activity, value addition of bio resources through local processing and support in marketing. Most of the NTFP are sold/ exported in raw form with little value addition leading to exploitation and poor returns for primary collectors. Providing assistance and training in innovative measures for sustainable and timely harvesting, grading, local methods for improving the shelf life etc.
5. Development of Biotech park to facilitate industry linkages and benefit sharing.

Access and Benefit Sharing

1. National Biodiversity Target 9 has set a goal that by 2015 Access to genetic resources and fair and equitable sharing of benefits arising from their utilization (ABS) as per Nagoya protocol is operational. MoEF has also directed National Biodiversity Authority, Chennai and State Biodiversity Boards to implement ABS on priority basis. The 13th plan should give the highest priority on developing a functional ABS system in Kerala.
2. Development of Kerala State ABS policy and guidelines.
3. Documenting the un-coded, oral traditional knowledge of local people especially tribal communities and artisanal fishermen.
4. Documentation of Traditional knowledge associated with biodiversity for bio-prospecting, new therapeutic remedies, benefit sharing as per ABS mechanism.
5. A state wide scheme for documenting commercially tradable bioresources with details of location, quantity, frequency of trade, value addition and traders involved.
6. A state wide scheme for documenting bioresources of potential economic value in the context of ABS and Bioprospecting.
7. Identification of industries commercially utilizing bioresources.
8. Developing ABS negotiating skills of BMC, implementation of ABS in Kerala
9. Encourage development of a Local Biodiversity Fund by way of levy of collection charges for bio resources. BMC is authorized to levy collection fees for accessing any biological resources for commercial purposes and guidelines are to be developed regarding this. This will also enable to mobilize funds for biodiversity conservation at local level and empowering BMC in the long run.
10. Policy support to issue an ABS order to all including government departments to comply with the provisions of the Act.
11. Linking compliance with Biodiversity Act to related rules may enable better awareness and stricter enactment at state level.

Institutional Infrastructure for Biodiversity

1. The 13th plan should focus on developing state of art Biodiversity Parks/ Gardens/Natural History Museum etc to document, study and disseminate knowledge concerning the natural heritage of Kerala.
2. Establish centres of excellence in systematic biology that incorporate conventional and modern molecular, digital and computational tools of taxonomy in institutions.
3. Capacity development of State Biodiversity Board mandated for conservation, sustainable utilization and benefit sharing through adequate manpower, office infrastructure etc.

CHAPTER 1
INTRODUCTION

1. Kerala's agenda for 13th five year plan should focus on sustainable development "ensuring clean air, water, soil, and food; a house to live, job security, basic education, basic health protection, social and cultural security, and energy security for its 33.41 million population. The UN Rio+20 outcome document "The Future We Want", acknowledged the need for mainstreaming sustainable development at all levels, integrating economic, social and environmental aspects and recognizing their inter linkages, so as to achieve sustainable development in all its dimensions.

2. Kerala economy has been growing at rates higher than the national economy the last three years. The period beyond 2001 saw construction, transport, storage and communication, trade, hotel and restaurants, real estate ownership, business and legal services, and other services boosting growth. The urban monthly per capita consumer expenditure at `3408 in Kerala is about 30% higher than the national average. The Kerala development model has served to achieve economic development and social development to a great extent, but the fallout on environmental and ecological dimensions of development has left its mark on our natural resources, environment, and human health. Sustainable development should seek to achieve, in a balanced manner, economic development, social development and environmental protection. The unsustainable utilization of bio-resources has led to deforestation, conversion of pristine marine coasts to artificial coasts with sea walls, damming of rivers, rapid urbanization, land use change, pollution and loss of biodiversity.

3. The Working group on Biodiversity was constituted to initiate the discussions for the formulation of draft proposals in the area of biodiversity conservation for inclusion in Thirteenth Five Year Plan with Prof. V.K. Ramachandran, Hon'ble Vice Chairman of State Planning Board in the chair. The key mandate was to list different sources of data, provide critical evaluation of data sources, identifying the gaps and role of LSG in natural resources management and to elaborate on sustainable utilization of biodiversity for the livelihood of working people.

CHAPTER 2
TWELFTH FIVE YEAR PLAN- AN OVERVIEW

4. The 11th and 12th Five Year plans had treated Biodiversity under the theme, Ecology and Environment in the section: Science, Technology and Environment, which had a total outlay of ₹ 1055 crore and ₹ 3189 crore (with over 200% increase in the current plan period) respectively. During 2012-13, 10 schemes were included under Ecology & Environment out of which 8 were implemented by the Department of Environment & Climate Change, 1 by the State Biodiversity Board and 1 by the State Pollution Control Board. With an outlay of 1250 lakh, an amount of 1083.48 lakh has been utilized (86.67%) for the implementation of the schemes.

5. However, Biodiversity also has been dealt under other outlays like (i) forest and wild life; (ii) KSCSTE R & D Institutions (KFRI & TBGRI); (iii) promotion of organic farming in the Agriculture and allied activities sector, (iv) Tourism and (v) Tribal knowledge documentation in Social Services sector of the FYPs. A pooled data of the outlays under different categories of the plan funds towards various sectors of biodiversity like (i) forest biodiversity; (ii) marine biodiversity; (iii) wetland biodiversity; (iv) agro biodiversity; and (v) microbial biodiversity is necessary for getting a correct picture of the total allocations given for biodiversity management in any plan period. The plan allocation under the sector Ecology and Environment, sub head Biodiversity conservation programmes for Kerala State Biodiversity Board during 12th five year plan is as follows

Table 1 *Plan fund (12th five year plan)*

Year	Plan fund (Rs in Lakh)
2012-2013	225
2013-2014	250
2014-2015	295
2015-2016	384
2016-2017	517

Brief Review of Status of PBR and Plan Funding

6. The major mandate of Kerala State Biodiversity Board is facilitating documentation of knowledge of the local people on the status, uses and management of biological resources in the (PBRs) and also the cultural heritage of the area. The documentation of biodiversity in Peoples Biodiversity register was taken up during the 12th five year plan and till date 854 PBR (82 %) has been completed.

Table 2 *Status of PBR till 2017*

LSG	No: of PBR completed	PBR to be completed
Panchayat	815	126
Municipality	37	50
Corporation	2	4
Total	854	180

Table 3 *Plan funding for PBR during 12th Five year Plan (KSBB)*

Year	Plan fund (Rs in Lakh)
2012-2013	120
2013-2014	125
2014-2015	120
2015-2016	122
2016-2017	142

7. The Government has facilitated the PBR preparation for fund utilization from the plan fund of the LSG or General Purpose fund of the LSG by issuing an order No 63664/DA1/2011/LSGD dt 2.12.2011 which was subsequently revised on 3.11.2014 as follows

Table 4 *Fund for PBR Preparation at LSG level*

LSG	Amount (Lakh)
Panchayat	1.25
Municipality	2.50
Corporation	5.00

Salient Achievements during 12th Five Year Plan

8. The salient achievements during 12th Five Year plan are as follows,

    1. BMC constituted in all LSG.
    2. PBR preparation completed in 82 % of LSG.
    3. A database of PBR was developed by using Microsoft visual studio 2008, VB.Net 3.5 as front end and SQL servers 2008 as backend. The software has provisions to add, edit and manage details of Agro biodiversity, Domesticated diversity, Wild biodiversity, urban biodiversity and Wetland biodiversity and search for details based on LSG. Database of one district has been completed during the 12th five year plan.
    4. State Biodiversity Fund has been constituted for the conservation and promotion of biological resources and socio economic development of the area.
    5. Development of Kerala Biodiversity Information system
    6. Several projects were initiated on
        1. Conservation of Agro biodiversity.
        2. Conservation of farm animal diversity.
        3. Biodiversity assessment of Vellayani lake, Sasthamkotta, and Vembanad.
        4. Urban biodiversity enhancement.
        5. Ecorestoration of abandoned quarries.
        6. Seed bank in collaboration with Kerala University.
        7. Sustainable utilization of medicinal plants and livelihood for tribal population at Wayanad.
    7. Biodiversity education through mobile Jaivavaividhyaratham.
    8. Work underway for Biodiversity Park at Vallakadavu and National Biodiversity garden at Munnar.
    9. Biodiversity exhibitions and seminars conducted annually.
    10. Biodiversity publications (6 handbooks, one documentary and one book).
    11. Establishment of more than 1000 biodiversity clubs and Children's Biodiversity congress annually.
    12. Biodiversity Research centre.

CHAPTER 3
CONSERVATION OF BIODIVERSITY - KERALA

Biodiversity Scenario of Kerala

9. The diverse physical features of Kerala have resulted in 13 agroclimatic zones and a variety of ecosystems such as forests, grasslands, wetlands, coastal and marine ecosystems which harbour rich biodiversity. Thirty nine sites in the Western Ghats in the States of Kerala, Karnataka, Tamil Nadu and Maharashtra were inscribed in the United Nations Education Scientific and Cultural Organization (UNESCO) World Heritage List in 2012, considering their outstanding universal value and high levels of endemism. Out of this 19 of the serial sites are located in Kerala. The Kuttanad below sea level farming has been recognized as a globally important agricultural heritage system (GIAHS).The short-neck clam fishery in the Ashtamudi Lake in Kerala has received India's first Marine Stewardship Council (MSC) certification. The certification to Ashtamudi short-neck clam fishery — only the third fishery in Asia to have received this recognition will help boost sustainable fisheries and also protect the ecosystem.

Floral Diversity

10. Kerala with 1.2 % of India's landmass harbors 25.69% of flowering plant species and 26.59% of Pteridophytes recorded in India. Herbs constitute 50.1%, shrubs 15.8% and trees 15.08% of the total flowering plant species of the state. About 5094 taxa (4606 species, 110 subspecies) under 1537 genera and 221 families of flowering plants are distributed in Kerala (*Sasidharan, 2012)*. A total of 1709 taxa that are endemic to Peninsular India are found in Kerala; of which 237 species distributed in 47 families are exclusively endemic to Kerala (*Nayar et al., 2008*). The flowering plants of Kerala include 858 exotics that have been introduced as agriculture, forestry as well as accidentally entered species (*Sasidharan, 2012*); of which around 200 species have become naturalised in the state. Gymnosperms are represented by just 5 species belonging to 3 genera. The state also harbors 337 species of pteridophytes (*Easa, 2003*), and 465 taxa of bryophytes (*Manju et al., 2008*). More than 45% of the total species are represented by nine families which accommodate more than 100 species. Fifty six families are represented by a single genus and out of which 25 families by a single species. Seven genera have 35 or more species. Impatiens is the largest genus with 78 species (*Nayar et al., 2008*). From Kerala 866 species of Algae, 4800 species of Fungi and 520 species of Lichens are reported. (*Jayaraman et al, 2008*).

Table 5 *Plant diversity of Kerala*

Sl. No	Plant Groups	No. of Species described			
		World (estimated)	India*	Kerala **	% in India
1	Bryophytes	14,500	2504	465***	18.57
2	Pteridophytes	12,000	1267	337	26.59
3	Gymnosperms	650	74	5	6.75
4	Angiosperms	250,000	17,926	4606	25.69

Source India 5th National Report to the Convention on Biological Diversity , 2014; Sasidharan (2012) Flowering plants of Kerala Version 2.0, Kerala Forest Research Institute, Peechi; Nayar TS, Sibi M, RasiyaBeegum, Mohanan N, Rajkumar G (2008) .Flowering Plants of Kerala Status and Statistics.Rheedea 18:95-106; Easa (2003) Biodiversity documentation for Kerala Part 5: Pteridophytes, Kerala Forest Research Institute, Peechi
Note **Plant Biodiversity of Kerala State – An overview , W. Arisdason& P. Lakshminarasimhan, BSI
***Checklist of Bryophytes of Kerala, Manju, C.N., K.P. Rajesh and P.V. Madhusoodanan, Tropical Bryology Research Reports, No: 7, 2008

Endemic Species of Kerala

11. The endemic species of Kerala includes 237 species distributed within 47 families. Out of this, 117 species (49.15%) are represented by five families. There are two monotypic genera (*Silentvalleya* and *Haplothismia*) endemic to the state.

Table 6 *Species of Flora (Flowering plants) under different threat categories in Kerala (IUCN)*

Threat Category	Number of species
Endangered	82
Critically endangered	22
Vulnerable	69
Near Threatened	12

Faunal Diversity of Kerala

12. Vertebrate diversity of Kerala is represented by 1,847 species in 330 families and 81 orders with Fishes (freshwater and marine) the most diverse group of vertebrates (905 species), followed by birds (500 species), reptiles (173 species), amphibians (151 species) and mammals (118 species). Of terrestrial vertebrates 36 % are endemic to Western Ghats and Kerala. Endemism is greatest among amphibians with 90% endemic species, of which 66% are endemic to the Western Ghats, while 24% are endemic to Kerala. Of 1,847 vertebrates of Kerala, 205 species are listed as threatened in the IUCN Red List of threatened Species of which 23 are Critically Endangered, 90 are Endangered and 92 are Vulnerable. (*Nameer PO, Praveen J , Bijukumar A, MuhmamedJaferPalot, Sandeep Das and Rajeev Raghavan(2015) A checklist of the vertebrates of Kerala State , India, Journal of Threatened Taxa November 7 (13)*).

Table 7 *Faunal diversity of Kerala*

Groups	No of genera/species
Protozoa	63 genera
Porifera	22 (genera)
Cnidaria	90 genera
Chaetognatha	18
Platyhelminthes	117 genera
Aschelminthes	265
Acanthocephala	27
Annelida	91
Mollusca(Fresh water)	26
Insects	6000
Non-insect Arthropda	600
Echinodermata	8

Table 8 *Terrestrial vertebrates of India and Kerala*

Taxonomic group	Terrestrial		
	India*	Kerala	Percent in Kerala
Inland Fishes	3022	189	6.2
Amphibians	342	151	44.1
Reptiles	526	164	31.1
Birds	1233	469	38.0
Mammals	423	95	22.4
All Vertebrates	5546	1068	19.2

Source India's 5th National Report to Convention on Biological Diversity; Nameer et al 2015

Marine Biodiversity of Kerala

13. The Kerala coast is biodiversically rich with 716 species of fishes and 23 out of the 25 species of Marine mammals found in India. Forty-two percent (779 species) of the vertebrates of Kerala occur in the marine environment.

Table 9 *Marine biodiversity- Kerala*

Sl No	Group	Approx number of species
1	Phytoplankton	468
2	Sea weeds	118
3	Mangroves	33
4	Zooplankton	251
5	Sponges	91
6	Coelentrates	151
7	Annelida	154
8	Crustacea	218
9	Echinodermata	112
10	Gorgonids	34
11	Mollusca	730

Source Joshi K.K., Narayanakumar R., Ranimary George, Molly Varghese, Jasmine S., Srinath K.R., Saravanan S., SomyKuriakose, Geetha Antony, Geetha P.M. and Gimy George (2015) Biodiversity Valuation of Marine Ecosystem of the South-West Coast of India with Special Reference to Kerala Coast -in Biodiversity Conservation - Challenges for the Future Pp. 183-193 (11) (Eds) Laladhas K.P., Oommen V. Oommen, Sudhakaran P.R.

Table 10 *Marine vertebrates - India and Kerala*

Group	India	Kerala**	Percent in Kerala
Fishes	2546	716	28.1
Reptiles	35	9	25.7
Mammals	25	23	92.0

Source Nameer et al 2015

Agro Biodiversity

14. The diversity of the 142 crop plants grown in Kerala is much high and is represented by 104 genera in 43 families. Of this 40 genera are represented by only 1 species—just the cultivated species—and among these, 28 genera are represented by only 1 species each in both Kerala and India.

15. There are many state and central research organizations in Kerala, which undertake plant germplasm collection and conservation. The major centres are listed below:

1. Central plantation Crops Research Institute, Kasaragod: plantation crops
2. Indian Institute of Spices Research, Kozhikode: spices
3. Kerala Agricultural University, Vellanikkara: field crops, plantation crops, spices
4. Indian Cardamom Research Institute, Myladumpara: cardamom
5. Rubber Research Institute of India, Kottayam: rubber
6. Central Tuber Crops Research Institute, Thiruvananthapuram: tuber crops
7. JN Tropical Botanical Research Institute, Palode: ornamentals
8. M. S. Swaminathan Research Foundation- Community Agrobiodiversity Centre: medicinal plants, ethnic food plants, and other traditional crop varieties.

16. *Germplasm exploration and collection.* From 1978-2016, a total of 237 exploration missions was executed, independently or in collaboration with ICAR/ SAU/ International institutes.

17. *New taxa described.* Six taxa new to science namely, *Curcuma karnatakensis, C. kudagensis, Momordicasahyadrica, Piper psuedonigrum* and *Vignakonkanensis* have been described from the region.

18. *New reports made.* New reports of extended distribution of the species *Curcuma albiflora, C. oligantha* and *Vignadalzelliana* were made from the region. Taxonomic status of *Cucumis callosus* as a sub-species of *Cucumis melo* and *C. setosus* as a valid species distinct from *C. sativus* was established.

19. *Unique collections made.*

    1. Coloured rice/red rice landraces of West Coast - 508 accessions
    2. Medicinal/*Njavara* rice of Kerala - 15 accs. (*Njavara, Chenellu, Jeerakachembavu, Kunjinellu*)
    3. Saline tolerant/ Pokkali rice landraces – 37 accs. (*Anakomban, Pokkali, Orkaima, Ormundakan*)
    4. Upland direct seeded rice – 42 accs. (*Keeripallan, Erinellu, Ambaladan, Boothakali, Karakozhivalan* etc.)
    5. Wild and semi-domesticated bitter gourds: *Rudraksha, Hagali, Methipavai, Karandakappaval* (81 accs.)
    6. Poly-embryonic mango landraces – *Muvandan, Vattan, Tholikaypan, Kotturkonam, Puliyan, Kilichundan, Kochukilichundan, Priyur, Kolambu, Vellari, Nambiar Manga, Chandrakaran*
    7. Fruit variability in oriental pickling melon – *Cucumismelo* var. *conomon*
    8. Medicinal ash gourd: *Neykumbalam*
    9. Variability in Chinese spinach (220 accessions), multi-cut leafy amaranth, dual purpose vegetable cum ornamental, deep magenta coloured leaves, late flowering type, small leaf bushy type (*Aarakeera*), green and magenta red livid amaranthus
    10. Slicing cucumber (23 accessions), dark green, ivory white, cooking types
    11. Coloured okra, West Coast landraces (170 accessions)
    12. Variability in horsegram (532 accessions)
    13. Fruit length and colour variability in snake gourd (58 accessions)
    14. Burmese Fish-tail Palm (*Caryotamitis*) - dwarf ornamental/multipurpose palm collected from A&N Islands
    15. Chop-chopa (*Garciniakydia*), a good monsoon season fruit comparable to mangosteen
    16. Sweet gourd (*Momordica cochinchinensis*) – from A&N Islands – a potential vegetable for popularisation
    17. Teasel gourd (*Momordica subangulata* subsp. *renigera*) - a potential bitter-less gourd vegetable from A&N Islands
    18. Kokum (*Garciniaindica*) variability - a potential tree oil seed and multi-purpose fruit

19. Malabar tamarind (*Garcinia cambogia*) variability
20. Fruit length variability in drumstick (*Moringa oleifera*)
21. Brinjal (*Solanum melongena*) - field tolerant lines to shoot and fruit borer
22. Variability in cultivated bitter gourd
23. Species diversity in wild edible and less cultivated fruits of Western Ghats
24. Crop wild relatives in the genera *Abelmoschus*(156 accessions), *Amorphophallus*(19), *Artocarpus*(3), *Cucumis*(43), *Curcuma* (71), *Dioscorea*(106), *Garcinia*(6), *Momordica*(89), *Moringa*(1), *Oryza*(41), *Piper* (61), *Sesamum*(64), *Solanum*(153), *Trichosanthes*(26), *Vigna*(307) and *Zingiber*(10 accessions)
25. A total of 5895 accessions of different tuber crops are being maintained in the National Repository for Tuber Crops at ICAR-Central Tuber Crops Research Institute (CTCRI), which comprises cassava 1383, sweet potato 1483, yams 1151, edible aroids 1350 and minor tuber crops 391 accessions along with 137 newly augmented accessions.
26. Spices Research Institute, Kozhikode is maintaining collections of spices as follows. Number of accessions of Black pepper is 1100 (9 cultivated types, 17 wild species and 943 accessions, Farmers varieties –6), Cardamom 580 collections (wild crop relatives 10, farmers varieties – 13), No of collections of Ginger is 196 with Wild crop relatives -53, Turmeric Number of collections is 121 with 64 Wild crop relatives, Nutmeg 333 (Farmers varieties -10, Wild crop relatives 18), Cinnamon Number of collections 248 (Wild relatives 26), Clove Number of collections 10 and wild crop relatives -9, Vanilla 93 with wild crop relatives 11.
27. NBPGR, Thrissur is maintaining 469 accessions of Rice.
28. *Germplasm characterization and evaluation.* So far, 4116 accessions of field crops comprising rice (3205 accessions) and horse gram (911), 1341 of horticultural crops comprising Chinese spinach (91), *Amaranthus blitum* (8), *A. graecizans* (2), *A. dubius* (15), bitter gourd (15), Chinese potato (33), field bean (47), *Mucuna pruriens* (15), okra (863), brinjal (174), snake gourd (49), taro (134), elephant foot yam (35), ginger (40), black pepper (85), lesser yam (65) and turmeric (426) were characterised. One hundred and ninety-seven accessions of okra and seven of taro were evaluated under multi-location evaluation along with crop based institutes. A total of 293 accessions of wild relatives of crop plants comprising *Curcuma aeruginosa* (31), *C. amada* var. *amada*(41), *C. amada*var. *glabra*(8), *C. aromatica* (14), *C. caesia* (5), *C. zanthorrhiza* (47), *Solanum incanum* (23), *S. insanum* (51), *Trichosanthescucumerina* (15), *T. lobata* (4), *Vignatrinervia*var. *bourneae* (3), *V. dalzelliana* (18), *V. marina* (1), *V. mungo* var. *sylvestris* (7), *V. pilosa* (1), *V. radiata* var. *sublobata*(3) and *V. trilobata* (21) were also characterised. Among the perennial horticultural crops, 49 accessions of jackfruit, 24 of Malabar tamarind, 9 of kokum and 40 of mango were also characterised.

Recommendations of Working Group

Conservation of Floral and Faunal Diversity

20. Kerala is rich in biodiversity but the high human population density and major transformation of the landscape since the mid-18th century emphasize the urgency for conservation of the floral and faunal diversity and sustainable use of its resources. Of 1,847 vertebrates of Kerala, 205 (~11%) species are listed as threatened in the IUCN Red List of Threatened Species of which 23 are Critically Endangered, 90 are Endangered and 92 are Vulnerable. Ninety-eight percent of fishes and 87 % of amphibians of Kerala have not been included under any Schedule of the Indian Wildlife (Protection) Act (1972) (WPA). Of the 173 reptile species endemic to Western Ghats, 17% are listed in various threat categories of IUCN. Nine hundred and five species of fishes are recorded from inland and marine waters of which 30% of fresh water fishes are endemic to state .Out of 779 marine species 93 % is not included in any schedules of wildlife protection act. The highest level of

endemism (between 77-102 species per sub basin) and highest species richness (133-160 species per sub basin) is found in the west flowing rivers Chaliyar, Bharatapuzha, Chalakkudy, Periyar, and Pamba with point endemics in certain cases. The 13th plan should focus on biodiversity assessment and monitoring at LSG level.

21. The major recommendations are
    1. Identify major threats to Biodiversity of Kerala and strategies for mitigating them at LSG level.
    2. Periodic floral and faunal biodiversity assessment and monitoring at LSG level.
    3. A coordinated scheme for assessment, and conservation of prioritized threatened species, i.e. endangered, critically endangered, endemic species and habitats. This scheme may be implemented by a network of reputed Institutions who have the competence to study the different groups of plants, animals and habitats.
    4. Conservation of endemic species through responsible community-based participatory approach.
    5. Resource augmentation in the context of Forest right act; restoration activities for RET and commercially important species. In Kerala more than 80 per cent of the raw drugs are derived from forests, including several RET species. Many of these are harvested using destructive methods for their root and wood. Moreover, the raw drugs available outside forests have become very rare due to conversion of wetlands, hillocks, pasture lands etc. for alternate land uses. Thus there is an urgent need to implement programmes contributing to the conservation and resource enhancement, especially for the Endemic, Rare and Threatened commercially important plants.

Mapping, Management and Restoration of Unique and Degraded Ecosystems

22. *Unique ecosystems.* Land use change a key driver of biodiversity loss includes change due to urbanization, cropping pattern, conversion of paddy lands/wetlands, quarrying and mining etc. The unique geography in Kerala facilitates diverse habitats and number of microhabitats within each habitat in different altitudinal ranges. Various micro-habitats mainly in the coastal and midland region lodges large number of organisms, especially of habitat specific species. Laterite hills, riparian habitat, wetlands, mangroves, sacred groves are few examples of these types of habitat. Also the habitats in high ranges such as shola and montane grasslands are highly sensitive to environment. Conservation of biodiversity in these microhabitats is only possible through the conservation of habitats. In order to ensure the survival of these habitats and species, an action plan for conservation of unique ecosystems is essential.

23. *Repairing of degraded ecosystems.* The extent of damage to the ecosystems renders ecosystem repair an essential part of our future survival strategy, and this demands that restoration ecology provide effective conceptual and practical tools for this task. Ecosystem Restoration should be an important component of conservation of biodiversity and sustainable development programmes so that the livelihoods of people depending on these degraded ecosystems can be sustained. The major recommendations are:
    1. Conservation of biodiversity rich areas outside forest as Biodiversity heritage sites/community and conservation reserves
    2. Identification and linking of corridors for conserving wildlife outside protected areas as Biodiversity heritage sites for maintaining meta-population of species. This will enable species movements and dispersal in response to land use and climate changes and their conservation

3. Mapping and biodiversity assessment of sacred groves and community conserved areas at LSG level
4. Mapping and protection of the fragile ecosystems such as hills and mountains, shola forests, laterite hills, mangroves, riparian habitats, fresh water swamps etc. through participatory ecosystem management at LSG level
5. Ecorestoration of degraded areas as mined areas (clay mining and lateritic mining) by BMC.

Below Ground Biological Diversity (BGBD)

24. With regard to scientific documentation of the organisms, higher plants and animals have been thoroughly studied and documented. Unfortunately, the lower group of organisms has not received much attention when compared to other groups and disciplines. Algae, lichens, fungi, bryophytes, pteridophytes etc. in the plant kingdom and invertebrates and amphibians, herpatofuana in animal kingdom are few examples.

25. BGBD comprising millions of species ranging from microscopic bacteria to earthworms is considered as one of the largest reservoirs of biota on earth. According to Young and Crawford (2004) 1g of fertile soil contains 10^{12} bacteria, 10^4 protozoa, 10^4 nematodes, 25 km of fungi and countless other species. The soil macro fauna such as earthworms, termites and ants are often called as the "Ecosystem Engineers" are very crucial for making available resources to other species and helping to build a healthy soil environment. The ecological linkage between the aboveground and belowground biota is also very critical for determining the quality of the ecosystem functioning. Understanding the services of BGBD as a system and on individual species basis is an important challenge for scientists for building up our knowledge on the biodiversity and ecosystem services. The reduced BGBD leads to reduction in productivity of forests and agro-ecosystems and the "resilience" of these ecosystems, which then become more vulnerable to adverse climatic impacts, erosion, pests, diseases, and other threats. So, it is very important to attempt the save- study- use approach and strategy in this category of biodiversity, for the sustainable management of the above ground biodiversity and food production.

26. *Lower groups of plant species.* One of the important conservation issues of biodiversity of Kerala state is lack of adequate taxonomic information and expertise in the area of lower groups of species such as algae, fungi, bryophytes, and pteridophytes. This is mainly because of the weakening of taxonomic skills and reduction of trained taxonomists to work on the lower groups of plant species. Developing taxonomic knowledge of biodiversity in its entirety becomes absolutely necessary to improve the biodiversity management skills and thereby informed decision making in the sustainable and equitable use of genetic resources.

27. It is urgent to attract researchers, students and teachers to the science of taxonomy and bringing coordination amongst the taxonomists by designing and delivering professionally satisfying programmes that are linked with modern tools like information and molecular biology techniques. The need for offering periodical training for the researchers and teachers to continually practice the taxonomic skills over time is also very important. The trainings coupled with hands-on coaching will help the takers to effectively deliver the critical capabilities of Taxonomy science.
    1. An initial intervention on compilation of the present information and expertise available in the state on the below ground biodiversity
    2. Publications on the taxonomy and ecology of BGBD of Kerala along with comprehensive knowledge on BGBD and soil ecosystem services.

3. A coordinated project on collection, conservation, cataloguing and characterization of all the lower groups of species, especially the less studied groups like fungi, algae, bryophytes and pteridophytes
4. Ex-situ conservation facilities and methods for a possible range of BGBD.
5. Introduction of Research Fellowships (funding for postgraduate students, Forestry, agriculture, botany, zoology, geology etc. to study the importance and value of BGBD).

Invasive Species Management

28. The threat to biodiversity due to invasive alien species is considered second only to that of habitat destruction. More than 80 species of plants has been identified as Invasive in Kerala out of which 11 species has been categorized as High risk. Alien invasive species such as *Lantana camara* and *Eupatorium odoratum* invaded the natural habitats of the Western Ghats several decades ago, but their impact on native vegetation has been significant. The two species have taken away most of the ground cover (space) available to the local grass species such as *, T. triandra* and *Cymbapogon flexuous* and other native herbs and shrubs. The proliferation of these two species has affected significantly the biomass of grass and browse available to elephants and other large mammals. Such an impact could also result in changes in vegetation dynamics through increased dependency of elephants on tree species that could imbalance the ecosystem and its biodiversity.

29. Invasive species monitoring system at local level by linking invasive species management with MGNRES schemes.

30. Training to MGNRES workers for identification of invasive species.

31. Invasive species identification should not be limited to invasive in forests – it should also include invasive in aquatic and marine ecosystems, grasslands, wetlands, etc. Special fund may be allotted to panchayat to eradicate Pistia and Eichornia.

32. A state wide invasive species database should also be created. The inventory should not only identify invasive species, but also their distributions, their origins, their mode of introduction, their ecological characteristics, risk category and control measures.

Coastal Ecosystem

33. The highly productive coastal and marine ecosystems are affected by the high density of population, coastal erosion, mining of beach sand for industrial purposes, shoreline changes, destruction and reclamation of wetland, development related degradation of the environment and violation of the provisions of Coastal Regulation Zone (CRZ).

34. As per the Shoreline assessment change of Kerala eroding areas account for 10.3 % during a period of 38 years form 1972-2010 based on a distance of 500 m interval from baseline. Sea walls have been constructed in as much as 310 km of coast (53% of coast) resulting in Artificial coast. Thus only 37% of Kerala coast is natural. Accretion is dominant along 25 % of the coast and artificial coasts are dominant at Kollam and Ernakulam. In Kerala the major threat to coastal area is the loss of natural coasts and almost 80 % of coasts in Kollam and Ernakulamhas been converted into artificial coasts and erosion prone. A few decades ago there were about 70,000 ha of mangroves; but during 2014-15 the total mangrove cover is reduced to 9 sq km consisting of 5 sq km of moderately dense mangroves and 4 sq km of open mangroves. Although 18 coastal and marine biodiversity areas have

been proposed in Kerala only one Kadalundi-Vallikunnu have been identified as Marine protected areas (Community reserves).

35. The highly productive freshwater and marine fishes are facing fast depletion on account of habitat loss as well as over-exploitation. The sharks, rays, ribbon fish, catfish, anchovies, goat fish, croakers, carangids and pomfret show clear declining trends. Conversely, sardines, squid, and seer fish show increasing trends. The major recommendations are
    1. Assessing marine and inland fisheries resource use and bycatch at landing centres.
    2. Monitoring of unexplored marine biodiversity of lower groups.
    3. Focus on sustainable development of coastal areas, by linking ecological security with livelihood security.
    4. Estimate maximum sustainable yield at different depth zones and develop strategies and policies for sustainable utilization of marine resources.
    5. Inventorying esturine areas, Marine flora and fauna, Littoral flora and fauna, Mangrove mapping and biodiversity assessment (compilation of existing data on diversity).

Wetland Ecosystems

36. Wetlands directly and indirectly support millions of people by providing ecosystem services such as protection from natural hazards, ground water recharge and discharge, food, fiber and raw materials in addition to educational and recreational benefits. The most prominent threats being faced by the Kerala wetlands include fishing (18.1%), and reclamation (17.4%), while the pollution by the solid waste account for 15.3% and pollution by domestic sewage accounted for 11.1%. In 2004, the State had around 3, 28,402 ha of wetlands; currently it has gone down to 1, 60,590 ha, a 49% decrease. The area under paddy cultivation was 7.53 lakh hectares during 1965 and has reduced to 1.9 lakh ha of paddy field during 2014-2015 a decrease of 74.5%. The water availability per capita in Kerala is one of the lowest in the country and has been declining overtime as it is dependent on rainfall and other climatic factors. The per capita water availability for India is about 15,600 litres per capita per day (lpcd), while for Kerala it is 1,250 and for Rajasthan 1,600 (Source: Kerala Perspective Plan 2030).

37. The main threats impacting freshwater biodiversity in the Western Ghats include pollution, overexploitation of bio resources, developments in catchment areas, dams and other land use change, alien invasive species and river sand mining. The major recommendations are
    1. Land use mapping at LSG level.
    2. Biodiversity assessment and monitoring of water bodies and wetlands and management plan.
    3. Develop inland fisheries, value addition and storage facilities to reduce pressure on native inland biodiversity.
    4. Promoting sustainable utilization of inland bio resources and awareness of unsustainable activities as monsoon floodplain fishery through BMC.

Agro Ecosystem

38. Plant genetic resources in agric-horticultural crops and their wild relatives are of immense value to mankind as they provide food, fodder, fuel, shelter and industrial products and provide gene pools for crop improvement. However, in the wake of spread of high yielding varieties, this genetic variability comprising landraces is gradually getting eroded resulting in the large scale depletion of agro biodiversity. In Kerala Rice covers a wide array of ecological niches and about 2000 local land races were grown in different agro climatic regions of Kerala including resistant varieties to biotic

and abiotic stresses, with ability to adapt to drought or floods, quality attributes like medicinal value, aroma and resistance to diseases. The area under paddy production of local varieties has reduced drastically from 19.23% (59717 ha) of total area in 2002-2003 to 6.45% (13423 ha) in 2011-2012.

39. A prominent structural feature of agricultural ecosystem in Kerala is the prevalence of smallholder production systems. As the demand for food, fodder and bioenergy crops grows, many agricultural systems are depleting soil fertility, reducing agro biodiversity and impacting water resources. Indeed, agricultural lands in Kerala are faced with two problems, intensification and abandonment. Intensive agriculture has caused degradation of some ecosystem services. For instance, intensification of rice farming in the past, such as chemical usage and efficient drainage systems, has threatened aquatic plants, invertebrates, frogs, fish and birds since the mid-1960s. On the other hand, abandoned farmlands (e.g., paddy) are increasing in the state since the 1980s, and vegetation succession has changed the dominant species in rice field from aquatic to terrestrial species. To arrest this phenomenon and to revitalize agriculture in the state, the Government may formulate policies such as "farming first" and "return to farm".

40. The major recommendations of the working group include,

    1. Development of village level seed bank and a seed management committee with representatives of local farming community for conservation of landraces/farmers varieties/wild relatives.
    2. Agro biodiversity inventory at LSG level through PBR.
    3. Digital Documentation of agrobiodiversity and maintenance of databases related to the associated TK and Innovations.
    4. Inventory of genetic diversity and conservation of wild relatives of the domesticated species in the forest.
    5. Reviving the food diversity and thereby nutritional security by focusing on promotion of Agro biodiversity and diversifying food crops.
    6. Ensuring food safety by Good agricultural practises thereby maintaining the populations of beneficial fauna as pollinators, natural predators and pests.
    7. Promote agroprocessing industries and market for local produce and underutilized species through certification.
    8. Promotion of local breeds as Vechur cow, Poultry, Attapady goat etc and integrated farming.
    9. Promotion of studies on diversity of natural pollinators and predators in Agroecosystem.
    10. More attention on the under-utilised species as tubers, green leafy vegetables etc on which considerable genetic diversity already exists in the homegardens.
    11. The Government may revitalize organic agriculture, employing the provisions of Participatory Guarantee Scheme (PGS) of the central government for organic certification (for field crops, species, condiments, vegetables etc.).
    12. A tropical homegarden initiative, on the lines of Satoyama initiative of the Government of Japan to conserve and sustain tropical homegardens in the state focusing on promotion of multipurpose tree planting on farmlands such as establishing experimental tree islands in the agricultural landscape, e.g., boundary/bund planting in paddy fields, rubber and coconut plantations, intercropping with nitrogen fixing trees in forest plantations etc.), payment for ecosystem services etc. to enhance on farm agrobiodiversity conservation.
    13. Inventorying and conservation of local varieties of priority species as mango, jack and tubers. Special programme for their protection and conservation in the homesteads and other human habitats.

14. The state may consider formulating an agroforestry policy on the lines of the National Agroforestry Policy focusing on promotion of multipurpose tree planting on farmlands such as establishing experimental tree islands in the agricultural landscape, e.g., boundary/bund planting in paddy fields, rubber and coconut plantations, intercropping with nitrogen fixing trees in forest plantations etc.), payment for ecosystem services etc.

Urban Biodiversity

41. Biodiversity in cities and towns is concentrated in the remaining green spaces. Because urban green space can provide important ecosystem services and sometimes supports threatened species, balancing conservation and development is becoming an urgent issue. Although in the last several decades, urban green space is increasing in most of the megacities of the world, occupying occasionally up to 30% of urban areas (Singh et al. 2010, Yang et al. 2014), no such policies are in place in the state of Kerala. Per capita urban green space ideally should approach the standard determined by developed countries ($20m^2$).

42. Urban and periurban food production in farms, back-yards, community gardens, and on roof tops and balconies, can make a significant contribution to the urban food supply, as well as plant and animal habitats. Within cities, plants and vegetation contribute to human well-being by moderating the urban heat island effect, reducing noise, removing atmospheric pollutants, and reducing run-off and flooding. Efforts to reduce these "biodiversity footprints" (Lenzen et al. 2012) are required for the sustainability of global biodiversity.

43. Although private green spaces constitute the core of urban sustainability, they have received far less attention compared to urban green spaces under the public domain. A study on urban home gardens (a form of private green space with multistoried vegetation that abounds in the tropical regions) in Kozhikode city reveals a decline of 11.5% in the cultivated plants that reflects the loss of urban sustainability (Balooni et al. 2014). The major recommendations are
    1. Development of city biodiversity index.
    2. Ensure local community participation under the auspices of decentralized governance, for promotion and conservation of private green spaces/aquifers in urban and peri-urban areas.
    3. Using diversity of Microbes and Lichens for pollution indexing in Urban areas.
    4. Formulation of a policy to control indiscriminate felling of indigenous varieties in private land and public land.
    5. Corporations and municipalities should initiate massive tree planting activities towards green cities. Technical support from KFD, Agri. Dept. KSBB and Universities and NSS volunteers with involvement of Biodiversity club members.

CHAPTER 4
SOURCES OF DATA AND DATA SHARING

44. Biodiversity is one such sector that has maximum cross-sectoral linkages, necessitating effective coordination to safeguard the interests of the sector. In such a situation, effective coordination and consultation with other concerned Departments at the State level and Central level would be necessary.

Sources of Data

45. The National Biodiversity Authority has estimated that about 115 governmental and non governmental institutions are involved in the collection of data related to biodiversity and environment. This data is either spatial (e.g. species occurrence, water pollution), temporal (e.g. population trends of species, yearly harvest and trade of commercial species) or descriptive (e.g. species descriptions, habitat details, wildlife crime). The data generated by these agencies are currently used for specific objectives such as species inventory, pollution monitoring and wildlife crime control. But this data is not available in public domain for scientific documentation, monitoring and management of biodiversity and natural resources.

46. The various sources of data includes to cite a few
    1. ENVIS centre of BSI.
    2. ENVIS centre of ZSI.
    3. Forest genetic resources database at IFGTB, Coimbatore.
    4. Marine Biodiversity Informatics for Kerala - database developed by Dept of Aquatic Biology and Fisheries.
    5. The database of Marine fishery resources of CMFRI.
    6. Eprints@CMFRI the Open Access Institutional Repository of Central Marine Fisheries Research Institute containing Research outputs of CMFRI - journal papers, conference papers, reports, theses, patents etc.
    7. Information of Marine bioresources at Centre for Marine living resources and Ecology, Kochi.
    8. Envis Center *of* Kerala State Council for Science, Technology and Environment.
    9. The digital herbarium of JNTBGRI which provides passport data and good quality scanned images of 4860 herbarium specimens.
    10. KFRI Database on Rare, Endangered and Threatened (RET) plants of Southern Western Ghats.
    11. Forest department database of sacred groves in Kerala, Forests of Kerala.
    12. Kerala Bhuvans portal by the Kerala State Remote Sensing and Environmental Centre (KSREC) and the ISRO which offers detailed imagery with resolution up to one meter. It allows users to view 2D and 3D images, along with information on terrain and water resources.
    13. Information on Agro biodiversity of spices at Indian Institute of Spices research, Kozhikode.
    14. Tuber diversity at CTCRI, Trivandrum.
    15. Rice and vegetable diversity at National Bureau of Plant genetic Resources, Thrissur.
    16. Land Resources Information System (LRIS) a web based GIS project implemented by Kerala State Land Use Board, with the technical assistance of IIITM-K for scientific management of the land and its resources at grass root level in the planning process.
    17. Kerala University, Calicut University , Central University, Colleges of Kerala, College of Forestry, KAU, Veterinary and Fisheries college etc.

18. Agro biodiversity data at MSSRF, Wayanad.
19. Survey conducted by Forest departments, NGO's as ATREE, WFF, Natural History society etc.

Recommendations of Working Group

47. The 13th Plan should focus on

1. Need for pooled data of the financial outlay on Biodiversity in Kerala under various schemes of State and Central Government. It should include total budget expenditure for Biodiversity including core funding, non-core (indirect) of state govt. institutions and external funding during 12th plan, Estimated funding for Biodiversity conservation and sources during the next five years.
2. A data sharing system for periodic update of status, trends and threats to Biodiversity in the form of a web based Kerala State Biodiversity Information System for scientific documentation, monitoring and management of biodiversity and natural resources through sharing of data from different sectors.
3. The system will be supported by a consortium of research organizations - Biodiversity cell.

Creation of a Biodiversity Cell for Local Knowledge-Science -Policy Interface

48. A Biodiversity cell can be set up to function as a State wide local knowledge- science-policy interface that helps translate facts of science with sound policy making. The Biodiversity cell can include Government departments, KSBB, Technical support groups, operating at state and district levels. It will enable Data sharing -developing linkages with state departments for data sharing and management. It will also facilitate technical support for linking scientific biodiversity databases and PBRs.

Data Sharing Policy

49. Mechanism to integrate multi-disciplinary data is critical including interlinking and collaborating with existing and upcoming (national and regional) information systems and networks. This cannot be achieved by a single institution since data itself is isolated, dispersed, distributed and in heterogeneous forms and format. The stakeholders range from biodiversity researchers, academicians, ecologists, conservationists, natural resource managers, planners, policy makers and people at large. A well-crafted data sharing policy is of paramount importance to facilitate this. A number of issues would however need to be addressed, such as: maintaining confidentiality while promoting value addition, IRP issues in the context of value addition and benefit sharing. The data sharing policy should include
    1. Ownership and custodianship (intellectual property rights must be defined).
    2. Privacy rules (access to private data and what part of data is in the public domain).
    3. Liability (protection from legal recourse).
    4. Sensitivity (sensitive data must be defined).
    5. Law and policy requirements.
    6. Encourage citizen involvement in continual development of data through citizen science projects.
    7. It should be made mandatory that after completion of a government funded project, the scientific data along with meta data should be deposited in the Data Archive after a period of 3 years. During the 3 year period, scientists involved in the project should publish reports, papers and books and this also should be submitted to the data archive.

Biodiversity Information System

50. To monitor the state of biological resources it is important to have an accurate and adequate database which will facilitate informed decision making to ensure sustainable development and conservation of biological resources.

51. There is a need to set up an Kerala Biodiversity Information System (KBIS), which can be developed as an ENVIS centre based on the wealth of existing information on biodiversity, as well as the information generated from preparation of PBRs. The Biodiversity Information System could bring together scientific information on species with reference to the following topics: scientific and common names; field identification; diagnostic characters, images, morphology, life history/phenology, habitat, geographical distribution, trends in abundance, local uses, ecological services, conservation measures, good habitat management practices, environment friendly control methods, value addition technologies, marketable products and prices, scientific papers published, and database of experts. Biodiversity Information System will be network of networks that will work closely with all custodians and publishers of biodiversity and ecosystems data and information.

52. *Interlinking of Kerala biodiversity information system with other databases.* Preparation of KBIS has been taken up by KSBB with initial funding from NBA. The database website Biodiversity Information System of Flora and Fauna of Kerala is designed to manage details by using HTP (PHP) as front end and MySQL as backend (database). By using this webpage system we can add, edit and manage details of Flora and Fauna. This website system also includes Multilevel Category Management, Advanced Search and Optimization. Mobile compatibility is an additional feature. There are three type of users (1) Administrator (2) Database admin and (3) Public users. Administrator controls the overall site and integrates new features. Database admin controls functioning of the database and public users can only have the provision to view the details. This website provides the details of Flora and Fauna such as Scientific Name, Common Name, Family, IUCN Status, Habitat, Propagation, Description, Synonyms and districts of occurrence. Two additional information grids, Ecosystems and Biodiversity Management Systems are proposed to be set up. The modalities for setting up of this grid could be worked out in consultation with the NIC. Local landscape maps can be generated which can be integrated in a central facility. The primary technical base for landscape planning is maps and depending on management objectives, various spatial information can be integrated into maps. Important layers would be wetlands, vegetation types, eco-types, land uses, panchayats, public and private lands.

53. Modern technologies such as 'cloud computing' could be used for the grids, which would be cost-effective in the long run. The grids will be the repository of all information on Biodiversity of Kerala and will be a single-window source for all information relating to the sector; and will facilitate networking with all key stakeholders and will facilitate reporting system for user groups.

CHAPTER 5
STATE BIODIVERSITY STRATEGIES, ACTION PLAN AND INDICATORS

54. The Biodiversity Act provides an approach to sustainably use the economic potential provided by biodiversity and ecosystem services for human welfare by imposing regulations, at the same time exempting local communities from such restrictions.

National and State Scenario

55. A set of both generic (to identify type of issues that to be monitored) and specific indicators (to monitor changing trends in these issues) developed by decision XIX/4 of the UNEP/CBD/SBSTTA/REC/ are available for assessing the progress made globally on the 20 Aichi Biodiversity Targets (ABTs)*. Though some of the generic indicators exist currently without any specific indicators, many of these indicators are highly relevant for developing guidance on the use of national indicators and approaches to monitor progress towards the ABTs.

56. The NBA had identified some preliminary indicators for the biodiversity targets developed by them in 2012 (http://nbaindia.org/uploaded/pdf/Targets.pdf). In India's 5th national report to CBD there is reference on a set of composite indicators along with responsible agencies and frequency of monitoring to measure the progress of the 12 National Biodiversity Targets, (https://www.cbd.int/doc/ world/in/in-nr-05-en.pdf).:

Recommendations of Working Group

57. Major recommendations are as follows,

    1. The 13th plan should work to develop a comprehensive **Biodiversity Policy, Biodiversity Strategies and Action Plan**, Local Biodiversity Action Plan in alignment with India's commitments.

    2. Measurable indicators and composite indicators and responsible agencies along with time frame and frequency of monitoring are to be identified.

    3. The Action plan should also specify and identify major threats to Biodiversity conservation in Kerala and strategies for mitigating them.

58. The Kerala Biodiversity Strategy and Action Plan brought out by the state biodiversity board identified 28 strategic areas of action with as many as 176 action points. The strategy number 8, which talks about establishing model for sustainable use of biodiversity for livelihoods and the equitable benefit -sharing has the maximum number of action points (17), followed by the strategy number 5 on conservation of species, genes and ecosystems and the number 25 that deals with biodiversity education and awareness programmes, each with 16 activities. The State Biodiversity Action plan was developed during 2008, in view of the publication of National Biodiversity targets in 2014 and Sustainable development goals in 2015 there is a need to update the Action plan along with measurable indicators.
59. Five outcome areas and twelve targets have been identified along with a set of 42 indicators (15 generic and 27 specific), which are adapted from that of the Aichi Biodiversity Targets for the sustainable management of biodiversity of Kerala for the plan period of 2017-2022.

Outcome Area 1: Dynamic Conservation of Biodiversity

60. The most desired outcome in this area is enhancement and sustainable use of all critical elements of biodiversity through integrated means of conservation -*in situ, on-farm* and *ex situ* -involving seed banks, cryogenic community gene banks, bio-parks and *in vitro* cultures. The targeted biodiversity components shall include (i) *forest biodiversity, (ii) marine biodiversity, (iii) wetland biodiversity, (iv) community biodiversity, (v) urban biodiversity and (vi) Below Ground Biodiversity*. The conservation approach shall include protection and sustainable management of land/seascapes, ecosystems, habitats, species, varieties, and populations across these six components.

Outcome Area 2: Cultivation of Biodiversity (Promotion of Bio-diverse/Eco-Agriculture)

61. The outcome goal of this area is promotion of low external input, eco-agricultural practices that are based on principles of bio-diverse and organic farming. The approach needs to be sustainable crop production and enhancement of ecosystem services of the agricultural landscapes.

Outcome Area 3: (Sustainable) Consumption of Biodiversity

62. Mainstreaming agrobiodiversity for food security and nutrition is the planned outcome in this area. The interventions in this area need to include revitalization of traditional food habits including the use of food diversity, the use of underutilized crops, medicinal plants, NWFPs, fish diversity and promotion of horticultural and agricultural diversity for nutritional diversity, and sustainable consumption by increasing fresh water availability.

Outcome Area 4: Commerce (with conscience) of Biodiversity

63. *Commerce* with the purpose of creating an economic stake in conservation by concurrently addressing the cause of conservation and livelihood security is the targeted outcome here. The interventions shall focus on creating an economic stake under the ABS regime for the fair and equitable sharing of benefits arising out of the utilization of genetic resources by establishing partnership with TK holders, scientists and private companies.

Outcome Area 5: Biodiversity Management and Implementation

64. These outcome areas becomes possible only when enough resources are available and coordinated action and synergy takes place between the various sectors in the state working on biodiversity. Some of the critical actions needed are (i) Participatory preparation of the State Biodiversity Strategy and Action Plan and Local Biodiversity Strategy and Action Plan; (ii) Mobilization of Resources (mainly funds and expertise); (iii) Capacity building for Management and Monitoring of Biodiversity.

State Biodiversity Targets (2017-2022)

65. A set of twelve targets have been identified that are in close line with the 2020 National Biodiversity Targets (NBTs) that are to be achieved by2020. For measuring the progress and outcomes of these targets, a set of 42 indicators (15 generic and 27 specific) are adapted from that of indicators of Aichi Biodiversity Targets and is given here.

Outcome Area 1: Dynamic Conservation of Biodiversity

66. Kerala state has undergone a high degree of degradation in most categories of biodiversity and ecosystem services. For example, in case of forest biodiversity, almost all of the endemic species of plants or animals are living with degraded populations, the fresh water recharge and soil formation in most of the mountain regions have reduced drastically, and in case of fisheries, there is rapid depletion within marine and fresh water ecosystems. Threats ranging from habitat destruction to biological invasion and commercial exploitation to pollution continue to place pressure on such ecosystem services in the state. The scenario will be worst in the next five years in view of the climate change vulnerabilities and the rapid development taking place in the state.

67. *Target 1*. By 2022, a significant proportion of the state's population, especially the youth, is aware of the values of biodiversity and the steps they can take to conserve and use it sustainably. The indicators are as follows,

    1. Trends in public/youth/state awareness and engagement in conservation activities
    2. Extent of involvement of Mass Media, state legislature, Judiciary, LSGs, and the local institutions;
    3. Number of Media reports/stories/policies/ amendments/Litigations towards the ground conservation actions.
    4. Number of Local Institutions, especially LSGs, individual champions, Botanic Gardens, Museums, Zoos, and Educational institutions engaged in biodiversity awareness building;

68. *Target 2*. By 2022, values of biodiversity are integrated in the state planning processes, development programmes and poverty alleviation strategies. The indicators are as follows,

    1. Trends in institutional and technical capacity for integration of biodiversity principles and values in planning, policies and projects of state government and LSGs.
    2. Extend of capacity and number of institutions, departments, LSGs and NGOs engaged in implementing projects that contribute to Sustainable Livelihoods / Green economy/ Carbon neutrality goals.
    3. Number of LSGs engaged with people in preparing, updating, integrating People's Biodiversity Registers for local development.

69. *Target 3*. By 2022, strategies for reducing rate of degradation, fragmentation and loss of all natural habitats are finalized and actions put in place for environmental amelioration and human well-being in the state. The indicators are as follows,

    1. Trends in the number and value of incentives, including subsidies that reduce destruction and degradation of forests, marine waters, Backwaters, Lakes, Sacred Groves, Community Forests, and other ecologically sensitive areas.
    2. Number and value of incentives that promote biodiversity conservation and sustainable use.
    3. Number of LSGs and BMCs engaged in implementation of the Biodiversity Act.

70. *Target 4*. By 2022, invasive alien species and pathways are identified and strategies to manage them have been developed, so that populations of prioritized invasive alien species are managed. The indicators are as follows,

    1. Trends in identification, prioritization and eradication of invasive alien species.
    2. Number of specialists and projects in the area of study and eradication and prevention of introduction of invasive alien species.

71. *Target 5*. By 2022, ecologically representative areas under terrestrial and inland water, and also coastal and marine zones, especially those of particular importance for species, biodiversity and ecosystem services, are conserved effectively and equitably, based on protected area designation and management and other area based conservation measures are integrated into the wider landscapes and seascapes, covering over 20% of the geographic area of the state. The indicators are as follows,

    1. Trends in area size, quality and management efficiency of terrestrial, marine, coastal and inland waters, and community conservation/heritage areas.
    2. Trends in rarity and threat status of species, genetic resources, ecosystems and number of species extinctions.
    3. Coverage and quality of protected forests, marine area, mangroves, sea weeds; backwaters, lakes, sacred groves, community forests, and other areas;
    4. Number of specialists, projects and networks in the area of study and conservation of Rare, Endemic and Threatened Species.
    5. Per capita availability of biodiversity, particularly the natural habitats and native wild species.
    6. Trends in area and number of corridors declared as BHS so that connectivity between wider landscapes is restored or rehabilitated to facilitate species movements and dispersal within the framework of changing land uses, climate and habitat loss, and the meta population structure of populations is maintained and gene flow enabled for long term population viability.
    7. Trends in Implementation of buffer zones and ecologically sensitive areas outside protected areas, where land use is optimised, cultivation of edible crops/animal husbandry is minimised to enable buffering between protected areas and agricultural landscapes to reduce wildlife incidents.

Outcome Area 2: Cultivation of Biodiversity

72. The major outcome in these domains shall be achieving biodiversity- compatible production practices, and helping the state and local governments to mainstream biodiversity in food systems and agriculture, fisheries, and forest resource management. Three innovative pathways are needed to contribute to this outcome – (i) revival of native agro-biodiversity with maximum possible genetic diversity in the local dietary system achieved through synergising various local eco technologies with frontier technologies, (ii) increase in Soil Organic Carbon stock through appropriate ecological intensification and Biodiverse LEISA (B-LEISA) practices, and (iii) strong opportunities for incentivising B-LEISA practices by linking with PES mechanism and market-driven eco-enterprises including farm-tourism.

73. *Target 6*. By 2022, measures are adopted by the state for sustainable management of agriculture, forestry and fisheries. The indicators are as follows,

    1. Trends in biodiversity-compatible production practices (proportion of area of sustainable agriculture, aquaculture, aqua silviculture, agro-forestry, forestry and wild fisheries under sustainable practices).
    2. Trends in agricultural/aqua-cultural/agro-forestry/wild forest/inland and coastal ecosystems affected by pollution and nitrogen loading.
    3. Percentage of areas of agricultural land under productive and sustainable agriculture/organic production/conservation agriculture/good agricultural practices/aquaculture/agro-forestry.

74. *Target 7*. By 2022, genetic diversity of cultivated plants, farm livestock, and their wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies

have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity. The indicators are as follows,

1. Trends in extinction risk and populations of agro-ecosystem associated species; species of Non-Wood Forest Produces, and wild edible fish.
2. Percentage of reduction in loss of genetic diversity of cultivated plants; extinction risk of socioeconomically and culturally valuable species, crop wild relatives, farmed and domesticated animals, forest trees, and in-land and marine fish, underutilized wild edible plants.
3. Number of plant and animal genetic resource for food and agriculture, health, culture and spiritual value surveyed/inventoried and conserved at on-farm and long-term ex-situ methods.

Outcome Area 3: (Sustainable) Consumption of Biodiversity

75. The targets 8 and 9 could be achieved by promoting sustainable production and consumption of biodiversity and ecosystem services, in which ensuring continued availability of fresh water, increasing diversity of food, health and income value is very crucial. It is urgent to build the capacity of women (Kudumbasree) groups and local community members to promote a local agrobiodiversity based sustainable food system by safeguarding the biodiversity and ecosystem services of the state.

76. *Target 8*. By 2022, ecosystem services, especially those relating to water, human health, livelihoods and well-being, 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. The indicators are as follows,

    1. Trends in protected and restored ecosystems including the agricultural landscapes along with the associated keystone species, varieties and populations of species that provides essential services and the yielded benefits.
    2. Percentage of population especially women using safely managed drinking water services, high diversity of foods, wild food plants, NWFPs, and medicinal plants as well as good quality seeds, planting materials.
    3. Percentage of tribe, fishing communities, and women groups earning income from NWFPs, medicinal plants of safeguarded forests, marine and coastal areas.
    4. Red List Index (species used for food, medicine, health and livelihood value; pollinating species).
    5. Species-Habitat index (species that provide essential services).

77. *Target 9*. By 2022, national initiatives using communities' traditional knowledge relating to biodiversity are strengthened, with the view to protecting this knowledge in accordance with national legislations and international obligations. The indicators are as follows,

    1. Trends in style and management of forests and marine areas in particular (TK oriented) and trends in land-use change and land tenure of tribal communities.
    2. Trends in which TK and practices, traditional languages are respected and integrated in forest management; and effective participation of tribal communities in the implementation of the NBSAP/LBSAPs.

3. Number of local community-based documentations (Community Biodiversity Registers), monitoring on traditional knowledge, innovations and practices of traditional and local communities relevant for the conservation and sustainable use of biodiversity.
4. Proportion of tribal communities who has secured land and property rights/tenure rights/Farmers' Rights under the Forest Rights Act 2005, Biodiversity Act 2002 and PPVFRA 2001.

Outcome Area 4: Commerce (with conscience) of Biodiversity

78. The concept of "do ecology" which revolves around creating economic stake in conservation to serve simultaneously conservation as well as reduction of poverty becomes very relevant for Kerala. This is especially true with respect to the conservation of little known crops/ orphan species, medicinal plants for which market can stimulate their conservation. The ABS offers ways and means to help the individuals and communities to target market development for biodiversity.

79. *Target 10.* By 2022, 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 legislations. The indicators are as follows,

    1. Trends in the implementation of the Nagoya Protocol.
    2. Legislative, administrative and policy frameworks for implementation of the Protocol.
    3. Number of case of bio-partnerships developed with free and prior informed consents.

Outcome Area 5: Indicators for Biodiversity Management Planning and Implementation

80. Updating the State Biodiversity Strategy and Action Plan and preparation of Local Biodiversity Strategy and Action Plans, and resource mobilization for the implementation are the immediate actions. Capacity building for effective planning, implementation, monitoring and resource mobilization will be also an important need. The CSR amongst the Indian and multi-national companies should be explored for fund raising. Involving reputed international donor agencies and private firms in achieving the targets from the beginning may help in mobilizing funding support.

81. *Target 11.* By 2022, an effective, participatory and updated national biodiversity action plan is made operational at different levels of governance. The indicators are as follows,

    1. Trends in development, adoption and implementation of national biodiversity strategies and action plans, as policy instruments.
    2. Revised State Biodiversity Strategy and Action Plan for Kerala.
    3. Number of Grama Panchayths with developed LBSAPs.
    4. Number of institutions/departments mainstreaming the SBSAP/LBSAP.

82. *Target 12.* By 2022, 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 identified and the Strategy for Resource Mobilization is adopted. The indicators are as follows,

    1. Trends in the mobilization of financial, human, physical and technical resources.
    2. Financial reports on public expenditure on conservation and sustainable use of biodiversity and ecosystems from the Central and State Planning bodies;

3. Level of involvement of international donor agencies, and private enterprises in establishing financial support and strategies.

Way Forward

83. The implementation strategy for these targets needs to be through integration of the activities with various institutions of the state and local governments' programmes that have biodiversity conservation and climate change obligations. The State Biodiversity Board in alliance with the National Biodiversity Authority and the Biodiversity Management Committees at the grass root level can take leadership to achieve these targets that have clear implications on sustainable development of the state.

CHAPTER 6
ROLE OF LSG AND BMC IN BIODIVERSITY CONSERVATION AND SUSTAINABLE UTILIZATION

Introduction

84. The Biodiversity linked traditional and indigenous knowledge system particularly the uncoded and informal knowledge is being rapidly eroded. The forest dwellers, forest produce collectors, folk practitioners of herbal remedies, native fisher-folk and the traditional farmers hold reliable information on bio- resources as they depend on them for their sustenance. In the light on these it is realized that the formidable task of conservation, sustainable use and equitable sharing of benefits of biodiversity can be addressed only as a People's movement.

85. In Kerala, LSGs have been successfully empowered through massive transfer of resources as well as administrative powers and the process can be considered as a model for administrative decentralization, fiscal decentralization, participatory planning, setting up supporting institutions for local governance and so on. To operationalise decentralisation, Kerala chose the path of participatory local level planning as the entry point. It aimed to reach the level of empowering the people to take their own decisions after analysing the local situation. Peoples Plan ensured People's participation in all stages of a development programme right from identification of a need and formulation of a scheme through its planning, implementation, operation and maintenance as well as monitoring and evaluation phases.

86. The Environmental and Social Assessment Report , Kerala Local Government Service Delivery Project has identified the important constraints of the capacity building efforts for natural resources and environment for local governments during the Ninth and Tenth Plan period as:

    1. Lack of policy and legal framework for intervention of local government in natural resources and environment management.
    2. Capacity gaps of elected representatives and officials of local governments was not scientifically assessed and training was not properly designed.
    3. Scope and importance of sustainable development was not explicitly incorporated in the training modules.
    4. No separate working group at the local level for watershed development and natural resources management.
    5. Lack of comprehension on the concept and methodology of integration of different development sectors with an overall objective of sustainable development.
    6. Lack of capacity of the plan appraisal team to assess the environmental impact of different development projects and effective tools and techniques for doing environmental assessment.
    7. Inadequacy of appropriate Environmental Management Framework.
    8. The lessons learned from the last two five year plans can be adopted for 13th plan for following a path of sustainable development through empowering BMC for conservation of Biodiversity and empowering them to function as Environmental watch groups.

Present Structure of LSG in Kerala

87. Presently the Grama Panchayats are assigned with functions and as much as 29 subjects, in the Eleventh Schedule of the Constitution. Among the 29 subjects, the following are related to environment management,

1. Agriculture including agriculture extension.
2. Land improvement, implementation of land reforms, land consolidation and soil conservation.
3. Minor irrigation, water management and watershed development.
4. Social forestry and farm forestry.
5. Drinking water.
6. Non-conventional energy sources.
7. Health and sanitation, including hospitals, primary health centers and dispensaries.

88. As per the Panchayat Raj Act in Kerala, The Standing Committee system consists of 3 in Village Panchayats and Block Panchayats, 5 in District Panchayats and Municipalities and 7 in Corporations – with clear functional roles structured in such a way that every elected member belongs to one Committee or the other. This system facilitates in depth analysis of issues and proposals before they are considered by the full body. There is also a provision for constituting Functional Committees for different subject areas inclusive of experts, activists, professionals, practitioners and other stakeholders. For the preparation of projects for different Local Governments, Working Groups are set up for different sectors. Panchayats are free to constitute as many Working Groups as may be required depending on availability of experts. The typical Working Group is headed by an elected member and has experts professionals, officials, practitioners and other stakeholders. Similarly for vetting the large number of projects, Technical Advisory Groups are set up by the District Planning Committee at the Block / Municipal/Corporation and District levels. These bodies again draw expertise from different sources largely on a voluntary mode.

KSBB Study of BMCs

89. In order to understand the development paradigm and environmental concerns of local bodies at various levels and activities undertaken for environment protection and conservation outside forests through peoples participation at the local level KSBB had conducted a desk review of Plan funding of panchayats in 14 districts. The funding for Environmental and natural resources conservation projects etc. in 86 panchayats including coastal, high land and midland were studied. The major funds were for preparation of banana cultivation, special live stock breeding programme, paddy development, intercrop cultivation, coconut cultivation, tubercrop development, goat rearing, vegetable development programme, jalanidhi, cattle rearing, soil conservation, biodiversity register etc. Only in very few panchayats as in Wayanad funds were allocated for river bank protection, canal restoration, wetland conservation etc. The major funds are being allocated for Agriculture, Fisheries etc while conservation of natural resources, environment protection, and biodiversity conservation has very limited fund allocation. A detailed review of plan fund allocation at LSG level for natural resources conservation/ environmental protection is necessary for identifying the gaps.

90. KSBB had conducted an exit survey among the outgoing BMC members before the local elections. During this structured questionnaire were distributed to all the 978 panchayats, 60 municipalites and 5 corporation and responses were received from 70% of LSGs. 90 % of the BMC felt the need of Capacity development of BMCs. A detailed report is being prepared based on this. After the elections BMC has been reconstituted in 90 % of LSG during 2016-2017. Based on the exit survey a three tier system for capacity development and suggestions for strengthening the institutional structure of BMCs is proposed for implementation during the 13th five year plan. The work can be taken up in a phased manner and 100 BMC can be taken up initially.

Strengthening Institutional Structure of BMC

91. *Capacity development of BMC.* Facilitating the establishment and capacity building of Biodiversity Management Committees all LSGs of Kerala BMC of Kerala has been authorized for taking timely action, against activities which cause or may cause environmental degradation, violation of Environmental laws, acts and ordinances. BMC has been authorized to formulate directions for incorporating Primary environmental protection programmes in the schemes of the panchayat , present them in the Gramsabha and take actions to include them in the development schemes of the panchayat. Empowering BMC to function as Environmental watch groups and equip them to implement all activities and projects at local level relating to environment and biodiversity conservation is absolutely essential. Strategies for this and identifying appropriate training needs are necessary.

92. Natural resource and environment management and sustainable development was one of the topics in the generic training module on local plan formulation for all the stakeholders of local governance. In the designing and implementing of the training module on natural resources and environment KSBB can provide a key role.

93. At the state level 14 key resource persons will be trained by KSBB who in turn can train 5 district resource persons who will be responsible for capacity development at LSG level. KSBB will prepare modules and handbooks for each of these phases. Training institutes as Kerala Institute of Local Administration (KILA) can be identified as the nodal institution for capacity building at district level and local level.

    1. Intellectual Property Rights (IPRs)/ABS related issues are complicated. Therefore a separate training or guidance on IPR issues is essential.

    2. Capacity building trainings and Gap assessment needs to be conducted on a regular basis based on which modules and curriculum can be developed.

    3. Mere classroom training is not sufficient and exposure visits may lead to good learning for BMCs. Trainings for BMCs can be arranged in Forest Schools and State Institutes for Rural Development (SIRD).

    4. It is imperative to develop better understanding of roles and responsibilities of BMCs amongst other stakeholders such as panchayat leaders, frontline forest and other development officials. The cooperation of LSG is essential and Awareness of roles and responsibilities of BMC to elected representatives is necessary.

94. KSBB along with identified institutions at district level will be responsible for preparation of the following Tool kits.
    1. BMC training tool kits.
    2. Working Group Reports.
    3. Biodiversity conservation/Envt protection reports and schemes.
    4. Conduct of Environmental / Biodiversity GramaSabha/Ward Sabha.
    5. Format for Local Biodiversity Action Plan.
    6. Handbooks for different sectors.

7. Guidelines for functioning as Environmental watch groups.

95. *Institutional and policy support to BMC.* As per Biodiversity Rules 2008, section 22 subsection (4) the BMC is chaired by Head of LSG, secretary is the convener. There has to be six more members—(2 women, one SC/ST, and 3 others). We should recommend that at least one should be a postgraduate in Botany/Zoology/ Agriculture. One Ayurveda practitioner should also to be included.

96. *Standing Committee.* The Gram Panchayats and the Block Panchayats have three standing committees namely the Finance, Development and the Welfare standing committees. In view of India commitment to UN Sustainable development goals a standing committee of Biodiversity and Environment can be set up. The members and the chairpersons to these committees can be elected from among the members of the concerned local government itself. The chairperson of the standing committee can function as convenor of BMC.

97. Cross representation of members of Environment/Biodiversity Standing committee in other committees will enable cross linkages.

98. Alternatively Biodiversity and Environment can be included as a subject in the Standing committee for Development and one of the members of the Standing committee can function as BMC convenor.

99. Presently sectoral development functions of panchayat include Agriculture, 2. Animal Husbandry and dairy development, 3. Minor irrigation Fisheries, 5. Social Forestry, 6. Small scale Industries, 7. Housing, 8. Water supply 9. Electricity and Energy, 10. Education, 11. Public Works, 12. Public Health and Sanitation 13. Social Welfare, 14. Poverty Alleviation, 15. Scheduled Caste / Scheduled Tribe Development, 16. Sports and Cultural Activities, 17. Public Distribution System 18. Relief and Natural Calamities, 19. Cooperation. In addition Environment protection and Biodiversity conservation can be included as a mandatory function of the panchayat.

100. *Working group.* One of the constraints identified in the Environmental and Social Assessment Report is the lack of a separate working group at the local level for watershed development and natural resources management. To address this gap a working group of Biodiversity and Environment can be set up headed by an elected member. A leading expert in Biodiversity and Environment can be nominated as the Vice-Chairman of the Working Group. Experts should be identified from among 'model' practitioners, professionals, and from among academically qualified people. Working group may also include a representative from other working groups to ensure cross sectoral linkages.

101. The Working group will be responsible for

1. Suggesting short term and long term solutions to environmental issues.
2. To prepare technical Local Biodiversity Action Plan considering the forward and backward linkages of various proposals.
3. To provide leadership for the programme implementation.
4. To monitor the implementation of conservation activities.

102. A working group member of Environment and Biodiversity should be included in the working groups of Agriculture, Fisheries and other related working groups.

103. *Regional technical support group.*

1. The BMC may also identify a six member technical group consisting of academicians, taxonomists, teachers, forest, agriculture, fisheries department etc who will be special invitees to BMC meetings as mandated by section 20 (3) of Kerala Biological Diversity Rules 2008.
2. The Grama Panchayat/ Panchayats shall make available the services of the required staff for the functioning of the working group/' regional technical support group, clearly indicating their duties and responsibilities.

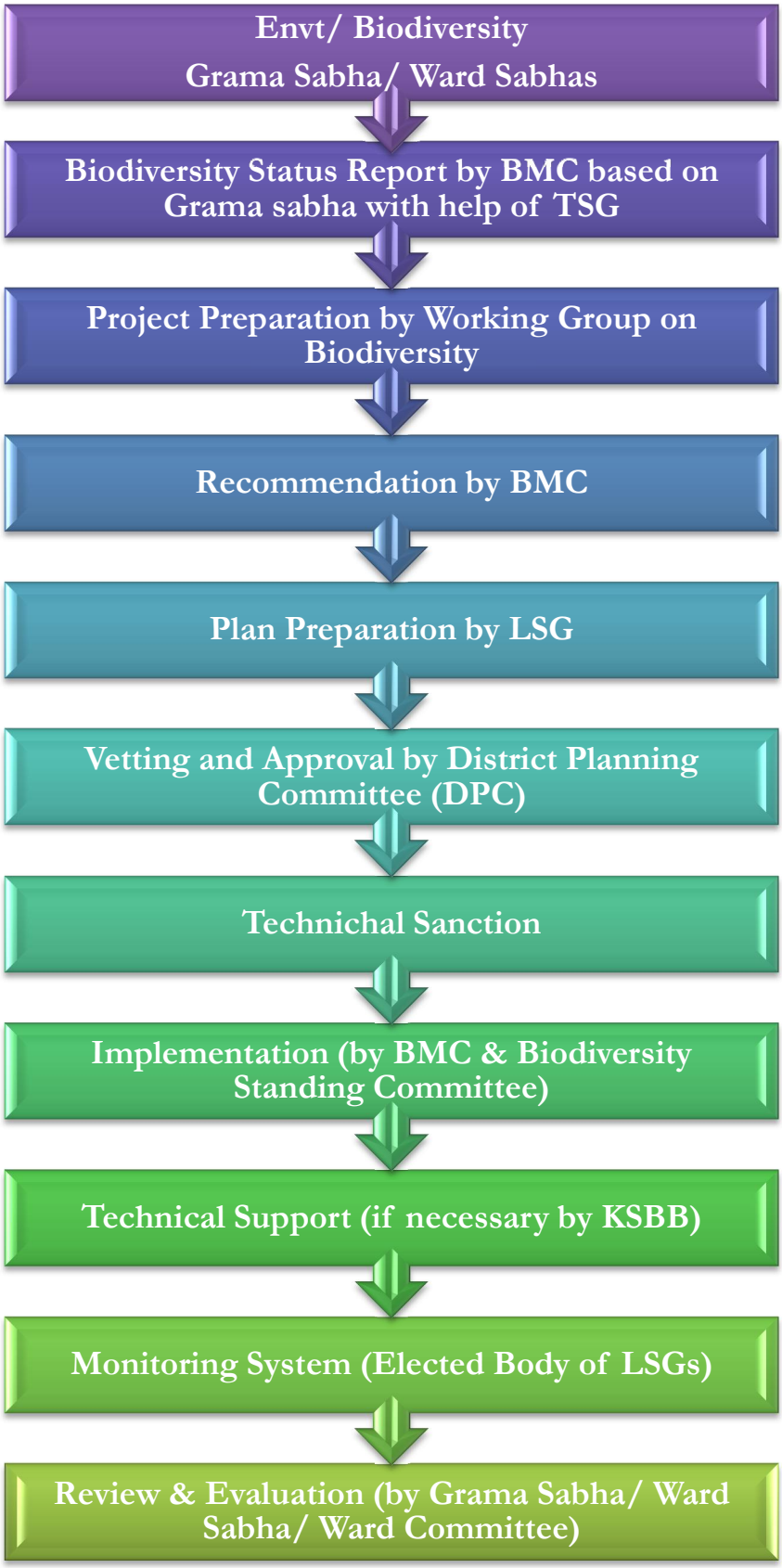
104. *Environmental/biodiversity gramasabhas.* Panchayats can constitute Environmental/Biodiversity gramasabhas. Alternatively the Watershed sabhas can be redifined as Environmental/Biodiversity gramasabhas to bring all environmental issues under a single umbrella. Through the questionnaire method and with the facilitation of trained personnel, the Grama Sabhas / Ward Sabhas can be asked to list out priorities clearly ranked. This will ensure that Biodiversity conservation and environmental protection activities start with the Gram Sabhas with Peoples participation. Efforts have to be made to ensure that every section of society participates in the Grama Sabhas and Ward Sabhas and takes active part in discussions and dialogues on local development issues, in prioritizing them and in suggesting the optimum solution.

105. *Environmental/biodiversity status report.*

1. Based on the Environmental/Biodiversity gramasabhas and PBR, with technical support of regional TSG, BMC can prepare Environmental/ Biodiversity status Report. It is an entry-point document based on which the second phase of activity commences.
2. *Guidance regarding bioresources of the panchayat f*or effective natural resources management a digitally searchable data base of identified species or checklist can be made available to BMCs.
3. The District level Technical Support Groups shall procure authentic data of bioresources at Panchayat level from the State Land Use Board, Survey and Land Records, Centre for Earth Science Studies, BSI, ZSI and it shall be handed over to the respective BMC.

106. *Local biodiversity action plan.* The BMC can hand over the Environmental/ Biodiversity status Report to the panchayat and to the Working Group on Biodiversity/Environment. Based on this the Working group can formulate Local Biodiversity Action Plan and formulate projects for inclusion in Plan funding. The KSBB can prepare broad guidelines for the preparation of the local plans.

Figure 1 *Process in Local Planning of Biodiversity Conservation*



107. *Financing for local biodiversity conservation activities.*

1. BMCs could pass resolutions along with the estimated expenditure for biodiversity conservation measures based on the report by the working group well before preparing budget estimates of the Panchayat. The recommended proposals could be presented to the Zilla Parishad for consideration and funding.
2. Revenue generation options for BMCs need to be elucidated and alternatives to finance activities of BMCs in absence of revenue generation needs to be emphasized.

108. *Environmental assessment of development projects.*

1. Kerala Local Government Service Delivery Project has proposed an Environmental and Social screening for identification of adverse environmental and social impacts of developmental projects. Many of the major and medium projects are brought under the purview of environmental assessment and correction mechanisms, but many small scale interventions can cause adverse impacts which are not subjected to any check measures, as such. All developmental activities having an effect on Biodiversity/Environment as quarrying, sand mining, wetland conversion shall be with approval of Environmental gramasabha/BMC.
2. Impact assessment report of the BMC should be considered for the final clearance of the projects by Impact Assessment authority at district level.

109. *Promoting cross sectoral linkages and relation to existing institutions.*

1. BMC leaders may be encouraged to hold posts in local bodies, such as Panchayats. This provides an opportunity to integrate biodiversity concerns into the working principles of the Panchayats.
2. Local bodies may designate one ward member who can function as BMC convenor/member and is responsible towards the activities of BMCs.
3. Clarity regarding role of BMCs in relation to other natural resource management institutions such as Joint Forest Management Committees (JFMCs), Eco Development Committees (EDCs), Watershed Development Committees etc. need to be thoroughly documented.
4. Participation of Kudumbasree members in BMC to be promoted.

110. *BMC monitoring and reporting.*

1. It is crucial to report the progress or the outcome of the activities of BMCs. These could be highlighted periodically in the public domain through sustained and concerted awareness campaigns.
2. A dedicated web platform needs to be developed with updates regarding activities of the BMCs.

111. *Engaging youth in biodiversity conservation through BMCs.*

1. It is essential to involve the youth, particularly college students in the activities planned by BMCs.
2. Strengthening Biodiversity clubs constituted by KSBB is necessary.
3. Involvement of National Service Scheme (NSS) and National Cadet Corps (NCC) student volunteers with clear focus on Biodiversity Conservation needs to be developed.

112. *Involvement of stakeholders.*

1. NGOs could be involved in BMCs for working with communities at the grass-root level.
2. Further, Research institutions could also be involved in the activities of BMCs, particularly in development of Biodiversity Data Base.

113. *Collaboration between BMCs.*

1. Documentation, interaction and exchange of information between BMCs and Pachayats at regular intervals would help in enhancing effectiveness and facilitate faster implementation of the relevant programmes.
2. Strengthening BMC will be taken up in a phased manner and 100 model BMC can be developed.
3. During the later stages of the Campaign, Panchayat to Panchayat training programmes on various thematic areas where in those Panchayats who had performed well can serve as model BMC's and exposure visits and sharing of experiences can be planned.

114. *Infrastructure for BMC.* Funds may be allocated for developing basic infrastructure facilities for BMC/ holding of BMC meeting etc and office space for BMC.

Model BMC

115. Environmental and Social Assessment Report published by State Planning Board has suggested that citizen-scientist partnerships play an important role not only in documenting and validating data collected on biodiversity, but also in utilizing the bioresources. Since this is a new exercise in itself not only to Kerala but to India itself it is proposed that in the 13th Plan KSBB should be supported to coordinate a scheme to empower 100 model BMCs per year. The BMC will be selected from each of the 14 districts and will include those from High ranges, Midland and Coastal areas. The activities can be under four schemes

1. Capacity development of BMC.
2. Strengthening institutional structure of BMC.
3. Policy support to BMC.
4. Biodiversity conservation projects through BMC.
5. Support for Resource mobilization for Biodiversity conservation at LSG level.

116. Considering the critical issues of malnutrition among tribals and increased incidence of lifestyle diseases among urban people, the developmental projects can be under

1. Biodiversity for Nutrition; Activities where sustainable and equitable utilization of biodiversity that have direct socio-economic benefits, especially in overcoming micronutrient malnutrition and achieving the zero hunger challenge.
2. Biodiversity for Climate Adaptation and Mitigation. Activities where biodiversity conservation directly benefit to mitigating, and adapting with climate vulnerable.
3. Activities that increases awareness on biodiversity's value and thus benefiting biodiversity itself, especially its rare and threatened group of species and varieties; and
4. Biodiversity for Income; Activities related to access to biodiversity that benefit the local communities who possess unique knowledge about various uses of a multitude of genetic resources.

117. The scheme will be coordinated by KSBB, and Biodiversity cell consisting of a network of specialized Institutions to provide technical support and key organizations responsible for delivering LSG training in Kerala and implemented by BMC.Sufficient plan fund shall be allotted to BMC for environmental/ biodiversity management plan, for conducting EIA, protection and preservation of endemic and threatened species, conducting awareness programmes and publication of newsletters, brochure and booklets on importance of conservation of biodiversity. The activities envisaged to be implemented by model BMC can include

118. *Conservation of biodiversity.*

1. BMC can prepare model development Projects and present them in the Working Group on Agriculture/ Environment. KSBB will provide a list of model projects for reference.
2. Development of City Biodiversity Index by Corporations.
3. Developing Primary Diversity Indices for the Agro- biodiversity.
4. Greening of urban areas.
5. BMC shall prepare a list of all areas where there is large scale irreparable destruction of natural resources specifying the threat, nature of problems created to the livelihood of people around, and also how this could be avoided.
6. Make an inventory of places, areas in the GP/ Municipality which are ecologically sensitive and need protection for instance it may be, sacred groves, wet lands, small patch of forest, etc and propose such areas for notification as Biodiversity Heritage Sites.
7. Enhance the size, quality and management efficiency of terrestrial, marine, coastal and inland waters, as community conservation/heritage areas.
8. List very rare plants, animals, cultivars, local animal breeds in the area and threats they face. Preserve and promote local biodiversity and advice LSG regarding conservation of natural resources.
9. Maintain data of plants/ resources/ local vaidyas/ bioresources of economic potential.
10. Help LSG for identification, prioritization and eradication of invasive alien species.
11. Prepare map of local land use and analyse trends in land-use change.
12. Ecorestoration of degraded areas, abandoned quarries, degraded ponds etc.
13. Evaluate Carrying capacity of eco- tourism and promote sustainable ecotourism.
14. Implement projects for rainwater harvesting to improve ground water near villages. Develop small check dams for water storage, on small streams within and in forest fringe areas.
15. Inventory of Rural Rituals and Festivals and their link to Agrobiodiversity.
16. Documentation and Revival of Rural Culture Festivals with emphasis on conservation of local biodiversity.
17. Studies on agrobiodiversity of coastal and immediate inland zone vis-à-vis climate change adaption and mitigation.
18. Establishment of Nutritive/Biodiversity Gardens in panchayat.
19. Biodiversity parks in schools.
20. Promote agroforestry initiatives in Homesteads.

119. *BMC as environmental watch groups.*

1. The Biodiversity Management Committees of Kerala has been recognized as Environmental Watch Group as perG.O (P) No: 04/13/ Envt dated May 13, 2013. As per this
2. The grass root level community primary environmental protection will be the responsibility of the BMC of respective panchayat.

3. The BMC is responsible for formulation of directions for environmental conservation of Panchayat and their implementation through the Panchayat committee, to timely inform the regulatory authorities regarding instances relating to violation of environmental clearance regulations etc.
4. To formulate directions for incorporating Primary environmental protection programmes in the schemes of the panchayat , present them in the Gramsabha and take actions to include them in the development schemes of the panchayat.
5. To generate awareness regarding Government programmes related to environmental protection (eg Organic farming, conservation of native breeds and varieties, Biogas from household waste, rain water harvesting, protection of water bodies, planting of trees, solar energy etc) and peruse activities to include them in the annual schemes of the Panchayat.
6. Establish linkages with district level afforestation projects on water conservation river banks rejuvenation.

120. *Sustainable utilization of bioresources.*

1. Support biodiversity-compatible production practices in agriculture, aquaculture, agro-forestry, forestry and fisheries under sustainable practices.
2. Involve in the prevention of loss of genetic diversity of cultivated plants; extinction risk of socioeconomically and culturally valuable species, crop wild relatives, farmed and domesticated animals, forest trees, and in-land and marine fish.
3. Identify households dependent on biological resources for sustenance and traditional knowledge holders, innovations and practices of traditional and local communities relevant for the conservation and sustainable use of biodiversity.
4. Estimate harvest rates of NTFP s and assess market values.
5. List the items harvested/traded from the panchayat and valuate these resources.
6. Implement access and benefit sharing mechanisms. KSBB will provide training for negotiations skills for ABS.
7. Work out Red List Index (species used for food, medicine, health and livelihood value; pollinating species) and Species-Habitat index (species that provide essential services).
8. Establish co operative interventions and collection centres for effective management of NTFPs.

121. *Regulatory functions.*

1. Applications for environmental clearance/actions against pollution of water bodies/conversion of wetlands/destruction of biodiversity shall be addressed by convening special meetings if necessary.
2. Integrating information on environment and biodiversity from PBR for Panchyat level micro-planning and develop strategy and action plan for short and long term.
3. Advice State & National Biodiversity Boards on matters related to depletion and unsustainable harvesting of local biodiversity.

122. *Public Awareness programmes.*

1. The BMC shall conduct classes, seminars and workshops among students, and public at large to disseminate its findings.
2. Ensure the involvement of Mass Media, state legislature, Judiciary, LSGs, and the local institutions in Biodiversity conservation.

3. Involve in activities of institutions, departments, LSGs and NGOs engaged in implementing projects that contribute to Sustainable Development / Green economy.
4. Apprise LSG of the environmental effects of developmental projects being undertaken by LSG.
5. Develop support systems for Eco -clubs and biodiversity clubs in schools and colleges.

Landscape Level Approach to Conservation through Joint BMC

123. A landscape approach is an integrated, strategic approach to biodiversity conservation as it examines larger areas to more fully recognize natural resource conditions and trends, natural and human influences, and opportunities for integrated resource conservation, restoration, and development which may not be evident when managing smaller land areas. Planning in smaller areas is necessary but not sufficient. Despite the fact that these individual activities may have a high-level conservation vision and goals, their individual design and implementation can be independent not only of each other but also of the patterns and processes across higher spatial scales and a broader landscape. A landscape approach informs and enhances local management. For example, a species might be very common in one site, and very rare or not available in others. Therefore intensive harvesting in a site is not sustainable at the larger scale and can drive the species to extinction. Therefore assessing the occurrence and population sizes of economically important species at the level of the state, region and at local administrative units in each BMC is critical for its long term conservation and sustainable use. Apart from human impact, anthropogenic climate change will affect rainfall patterns. Some species are more resilient to changing climatic pattern than others. Consequently, a landscape planning approach will have significant gains when superimposed on proper management of individual BMC's and for implementation of the Biological Diversity Act 2002.

124. Among the challenges faced by managers is documenting and inventorising resources that are of utility value to local communities either for sustenance or trade, regulation of harvest rates, developing indices of land degradation, invasive weeds, water resources, energy usage, urbanisation and others. The inventories are no end in themselves; they are essentially management tools indispensable for sustainability.

125. An integrated broader-scale approach to management, conservation and planning serves to bring partners and stakeholders together to work toward common and shared goals that consider both site-level needs and wider landscape considerations. On the one side, landscape inventories detect areas that are sensitive to over-exploitation by mapping resources (individual trees, species density, fruit production, insect abundance, etc.) and certain stressors (classically population density, lifestyle, market demand, road density, visit intensity, poaching, harvest, pesticides, etc.). Comparing resource states and stressors help identify areas that need immediate management intervention, in general a more rational harvest regime. In this manner, the resource runs a much lower risk of becoming locally extinct, at the detriment of the population. This strategic approach makes it easier to efficiently use and balance resource demands, coordinate activities, and accomplish shared strategic management goals. It enables a better understanding of the impacts of cumulative effects on biodiversity and natural resources spatially, quantitatively and in a cost-effective manner, in order to prioritize responsive management actions.

126. For example market access of a particular product can be managed at higher scales by integrating information from several BMC's in a region and coordinating transportation networks. Integration and coordination can be achieved with other government departments such as the Forest Department, Agriculture and other biodiversity initiatives such as forest and wildlife conservation,

medical plants, trees within agricultural areas to ensure sustained, long-term ecological, social and economic benefits to communities. Coordination can also identify duplication of effort and suggest opportunities to more effectively implement sustainability practices across the landscape.

127. *Role of Joint BMC in landscape planning.* Western Ghats is one of the eight hottest biodiversity hotspots of the world. 27% of all species present in India are found in the Western Ghats. Many wild relatives of crops such as Pepper, Cardamom, Mango, Jack Fruit and Banana also occur in the Western Ghats. Many rivers and water bodies which are the source of drinking and irrigation for above 250 million people, also originate from the Western Ghats. Landscape management implies using an integrated approach in the management of extended landscapes, defined by ecosystems rather than boundaries, in which both conservation and sustainable use of the components of biological diversity are considered, and in which people and their sociocultural resources are placed at the centre of the conservation framework. This approach has been strongly recommended for linking conservation with sustainability, involving communities in decision-making processes, and can be adopted for biodiversity hotspots as Western Ghats through establishment of Joint BMC in the Western ghats region.

128. In particular, data that seem to be needed for any elaboration at the landscape level are:
    1. Location of each BMC and its jurisdiction.
    2. Mapping land use within each BMC such as ownership (public or private) human population density, household size, occupation, assessing levels of poverty using indices such as house condition/ownership of motorised vehicle (available from Census of India website at district level), energy use etc.
    3. Biodiversity such as flora, fauna and below ground resources within BMC that are harvested and traded (officially and unofficially harvested); their use (i.e. medicine, food, fuel , agricultural input, etc.); number of households dependent on that resource; market value of the resource; quantity harvested per year for trade or household use; location of market for products.
    4. Indices of sustainability can be developed to assess harvesting pressure.
    5. Identify threats such as invasive species, climatic variability, poaching, illegal plant and wildlife trade etc.
    6. Indices of forest loss and degradation (from Forest Survey of India database); invasive species, poaching.

129. Databases can be integrated across higher spatial and administrative scales such as the district, region, eco-type etc. to form a baseline for management of biodiversity from the local to the state level. This will enable mapping of critical resources, identify regions where resources are being depleted, identify illegal harvest networks and marketing. This will also provide an opportunity for adaptive management of resources, designating periods when off take should be reduced, finding alternatives when the resource is depleted.

130. The French Institute of Pondicherry in collaboration with the Kerala Forest Department and the Mahatma Gandhi University, Kottayam has been developing the landscape approach to biodiversity conservation in Kerala state (http://apps.ifpindia.org/Landscape-Analysis-for-Biodiversity-Conservation.html). The GIS database is already available for the Western Ghats section of Kerala. What needs to be done is a compilation of databases at different scales. The data needs to be embedded within a management framework: evaluation of existing knowledge, gaps in knowledge, objectives, measurements, assessment, to come back to gap analysis in a loop. This can be done by an institution such as the Madras School of Economics (http://coe.mse.ac.in) and others that have

the requisite resources, socio-economic databases and expertise. Experts from this and/or other institutions can help carry out a valuation of biodiversity in Kerala State (http://earthmind.net/rivers/docs/oecd-handbook-biodiversity-valuation.pdf), which will help with the management plan.

131. What needs to be done is:
    1. Evaluation of previous knowledge.
        1. What projects exist, main results.
        2. Review of National and International programs because they give solid frameworks and methodologies within which to embed the plan.
    2. Gap analysis.
        1. Realizing the economic importance of biodiversity through an academic effort to summarize it.
        2. Gathering existing knowledge (topographic, road, ecosystem, land use, etc… maps), published scientific papers, existing statistics (village, district, state population, water resources, rainfall).
        3. Organizing existing knowledge in databases (Geographic Information System, database).
        4. From existing documents, make a gap analysis: what needs to be addressed in priority, preferably within an existing National or International framework. For example, implementation of National Biodiversity Act 2002.
    3. Mapping of resource: Academic and research institutions can be involved in such an effort
        1. Obtain a Topographic map of Kerala state.
        2. Identify different natural and managed ecosystems using remote sensing techniques and ground truthing.
        3. List the biological wealth of each ecosystem.
            1. Use the PBR to list the biological diversity in each locality.
            2. Use GIS tools at the level of each PBR to map the resources that are critical for human welfare.
            3. Identify resources that are harvested and/or traded. Legal and illegal harvest needs to be detected. Available sources of information can help preliminary assessments.

132. The second objective is to use the knowledge obtained through Peoples Biodiversity Register and efficient use of biodiversity for people's livelihood.

133. This involves biodiversity monitoring at the local level which can then feed into the GIS to assess spatial and temporal patterns of biodiversity and resource use by local communities. The Joint Biodiversity Management Committees (BMC) can function as a very important component of local level participation in biodiversity use and conservation.

CHAPTER 7
PEOPLES BIODIVERSITY REGISTER- DECENTRALIZED PLANNING

Introduction

134. The PBRs, would become authentic natural resource data base of every local body, as it envisages listing and mapping of the ecosystems and biodiversity at LSG level. Further, PBR also envisages preparation of action plans for the management of biodiversity and ecosystems at the grass root level, with the involvement of stakeholders at the grass roots. The PBR OF Kerala provides a baseline data about the local bioresources available with specific reference to landraces. The local people-scientist partnerships play an important role not only in documenting and validating data collected on biodiversity, but also in utilizing the bioresources sustainably. PBRs could be used as a tool for promoting conservation, sustainable utilization and benefit sharing through commercialisation of products out of the TK.

135. The functions of Peoples' Biodiversity Register was envisaged as

1. Promote decentralized management of natural resources.
2. Recording of biodiversity related knowledge at LSG level.
3. Monitoring resource changes-Agro biodiversity, Faunal diversity, Forest diversity.
4. Promoting knowledge-based sustainable management of agriculture, livestock, fish, forests and public health.
5. Regulation of access to biodiversity resources leading to sustainable harvests
6. Opportunities to generate funds through imposition of collection fees for access to biodiversity resources.

136. The Peoples Biodiversity Register of Kerala chronicling the local biodiversity and the cultural landscapes at Panchayat, Municipality and Corporation level prepared in a truly decentralized manner by State Biodiversity boards focus on, areas having natural vegetation of cultural significance, such as sacred groves, water bodies, hillocks etc. and similar areas associated with cultural and religious beliefs and practices. KSBB has prepared 854 PBR so far but it cannot be considered as an end. PBR preparation should be a continuous periodic updation process but at the same time each PBR contains valuable information on some or the other aspects related to bioresources. In addition most of the PBR contains information about the history of the place, the story behind the origin of the name.

137. The major mandate of PBR is documentation of biodiversity and associated knowledge, ways to accrue benefits to community, quantification and sustainable management of resources.PBR envisages the creation of database of biological resources, cultural heritage of locality and local knowledge on uses of resources. The PBR gives account of areas having natural vegetation of cultural significance in the locality, such as sacred groves, water bodies etc. and similar areas associated with cultural and religious beliefs and knowledge and practices concerning nature, traditional medicine. Traditional knowledge, local ecological knowledge accumulated within a society and transferred through cultural modes of transmission, such as folklores and riddles are also mentioned in PBR. The challenge before the scientific community lies in being able to put meanings into, what may just seem to be mere belief systems, and link it with the decision-making process in the contemporary context of nature-culture linkages and interactions.

138. Expressions of traditional culture such as local festivals and mythology, Folklores and riddles connected with harvesting and agriculture, local arts and crafts, sacred groves, cultural diversity, local viads and primary health care, age old systems of biodiversity conservation, local land races, agro biodiversity, and native breeds of animals, traditional knowledge holders of locality are some of the components of PBR. Thus PBR from Tirunelli describes important festival among some communities as Thira. The festival is celebrated in the paddy field and shows the link with paddy in Wayand. After fasting for a long period they put the dress for Thira and there is a belief that if the fast is broken some disaster will occur. Thira is celebrated to solve all the problems of the locality. It is believed that by doing so all disasters are removed and life will become happy.

139. The agriculture calendar is linked with socio-cultural festivals and ceremonies. Agricultural, soil, land preparation, sowing and planting of propagules, manuring, irrigation, intercultural operation, intercropping and harvesting etc form main themes in the folk-poems and are mentioned in PBR. There are many folklores relating to importance of quality seeds in agriculture, use of organic manure, time and method of sowing and planting, soil and land preparation, the quality of local land races etc in PBR. Farmers conserve several indigenous varieties adapted to diverse environmental conditions and cultural needs. A wide range of local landraces and farmers varieties of rice are mentioned in PBR showing variability for different characters such as duration (long, medium and short), grain size (big, medium and slender), season (Nancha and Puncha cultivation), Landscape (lowland, upland and Marshy land). Cultural landscapes can provide the basis for the crops of with greater resilience to adverse climatic conditions and the PBR throws light on the local land races and wild relatives of agricultural crops of Kerala. KSBB has already submitted a document on Agro ecological Planning based on a desk review of PBR to Planning Board.

Box 1 *PBR data and future opportunities*

Agriculture	1. Documentation of Agro biodiversity 2. Different types of soil as per local knowledge 3. Information on pests and diseases of crop fields and local remedies 4. Local songs associated with harvesting of crops, seeds etc
Animal husbandry	1. Diversity of domesticated animals 2. Home remedies used in Animal health care
Ecosystems	1. Documentation of ecosystems as wetlands, ponds, natural aquifers, laterite hills, grasslands, waste lands, agricultural lands etc 2. Document land degradation and land use change 3. Documentation of weeds and other invasive species
Environment and human health	1. Documentation of overexploitation of bioresources 2. Document polluting industries and other sources of pollution in inland, marine and terrestrial ecosytems 3. Pollution due to Solid, liquid, industrial, agrochemicals, e-waste 4. Outbreak of communicable diseases and vectors and local remedies for mosquito control etc. 5. Unsustainable urbanization 6. Quarrying and mining
Forest and Livelihood	1. Documentation of areas with good tree cover, mangroves, riparian vegetation etc 2. Deforestation, diversion of forest for other land use 3. Promotion of monoculture 4. Endemic species and bioresource change
Inland and marine waters	1. Documentionof destructive fishing practices such as use of

	dynamite and pesticides. 2. Document bioresource utilization and decline in stock 3. Documentation of artificial coasts and sea walls, encroachments etc
Traditional Knowledge	1. Recording of traditional knowledge as well as grass-roots innovations associated with biodiversity such as medicinal uses, vegetable dyes, cosmetics, pest control agents. 2. Recording of folk arts and crafts associated with biodiversity 3. Recording of home remedies for human healthcare
Biodiversity and local livelihood	4. Documentation of Artisans and craftsman utilizing bioresources 5. Documentation of bioresources with commercial potential

Applications of Knowledge Recorded in PBR

1. Ex situ conservation of germplasm of local landraces and farmers varieties in accessions of Agriculture department / NBPGR .
2. Promote in situ conservation measures of crop varieties at LSG level with Agriculture department.
3. Promote local knowledge of Animal husbandary at LSG level with Animal husbandry department.
4. Rewards conservators of Farmers varieties/ Local breeds under the Protection of Plant Varieties and Farmers' Rights Act/ Breed saviours award/ KSBB Biodiversity award.
5. Promote home remedies for local healthcare at LSG level/ AYUSH Dept.
6. Promote dietary diversity through documenting uses of minor food crops/ leafy vegetables/ tubers etc.
    1. eg. Diversity of local landraces of rice at Wayanad (Tirunelli PBR)
    2. Diversity of banana cultivars (Parassala PBR)
7. Traditional agricultural implements/ Local songs associated with Agriculture can be preserved in association with culture department (Nedumangad PBR).
8. History of the panchayat and local knowledge from older generations (Idavetti PBR) can be added to database of culture Dept.
9. Local festivals and Local songs associated with harvesting of crops, seeds etc. (Velinezhi PBR).
10. Strengthen marketing linkages for bioproducts produced by local Artisans and craftsman listed in PBR (Velinezhi PBR).
11. Identification and promotion of ecologically unique areas listed in PBR as BHS (PBR of Peringadavila, Amboori).
12. Promote maintenance of ecosystems and take action for forest diversion and wetland encroachment.
13. Identification of wastelands and Promote planting of endemic trees and shrubs and fodder crops.
14. Identification of natural aquifers and promote their maintenance.
15. Protect wetlands from encroachments, reduction of water inflow from catchments.
16. Promote eradication of alien invasive species like Water Hyacinth and African catfish from water-bodies.
17. Organize effective pollution monitoring using, where possible, more accessible bio-indicators.
18. Document and regulate over-fishing in inland waters.
19. Record and check destructive harvests by community members as well as outsiders.
20. Promote sustainable fishing practices.
21. Provide data for Watershed programmes at local, regional and state levels.
22. Promote traditional conservation practices like protection to sacred groves, ponds, and heronries.
23. Promote sustainable fishing practices such as protection to fish migrating upstream for spawning.
24. Provide data for working out methods and schedules of sustainable harvests of minor forest produce.
25. Promote value addition to minor forest produce.

26. Use of modern Information and Communication Technologies in the PBR exercises such as video recording, voice recording would provide for protection of TK.
27. Trainings may be given to promotion of income generating activities identified from local bioresources such as Banana fibre, screwpine (eg PBR from Balaramapuram for eg. in PBR of Balaramapuram details of production of various products from Banana fibre, method of producing Ayurvasthram, Ayurbhavanam , mosquito nets etc are mentioned).
28. Marketing linkages and support for GI indications, Fair trade, organic certification and other such ecofriendly and socially sensitive certification programmes etc.
29. Training for local methods for drying and storage of Non wood forest produce sourced from the panchayat Encourage value addition through local processing and help in marketing, if necessary, by fixing a support price for major products of the area. This will help in generating considerable off farm employment opportunities.eg Weaving, Basket making, Musical instruments etc.

Recommendations of the Working Group

140. The prospect of bringing together detailed locality and time specific information on biodiversity collected at grassroot level with scientific validation promises to generate new levels of understanding. The PBR exercise attempted by KSBB is an initial step and should be a continuing endeavour and the list of *focal issues* based on priority set by different user groups should form the basis of the next phase of the PBR exercise and more and more issues can be taken up in due course of time.

141. After reviewing the achievements made during 12th Five Year Plan in the existing schemes/ programmes of Kerala State Biodiversity Board the Sub-group recommends the following for inclusion in 13th Five Year Plan in the subgroup PBR.

1. Periodic updation of PBR for participatory biodiversity monitoring and reporting after identification of major gaps in knowledge
2. State wide documentation of uncodified traditional knowledge
3. PBR data management system
4. PBR as a textbook and Panchayat as a classroom
5. PBR and natural resource management

Periodic Updation of PBR for Participatory Biodiversity Monitoring and Reporting

142. At the threshold of the 13th Five year plan a fresh assessment is required for identifying and filling the gaps in the PBR and maintenance of data. Conservation and sustainable utilization of bioresources as mandated in Biodiversity Act requires accurate data and monitoring the current status and trends and identifying decline in population sizes and other threats. This data needs to be constantly updated and the information generated needs to be consolidated and put in public domain for management decisions at local, regional and state levels.

143. Some of the specific areas which have to be concentrated on include:

1. Developing monitoring and quantification criteria specific to local level.
2. User friendly data collection formats for updation.
3. Identifying season and frequency of measurements.
4. Identification of changes in unique habitat and resources.

5. Identifying and ranking the threats to biodiversity and impact assessment of developmental projects.
6. Documentation of Bio-trade and bio-resources with ABS potential.
7. Traditional knowledge, innovations and identification of knowledge holders.
8. Identification of people dependent on bio-resources and develop support systems for enhancing their livelihood opportunities.

144. Efforts should be organized at the state and local levels to develop [a] resource material, [b] training modules, [c] a network of experts and technical institutions to support PBR updation activities and [d] a database designed to organize the locally collected PBR information and link it to a broader networked Biodiversity Information System. The PBR should be updated to perform as a Participatory Biodiversity monitoring and reporting system at local level.

145. *PBR and indigenous species and unique ecosystems.* The updation should focus on generating an inventory of local landraces of domesticated crops and breeds. It should also include listing of ecologically sensitive areas and species in each LSG that need to be protected, its importance to be studied and described, threats to these to be delineated and protective measures suggested.

146. *PBR for biodiversity monitoring in forest areas.* Protected areas are the cornerstone of biodiversity conservation; they maintain key habitats, provide refuge, allow for species migration and movement, and ensure the maintenance of natural processes across the landscape. The forest areas of Kerala occupy 29.101% of total geographical area of Kerala and 8.26% of total geographical area is under protected area. Biodiversity monitoring in forest areas with special focus on Tribal ecological knowledge and their documentation in PBR shall form the core of 13th five year plan. This work can be taken up in association with Forest department.

147. *PBR in Agroecological zones.* In Kerala using a matrix built upon altitude, rainfall, soil and topography, the state has been delineated into thirteen agro-climatic zone using Block Panchayat as the unit for purposes of delineation. The compilation PBR data along with updation based on agro-climatic zone will enable scientific management of regional resources to meet the livelihood of people without adversely affecting the status of natural resources and environment.

148. *Marine Biodiversity Register.* Documentation of Marine biodiversity along Kerala coast and traditional knowledge of artisanal fisherman.

149. *Capacity needs for PBR updation.* A periodic updation for assessment of local resources necessitates skill development programmes for stakeholders including exposure visits. The training module for village botanists/zoologists/marine ecologists developed by FRLHT, Bangalore can be considered as a model after incorporating specific needs of the state. The peer to peer exposure visits organized by Telengana Biodiversity Board for its BMC members for PBR preparation is another replicable model.

Documentation and Database of Best Practises in Uncodified Traditional Knowledge

150. Following the adoption of the UN- Strategic Plan for Biodiversity 2011- 2020 and its Aichi Targets 20, India has developed 12 National Biodiversity Targets (NBTs) in line with the 20 Aichi targets and updated National Biodiversity Action Plan (NBAP) by including the NBTs. National Biodiversity Target 9 has set a goal that by 2015 Access to genetic resources and fair and equitable sharing of benefits arising from their utilization (ABS) as per Nagoya protocol is operational. PBR

contains a wealth of information on local home remedies and has documented the un-coded, oral traditional knowledge of local people to a limited extent. Considering that this is a stupendous and time-consuming exercise, it is proposed that an Coordinated Project on Uncodified Traditional Knowledge may be launched in the 13th Plan in the context of ABS.

1. For documenting the un-coded, oral traditional knowledge of local people, especially of little-known bioresources of potential economic value in the context of Access and Benefit sharing.
2. Document commercially tradable bioresources with details of location, quantity, frequency of trade, value addition and traders involved.

PBR Digitization for Data Management and Analysis

151. New information technologies have enabled the scientists and stakeholders to adapt, adopt, and leverage novel approaches and digitization of recorded knowledge enhances their value by improved access to core biodiversity information, increases use, relevance and potential downstream value, for example, in the management of natural resources, policy development, food security, and human health. PBR Data management and analysis is an important step and the documentation should help prevent loss of grass-roots knowledge associated with biodiversity, secure recognition for such knowledge and add value to it.. KSBB has developed a web based PBR database and NBA has also set up a national committee to develop a uniform software for the same. The database of PBR is designed to manage the information in PBR by using Microsoft visual studio 2008, VB.Net 3.5 as front end and SQL servers 2008 as backend. By using this we can add, edit and manage details of Agro biodiversity, Domesticated diversity, Wild biodiversity, Urban biodiversity and Wetland biodiversity and search for details based on LSG. The 13th Plan should focus on improving upon the PBR database for accurate retrieval of data and data analysis. The digital recording of PBR can be completed in a time bound manner in two years. This can be accomplished by utilizing 20 resource personnels (@ 2 PBR/month) for 24 months. Services of two taxonomists and one project co-ordinator may also be required. The gaps identified are to be addressed at the institute level and at field level.

PBR as a Text Book and Panchayat as a Classroom

152. Biodiversity education is a crucial tool for conservation and sustainable utilization of biodiversity and field exposure has an important role in formal and non-formal education systems. Each region and locality has different ecosystems, endemic species and local land races which act as a vital link in the web of life. The PBR will provide real-life exposure to students to get acquainted with the local diversity of agricultural crops, food diversity, medicinal plants as well as wild flora and fauna of their panchayat and the threats to biodiversity as also traditional knowledge and home remedies widely used in their locality by the older generation. Educational institutions at all levels, from primary schools to universities, could play an important role in periodic updation of PBR which could also become a very valuable component of environmental education curricula. KSBB had already implemented a project with support of NBA in five districts: Thiruvananthapuram, Kollam, Ernakulum, Malappuram and Wayanad. The project involved a total of 5000 students in the state spread over 25 grama panchayats and 28 schools.

153. People Biodiversity register can be used ideally as a handbook for assessing locally significant elements of biodiversity as part of formal and non-formal education. The project can be introduced as part of education in a phased manner in the educational institutions of Kerala.

PBR and Biodiversity Heritage Sites

154. The 13th Plan schemes should strive to make a transition from regulations to promote local and community conservation-oriented actions in the context of traditional practices. Section 37 of the BD Act provides for designating well defined areas that are unique and ecologically fragile ecosystems as Biodiversity Heritage Sites. The purpose is not to cover the already designated protected areas such as national parks and wildlife sanctuaries but to cover sites rich in biodiversity, wild relatives of crops, or areas, which lie outside protected area network without imposing any regulations for local community. In Kerala 8.26 % of total geographical area is under protected area network and 49.5 % of the state is under forest cover (tree canopy density of more than 10%, minimum area of one hectare). The State government has to designate such areas with good tree cover in consultation with the LSGs, and to frame rules for conservation and management of such heritage sites. This would facilitate management of biodiversity hotspots in the state, which now remains outside the protected area network.

155. The data from several PBR can be used for identifying potential sites to be declared as BHS (PBR of Peringadavila, Amboori).

PBR and LSG

156. Cultural diversity and natural diversity are mutually interconnected as cultural practices depend upon definite aspects of biodiversity for their existence and biological diversity is maintained and conserved by cultural groups. Kerala is a land of rich and varied folk art tradition. The folk and tribal arts of Kerala are simple, ethnic and colorful. It speaks volumes of country's rich heritage. Folklore is probably the most important and well-acclaimed component of the cultural heritage of a nation. Verbal expressions, such as folk tales, folk poetry and riddles. Religious customs, festivals, oral traditions and expressions, including performing arts, traditional craftsmanship, social practices, knowledge and practices concerning nature, traditional medicine finds mention in PBR. Each locality is replete with their own myths and legends most of which are associated with nature.

157. Cultural beliefs and traditional values prevent overexploitation of resources and sustain the systems in which indigenous societies live for their own benefit and that of future generations. These communal-centric concerns towards natural resources around are reinforced through myths, rituals and ceremonies. Most of these are expressed and perpetuated through folkdance, music and arts. The recorded traditional knowledge of history of the panchayat, local festivals and folksongs and myths related to agricultural harvesting etc in PBR can be added to the database of Department of culture, incorporated in the website of LSG.

CHAPTER 8
BIODIVERSITY AND LIVELIHOOD ENHANCEMENT

158. Integrating biodiversity conservation and agro and agro-aqua production systems is one of the best but complex ways of achieving community participation and ownership of biodiversity conservation and sustaining livelihood security of rural community. Such an approach is applicable to all the 13 agro-climatic zones of Kerala but it is more relevant to midland plains and coastal areas of Kerala where different types of productions systems, evolved over period of time, exist. The 13th plan should focus on

1. Inventory of potential bioresources and then business development plans from micro level: on pilot basis this can be done in specific areas and with specific resources.
2. Livelihood enhancement schemes through value addition of Agricultural produce and marine and inland resources.
3. Frame work for assessing natural bio resource use such as marine and inland fish, Non Timber forest resource etc and a database of bioresources with economic potential and associated knowledge.
4. Traditional knowledge associated with biodiversity for bio-prospecting, new therapeutic remedies, benefit sharing as per ABS mechanism.
5. Development of new entrepreneurial units based on handicrafts, bamaboo crafts etc to be set up in Panchayat, jointly with Local Self Government Institutions. They will be provided with mentor support in the initial years and marketing support through Govt. institutions.
6. Involve research institutions NGOs and research institutions to set up processing plants.
7. Development of Biotech park to facilitate industry linkages and benefit sharing.
8. Resource base assessment of NTFPs, its quantitative assessment, harvesting schedule and standardization of extraction technique for ensuring its sustainable supply and effective management.
9. A centre is to be established for standardizing the scientific collection, processing and value addition of NTFPs from forests.

Community Seed Banks for Ex Situ Conservation of Local Landraces

159. To promote and encourage the farmers to continue in-situ conservation of traditional varieties identified in PBR, which can be stored and conserved in Community seed banks managed by local people under BMC/ LSG.

160. The domesticated biodiversity includes a wide range of land races of plants and breeds of animals which constitute valuable gene pools useful for improvement of modern varieties/cultivars. One method of conservation of these gene pools is on-farm conservation through appropriate incentives to the farmers and *ex situ* conservation in seed banks. In Kerala 2000 local landraces of rice were reported, 19.23 % of total paddy area was under cultivation with local landraces during 2002-2003 but this has reduced to 6.45 % during 2011-2012.

161. The main objective is establishing a scientifically organized community level seed bank of traditional varieties of rice. The seed bank will serve as a repository of seed samples of traditional varieties of rice collected from fields. The seed bank will be set up with the help of local farmers who have been trained to clean, dry and store their seed at optimum temperature and moisture content and, control pests. Seed banks will be financially supported during the 1st year of implementation for setting up the required infrastructure like the purchase of pots for storage of seeds, construction of space to store the pots, etc and after the 3rd year it will be maintained in a self-sustainable participatory manner under BMC/ LSG. BMC will provide necessary training, technical support and support the initial collection and establishment of seed bank. Farmers will have to return an equal amount of seed they have taken from the seed bank, during the next season. The seed bank will be mostly managed by women who are trained on seed selection, storage, record keeping and other aspects of seed bank management. The project will also support the revival of the traditional seed storage device. A representative sample of the varieties will also be maintained for long term storage in ex-situ seed banks established under KSBB in association with Kerala Agricultural University.

Integration of Biodiversity and Agro Production System

Integration of Conservation of RET (Rare, Endangered and Threatened) Trees in Coffee Agro System

162. Kerala is the second largest producer of coffee in India. According to the Coffee Board, Government of India, Kerala produced about 69000 ton of coffee during the year 2015-16, which is about 23% of the total coffee production in India. The coffee economy of Kerala is virtually the coffee economy of Wayanad. Wayanad produces 90 percent of the total coffee output in the State. In the Wayanad district alone coffee is being cultivated in about 67000 ha, whereas in Travancore and Nalliampathy zones it is grown in limited areas. According to the Agriculture Department, Government of Kerala marginal and small holdings constitute more than 90% of the coffee holdings. The marginal coffee farmers own one hectare (ha) or less than one ha of land whereas small farmers hold land between one and two ha.. A rough estimate indicates that in Wayanad district alone coffee cultivation generated 6067000 man days of employment (men: 3101182; women: 2966348).

163. Coffee plantation in Kerala was started during early 1820s and spread quickly into large areas at the expenses of biodiversity since evergreen forests, which are home for diverse plants and animals, were cleared in large scale to establish these coffee plantations.

164. In the beginning coffee was cultivated in relatively large shaded areas of native trees but later to increase yield coffee was started cultivated under full sun; now it is being grown with a few shade trees such as jack tree and exotic species silver oak. In these sun-grown and partially shaded coffee plantations a variety of problems are encountered including low soil organic content leading to heavy use of chemical fertilizers and increased pest and disease attack leading to application of pesticides and other chemicals. The increase in input costs, reduced productivity and volatile market prices made coffee farming is not remunerative but for small and marginal coffee farmers income it is their only source of income.

165. This situation provides opportunity to integrate conservation of RET tree species in coffee agro systems. It is to be mentioned hear that southern Western Ghats houses more than 4465 flowering plants of which 4050 species are native plants. Out of this, 497 species are recorded and belong to RET categories and deserves immediate conservation attention. These RET tree species can be planted in coffee farms as shade trees, which will have multiple benefits:

166. *Livelihood Benefits.*

1. Reduce production costs, as conservation of RET tree species along with its own fauna including bird species, which will naturally manure the coffee plantations and also increase soil organic carbon leading to lesser usage or no usage of chemical fertilizers.
2. Increase productivity over the long-term, as coffee trees grown under shade have a longer lifespan than those grown under very lightly shaded or full-sun conditions.
3. Increase quality of the coffee, which can lead to higher prices, as shaded coffee trees generally produce slow-maturing, larger beans with a better flavor profile.
4. Provide farmers with additional sources of income in the form wood and also ensure food and nutritional security in the form of fruits.

167. *Environmental Benefits.*

1. Enrich the soil and strengthen root systems, preventing soil degradation and erosion.
2. Capture and retain rainfall, lowering temperatures for the heat-sensitive coffee trees.
3. Attract birds, ants, and other organisms that serve as a natural pest control against coffee pests.
4. Remove carbon from the atmosphere, helping with climate change mitigation
5. Serve as important habitat for wildlife, such as migratory birds – this is why shade-grown coffee is often also called "bird-friendly" coffee.

168. Apart from these, coffee grown under the shade of RET species can be branded as green brand or carbon neutral, which will increase the income of these marginal and small coffee farmers.

169. Though in shade-coffee agro systems coffee trees have longer life span and more resilient to pests and diseases they produce less coffee beans but coffee grown in shaded condition can get premium price.

170. Thus, converting sun-grown and partially shaded coffee farms into RET tree- shaded coffee agro systems involves a complex process and requires long-term plan with clear incentives to farmers.

Integration of Biodiversity and Agro-Aqua Production Systems

171. Presence of extensive tidal inundated saline land is a characteristic feature of the coastal zone of Kerala. About 26400 ha of coastal saline soil is present in Kerala of is about 20000 ha is located in Ernakulam District, about 3000 ha in Alappuzha and about 2000 ha Kannur and 1400 ha in other districts. All these lands are part of the Vembanad-Kol wetland complex. The coastal saline soil along the Ernakulam district is referred to as pokkali fields, whereas in the Alappuzha and Kannur districts they are known as Karilandsand Kaipad, respectively. A major portion of these saline lands (Kayal and Lower Kuttanad) are about 0.6 to 2.0 m below sea level. These saline lands are inundated with freshwater during the monsoon season (June to October) and filled with brackish water during remaining season (November to April). The farmers in these regions developed a traditional te-chnique by which paddy-shrimp farming is practiced in these lands on rotational basis. This traditional paddy-shrimp farming system received recognition from Food and Agriculture Organization (FAO) as a Globally Important Agricultural Heritage Site (GIAHS).

172. The flood plains, kayals, ponds and canal works associated with these saline lands are rich in fish and shell fish. The wetland environment with changing salinity and water levels contributes to richness in aquatic diversity. It has been reported that over the last thirty years, the fish diversity in this region has reduced from 150 species to 36 species and many are reported as critically endangered or even extinct in the region. Some of the endangered fish species of the region are the endemic carp of Central Travancore, *Labeo dussumieri*, the golden catish, *Horobagrus brachysoma*, the riverine coldwater fish, *Gonoproktopterus curmuca*, the glass perch, *Parambassis dayi*, *Macropodus cupanus*, and *Nandus nandus*. The highly threatened endemic species in the fresh water reaches include *Channa micropeltes*, *Channa leucopunctatus*, *Pristolepis malabaricus* (Pannakarimeen), *Ompok bimaculatus* and *Clarias dussumieri*. Four species of clams (*Villoritta cyprinoids, Meretrix casta, Paphia malabarica and Sunetta scripta*) are reported from the region, in which *Villoritta cyprinoids* is harvested for meat and it is an important livelihood option for the poor families of the region. Its production was estimated about 31430 ton in 2000. The abundance of the clam used to be more in the intertidal zones where it was reported in dense forms. Apart from these, these wetland systems were once rich in mangrove biodiversity also but now its presence is reduced to restricted areas. Aqua-silvi technique can be practiced in the mangrove areas for enhancing livelihood opportunities of local people.

173. The saline tolerant pokkali rice varieties such as choottupokkali, cheruviruppu, kuruka, anakodan, eravapandy, bali, orkayama, orpandi and pokkali are the traditional cultivars prevalent in this tract and they are rich source of genetic diversity, which can be used to develop saline tolerant crop varieties. These traditional varieties are also tolerant soil acidity and submergence. pokkali varieties are very rich in antioxidants and amount of which is even higher than that of the medicinal rice njavara. The pokkali rice is rich in amylase content and hence it can be popularized as rice which is good for diabetic patients.

174. Though this rice-shrimp farming system has many advantages, it is fast disappearing due to various reasons. A study indicates that about three decades ago *pokkali*f arming was practiced in about 25000 ha in the 1980s which has now drastically to 2200 ha.

175. Revival of this system with innovative practices will play a major role in conserving aquatic biodiversity and also offers an opportunity of climate resilient farming practice in the event of the change in climate scenario particularly in the recent decades. Some innovative practices that can be introduced during the revival of Pokkali and Kaipad systems are given below.

176. *Integration of fish farming in Pokkali system.* In the Pokkali system, saline tolerant paddy is grown during the monsoon season (late May to October) when the system is filled with freshwater or low saline water. During the remaining period, Pokkali paddy fields are allowed to be inundated with brackish water in which shrimp is grown. Apart from this cyclic system of paddy-shrimp production, culture euryhaline fish can be promoted simultaneously along with paddy cultivation during the monsoon season, which will give additional income to the farmers. Fish such as mullets, milk fish, tilapia and pearl spot can be grown along with paddy. In order to achieve this, design of the paddy field needs to be changed, which can be done through a consultative process with the farmers. Culturing of many of the endemic fish species can also be evaluated in this system.

177. *Integration of mangroves in Pokkali system.* One of the serious problems faced by Pokkali and Kaipad farmers is instability of bunds along the margin of the rivers and canals (marginal bunds) and along the periphery of each Padasekarams (Polders). Many of the Pokkali and Kaipad fields become non-operational due to broken bunds and insufficient bund height in many places due to the increase in tide level especially during the spring tides. The over flow of water over the bunds cause damages to

the bunds and also leads to movement of fish and shrimp grown in the farms to other farms and to rivers and canals. This is one of the reasons indicated by the farmers to refrain from paddy-shrimp farming. This problem can be solved by integrating mangrove plantation in the marginal bunds. Role of mangroves in avoiding soil erosion is well known. Many of these mangrove species have extensive root system which can hold soil together even when the speed of the water current is high. Apart from this, mangroves enriche soil of the paddy field with organic carbon and can also enhance fishery production by acting as nursery for young shrimps and fish.

178. *Approaches.* As shown in the above examples, integration of biodiversity conservation in agro and agro-aqua production systems requires a kind of approach which may be called "Go back to tradition with modern knowledge and practices". Acceptance of such approach requires support of the both the government as well as scientific community, first for the development and demonstration of successful models of integrated systems and then for upscaling. Secondly, as indicated in the above examples, such integrated systems should look into five capitals relating to livelihood security of rural community, which commonly called sustainable livelihood approach- Natural, Social, Human, Physical and Financial capital. Simple tools are available to assess status of these capitals and such assessment provide better understanding of the assets, capabilities, needs, and strategies that are present within the community, what the constraints on the system are, and how the system might be most effectively influenced to integrate conservation of biodiversity and livelihood security.

179. These approaches will ensure sustainable use of biodiversity, improved and Participation and empowerment of local communities.

Sustainable extraction of Non-Wood Forest Resources (NWFR)

180. *Inventories on resource availability.* Over the years, the demand for forest resources especially the NWFPs has increased tremendously due to their requirement for manufacturing a variety of products on commercial basis. This has lead to increased exploitation, often in unsustainable basis. At present, the State does not have a comprehensive account on different economically important species (except a few medicinal plants) that are being used for various purposes, its distribution, resource availability, population density, occurrence, phenological aspects etc. NWFR are sustainable only if the harvesting is proportionate to the regeneration/recouping ability of the harvested plant or plant parts before the next harvesting season. Most of the Non-Wood Forest Resource (NWFR) collectors give little or no consideration to the perpetuation of the resource and their focus is to collect the maximum within the shortest time possible. Also, the collectors prefer to collect premier items which fetch a higher price. Collection of bark, stem and roots of tree are destructive. Collection of bark by girdling the tree often results in the death of the tree. Collection of resin is done by making cuts on the bark and the hardened resin is collected after a few days and its price is determined by the size. This also leads to the death of the tree. Collection of fruits is often before they ripen. Collection of entire plant in the case of herbaceous NWFRs leads to population depletion. Hence, sustainable levels of harvest of popular, less resilient species need to be established and monitored as part of an adaptive management process.

181. This can be achieved through creative partnerships between various stakeholders and technical co-operation.

    1. Establish a state level task force on NWFR , their status, conservation and use

2. A complete inventory of the forest resources of Kerala with relevant details on resource availability of rare, endangered and threatened NWFPs will be of immense use for devising strategic plans for strengthening resource base and conservation.
3. Promotion of cluster development activity in Kerala related to value addition of bio resources as most of the NTFP are sold/ exported in raw form with little value addition leading to exploitation and poor returns for primary collectors.
4. Providing assistance and train them through research support in innovative measures for sustainable and timely harvesting, grading, processing and value addition of NTFPs.
5. Encourage value addition through local processing and help in marketing.
6. *Exploration of underutilised resources:* Forests of Kerala are a treasure house of underutilized plants having potential to contribute to the food security, health, income generation and environmental services. The range of these species is wide, including plants that provide edible fruits, grains, leaves, nuts, oils, roots and tubers, fibres, medicines, spices, stimulants and other products. Sustainable utilisation of these resources supports the food and health security, especially of indigenous people those who reside in the premises of forests, which leads to long term conservation especially in the context of Forest Right Act. The conservation of these repositories is essential since it's a matter of livelihood security of the locals.

CHAPTER 9
ACCESS AND BENEFIT SHARING

Introduction

182. The rich biological resources and associated traditional knowledge of Kerala is an asset that should be sustainably used by stakeholders in a manner that access to such resources and associated traditional knowledge, subsequent use and commercialization result in sharing of benefits with those providing the resources. The ABS framework for the state should be oriented to
    1. Promote the conservation and sustainable use of Kerala's biological resources
    2. Outline the role of various sectors and stakeholders in implementing the state level ABS mechanism.
    3. Establishing enabling conditions that support both R&D in biological resources and associated traditional knowledge.
    4. Providing mechanisms for BMCs to benefit from access and commercialization of Kerala's biological resources and associated knowledge.
    5. Preventing misappropriation of Kerala's biological resources and associated traditional knowledge.
    6. Improve economic and livelihood opportunities for communities in Kerala using ABS as a sustainable financing option.
    7. Suggest the implementation options for ABS system, at state level, as suggested in Section 7 of the Biological Diversity Act and the Kerala State Biodiversity Rules; and

International Scenario

183. The Convention on Biological Diversity was opened for signature on 5 June, 1992 at the United Nations Conference on Environment and Development (the Rio "Earth Summit") and entered into force on 29 December, 1993. The Convention is the only international instrument comprehensively addressing biological diversity. The objectives of the Convention are:

    1. Conservation of biological diversity.
    2. Sustainable utilization of biological diversity.
    3. Fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

184. The third objective of the convention emphasizes the access to the genetic resources and its fair and equitable benefit sharing. The Convention on Biological Diversity (CBD) provides national governments with sovereign rights over genetic resources and associated traditional knowledge with the aim to ensure that countries receive a fair share of benefits from their biological resources and traditional knowledge in return for conserving and allowing access to these resources.

National Scenario

185. The Biological Diversity Act 2002 and Rules 2004 by Government of India is a landmark legislation which provides for regulated access to bio resources for commercial utilization or for bio-survey and bio-utilization. Following the adoption of the UN- Strategic Plan for Biodiversity 2011- 2020, India has developed 12 National Biodiversity Targets (NBTs) and updated National Biodiversity Action Plan (NBAP). National Biodiversity Target 9 has set a goal that by 2015 Access to genetic resources and fair and equitable sharing of benefits arising from their utilization (ABS) as per Nagoya protocol

is operational. MoEF has also directed National Biodiversity Authority, Chennai and State Biodiversity Boards to implement ABS.

186. The effective implementation of Access and Benefit Sharing (ABS) provisions in the territorial jurisdiction of India is dealt with in the Sections 3, 4, 5, 6 and 7 of Biological Diversity Act 2002 and in the Biological Diversity Rules 14-20.

187. **A conservative estimate by the industry and Ministry of Environment and Forests (MoEF) sources puts the loss due to non-implementation of ABS nationally at Rs 20-25,000 crore annually.**

Provisions for ABS- An Overview

188. The provisions under ABS are as follows,

1. Section 23 of the **Biological Diversity Act (2002)** mandates the State Biodiversity Boards to advice central and state governments on matters relating to conservation of biological diversity, sustainable use of its components and equitable sharing of benefits. Besides, the Section calls for the State Biodiversity Board to regulate, by granting of approvals or otherwise, requests for commercial utilization or bio-survey and bio-utilization of any biological resource by Indians and elaborate that Sections 9 to 17 of the Act apply to the State Biodiversity Board as well.
2. **The Biological Diversity Rules (2004)**, vide Rule 20 (3) calls for determination of benefit sharing formula on a case by case basis while Paragraph 20(5) indicate the quantum of benefits have to be mutually agreed by the applicant and the Authority (read State Biodiversity Board vide Section 23(5) of the Act).
3. Sections 12, 16 and 20 of the **Kerala Biological Diversity Rules (2008)** detail various functions of the State Biodiversity Board, that includes *inter alia*, to recommend, prescribe or modify collection fee of the biological resources from time to time, enter into agreements on provision of access and subsequent benefit sharing and provide guidelines for the Biodiversity Management Committees (BMCs) terms of access and fee collection.
4. As per the UN- Nagoya Protocol to the Convention on Biological Diversity, the MoEF (National Biodiversity Authority, NBA) has .issued Gazette notification "Guidelines on Access to Biological Resources and Associated Knowledge and Benefits Sharing Regulations, 2014". Paragraph 5 of the Guidelines indicate that the collection fee levied by the BMCs will be in addition to the benefit sharing component to be provided to the State Biodiversity Board for commercial utilization of biological resources and associated traditional knowledge. Benefit sharing provisions under the ABS regulations 2014 include both monetary and non-monetary modes. Under monetary, the important provisions are-upfront payment, one-time payment, milestone payments, share of licence fee, contribution to national/state/local biodiversity funds, funding R & D activities in India etc. Under non-monetary, the major provisions are providing institutional capacity building, infrastructure, transfer of technologies, education and training on conservation and sustainable use of biological resources and taxonomic research.

189. *Option of benefit sharing on sale price of the biological resources accessed for commercial utilization.* The said notification has also prescribed three different slabs for payment based on ex-factory sale of product. The applicant shall pay the benefit sharing ranging from 0.1 to 0.5% at the following graded percentages of

the annual gross ex-factory sale of the product which shall be worked out based on the annual gross ex-factory sale minus government taxes as Table 11.

Table 11 *Range of benefit sharing component* in per cent

Annual Gross ex-factory sale of product	Benefit sharing component
Up to Rs 1,00,00,000	0.1 %
Rs 1,00,00,001 up to 3,00,00,000	0.2 %
Above Rs 3,00,00,000	0.5 %

190. *Procedure for bioresources having high economic value.* In cases of biological resources having high economic value such as sandalwood, red sanders etc, and their derivatives the benefit sharing may include an upfront payment of not less than 5% on the proceeds of the auction or sale amount and the successful bidder or purchaser shall pay the amount to the designated fund before accessing the biological resource.

191. *Mechanism for sharing of benefits.* Mechanism for accrual and sharing all benefits accrued from the means detailed above would be credited in to a separate account to the State and Local Biodiversity Funds, established as per the provisions of the Biological Diversity Act, Biological Diversity Rules. The benefits accrued through the ABS framework will be used explicitly for purposes of conservation and sustainable management of biological diversity and associated traditional knowledge as elaborated under the Biological Diversity Act.

192. *Exemptions under the Act.* The provisions of this Act shall not apply to the local people and communities of the area, including growers and cultivators of biodiversity and vaids and hakims, who have been practicing indigenous medicine. As per Section 40 of the Act biological resources listed as normally traded commodities are exempted. Such exemption is available only when the notified item is normally traded as commodity. When the same item is used as a resource in a process or for the development of a product, such item is not exempted and shall be treated as a biological resource, the access and obtainment of which is regulated by the provisions of this Act.

193. *Penalties under the Act.* Collection of any bio-resources for commercial utilization in violation of Section 7 and Sub section (2) of Section 24 of Biological Diversity Act, 2002 will attract Section 55 (2) of Biological Diversity Act, 2002 under which violation of said Act and provisions shall be punishable with imprisonment for a term which may extend to three year or with fine which may extend to five lakh rupees, or with both.

Case Studies of Successful Models of ABS

194. ABS is being implemented in various states of India and a few examples are listed below,

1. Gujarat Biodiversity Board has generated an income of Rs 7,964,993 from ABS during last year.
2. Uttarakand Biodiversity Board has charged Rs 10 crore form Patanjali and Rs 2 crore from its subsidiary for using the natural resources of the state.
3. In Madhya Pradesh, the SBB facilitated an ABS agreement for the medicinal herb Kalmegh (*Andrographis paniculata*) between the Malajkhand municipal BMC in Balaghat and the bioresource company Natural Remedies, manufacturers of ayurvedic veterinary products and herbal medicines. The non timber forest product collectors were collecting Kalmegh from wild and selling it at the rate of Rs 5/kg. Natural Remedies assured a minimum purchase price

of Rs 23/kg. This case study demonstrates the role of SBB and BMC in identifying demand for specific medicinal plants for trade and marketing in the area.

4. In Andhra Pradesh, Bio-India Biologicals (BIB), Hyderabad, along with NBA , SBB and BMC entered into a benefit sharing agreement for top quality leaves of Neem with a procurement price of Rs 100 per kg. The leaves are to be transported to Japan to produce Neem based water for a Japanese company. The Neem leaves were sourced from the Amarchintha village in Mahabubnagar district.
5. Telengana Biodiversity Board has signed 11 ABS agreements so far. IIOR, Hyderabad is one of the first ICAR institute to take up the initiative to follow Act and Rules in accessing local bio-resources by obtaining necessary permissions for their research patents and subsequent commercial utilization. IIOR accessed microbial bio resources for R & D to develop eco friendly insect pest and plant disease management of crops and transferred the research results to two private companies M/S Maa Bhagwathi and M/S Poabs Biotech for commercial purposes. Both the companies submitted Form I to state biodiversity boards of Andhra Pradesh and Telengana and entered into ABS agreements The BMCs are expected to get Rs 10 lakh/ year from the two companies out of these agreements, further IIOPR is sharing 3% of the licence fee charged from entrepreneurs with SBB. IIOR has also paid Rs 25,000 to the BMC for licensing the formulations to different biopesticide entrepreneurs. The benfits accrued is proposed to be utilizaed for conservation of biodiversity.

KSBB Standard Operating Procedure for ABS

195. The standard operating procedure for ABS followed by KSBB is described below,

1. All stakeholders (Indians and Indian entities) accessing biological resources and associated traditional knowledge shall submit an application for approval of access to bioresources from Kerala using From I ,annexed to the Kerala Biological Diversity Rules and Form A by paying the prescribed fee.
2. On receipt of an intimation, the State Biodiversity Board may, in consultation with the local bodies concerned and after making such enquires as it may deem fit, by order, prohibit or restrict any such activity if it is of opinion that such activity is detrimental or contrary to the objectives of conservation and sustainable use of biodiversity or equitable sharing of benefits arising out of such activity ***[Sec 24 of the Biological Diversity Act, 2002]***.
3. No order of restriction/prohibition shall be passed without giving reasonable opportunity of being heard to the affected person. ***[Sec 24 of the act]***.
4. The State Biodiversity Board will review the application and in consultation with the concerned BMC, as appropriate, will provide a written permission (ABS agreement) to the applicant to access the requisite biological resource(s) and associated traditional knowledge.
5. The access and benefit sharing (ABS) amount is calculated on the basis of "Guidelines on Access to Biological Resources and Associated knowledge and Benefit Sharing Regulations, 2014". ***[Notified by NBA in exercise of its powers conferred under Sec 21(4) of the act]***.
6. After the calculation of ABS as per act/rules/guidelines, the commercial users of "biological resource" are invited for ABS negotiation. Every effort will be made to address and resolve the objections raised by the commercial users (traders/manufacturers) as per the existing provisions of act/rules and regulations/guidelines.
7. Both the State Biodiversity Board and the user(s) can negotiate the benefit sharing arrangement, on a case-by-case basis, depending on the nature of application and benefits intended to accrue.
8. Such an agreement will be drawn up upon consultation with relevant BMCs, as needed.

9. The order pertaining to the calculated ABS amount by the commercial users (calculated on the basis of guidelines) is communicated and the objections are invited.
10. After removal of objections, request for payment of ABS is made as per mutually agreed terms.
11. The permission will become the 'Certificate of compliance' by the users to access the biological diversity and associated traditional knowledge.
12. Subject to requirements of confidentiality, suggested by the user(s), the information related to the 'Certificate of Compliance' will be made available on-line using the Kerala State Biodiversity Board website.
13. The State Biodiversity Board will be responsible for negotiating the terms and conditions of the ABS agreement, ensuring compliance, facilitating access to resources and associated traditional knowledge, securing benefits – monetary and non-monetary – as agreed under the ABS agreement, operationalizing the State Biodiversity Fund, ensuring sharing of benefits with the BMCs, building capacities and supporting relevant activities at BMC level contributing to conservation and local development and undertaking periodical assessment of efficiency of implementation of the ABS framework in the State.

196. *Operationlization of benefits accrued.*

1. Mechanism for accrual and sharing all benefits accrued from the means detailed above would be credited to the State and Local Biodiversity Funds, established as per the provisions of the Biological Diversity Act, Biological Diversity Rules and Kerala State Biological Diversity Rules.
2. The State Biodiversity Board, in consultation with all relevant stakeholders and BMC representatives will issue a detailed guideline on use of the benefits accrued to the State and Local Biodiversity Fund.
3. KSBB may retain a share not exceeding 5% of benefits accrues towards administrative charges and remaining share shall be passed on the concerned BMC or benefit claimers.
4. Provided that such organizations cannot be identified the fund shall be used for conservation and sustainable use of biological resources.

Scope for ABS in Kerala

197. Kerala is a biodiversity rich state and many economically important plant and marine species are found in Kerala. There is a need to identify ABS as resource mobilizing strategy for generating local finances for conservation of marine bioresources. Regulation of access to bioresources for commercial utilization is necessary in view of the increasing instances of bio-piracy and growing emphasis on ethical bio-trade and it is the primary step before negotiating for benefit sharing. The share of fisheries sector in the State Domestic Product has declined from 1.12 percent in 2011-12 to 1.07 per cent in 2014-15. For eg : In Kerala, the whitefish, *Lactarius lactarius* and the silver pomfret, *Pampus argenteus* were identified as depleted stocks as their recent average catch levels were between 10 and 6% of the maximum and Arius sp. was identified as a collapsed stock as its recent average catch level was only 0.7% (below 5%) of the long-term maximum catch. Overexpolitation of food fishes has resulted in population declines of H*orabagrus brachysoms*(35% decline over the past 10 years) , *Tor khudree* (60-70%), *T. malabaricus* (50-60%) , *Hypselobarbus curmuca (* 50%) *H. dubius*(30%) ,*H. kolus*(30%) and *H. micropogon* (50%).

Bioresources of Economic Value in Kerala – An Overview

198. *Marine and Inland fisheries.*

1. Among the total landings in India during 2013-2014 maximum contribution was from Gujarat (19.8%, 7.12 lakh tonnes) followed by Tamil Nadu (18.5%, 6.65 lakh tonnes) and Kerala (16.0%, 5.22 lakh tonnes). In total fish production in 2014-15, Andhra Pradesh was the highest contributor and Kerala stands at 5th position.
2. Kerala exports fish products worth approximately Rs 1,200 Crores and has domestic sales worth Rs 600 crore annually, accounting for roughly three per cent of the state revenue.
3. The export of short-neck clam meat is around 400-500T earning 3-4 crores rupees as foreign exchange. 80% of the clam meat exported is from Ashtamudi estuary, Kerala. The total annual mussel production varies from 10,000T to 15,000T.
4. The value of marine fish landings during 2014 at landing centre level was Rs 31, 754 crores. At retail level the estimated value is Rs 52,363 crores. Kerala is having the highest realization of prices at landing centre and retail centre registering a growth of 18.28% and 19.38% over 2013.
5. Marine fish landings in Kerala during 2014-15 were 5.24 lakh tonnes. Marine fish production has increased marginally from 5.22 lakh tonnes in 2013-14 to 5.24 lakh tonnes in 2014-15 but shows a general decline. The marine fishery resources of the State have almost attained the optimum level of production.
6. Total revenue collected from fishing harbours and fish landing centres has fallen from ` 510.58 lakh in 2013-14 to 490.96 lakh in 2014-15.
7. Kerala has over 7 % of the inland water bodies but its share in inland fishing is just above 2 % of that of India. During 2012-2013 Inland fish production was 149098 M T with a total value of 149881.17 Lakh.
8. The total fish production in Kerala during 2014-15 was 7.26 lakh metric tones. At the national level about 65 per cent of the total fish production is contributed by the inland sector, were as at the State level, the share of inland sector is relatively less than the marine sector. Kerala has over 7 % of the inland water bodies but its share in inland fishing is just above 2 % of that of India. Kerala's productivity (fish production in kg against the total water bodies in ha) in inland fishing is lower than in many other states.
9. The coastline of Kerala shows a rich diversity of seaweeds. The state is endowed with more than 25 species of sea weeds among them 12 species are commercially very important. The estimated standing stock of seaweeds in Kerala is 1000 tonnes (wet wt.), of which about 150 tonnes are economically important seaweeds .
10. About 117 species of marine ornamental fishes are reported from Kerala coast.
11. About 14 species of commercially important gastropods are recorded form Kerala coast
12. There are 2 species of mussel, 5 species of clams, 1 species of edible oyster and 2 species of crabs distributed in the brackish water areas suitable for aquaculture.

199. *Forestry.*

1. Many species in Kerala are of good economic use. There are 117 species used for soft wood purposes, 146 species for extraction of tannin, 29 species for latex, 111 species for gum, 65 species for resin and 284 species for oil. 1170 species are used medicinally. About 1,000 species are used for basketry, green manure and other uses.
2. Forests provide not only timber and fuel wood but also other materials of both plant and animal origin, occurring naturally and sometimes in cultivation in forest areas. The forest supply non-wood forest produce valued at Rs 5 crore annually. There are about 550 species utilized as NWFP. There are 145 NWFP items as per the list of the Kerala Forest

Department, which is classified as Minor Forest Produce (MFP) as of 2007. The price spread has been estimated to be more than 100% in certain cases.

3. The revenue from the forestry sector by way of sale of timber and other forest products comes to Rs 300.4 crore in 2014-15 and the revenue from the forest sector in 2013-14 was Rs 329.94 crore, showing a decrease over the previous year. During 2014-15 Rs 269.43 crore was the revenue from timber, which account for 89.6% of the total forest revenue.

200. *Agriculture.* Kerala is a major processor of various agricultural products such as spices, cashews, coconuts, etc. Approximately INR 5000 Crore worth of processed food is exported annually from Kerala. In spite of its limited land mass, Kerala accounts for nearly 20.0 percent in the country's total food exports.

201. *Medicinal Plants.*

1. In Kerala, the marketing of medicinal plants is undertaken by the Kerala State Federation of Scheduled Caste and Scheduled Tribes Development Co-operatives Limited. In spite of this nearly 60 to 70% of non-wood forest produce is marketed by private traders illegally. This supply chain often extends to 3 - 4 tiers without much value addition but with an increase of 70 to 300% in sale price of crude drugs from primary collector's level to end used level.
2. The rural folk and tribal communities make use of about 2,000 species of lesser-known wild plants for various medicinal uses.

Recommendations of Working Group

202. The implementation of ABS in Kerala requires a concerted effort by Government and cooperation of all stakeholders. The major recommendations are

1. A coordinated project to identify the bioresources being commercially traded from each panchayat in Kerala is necessary.
2. Encourage development of a Local Biodiversity Fund by way of levy of collection charges for bio resources as per Section 41 of the Act BMC is authorized to levy collection fees for accessing any biological resources for commercial purposes. Guidelines for levy of collection fees by BMC can be developed only when the quantity and resources being extracted at local level is available. This will also enable to mobilize funds for biodiversity conservation at local level and empowering BMC in the long run.
3. Policy support to issue an ABS order to all concerned to comply with the provisions of the Act.
4. As per Biological Diversity Rules Section 20 (14) the Board shall provide guidelines for terms of access and collection by the BMC. Policy support for implementation of the provisions of this Act is required.
5. KSBB had requested Kerala Forest department that while conducting auction the guidelines of MoEF may be followed and necessary provisions may be incorporated in the Special terms and conditions of e-auction of sandalwood being issued by Kerala Forest Department. Policy support and interdepartmental co-operation is necessary for this.
6. Linking compliance with Biodiversity Act to related rules may enable better awareness and stricter enactment at state level.
7. The possibilities of linking compliance with the provisions of Section 7 of BD Act to manufacturing licenses and GMP certification by Drug control department/ issue of permits by forest department also has to be explored.

8. The import and export of wild animals and plants is permitted in India through the Customs points at Mumbai, Cochin, Amritsar, Kolkata, Delhi, Chennai and Tuticorin. To check illegal trade in wildlife, Wildlife Crime Control Bureau (WCCB) has regional and sub regional offices. Building synergies between such policies will facilitate stricter enforcement of BD Act.

CHAPTER 10
INSTITUTIONAL INFRASTRUCTURE FOR BIODIVERSITY

Human Resources

203. The development of any sector largely depends on the human resource and programmes that are implemented by trained and skilled personnel are often successful. Therefore, human resource development (HRD) is integral part of development and cannot be overlooked.

204. Presently KSBB the state's premier organization dealing with conservation, sustainable utilization and benefit sharing of bio resources does not have any permanent staff and is functioning on Government staff on deputation and project personnel's employed on temporary basis. For implementing the above schemes the Board needs to be appropriately staffed with quality manpower. The 13th Plan should address the manpower requirements for Biodiversity conservation through Scientists at appropriate levels and scientific personnel's at contract level.

Infrastructure Support

Biodiversity research centre

205. Strengthening Biodiversity research for collection, collation, management, analysis and dissemination of data on Kerala's biological diversity is required. Identify institutions which are presently doing biodiversity research i.e. College of Forestry, KAU, KFRI, TBGRI are few examples. The facilities in the above Institutions can be improved by sanctioning sufficient fund for biodiversity research. The establishment of a fully equipped Biodiversity research will provide scientific support to Kerala State Biodiversity Board on salient environmental and conservation issues. The centre should also provide scientific support to Board for validation of traditional knowledge for the implementation of ABS mechanism as per Nagoya Protocol on Access and Benefit sharing. The 13th plan can also allocate funds for establishing an office set up for Biodiversity Board.

Strengthening Taxonomy

206. Limited office space and seed money for infrastructure development for data analysis on priority basis and basic research work in future is the primary requirement. Taxonomy is the key discipline for inventorization, monitoring, and conservation and sustainable utilization (including bio-prospecting) of biodiversity. There is an urgent need for capacity building (including human resources) in Taxonomy linked to Conservation and Sustainable Utilization of biodiversity. Consequently, the subgroup emphasizes a comprehensive capacity building for Taxonomy along with sufficient support in the following disciplines

1. Biodiversity assessment and monitoring
2. Taxonomy
3. Ethno medicine and Ethno pharmacology
4. Biodiversity and Environmental legislations, IPR , Access and Benefit sharing

Seed Banks

207. Ex situ Conservation of biodiversity is of paramount importance. Identification of institutions which can function as repository for germplasm and seed banks for ex situ conservation of bioresources may be developed in different institutes so that each will function as a repository for specific genetic resources.

Communication, Education and Public Awareness

208. CEPA is an important prerequisite for conservation. As plant species are declining due to habitat degradation, invasive alien species, overexploitation, pollution and climate change, conservation is becoming a vital rationale for the development of botanical gardens. Gardens are at the forefront of implementing many of the Global Partnership for Plant Conservation targets, particularly those on ex situ conservation, taxonomy, development of protocols for conservation and sustainable use, education and public awareness and capacity building.

1. The 13th plan should focus on developing state of art Biodiversity Parks/ Gardens/Natural History Museum etc to document, study and disseminate knowledge concerning the natural heritage of Kerala and to develop a greater awareness of man's growing role in the environment in which he lives. Support may be provided for Biodiversity Park at Vallakadavu and National Biodiversity Garden at Munnar.
2. As part of the NavaKerala mission Biodiversity parks are being set up in schools this can be implemented in association with Biodiversity clubs constituted at schools.

ANNEXURE 1

STATE PLANNING BOARD

(Present: Sri V S Senthil IAS)

Sub: Formulation of 13th Five Year Plan – Constitution of Working Groups – reg.

Ref: Note No. 260/2016/PCD/SPB dated 06.09.2016 of the Chief (i/c), Plan Co-ordination Division, State Planning Board

Order No. 300/2016/AGRI (W9)/SPB Dated: 19.09.2016

As per the reference cited, State Planning Board has constituted Working Group on 'Biodiversity' to formulate the draft proposals in the sector for inclusion in the Thirteenth Five Year Plan.

The Working Group on '**Biodiversity'** is hereby constituted with the following members.

Co-Chairperson

Dr Oommen V Oommen, Chairman, Kerala State Biodiversity Board

Co-Chairperson

Prof Priya Davidar, Head of Dept. of Ecology and Environmental Sciences, Pondicherry University, Pondicherry

Members

1. Smt Padma Mahanti IFS, Director, Environment Department
2. Dr K G Sreekumar, Retd CEO, State Medicinal Plants Board, Thundathil, Fort P.O, Thiruvananthapuram
3. Dr N Omanakumari, Member, Kerala State Biodiversity Board
4. Prof B Mohan Kumar, Professor & Dean, School of Ecology and Environment Science, Nalanda University, Patna, Bihar
5. Prof T P Sreedharan, Former Head, Department of Zoology, Payyannoor College, Sreelayam, South Bazar, Payyannoor, Kannur
6. Dr S Bala Ravi, Former Assistant Director General ICAR and Advisor MSSRF, Dhanalaxmi Housing Society, Mahendra Hills, Hyderabad
7. Dr N Anil Kumar, Director, MSSRF, Community Agro Biodiversity Center, Puthoovvayal P O, Meppadi, Wayanad.
8. Dr K Vidyasagaran, Dean, College of Forestry, Kerala Agriculture University, Trissur
9. Dr P Sujanapal, Scientist, Silviculture, KFRI, Thrissur.
10. Dr C Satish Kumar – Tropical Botanical Gardenand Research Institute, Palode, Thiruvananthapuram
11. Dr V Selvam, Director, MSSRF, Chennai
12. Dr KP Laladhas, Member Secretary, Biodiversity Board, Thiruvananthapuram

Convener

Dr P Rajasekharan, Chief(Agriculture), State Planning Board

Co-Convener

Smt Roshni Pdmanabhan, Research officer, State Planning Board

Terms of reference

1. To review the development of the sector with emphasis as to progress, achievements, present status and problems under its jurisdiction during the 11th and 12th Five Year Plan periods.
2. To evaluate achievements with regard to the plan projects launched in the sector, both by the State Government and by the Central Government in the State during these plan periods.
3. To list the different sources of data in each sector and provide a critical evaluation of these data sources, including measures for improvement.
4. To identify and formulate a set of output and outcome indicators (preferably measurable) for each sector and base the analysis of the previous plans on these indicators.

5. To outline special problems pertaining to Biodiversity conservation, and examine the role of various agencies/departments/local self-governments in the implementation of Biodiversity conservation related programmes. To review and suggest measures' in particular

   a) for developing the linkage between biodiversity and livelihoods and identifying specific options, including those offering greater value addition and greater income,

   b) for conserving and enhancing biodiversity focusing particularly on methods appropriate for integration with key developmental imperatives,

   c) to develop methods to appropriately use the knowledge gained through the People's Biodiversity Register and incorporate them into decentralized planning and

   d) to develop specific schemes for the further study of biodiversity and the linkage to incomes and livelihood enhancement.

6. To suggest, in particular, a set of projects that can be undertaken during the 13th Plan period in the sector.
7. The Co-Chairperson is authorised to modify terms of reference with approval of State Planning Board. The Co-Chairperson is authorised to invite, on behalf of the Working Group, experts to advise the Group on its subject matter. The non-official members of the Working Group will be entitled to travelling allowances as are applicable to class I officers of the Govt. of Kerala. The class I officers of GoI will be entitled to travelling allowances as per rules if reimbursement is not allowed from Departments.
8. The working group will submit its draft report by 1st December 2016 to the State Planning Board.

Sd/-
Member Secretary

To

The Person concerned
The Sub treasury Officer, Vellayambalam

Copy to:-

The Accountant General, Kerala (A&E) with C/L
All Divisions, State Planning Board
PS to VC
PA to Member Secretary
Stock file

Forwarded by order
Sd/-
Chief (Agriculture)