AGROFORESTRY POLICY, 2018

Government of Bihar,

DEPARTMENT OF ENVIRONMENT, FOREST & CLIMATE CHANGE
1. **Introduction** /Introduction & Context

Bihar a north Indian state, situated in the east, in lower Ganga basin land locked amidst states of West Bengal, Jharkhand, Uttar Pradesh and the Himalayan country Nepal. Its geographical extent is of 94,163 sq. km. i.e. 2.83%, or about one fortieth of the geographical area of the country. The major chunk of its area, about 90% comprises of fertile plains in the sub-basins of Ganga and its tributaries: the Himalayan and sub-Himalayan rivers - Ghaghra, Gandak, BurhiGandak, Bagmati, Kosi and Mahananda in the north emanating from Nepal-, and the rivers ensuing from Chotanagpur plateau - Sone, Punpun, Kiul in the south. Less than one tenth area is under hilly, plateau and associated natural forests and wilderness landscape, consisting of mostly Chotanagpur plateau bordering Jharkhand, Kaimur Plateau bordering Uttar Pradesh and a small parcel of Sub-Himalayan Bhabar-Terai tract in West Champaran, bordering Nepal and Uttar Pradesh.

The climate of Bihar is characterised as *humid subtropical* with rainfall varying from 1000 mm to 2000 mm and annual temperature range between 20°C to 28°C. The *monsoon phenomena* as a major feature of the climate is accompanied by rainy season between mid-June to September with dominant hot and humid weather. Short spells of extreme heats in summers and cold in winter season lend continental flavour. A variegated occurrence of floods and droughts, and extreme weather events over different parts of the State with patterns undergoing perceptible changes in the recent Climate Change scenario adds to the complexity of the manifestation of geo-climatic phenomena. The State has currently 38 districts which are constituted on administrative considerations factored by historical and geographical aspects, and many of these districts have conspicuous variations in bio-physical and climatic features.

The soils (with fine alluvium in the plains of north and the fringes on south bank of Ganga, and first-formed soils in south Bihar), wateravailability (precipitation and brought in by the Himalayan and plateau rivers) and prevalent weather systems across different parts of the state render most of the area in all of the 38 districts suitable for agriculture of varied intensity and crop systems.

With a population of 104.10 million as per 2011 census, 8.59% of the country, Bihar is the third most populous state. In terms of density, it is the most densely populated with 1106/sq. km. compared to the national average of 382 /sq. km and 1,029/sq. km. in West Bengal, 859/sq. km. in Kerala and 828/sq. km. in Uttar Pradesh. With a decadal population growth rate of 25.1 %, the highest among all populous states and overtopping with margin of 5% compared to other populous state, the population density in Bihar is slated to become extremely high over next few decades. The 19th livestock census, 2012 has reported a total livestock population of 32.93 million in the state. The rural and urban population constitute 88.71% and 11.29% respectively, and even with paced urbanization, the rural population load would continue to be very heavy in near future. Agriculture is the mainstay of economic activity and employment for major chunk of the population and it shares substantive role in the economy of the state, and in coming decades, even with decrease in share of agriculture in the economy,
substantial population would continue to be dependent on agriculture and allied activities. In view of the trends and scenarios of population growth, urbanization and developments in agriculture sector and the nature of land resources in the state, and the external economic and market situations, agriculture and allied land based biological production systems shall continue to be major and critical component of the economy of Bihar and especially with regard to providing gainful employment to growing population over several decades.

The forest cover in Bihar has been assessed at 7,229 sq. km. (India State of Forest Report, Forest Survey of India, 2017), being 7.75% of geographical area, which mainly includes the natural forests in 12 districts and such other tree dominated vegetation of such minimum extents that qualify as forests.

For States like Bihar whose major chunk of area consists of non-forest and non-wilderness plains in agricultural tracts which are also densely populated and intensely farmed, the Forests plus the areas under Trees Outside Forests (ToF) have been recognised as crucial indicative measure of vegetation for environmental and ecological considerations. The Trees Outside Forests (ToF) also have the main role in enhancing economic production and employment generation systems based on environmentally optimised land use practices in Bihar, because the limited and confined natural forest tracts have to be preserved and used very conservatively for ecological considerations and ecosystem services. Given the land - population set up in Bihar and the future scenarios, augmentation of Trees Outside Forests (ToF) only has the potential both for economic gains and for environmental factors and sustainable development goals.

Realising this potential with practical limitations, a target of 15% of Forests plus ToF was set in 2012 in the document of 2nd Agriculture Road Map and the same is on the verge being achieved. Now, the target has been stepped up by another 2% so the forests plus ToF cover in Bihar reaches 17% by 2022. Agriculture being the mainstay of land based production system, Agroforestry has to apportion the major share of augmenting Trees Outside Forests (ToF) to a substantial extent in Bihar.

The significant features and benefits of agroforestry, also especially relevant to Bihar are as under:

1.1 As a land use system which integrates trees and shrubs on farmlands to enhance productivity, profitability, diversity and ecosystem sustainability, it is a dynamic, ecologically based, natural resource management system that, through integration of woody perennials on farms and in the agricultural landscape, diversifies and sustains production and builds social institutions. Trees on farm or agroforestry are uniquely placed for achieving multiple objectives, especially the food, nutrition, employment, health and environmental security.

1.2 It includes both traditional and modern land-use systems where trees are managed together with crops and/or animal production systems in agricultural settings, practiced in both irrigated and rain fed conditions to produce food, fuel, fodder, timber, fertilizer and fiber, contributes to nutritional and ecological security, sustains livelihoods, alleviates poverty and promotes productive and resilient cropping and farming environments. It also enhances ecosystem services through carbon storage, prevention of deforestation, biodiversity conservation, and soil and water conservation. When applied on a large
scale, with appropriate mix of species, it enables agricultural land to withstand extreme weather events, such as floods and droughts.

1.3 It is the most viable option for meeting the target of increasing tree cover up to 17% of the State of Bihar and contributing to national target of 33% tree cover.

1.4 It has significant employment potential for rural and urban population through production, industrial application and value addition ventures - a critical concern for Bihar with massive population growth in ensuing decades requiring employment generation on sustained basis.

1.5 As the land-holding size in the state is very low and is further shrinking, tree farming combined with agriculture is the only way to optimize the farm productivity and thus, enhancing livelihood opportunities and the safeguard against disasters including climate change impacts of vulnerable small farmers, landless and the women.

1.6 Agroforestry has potential to mitigate the climate change effects through microclimate moderation and natural resource conservation in the short run and carbon sequestration in the long run. Agroforestry species are known to sequester as much carbon in below ground biomass as the primary forests and far greater than the crop and grass systems.

In order to foster and propel agroforestry in Bihar to substantial scale and extent amidst the extant constraints, a State Agroforestry Policy and Action Plan document encapsulating strategic formulations and programmatic outlines on the fronts of adequate investment, suitable extension strategies, incentives to agroforestry practitioners, enabling legal and regulatory environment, marketing of agroforestry produce, post-harvest processing, development of new products, appropriate research interventions, is required drawing thematic contours from the National Agroforestry Policy and focused on Bihar specific conditions and factors.

2. **Present Status**

To increase the Forest plus Trees outside Forests cover, the State has gambit extensive afforestation activity to achieve the set target, by implementing the agroforestry programmes such as KrishiVanikiYojana and MukhyamantriNijiPaudhashalaYojana, and other similar initiatives initiated under Hariyali Mission, Bihar. [Too many "initiated"]

Agroforestry- Poplar ETP scheme is being implemented in north Bihar for the set objective of promoting short rotation and commercial poplar plantation in farmers' land to promote - tree produce based industries in state and to increase tree cover for environmental services. The department provides poplar ETP free of cost to the selected beneficiaries of this scheme. Based on survival of the plants, farmers get incentive amount of Rs. 10, 10 and 15 per plants in three consecutive years.

A total of 237.17 lakh plants have been planted during the period 2012-17 in the State.

Agroforestry for other species scheme: This Scheme is being implemented in all the - districts of Bihar for the set objective of enhancing economic benefits to farmers, and to increase green cover for environmental services. The department provides plants of species other than poplar free of cost to the selected beneficiaries in the scheme. Based
on survival of the plants, farmers get incentive amount of Rs. 10, 10 and 15 per plant in three consequent years. The farmers have full rights on plants.

A total of 364.22 lakh plants have been planted during the period 2012-17 in the State.

MukhyamantriNijiPaudshala-(Poplar): This scheme is being implemented in all the districts of north Bihar to grow poplar plants to fulfill the demand in agroforestry, to generate employment for economic strengthening of the farmers.

In this scheme department provides the poplar cutting free of cost to the selected beneficiaries to raise the nursery. On the basis of the survival percentage department gives promotional amount ranging from Rs. 13 to 15 per plant to the farmers. A total of 416.32 lakh plants have been planted during the period 2012-17 in the State.

MukhyamantriNijiPaudshala-(Other Species): The scheme is being implemented in all the districts of Bihar to grow quality plants/seedlings to fulfill the demand of agroforestry schemes, to generate employment for economic strengthening of the farmers. In this scheme department help the selected beneficiaries to raise the nursery by providing technical support. On the basis of the survival percentage, department gives promotional amount maximum up to Rs. 6.30 per plant in two installments to the farmers. A total of 540.89 lakh plants have been planted during the period 2012-17 in the State.

In recent times, the regulatory control by transit rules for timbers and wood have been relaxed and eased to promote tree planting over agricultural lands under agro forestry and farm forestry. Currently 27 species have been altogether exempted from the provisions of transit rules. Further, for movement of timber and wood of non-exempt species within district, the power for issuance of transit permit has been delegated to the PanchayatMukhia.

3. **Need for dedicated Agroforestry Policy for Bihar**

3.1. Absence of a focused state policy and a suitable institutional mechanism: Major policy initiatives of the country, emphasize the role of agroforestry for efficient nutrient cycling, organic matter addition for sustainable agriculture and for improving vegetation cover. However, agroforestry has not gained the desired importance due to various factors which include: - near non-existent extension mechanisms, lack of institutional support, lack of quality planting materials, inadequate research, inadequate marketing infrastructure and price discovery mechanisms, lack of post-harvest processing technologies, etc. While there are many schemes dealing with tree planting / agroforestry, there is an absence of a dedicated and focused policy, and lack of an institutional mechanism for coordination and convergence among the schemes to pursue agroforestry in a systematic manner.

3.2. Lack of an integrated farming systems approach: Farming enterprise, more so in case of small farmers needs to be developed as a portfolio of activities rather than as “fixed one type of cropping system”. Survival of trees is one of the most challenging tasks in the establishment phase of the trees, and without addressing the issue of water and other critical or adverse factors; this does not seem to be possible. The enthusiasm of farmers depletes substantially with the higher mortality rate.
3.3. Lack of research, extension and capacity building: There are deficiencies in actionable research on the agroforestry models and practices suitable for the different agro-climatic regions and varied soil moisture regimes. As a result, over-emphasis on few species (Poplar, Eucalyptus, Kadam, Semal etc.) and limited number of models restricts the actual gainful utilization of the productive potential. For secure and productive agroforestry more robust and reliable models with variety commensurate with varied conditions need to be developed. Bihar also lacks in processing technologies and infrastructure for timber, softwood, and pulp and fibre species and also conversion of these tree biomass produces into manufactured wood products.

3.4. Lack of quality planting material: Planting/Propagation material such as seeds, seedlings, cuttings, transplants and the clones, hybrids, improved varieties, etc. thereof are generally of mixed quality or unascertained quality. This mainly relates to the production, handling, distribution and planting and supervision of high quality planting material. The quality aspect is crucial for success of agroforestry in terms of productivity which in turn would ensure farmers adopting the tree cropping as an economically attractive competing venture.

3.5. Non-existent market access for agroforestry produce: The marketing infrastructure (market yard, etc.), including “price discovery” mechanisms for agroforestry produce in general are unavailable, resulting in low financial motivation for agroforestry practices and barrier or hindrance as against other commercial activities.

3.6. Lack of Industry in the state: In Bihar there is hardly any industry at present which process and utilize the agroforestry produces at large commercial scales to yielding high-end products. The restrictions on primary processing at production sites after harvesting, leads to higher cost for transporting entire stock to the factory. The agroforestry policy should facilitate that products are developed at competitive prices within the state for generating local employment.

4. Vision

Agro forestry is established as a significant component of agriculture in Bihar, commensurate to its potential roles and functions as environmentally benevolent and economically efficient system, with substantial contribution to state's economy (GDP) and employment, and targeted benefits for the deprived sections of farming dependent rural population.

5. Goals

5.1 Sustaining substantial tree cover over vast agricultural landscape of the State as a major component of environment protection process and environmental security system, and also adaptation and mitigation mechanisms in respect of climate change.

5.2 Improving by appropriate incorporation of agroforestry, the productivity of agriculture and allied production systems; and employment, income and livelihood opportunities of rural households, especially the small and marginal farmers.

5.3 Augmenting the production of timber, food, fuel, fodder, fibre, and fertilizer and many other tree sourced produces and products so that the increasing demand of these are met.
from within the State and also from areas outside the natural forests in the State; thereby also conserving the natural forests and resources therein.

5.4 Bringing coordination, convergence and synergy among –different elements of agroforestry scattered in various existing missions, programmes, schemes and agencies pertaining to agriculture, horticulture, animal and fish resources, environment and forests and rural development in the Government and other key stakeholders for effective pursuance of the above goals.

5.5 Protect and stabilize ecosystems and promote resilient cropping and farmingsystems to minimize the risk during extreme climatic events.

6. **Basic Objectives**

The basic objectives of the State Agroforestry Policy are to:

6.1 Promote inclusion of tree plantation/cropping with agricultural crops, livestock, and fishery production in appropriate and integrative manner to improve productivity of available land and other resources -beyond subsistence level and breaking the marginality in many cases.

6.2 Enhance employment, income and livelihood of rural households, especially the marginal farmers through growth and expansion of agroforestry.

6.3 Protect and stabilize ecosystems and promote resilient cropping and farming systems to minimize the risk during extreme climatic events and vulnerability of the marginal farmers.

6.4 Promote establishment of wood based industries in the state for creating secured and sustained industrial demand for outputs of agroforestry within the state.-

6.5 Promote wood lots as farm forestry and agroforestry -in the adjoining fringe areas outside the forests to minimize pressure on natural forest for food, fuel, fiber etc.

6.6 Foster research in agroforestry catering to varied soil-water-climate regimes, land-holding sizes and socio-cultural settings; Build up and strengthen capacity in state or private agencies for transfer of technology and extension services.-

6.7 Provide and ensure supportive and conducive marketing institutions and facilities.

7. **Strategy:**

7.1 A State Agroforestry Mission or State Agroforestry Board with representation of key stakeholders and necessary authority shall be constituted to implement the state Policy.

7.2 Agroforestry produce has to be declared as “agricultural produce” so that it becomes free from income tax liabilities as well as eligible to be compensated in the case of adverse climate disaster.

Compensating the farmer for fixed felling period of the species planted on their field. This will ensure survival/ maintenance of the agroforestry produce for their full period of rotation.

7.3 Agroforestry based industries shall be included in the priority sector of Bihar Industrial Investment Promotion Policy, 2016
7.4 The transit rules shall be relaxed for agroforestry produces and replaced with self-declaration system for 26 districts (enlisted in Annexure - ) which do not have natural forest lands.

7.5 The Agroforestry practices in the state will be reformed to encompass the “system approach” rather than “tree approach”. Farmers in different agro-climatic zones will be encouraged to adopt agroforestry in combination of plants’ species and suitable agricultural crops so as to ensure that the process is insulated from and adverse effect of natural disaster/ climatic change and steep price fluctuation of the produce along with ensuring nutritional stability.

7.6 Giving all wood based industries sourcing raw material from agroforestry produce of the State priority in licensing. Their installation in clusters to be encouraged to promote such clusters as markets for the farmers.

7.7 Establishing agroforestry industrial zones in the State where establishment of wood based industry are encouraged for easy consumption of the produce.

7.8 Striving to create and strengthen the marketing opportunities for agroforestry produces in such a way that a fair price for the product is available to the farmer. The services of the State Forest Development Corporation may be utilized for the purpose.

7.9 Value addition to the agroforestry produce is of utmost importance in order to tap the market and to increase the farmers' income. Training for skill development of the farmers and local artisans and entrepreneurs has to be fostered so that local entrepreneurship takes a Centre stage.

7.10 The incentive scheme formulations of monetary and non-monetary forms of incentives, their limits vis-à-vis beneficiary class of farmer based on land holding and other factors, and payment schedules etc. should be rationalized learning from the past experiences. Dovetailing with National Ayush Mission Programme and other programmes may also be considered where feasible to cater to such farmers with large landholding willing to invest large portions in Agroforestry.

    The incentive policy be reviewed after every 10 years with mid-term appraisal for urgent course correction.

7.11 Encouraging technology development or adaptation to diversify usage of agroforestry produce which will help to ensure a ready market.

7.12 Striving to convert the present "buyer's market" status of agroforestry produce to "seller's market" by exploring the possibility of public private partnership to promote agroforestry in order to maximize the economic return to the farmers.

7.13 Propagating the agroforestry practices by setting up demonstration plots in different agro climatic zones of the state. KrishiVigyanKendras and Agriculture and Horticulture Colleges should be associated in such tasks.

7.14 The state to strive to promote, advertise and create awareness about the agroforestry practices and its benefits on campaign mode.

7.15 The state shall -support training and capacity building of the stakeholders in relevant aspects of agroforestry.
7.16 Examining the possibility of different incentive models for native and exotic species to be planted in agroforestry.

7.17 Production of good quality planting stock to be made available to the farmers is to be given emphasis with necessary remedial measures and reforms in the current process and practices. The quality of planting stock needs to be reckoned in terms of productivity and establishment and survival capacity and quality assurance system needs to be strengthened.

7.18 It is necessary to formulate an arrangement by which any investment in agroforestry / farm forestry gets relief in income tax as in case of agriculture.

7.19 Adoption of suitable species of Bamboo and medicinal and aromatic plants in agroforestry models in different agro-climatic zones as appropriate for the local soil-moisture conditions should be promoted.

7.20 The institution of Payment for Ecosystem Services should be initiated for farmers lending their lands to tree cover under agroforestry and thereby postponing economic return vis-à-vis other annual or very short term cash crop like sugarcane. A rationalized and equitable framework and mechanism need to be devised with creation of a corpus fund and executed on pilot basis.

7.21 Using latest technological services and support systems including IT & GIS to promote and monitor all agroforestry activities and its spread in the state on a regular basis.

7.22 The LDPE polybags have to be replaced by HDPE bags to be used for raising tall nursery plants in view of technological considerations and environmental benefits.

7.23 The state to strive for gradual replacement of Nijipaudhshala by departmental paudhshala in order to ensure good quality plant production.

7.24 Formulating a mechanism to compensate the farmers who keep their horticulture orchards for doing the eco- services and contributing to the overall tree cover of the state. The State will strive to create a corpus for the same.

8. **Key Steps to promote Agroforestry in the state**

8.1 Establishment of dedicated institutional -organ to promote Agroforestry

An institutional mechanism, such as a State Agroforestry Mission or Board is to be established for implementing the agroforestry policy. It will provide the platform for the key stakeholders to jointly plan and identify the priorities and strategies, for inter-departmental/ministerial coordination, programmatic convergence, financial resources mobilization and leveraging, capacity building facilitation, and technical and management support. Such an institutional arrangement will ensure that agroforestry gets initial thrusts and emphasis and subsequently due share of impetus with other forestry and agricultural enterprises.

8.2 Establishment of Agroforestry Demonstration and Training Centres

Demonstration centres may be established in different agro-climatic regions to showcase region specific agroforestry systems (tree-crop combination) and scientific interventions. These centres may also be utilized for production and supply of quality planting material (QPM) to the farmers.

[9]
8.3 Farmers coordinating centres

Van Sansadhan Kendra (VSKs) of the Department of Environment and Forests, VVKs of ICFRE and KVKs of ICAR/AUs should act as contact/facilitation points/centres for the farmers regarding support in connection with agroforestry production, processing and consumption activities.

8.4 Simple regulatory mechanism

Mechanisms and procedures to regulate the harvesting and transit of agroforestry produce within the State need to be further simplified.

8.5 Investing in research, extension and capacity building

8.5.1 Appropriate agroforestry models suitable for different agro-climatic regions of the state be identified.

8.5.2 Farmers and interested people be provided opportunities through institutions, such as the Van VigyanKendras, Van SansadhanKendras, Trainers' Training Centres to learn agroforestry, agri-silvicultural and silvicultural techniques to ensure optimum productive use of their land and water resources.

8.5.3 The cost-benefit ratios of various agroforestry systems, based on yield and volume tables of agroforestry tree species for different models and varied site conditions in Bihar have to be assessed for efficient choice and decision for agroforestry ventures to be undertaken by the farmers. The species with high carbon sequestration capacity need to be identified.

8.5.4 A common web-based interactive platform may be setup to bring all research findings and available knowledge in the area of agroforestry for access of all stakeholders.

8.6 Improving farmers’ access to quality planting material

Certification of nurseries, seeds and other planting materials for agroforestry is essential, to make available good quality planting material at the required scale. Institutional mechanism for registration of private nurseries and their accreditation be established.

8.7 Facilitating industries dealing with agroforestry produce to set up their units (processing and manufacturing units) in the state and increased participation in research and development.

Corporate Social responsibilities

8.7.1 State to strive to make industries to invest at least 1% of the CSR funds in agroforestry sector of the state.

8.7.2 The role of agroforestry based industries in the promotion of agroforestry is crucial.

8.7.3 The role of industries in the promotion of agroforestry can be tapped in multiple ways, especially in the areas of (a) production and supply chain development for high quality planting materials, (b) technology development and dissemination, especially for planting materials, processing, etc.

8.8 Strengthening farmer access to markets for tree products.

8.8.1 Minimum Support Price
The state Government should strive to ensure fixation of “Minimum Support Price (MSP)” for major agroforestry species. All agroforestry products be treated equal to the agricultural crops and agroforestry be mainstreamed along with agricultural policies and strategies to ensure availability of subsidies for agroforestry practicing farmers.

8.8.2 Institutional credit: State to strive for creation of institutional credit facility for farmers taking up agroforestry on large scale. Bank may be nudged to consider an interest rate similar to agriculture crop loan system.

8.8.3 Tree insurance: the state to facilitate insurance scheme for agroforestry crop which may covers fire, lighting, acts of terrorism, storm, hail storm, cyclone, typhoon, tempest, hurricane, flood, drought, impact by rail/road vehicles and other aerial articles dropped there from, wild animals, loss due to named pests and diseases.

8.8.4 Incentives to farmers for adopting agroforestry

8.8.5 Incentive and support structure, such as the input subsidy, interest moratorium, etc. during the gestation period for promotion of agroforestry be provisioned to encourage farmers.

9 **Agro-climatic zone wise suitable agroforestry systems**

The detailed descriptions of the agro climatic zone the districts falling under these zones and suitable agroforestry system to be considered for adoption in those zones is appended as an annexure.

This prescription/recommendation will be reviewed at an interval of 10 years or before as decided by the government.

10 **Expected Outcome of the Policy**

10.1 Additional income/savings opportunities for farmers and employment which will also serve as a cushion to crop damage.

10.2 Increase in tree cover through Agroforestry will lead to higher carbon sequestration and compliment the National initiatives on climate change adaptation and mitigation efforts.

10.3 Trees grown in farm land will help in enriching soil organic matter and will enhance nutrient uptake of the crops measurable under different time interval.

10.4 Increase in Contribution in availability of agroforestry produce to meet the increasing demand of raw materials for wood based industries which will result in saving of foreign exchange being used for import of wood and wood based products.

10.5 Development of information system and database on agroforestry.

10.6 Increase in Income & livelihood generation of the farmers.
ANNEXURE

Table 1: Districts under each Agro-Climatic Zone

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Agro-climatic zone</th>
<th>Districts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Agro-climatic I (Northern West)</td>
<td>West Champaran, East Champaran, Siwan, Saran, Sitamarhi, Sheohar, Muzaffarpur, Vaishali, Madhubani, Darbhanga, Samastipur, Gopalganj, Begusarai</td>
</tr>
<tr>
<td>2.</td>
<td>Agro-climatic Zone II (Northern East)</td>
<td>Purnea, Katihar, Saharsa, Supaul, Madhepura, Khagaria, Araria, Kishanganj.</td>
</tr>
<tr>
<td>3.</td>
<td>Agro-climatic zone IIIA (Southern East)</td>
<td>Sheikhpura, Munger, Jamui, Lakhisarai, Bhagalpur &amp; Banka.</td>
</tr>
<tr>
<td>4.</td>
<td>Agro-climatic zone IIIB (Southern West)</td>
<td>Rohtas, Bhojpur, Buxar, Bhabhua, Arwal, Patna, Nalanda, Nawada, Jehanabad, Aurangabad, Gaya.</td>
</tr>
</tbody>
</table>

Table 2: Important Physiographic features of the Agro-climatic Zone

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Agro-climatic zone</th>
<th>Soil</th>
<th>pH</th>
<th>Organic Matter (%)</th>
<th>Available Nitrogen (Kg./Ha.)</th>
<th>Available Phosphorus (Kg./Ha.)</th>
<th>Available Potash (Kg./Ha.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Agro-climatic zone I (Northern West)</td>
<td>Sandy loam, loam</td>
<td>6.5–8.4</td>
<td>0.2-1.0</td>
<td>150-350</td>
<td>5-50</td>
<td>100-300</td>
</tr>
<tr>
<td>2.</td>
<td>Agro-climatic Zone II (Northern East)</td>
<td>Sandy loam, Clay loam</td>
<td>6.5–7.8</td>
<td>0.2-1.0</td>
<td>150-300</td>
<td>10-35</td>
<td>150-250</td>
</tr>
<tr>
<td>3.</td>
<td>Agro-climatic zone III (Southern East &amp; West)</td>
<td>Sandy loam, Clay loam, loam, Clay</td>
<td>6.8–8.0</td>
<td>0.5-1.0</td>
<td>200-400</td>
<td>10-100</td>
<td>150-350</td>
</tr>
</tbody>
</table>

General Climatic Features

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Agro-climatic zone</th>
<th>Soil</th>
<th>Total Rainfall (mm)</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Max.</td>
</tr>
<tr>
<td>1.</td>
<td>Agro-climatic zone I (Northern West)</td>
<td>Sandy loam, loam</td>
<td>1040 – 1450 (1245.00)</td>
<td>36.6</td>
</tr>
<tr>
<td>2.</td>
<td>Agro-climatic Zone II (Northern East)</td>
<td>Sandy loam, Clay loam</td>
<td>1200 – 1700 (1450.00)</td>
<td>33.8</td>
</tr>
<tr>
<td>3.</td>
<td>Agro-climatic zone III (Southern East &amp; West)</td>
<td>Sandy loam, Clay loam, loam, Clay</td>
<td>990 – 1240 (1115.00)</td>
<td>37.1</td>
</tr>
</tbody>
</table>
Physiography

a. Agro-Climatic Zone I:

Existing Agricultural system


Recommended Agroforestry systems:

<table>
<thead>
<tr>
<th>Sl no.</th>
<th>Agroforestry systems</th>
<th>Components combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Agri-silvicultural systems</td>
<td>In non-flood affected areas: Poplar, Shisham, Gamhar, Melia, Chah, Eucalyptus, Kadam, Semal, Ulmus, Sagwan, Toon, Bamboo, Casurina etc. In flood affected areas: Eucaluptus, Kadam, Semal, Chah, Arjun, Salix, Jamun, Bamboo, Casurina etc. With agricultural crops commonly grown in the zone.</td>
</tr>
<tr>
<td>2</td>
<td>Agro-Silvo-Horticulture</td>
<td>Mango, Litchi, Jamun, Kathal, Barhar, Guava, Beal etc. with Agri-Silviculture components given above in specific planting design.</td>
</tr>
<tr>
<td>3</td>
<td>Silvo-Pastoral Systems</td>
<td>Tree species given above along with livestocks</td>
</tr>
<tr>
<td>4</td>
<td>Agro-Silvo-Pastoral Systems</td>
<td>Crops+Trees+Livestocks</td>
</tr>
<tr>
<td>5.</td>
<td>Apiculture with trees</td>
<td>Apiculture to be undertaken along with Agri-Silvo-Pastoral system</td>
</tr>
<tr>
<td>6.</td>
<td>Aqua forestry</td>
<td>Pisciculture in ponds and trees planted along the bund of the ponds.</td>
</tr>
<tr>
<td></td>
<td>Silvo-Medicinal system</td>
<td>Medicinal plants like Kalmegh, Aswagandha, Sarpgandh, Satawar, Lemon grass, Safedmusli etc. can be grown along with tree component.</td>
</tr>
</tbody>
</table>
b. Agro- Climatic Zone II:

Existing Agricultural system


Recommended Agroforestry systems:

<table>
<thead>
<tr>
<th>Sl no.</th>
<th>Agroforestry systems</th>
<th>Components combination</th>
</tr>
</thead>
</table>
| 1.    | Agri-silvicultural systems            | **In non flood affected areas:** Poplar, Shisham, Gamhar, Melia, Chah, Eucalyptus, Kadam, Semal, Ulmus, Sagwan, Toon, Bamboo, Casurina etc.  
**In flood affected areas:** Eucaluptus, Kadam, Semal, Chah, Arjun, Salix, Jamun, Bamboo, Casurina etc.  
**With agricultural crops commonly grown in the zone.** |
| 2     | Agro-Silvo-Horticulture               | Mango, Litchi, Jamun, Kathal, Barhar, Guava, Bel, Ber etc.  
**with Agri-Silviculture components given above in specific planting design.** |
| 3     | Silvo-Pastoral Systems                | Tree species given above along with livestocks |
| 4     | Agro-Silvo-Pastoral Systems           | Crops+Trees+Livestocks                                                                 |
| 5.    | Apiculture with trees                 | Apiculture along with Agri-Silvo-Pastoral system                                       |
| 6.    | Aquaforestry                          | Pisciculture in ponds and trees planted along the bund of the pound                    |
|       | Silvo-Medicinal system                | Medicinal plants like Kalmegh, Aswagandha, Sarpgandh, Satawar, Lemon grass, Safedmusli etc. can be grown along with tree component. |
c. Agro-Climatic Zone III:

Existing Agricultural system


Recommended Agroforestry systems:

<table>
<thead>
<tr>
<th>Sl no.</th>
<th>Agroforestry systems</th>
<th>Components combination</th>
</tr>
</thead>
</table>
| 1.     | Agri-silvicultural systems | In non-flood affected areas: Shisham, Gamhar, Melia, Eucalyptus, Ulmus, Teak, Acaciasenegal, Neem, Casurinaetc.  
In flood affected areas: Eucaluptus, Kadam, Semal, Chah, Arjun, Salix, Jamun etc.  
With agricultural crops commonly grown in the zone. |
| 2.     | Agro-Silvo-Horticulture   | Mango, Litchi, Jamun, Kathal, Barhar, Guava, Beal, Ber etc.  
with Agri-Silviculture components given above in specific planting design. |
| 3      | Silvo-Pastoral Systems    | Tree species given above along with livestocks                                           |
| 4      | Agro-Silvo-Pastoral Systems | Crops+Trees+Livestocks                                                                   |
| 5.     | Apiculture with trees     | Apiculture/Apiary along with Agri-Silvo-Pastoral system                                  |
| 6.     | Aquaforestry              | Pisciculture in ponds and trees can be planted along the bund of the pound              |
|        | Silvo-Medicinal system    | Medicinal plants like Kalmegh, Aswagandha, Sarpgandh, Satawar, Lemon grass, Safedmusli etc. can be grown along with tree component. |

Other important species which can be included under agroforestry are:-

Fruit Crops
Apart from major fruit crops like Mango, Guava, Litchi, Banana etc., Makhana, Pineapple, Betelvine can also be included under agroforestry systems.

Vegetables
Almost all vegetable crops like solanaceous, cucurbits, beans, cole crops, okra, onion and other root crops can be incorporated under agroforestry systems.

Spices
Chilli, Turmeric, Coriander, Ginger, Garlic & Methi etc.

Flowers
The major commercial flowers like Marigold, Rose, Tuberose, Gladiolus and Jasmine can be included.

Aromatic Plants
The aromatic plants like Japanese Mint, Lemongrass, Pamaroja, citronella etc. may also be included.