Geography Optional - 2024

AGRO ECOLOGICAL ZONES AND SOCIAL FORESTRY

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Agro-ecological zoning

Sustainable agricultural development requires a systematic effort towards the planning of land use activities in the most appropriate way, apart from several other institutional and policy programmme initiatives. Agro-ecological zoning (AEZ) is one of the most important bases for agricultural developmental planning because survival and failure of particular land use or farming system in a given region heavily relies on careful assessment of agro-climatic resources. A practical zoning approach thus arises because climate represented by thermal and moisture regimes forms small geographic areas, resulting in a variable mosaic of specialized areas, capable of supporting varied land use systems .The approach is used to categorize agroclimatically uniform geographical areas for agricultural developmental planning and other interventions. A framework of agro-ecological zoning describing concepts, methods and procedures was conceptualized for the first time by FAO .

Agro-ecological zoning refers to the division of an area of land into land resource mapping units, having unique combination of landform, soil and climatic characteristics and or land cover having a specific range of potentials and constraints for land use .The particular parameters used in the definition focus attention on the climatic and edaphic requirements of crop and on the management systems under which the crops are grown. Each zone has a similar combination of constraints and potentials for land use and serves as a focus for the targeting of recommendations designed to improve the existing land use situation, either through increasing production or by limiting land degradation. The addition of further layers of information on such factors as land tenure, land availability, nutritional requirement of human and livestock populations, infrastructure and costs and prices, has enabled the development of more advanced applications in natural resource analysis and land use planning. AEZ can be regarded as a set of core applications, leading to an assessment of land suitability and potential productivity. An output of AEZ studies includes maps showing agro-ecological zones and land suitability, quantitative estimates on potential crop yields and production. Such information provides the basis for advanced applications such as land degradation assessment, livestock productivity modeling, population support capacity assessment and land use optimization modeling.

The ability of the world's natural resources to provide for the needs of its growing population is a fundamental issue for the international community. World's population is increasing rapidly and at the same time, essential natural resources, such as land and water, are declining both in quantity and quality due to such factors as competition with industrial and urban demands. The basic problem is that limits to the productive capacity of land resources are set by climate, soil and land forms condition. In this context AEZ can be regarded as a set of applications, leading to an assessment of land suitability and potential productivity in terms of climate, soil and land forms condition.

Agro-Ecological Zoning (AEZ) is one of the most important bases of sustainable agricultural development planning of a region. It is applicable in micro or local level planning mainly for rainfed agriculture. It assesses basically the yield potentialities of various crop conditions; evolves future plan of action involving crop diversification; determines suitability of different crops for optimizing land use, disseminates research results and agro-technology. As a result sustainable agricultural development planning is increasingly being based on agro-ecological zones. In this process agro climate zoning has become very popular . The initial focus of the FAO agro-ecological zoning system was to assess the suitability of different types of land use for selected land uses. It is an important starting point for selected land use planning with an overview of the whole region. It diagnoses the present situation with regard to farming and land use by categorizing, describing and analyzing, farming systems components.

- **Agro-Ecological Zoning (AEZ**) refers to the division of an area of land into smaller units, which have similar characteristics related to land suitability potential production and environmental impact.

- **Agro-Ecological Zone** is a land resource mapping unit, having a unique combination of land form, soil and climatic characteristics and/or land cover having a specific range of potentials and constraints for land use (FAO, 1996).

- **Agro-Ecological Cell (AEC)** is defined by a unique combination of land form, soil and climatic characteristics

The Soils and Land Use Survey Organization, Nagpur has delineated the agro-ecological regions. 21 major and 60 sub-regions have been carved out on the basis of meso level physiographic features, soil, general bio-climate and a five tier length of growing period. This classification is more useful from the viewpoint of agricultural possibilities as it includes physiographic and soil conditions. The 21 major regions are categorized into –

- **Dry Ecological region**
- **Semi-Dry Ecological region**
- **Sub-Humid Ecological region**
- **Humid-Par Humid Ecological region**
- **Coastal Ecological region**
- **Island region**

Dry Ecological Region

The Western Himalayan Region – Covering 4.7% area of the country, has cold dry conditions and shallow soil. The region experiences cool summers and harsh winters. The average temperature is 8° C, annual precipitation 15 cm and crop growing period under 90 days. This region has good possibilities for growing fruits like peaches, apples, etc.

Desert conditions with alkaline soils are found in western Rajasthan, south western Haryana and Punjab, north Kathiawar and Kutch. This region experiences hot summers and cold winters. Average precipitation is under 30 cm and length of growing season is under 90 days. The soil is predominantly sandy and saline. Drought further causes major constraint. Dry farming is prevalent in this region

The region bordering Karnataka and Andhra Pradesh has mixed red and black soil, 40-50 cm of annual precipitation and limited growing season of under 90 days are the characteristics.

Semi Dry Ecological region

The hot semi dry region extends from the northern plain to Gujarat plain. It covers 10% of country's area. The climate is characterized by hot dry summers and cool winters, 40-80cm annual precipitation and 90-150 days of growing period. The region has mixed soils and sand dunes in between. Dry farming is the general practice, however intensive cultivation occurs in the area of tube well irrigation. Saline soils, frequent droughts, falling ground water level are disturbing features.

Malwa upland and Kathiawar have hot dry climate and medium to deep black soils, 60-90 cm annual precipitation and 90-150 days growing period. Frequent droughts, salinity and alkalinity of soils are major constraints.

The Deccan region of Maharashtra and north western Andhra Pradesh and Karnataka have a hot and semi dry climate and shallow to deep black soils. Dry farming is practiced in medium heavy mixed soils with 60-

100 cm annual precipitation and over 150 days of growing period. Long spells of drought affect the agricultural productivity which may be increased by watershed management and appropriate irrigation.

The hot semi dry eastern Deccan and Eastern Ghats in Andhra Pradesh have mixed red and black soils, 60-100 cm of annual precipitation and 90-150 days of growing season. The region is suitable for growing cotton. Irrigated area is suitable for rice cultivation. Disrupted drainage, salinity and soil erosion are the major constraints.

Tamil Nadu upland and Karnataka plateau have red loamy soil, 60-100 cm of annual rainfall and 90-150 days of growing season, suitable for cotton cultivation. Rice is cultivated in irrigated regions.

Sub Humid Ecological region

This narrow belt extending over the Ganga plain has alluvial soil, 100-120 cm annual rainfall and 150-180 days of growing season. Water logging and salinity are major problems.

The uplands of Malwa and Bundelkhand has 100-150 cm rain, 150-180 days of growing season, medium to deep black soil. Floods along rivers and drought during kharif are major constraints.

Bundelkhand and Vidharbha regions have red and black soils. Cracks in clayey soil and soil erosion are major constraints.

Chhatisgarh and western part of Jharkhand have 120-160 cm rain, wheat and rice are grown here. Gully erosion, water logging and frequent droughts are the major constraints.

Eastern Jharkhand has 100 cm of rain, red loam soil, severe soil erosion and occasional drought are major problems.

The Tarai region of eastern Uttar Pradesh, Bengal and Bihar, 140-160 cm of rain, 180-210 days of growing season. Improper drainage, salinity and floods are major problems.

The western Himalayas have warm humid to cold humid climate, 160-200 cm of annual rain, 150-210 days of growing season. Severe cold, deforestation and landslides are major problems.

Humid Par Humid region

These regions include north eastern states having 160-200 cm annual rainfall with more than 270 days of growing season. Shifting cultivation, deforestation and deep soil erosion are major problems.

Coastal Region

The eastern coast has 120-160 cm of rain, 150-210 days of growing period, slightly acidic clayey soil, inadequate drainage is major challenge.

The west coast has 200 cm of rain, 270 days of growing period. The soil is alluvial to red laterites.

Island region

The region includes both the archipelagoes, with 160-300 cm of rain, 270 days of growing periods. Tropical diseases, water logging are major constraints.

Agro-Climatic Zones in India

The Planning Commission has categorized 15 agro-climatic zones in India, taking into account the physical attributes and socio-economic conditions prevailing in the regions.

Western Himalayan Region :

The Western Himalayan Region covers Jammu and Kashmir, Himachal Pradesh and the hill region of Uttarakhand.

Topography and temperatures show great variation. Average temperature in July ranges between 5°C and 30 °C, while in January it ranges between 5 °C and -5 °C. Mean annual rainfall varies between 75 cm to 150 cm; in Ladakh, however, it is less than 30 cm. There is alluvial soil in the valleys of Kashmir, Kullu and Dun, and brown soil in the hills.

The valley floors grow rice, while the hilly tracts grow maize in the kharif season. Winter crops are barley, oats, and wheat. The region supports horticulture, especially apple orchards and other temperate fruits such as peaches, apricot, pears, cherry, almond, litchis, walnut, etc. Saffron is grown in this region.

The high altitude alpine pastures, locally known as 'dhoks' or 'margs', are used by the Gujjars, Bakarwals and Gaddis to rear their sheep, goats, cattle and horses. The economy is largely agrarian.

The main problems of this region are poor accessibility, soil erosion, landslides, inclement weather, inadequacy of marketing and storage facilities. The population is generally rural-based and poor.

Research in better seeds and extension service for agricultural development are required.

Eastern Himalayan Region :

The Eastern Himalayan Region includes Arunachal Pradesh, the hills of Assam, Sikkim, Meghalaya, Nagaland, Manipur, Mizoram, Tripura, and the Darjeeling district of West Bengal. The topography is rugged. Temperature variation is between 25 °C and 30 °C in July and between 10 °C and 20 °C in January. Average rainfall is between 200-400 cm. The red-brown soil is not highly productive Jhuming (shifting cultivation) prevails in the hilly areas.

The main crops are rice, maize, potato, tea. There are orchards of pineapple, litchi, oranges and lime.

Infrastructural facilities in the region need to be improved and shifting cultivation controlled by developing terrace farming.

Lower Gangetic Plain Region:

West Bengal (except the hilly areas), eastern Bihar and the Brahmaputra valley lie in this region. Average annual rainfall lies between 100 cm-200 cm. Temperature in July varies from 26 °C to 41 °C and for January from 9 °C to 24 °C. The region has adequate storage of ground water with high water table.

Rice is the main crop which at times yields three successive crops (Aman, Aus and Boro) in a year. Jute, maize, potato, and pulses are other important crops. Planning strategies include improvement in rice farming, horticulture (banana, mango and citrus fruits), pisciculture, poultry, livestock, forage production and seed supply.

Middle Gangetic Plain Region:

The Middle Gangetic Plain region includes large parts of Uttar Pradesh and Bihar. The average temperature in July varies from 26 °C to 41 °C and that of January 9 °C to 24 °C average annual rainfall is between 100 cm and 200 cm. It is a fertile alluvial plain drained by the Ganga and its tributaries. Rice, maize, millets in kharif, wheat, gram, barley, peas, mustard and potato in rabi are important crops.

Alternative farming systems, and utilising chaur lands for pisciculture are some measures to boost agricultural production.

Reclamation of user lands, wastelands, and fallow lands for agriculture and allied activities (agro-forestry, silviculture, floriculture etc.) should be done.

Upper Gangetic Plains Region:

In the Upper Gangetic Plains region come the central and western parts of Uttar Pradesh and the Hardwar and Udham Nagar districts of Uttarakhand.

The climate is sub-humid continental with temperature in July between 26 °C to 41 °C and temperature in January between 7 °C to 23 °C. Average annual rainfall is between 75 cm-150 cm. The soil is sandy loam. Canal, tube-well and wells are the main source of irrigation. This is an intensive agricultural region wherein wheat, rice, sugarcane, millets, maize, gram, barley, oilseeds, pulses and cotton are the main crops.

Besides modernising traditional agriculture the region needs special focus on dairy development and horticulture. Strategies should include developing multiple mixed cropping patterns.

Trans-Ganga Plains Region:

This region (also called the Satluj-Yamuna Plains) extends over Punjab, Haryana, Chandigarh, Delhi and the Ganganagar district of Rajasthan. Semi- arid characteristics prevail over the region, with July's mean monthly temperature between 25 °C and 40 °C and that of January between 10 °C and 20 °C.

The average annual rainfall varies between 65 cm and 125 cm. The soil is alluvial which is highly productive. Canals and tube-wells and pumping sets have been installed by the cultivators and the governments. The intensity of agriculture is the highest in the country.

Important crops include wheat, sugarcane, cotton, rice, gram, maize, millets, pulses and oilseeds etc. The region has the credit of introducing Green Revolution in the country and has adopted modern methods of farming with greater degree of mechanisation. The region is also facing the menace of waterlogging, salinity, alkalinity, soil erosion and falling water table.

Some steps that may be required to make agriculture in the region more sustainable and productive are:

(i) diversion of some rice-wheat area to other crops like maize, pulses, oilseeds and fodder; (ii) development of genotypes of rice, maize and wheat with inbuilt resistance to pests and diseases; (iii) promotion of horticulture besides pulses like tur and peas in upland conditions; (iv) cultivation of vegetables in the vicinity of industrial clusters; (v) supply of quality seeds of vegetables and planting material for horticulture crops; (vi) development of infra¬structure of transit godowns and processing to handle additional fruit and vegetable production; (vii) implementation of policy and programmes to increase productivity of milk and wool; and (viii) development of high quality fodder crops and animal feed by stepping up area under fodder production.

Eastern Plateau and Hills:

This region includes the Chhotanagpur Plateau, extending over Jharkhand, Orissa, Chhattisgarh and Dandakaranya. The region enjoys 26 °C to 34 °C of temperature in July, 10 °C to 27 °C in January and 80 cm-150 cm of annual rainfall. Soils are red and yellow with occasional patches of laterites and alluviums. The region is deficient in water resources due to plateau structure and non-perennial streams. Rainfed agriculture is practised growing crops like rice, millets, maize, oilseeds, ragi, gram and potato.

Steps to improve agricultural productivity and income include cultivation of high value crops of pulses like tur, groundnut and soyabean etc. on upland rain-fed areas, growing crops like urad, castor, and groundnut in kharif and mustard and vegetables in irrigated areas, improvement of indigenous breeds of cattle and buffaloes, extension of fruit plantations, renovation including desilting of existing tanks and excavation of new tanks, 95.32 lakh ha of acidic lands through lime treatment, development of inland fisheries in permanent water bodies, and adopting integrated watershed development approach to conserve soil and rain water.

Central Plateau and Hills:

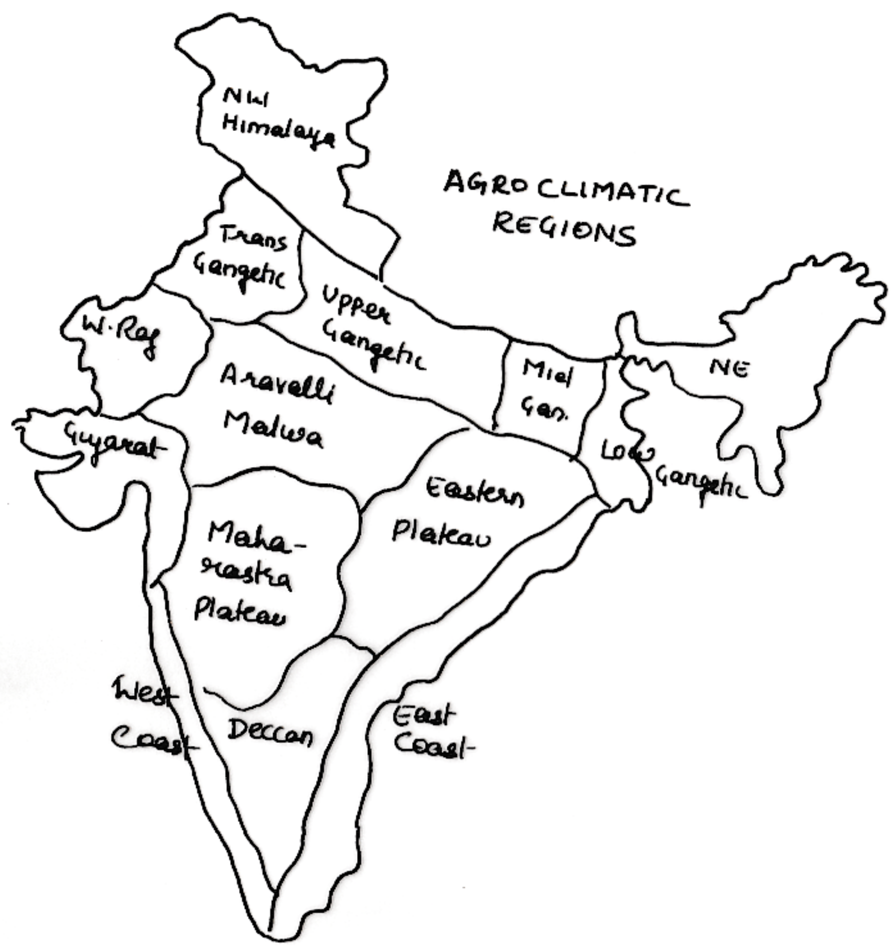
The region is spread over Bundelkhand, Baghelkhand, Bhander Plateau, Malwa Plateau, and Vindhyachal Hills. Semi-arid climatic conditions prevail over the region with temperature in July 26 °C to 40 °C, in

January 7 °C to 24 °C and average annual rainfall from 50 cm-100 cm. Soils are mixed red, yellow and black.

There is scarcity of water. Crops grown are millets, wheat, gram, oilseeds, cotton and sunflower. In order to improve agricultural returns, measures to be adopted are water conservation through water saving devices like sprinklers and drip system; dairy development, crop diversification, ground water development, reclamation of ravine lands.

Western Plateau and Hills :

Comprising southern part of Malwa plateau and Deccan plateau (Maharashtra), this is a region of the regur (black) soil with July temperature between 24 °C and 41 °C, January temperature between 6 °C and 23 °C and average annual rainfall of 25 cm-75 cm. Wheat, gram, millets, cotton, pulses, groundnut, and oilseeds are the main crops in the rain-fed areas, while in the irrigated areas, sugarcane, rice, and wheat, are cultivated. Also grown are oranges, grapes and bananas.



Attention should be paid to increasing water efficiency by popularizing water saving devices like sprinklers and drip system. The lower value crops of jowar, bajra and rainfed wheat should give way to high value oilseeds. Five per cent area under rain-fed cotton and jowar could be substituted with fruits like ber, pomegranate, mango and guava. Improvement of milk production of cattle and buffalo through cross-breeding along with poultry development should be encouraged.

Southern Plateau and Hills :

This region falls in interior Deccan and includes parts of southern Maharashtra, the greater parts of Karnataka, Andhra Pradesh, and Tamil Nadu uplands from Adilabad District in the north to Madurai District in the south. The mean monthly temperature of July varies between 25 °C and 40 °C, and the mean January temperature is between 10 °C and 20 °C. Annual rainfall is between 50 cm and 100 cm.

It is an area of dry-zone agriculture where millets, oilseeds, and pulses are grown. Coffee, tea, cardamom and spices are grown along the hilly slopes of Karnataka plateau.

Some of the area under coarse cereals may be diverted to pulses and oilseeds. Horticulture, dairy development and poultry farming should be encouraged.

Eastern Coastal Plains and Hills :

In this region are the Coromandal and northern Circar coasts of Andhra Pradesh and Orissa. The mean July temperature ranges between 25 °C and 35 °C and the mean January temperature varies between 20 °C and 30 °C. The mean annual rainfall ~ varies between 75 cm and 150 cm.

The soils are alluvial, loam and clay and are troubled by the problem of alkalinity. Main crops include rice, jute, tobacco, sugarcane, maize, millets, groundnut and oilseeds. Main agricultural strategies include improvement in the cultivation of spices (pepper and cardamom) and development of fisheries.

These involve increasing cropping intensity using water-efficient crops on residual moisture, discouraging growing of rice on marginal lands and bringing such lands under alternate crops like oilseeds and pulses; diversifying cropping and avoiding mono-cropping; developing horticulture in upland areas, social forestry and dairy-farming.

Western Coastal Plains and Ghats :

Extending over the Malabar and Konkan coastal plains and the Sahyadris, the region is humid with the mean July temperature varying between 25 °C and 30 °C and mean January temperatures between 18 °C and 30 °C. The mean annual rainfall is more than 200 cm.

The soils are laterite and coastal alluvial. Rice, coconut, oilseeds, sugarcane, millets, pulses and cotton are the main crops. The region is also famous for plantation crops and spices which are raised along the hill slopes of the Western Ghats.

The agricultural development must focus attention on raising of high value crops (pulses, spices, and coconut). Development of infra- structural facilities and promotion to prawn culture in brackish water should be encouraged.

Gujarat Plains and Hills :

This region includes the hills and plains of Kathiawar, and the fertile valleys of Mahi and Sabarmati rivers. It is an arid and semi-arid region with the mean July temperature reading 30 °C and that of January about 25 °C. The mean annual rainfall varies between 50 cm and 100 cm.

Soils are regur in the plateau region, alluvium in the coastal plains, and red and yellow soils in Jamnagar area. Groundnut, cotton, rice, millets, oilseeds, wheat and tobacco are the main crops. It is an important oilseed producing region.

The main strategy of development in this region should be canal and groundwater management, rain water harvesting and management, dry land farming, agro-forestry development, wasteland development and developing marine fishing and brackish/back-water aquaculture development in coastal zones and river deltas.

Western Dry Region :

Extending over Rajasthan, West of the Aravallis, this region has an erratic rainfall of an annual average of less than 25 cm. The desert climate further causes high evaporation and contrasting temperatures—28 °C to 45 °C in June and 5 °C to 22 °C in January. Bajra, jowar, and moth are main crops of kharif and wheat and gram in rabi. Livestock contributes greatly in desert ecology.

The main areas needing a thrust for development are rainwater harvesting, increasing yield level of horticultural crops like water melon, guava and date palm, adopting high quality germ- plasm in cattle to improve their breed; and adopting silvi-pastoral system over wastelands.

Island Region :

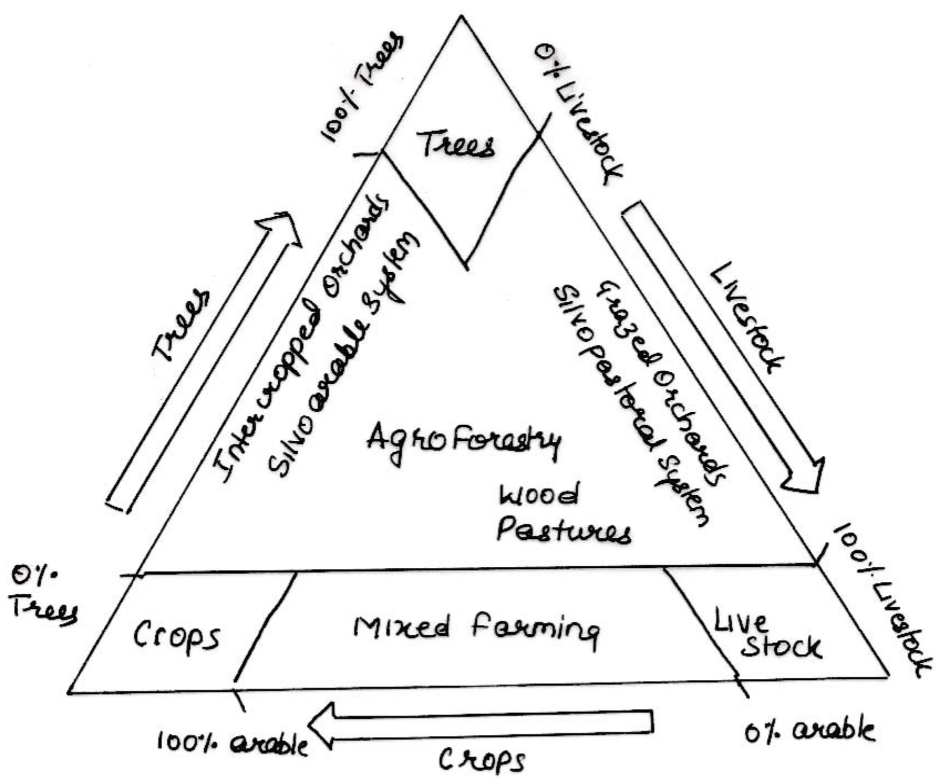
The island region includes Andaman-Nicobar and Lakshadweep which have typically equatorial climate (annual rainfall less than 300 cm; the mean July and January temperature of Port Blair being 30 °C and 25 °C respectively). The soils vary from sandy along the coast to clayey loam in valleys and lower slopes.

The main crops are rice, maize, millets, pulses, arecanut, turmeric and cassava. Nearly half of the cropped area is under coconut. The area is covered with thick forests and agriculture is in backward stage.

The main thrust in development should be on crop improvement, water management and fisheries. Improved variety of rice seeds should be popularised so as to enable farmers to take two crops of rice in place of one. For fisheries development multi-purpose fishing vessels for deep sea fishing should be introduced, suitable infrastructure for storage and processing of fish should be built up, and brackish water prawn culture should be promoted in the coastal areas.

AGRO FORESTRY

Agro forestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. In agro forestry systems there are both ecological and economical interactions between the different components. Agro forestry can also be defined as a dynamic, ecologically based, natural resource management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels. In particular, agro forestry is crucial to smallholder farmers and other rural people because it can enhance their food supply, income and health. Agro forestry systems are multifunctional systems that can provide a wide range of economic, sociocultural, and environmental benefits.



There are three main types of agro forestry systems :

AGRI SILVI CULTURAL SYSTEMS are a combination of crops and trees, such as alley cropping or home gardens. It is defined as growing of trees and agriculture crops together in same lands at the same time. This system is common in all agro-ecological zones of Nepal, where agriculture crops are grown in terrace flat and trees are grown in terrace bunds, borders and slopes.

The main advantages of this system are as follows:

- Produce multiple products such as food/vegetables/fruits, fodder and forage needed for livestock, fuel wood, timber, and leaf litter needed for organic manure production.
- Improve and sustain the crop productivity which increases the level of income of the farmers.
- Improve the nutritive value of animal feed due to the supply of green fodder..
- This is also the best practice for soil nutrient recycling, which also helps to reduce chemical fertilizer purchase.
- Improve the farm site ecology by reducing surface run off, soil erosion and nutrient loss, gully formation and landslides.
- Improve the local micro-climate and enhance the productive capacity of the farm.
- Reduce pressure of community forests and other natural forests for fodder, fuel wood and timber.
- This practices helps for the beautification of the surrounding areas.

Inter cropping practices can also adopt in this system in plain areas where trees should be grown maintaining rows to rows distance (5 meters) and plant to plant distance (2-3 meters). Management operations such singling, pruning and thinning in timber species and lopping, coppicing and pollarding in fodder species should be applied to reduce shading effects of trees on agriculture crops

SILVOPASTORAL SYSTEMS combine forestry and grazing of domesticated animals on pastures, rangelands or on-farm. Growing of trees, agriculture crops and grasses together in same lands at the same time is known as agri-silvi-pastoral system. This is typical hill farming system of Nepal, in which agriculture crops are grown in terrace flat, trees in terrace bunds, border and slopes and grasses in terrace slopes, and some farmers have been growing improved legume and non-legume grasses.

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The three elements, namely trees, animals and crops, can be integrated in what are called **AGROSYLVIPASTORAL SYSTEMS** and are illustrated by home gardens involving animals as well as scattered trees on croplands used for grazing after harvests. This system can be defined as growing of trees and grasses or forage species together in same lands at the same time. This system is common in all agro-ecological zones of Nepal, where land is marginal for crop production

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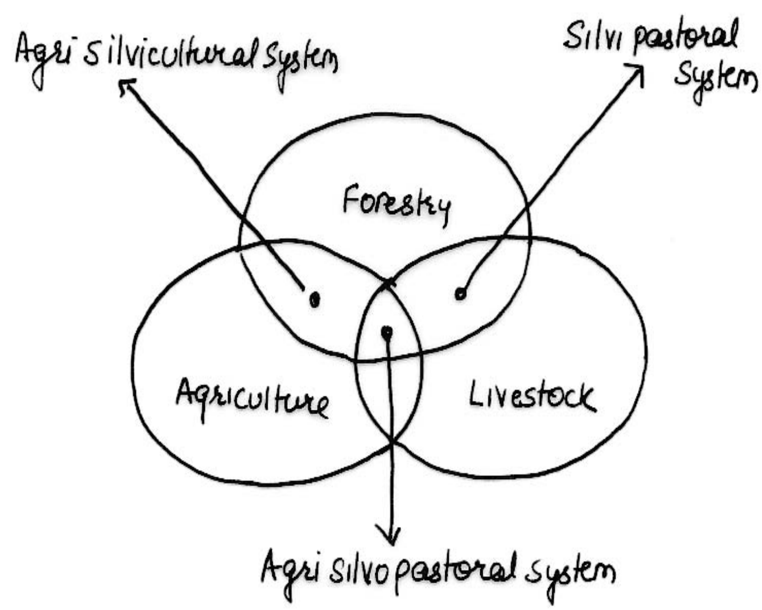

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