



ACCORDING TO ICAR SIXTH DEANS' COMMITTEE

FARMING BASED LIVELIHOOD SYSTEMS

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TEAM AGRI CAPITAL

BY; Mr. MAHI CHOUDHARY BHU

Mr. ISHWAR CHOUDHARY PDKV

AGRI CAPITAL

Syllabus:

- Status of agriculture in India and different states, Income of farmers and rural people in India,
- Livelihood-Definition, concept and livelihood pattern in urban & rural areas,
- Different indicators to study livelihood systems.
- Agricultural livelihood systems (ALS): Meaning, approach, approaches and framework,
- Definition of farming systems and farming based livelihood systems
- Prevalent Farming systems in India contributing to livelihood.
- Types of traditional & modern farming systems.
- Components of farming system/ farming-based livelihood systems- Crops and cropping systems, Livestock, (Dairy, Piggery, Goatry, Poultry, Duckry etc.), Horticultural crops, Agro--forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc.,
- Small, medium and large enterprises including value chains and secondary enterprises as livelihood components for farmers,
- Factors affecting integration of various enterprises of farming for livelihood.
- Feasibility of different farming systems for different agro-climatic zones,
- Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country,
- Case studies on different livelihood enterprises associated with the farming.
- Risk & success factors in farming-based livelihood systems,
- Schemes & programmes by Central & State Government,
- Public & Private organizations involved in promotion of farming-based livelihood opportunities.
- Role of farming based livelihood enterprises in 21st Century in view of circular economy, green economy
- Climate change, digitalization & changing life style.

Lecture No. 1

STATUS OF AGRICULTURE IN INDIA AND DIFFERENT STATES

Indian Agriculture:

Indian agriculture, which began around 11,000 years before present (BP) with the domestication of animals and early cultivation of plants, has made significant progress over the millennia. This found place in the ancient scripts of Vedas, Upanishadas, Ramayana and Mahabharata. Agriculture in India has been a complex mosaic of distinct agro-ecosystems, differentiated by climatic, soil, vegetation and other natural features, often heterogeneous, unorganized and subjected to vagaries from 'seed to market'. Historically, food shortage in pre-independent India caused serious impacts as agriculture was monsoon-dependent and unfavourable rains and natural calamities resulted in crop failures. The planning process in the independent India, therefore identified agriculture as the most prioritized sector and emphasized that 'everything can wait but agriculture'. In spite of the odds of uncertain weather, declining soil health, increasing atmospheric temperature and emergence of virulent pest and pathogens, which are continuing post-independence, Indian agriculture achieved several landmarks primarily due to science-led agricultural development. The most signifying milestone has been food security that brought confidence and raised the country's stature globally. We must not forget the ill memories of 'ship to mouth' till 1950s. It is the toiling work of millions of our farmers, scientists and the planners that transformed India from a food deficit country to a food surplus and net food exporter nation. The food grain production, which was merely 51 million tons (Mt) in 1950/51 increased over 6 times to over 314 Mt in 2022. The country has also become the largest producer of milk, pulses and jute and second largest producer of rice, wheat, cotton, fruits and vegetables in the world. India is also one of the leading producers of spices, fish, poultry, livestock and plantation crops. However, Indian agriculture continues to battle several intimidating challenges of increasing productivity, profitability and resilience at the backdrop of increasing population, depleting natural resource base, aggravating climate change and reducing farm income. We are now reimagining the Indian agriculture and prioritized for enhancing farmers income (200%), reducing fertilizer use (25%) and water use (20%), increasing

use of renewable energy (50%), reducing greenhouse gas emission intensity (45%) and rehabilitating degraded land of 26 million ha (Mha). India, being a signatory and prominent member of the United Nations, has several international commitments such as Panchamrit and carbon neutrality, land degradation neutrality, biodiversity conservation, regional agricultural development and Sustainable Development Goals (SDGs). Fortunately, advances in science have opened new avenues for addressing the challenges and fulfilling the priorities and commitments. A multi-pronged strategy with integration, diversification, intensification, customisation, farm mechanization, value addition and market access are the way forward to realise the full potentials of Indian farming with focus on profitable commercialization and export, ecosystem approach, sustainable agri-food system involving smart farmers and farming, post-harvest value addition and entrepreneurship engaging youth and women. Indian Council of Agricultural Research (ICAR) and the National Agricultural Research, Education and Extension System (NAREES), are determined to harness the advances of science and technology to infuse pull and push in agriculture for an all-round welfare of the society.

Agricultural research in India :

Systematic research in the country started with the establishment of Imperial Council of Agricultural Research (1929) in Delhi, which is known today as Indian Council of Agricultural Research (ICAR). This is the apex body with its headquarters at New Delhi for coordinating, guiding and managing research and education in agriculture including animal sciences and fisheries. The Council is an autonomous organization under the governance of Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers Welfare, Government of India. Established on 16th July 1929 as a registered society under the Societies Registration Act (1860) in pursuance of the report of the Royal Commission on Agriculture, ICAR now has 113 research institutes, 74 agricultural universities, 4 deemed-to-be-universities, 3 central universities and 731 Krishi Vigyan Kendras spread across the country. With these, ICAR leads one of the largest National Agricultural Research and Education System (NARES) in the world. India has one of the largest agricultural research human resource capitals in the world with

approximately 30,000 scientists and more than 100,000 technical & supporting personnel in the NARES. ICAR footprints are also extended to the neighbouring countries and several international, national and regional research organizations and universities are engaged with ICAR in agricultural research and development. Additionally, private and non-Governmental organizations and farmers themselves have done significant agricultural research in their own fields.

Landmark achievements in Indian agriculture:

In the year 1950-51 for which the data of agricultural production of majority of the commodities are available by the authorized sources, we have been producing about 135 Mt from agriculture and allied sectors. In 2021-22, total production of food and nonfood items was about 1300 Mt. This achievement is one amongst the very few noticeable landmarks in the history of Independent India. There has been multi-fold increase in the production of all the commodities, in spite the net sown area remaining almost constant at about 140 Mha. The country has witnessed a rainbow revolution in the agricultural commodities. The various colors of the Rainbow Revolution indicate various farm practices such as Green Revolution (Foodgrains), White Revolution (Milk), Yellow Revolution (Oil seeds), Blue Revolution (Fisheries); Golden Revolution (Fruits); Silver Revolution (Eggs), Round Revolution (Potato), Pink Revolution (Meat), Grey Revolution (Fertilizers) and so on. Thus, the concept of Rainbow revolution is an integrated development of crop cultivation, horticulture, forestry, fishery, poultry, animal husbandry and food processing industry.



Fig. 1. Revolutions in Indian agriculture

India now is one of the largest Agri-producers globally, ranking within the top 5 countries. These have enabled not only self-sufficiency in food, but also export of agri-commodities worth US\$ 50 billion. Production of most of the agricultural

commodities has increased by 6 to 68 times with only 1.3 times increase in area (Table 2). Thus, the country, which was food scarce till 1950, transformed itself into food shortage by 1960, food sufficient by 2000, food secured by 2010 and food surplus by 2010 onwards (Fig. 2). During the ongoing COVID-19 pandemic situation also, food production systems have been meeting the demands, with innovative interventions across the value chain. There are also indications that the greenhouse gas (GHG) emission intensity in agriculture is reducing and fertilizer use efficiency is improving in recent years (Pathak and Ayyappan 2020). A blend of science, technology, extension and policy has contributed in this journey of transforming the country from food scarce to food surplus nation.

Table 2 : Production of agricultural commodities and cultivated area in the country

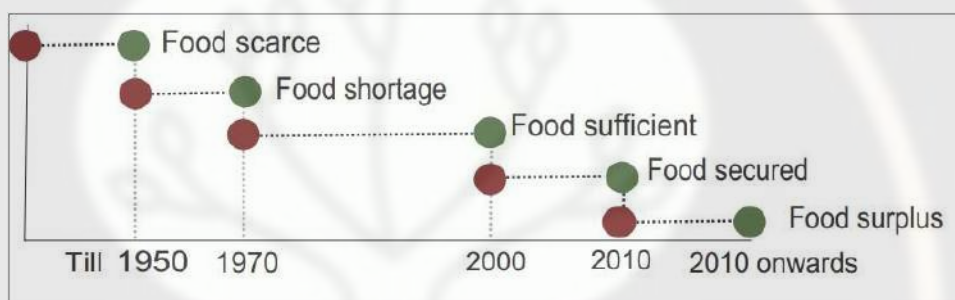


Fig. 2. Transformation of India from food scarce to food surplus nation in 1950-51 and 2021-22

| Commodity | 1950-51 | 2021-22 | Times increase |
|--------------------------|---------|---------|----------------|
| Food grains (Mt) | 51 | 314 | 6.2 |
| Vegetables & fruits (Mt) | 25 | 333 | 13.3 |
| Milk (Mt) | 17 | 210 | 12.4 |
| Egg (billion) | 1.8 | 122 | 67.8 |
| Fish (Mt) | 0.8 | 14.2 | 17.8 |
| Net sown area (Mha) | 130 | 140 | 1.1 |
| Gross sown area (Mha) | 150 | 198 | 1.3 |

Reference :

- Indian Agriculture after Independence – Pathak, H.; Mishra, J.P. and Mohapatra, T. (2022), Indian Council of Agricultural Research, New Delhi 110 001.

Highlights:

- *Nearly three-quarters of India's families depend on rural incomes.*
- *The majority of India's poor (some 770 million people or about 70 per cent) are found in rural areas.*
- *India's food security depends on producing cereal crops, as well as increasing its production of fruits, vegetables and milk to meet the demands of a growing population with rising incomes.*

While agriculture's share in India's economy has progressively declined to less than 15% due to the high growth rates of the industrial and services sectors, the sector's importance in India's economic and social fabric goes well beyond this indicator. First, nearly three-quarters of India's families depend on rural incomes. Second, the majority of India's poor (some 770 million people or about 70 percent) are found in rural areas. And third, India's food security depends on producing cereal crops, as well as increasing its production of fruits, vegetables and milk to meet the demands of a growing population with rising incomes. To do so, a productive, competitive, diversified and sustainable agricultural sector will need to emerge at an accelerated pace.

India is a global agricultural powerhouse. It is the world's largest producer of milk, pulses, and spices, and has the world's largest cattle herd (buffaloes), as well as the largest area under wheat, rice and cotton. It is the second largest producer of rice, wheat, cotton, sugarcane, farmed fish, sheep & goat meat, fruit, vegetables and tea. The country has some 195 m ha under cultivation of which some 63 percent are rainfed (roughly 125m ha) while 37 percent are irrigated (70m ha). In addition, forests cover some 65m ha of India's land.

Agricultural production and yield :

List of 10 Leading Agricultural States in India

The following are the top agricultural states in India by crop production –

| Sr. No. | State | Major Crops Grown |
|---------|----------------|-------------------------------------|
| 1. | Punjab | Wheat, Rice, Cotton |
| 2. | Uttar Pradesh | Wheat, Sugarcane, Rice, Maize |
| 3. | Maharashtra | Sugarcane, Cotton, Rice |
| 4. | Madhya Pradesh | Soybean, Wheat, Rice |
| 5. | Rajasthan | Bajra, Wheat, Pulses, Oilseeds |
| 6. | Bihar | Rice, Wheat, Maize |
| 7. | Andhra Pradesh | Rice, Sugarcane, Chillies, Oilseeds |
| 8. | Karnataka | Coffee, Sugarcane, Rice, Oilseeds |
| 9. | Tamil Nadu | Rice, Sugarcane, Banana, Oilseeds |
| 10. | West Bengal | Rice, Jute, Pulses, Oilseeds |

1st Leading Agricultural State in India — Uttar Pradesh

Uttar Pradesh is the largest agricultural state in India. Agriculture has always played a very significant role in the economic development of Uttar Pradesh. It is India's largest producer of several food grains such as wheat, rice, sugarcane, and potatoes. Some of the other major crops produced are pulses, oilseeds, milk, and sugarcane. The fertile Gangetic plains and favorable climate allow for double cropping in most parts of the state, contributing immensely to agricultural production. Rice-wheat is the dominant cropping system practised here. Sugarcane is another important cash crop. Dairy farming and animal husbandry also forms an crucial part of the rural economy. The agricultural sector employs about 80% of the state's workforce. Uttar Pradesh has achieved tremendous growth in food grain production over the past few decades, consolidating its position as India's biggest producer as well as the leading agricultural state.

2nd Leading Agricultural State in India — West Bengal

West Bengal is renowned for its high rice production, contributing significantly to the nation's food supply. The state also excels in growing jute, earning it the nickname "Jute Bowl of India." Tea plantations in Darjeeling produce world-famous tea. Additionally, West Bengal is a major producer of fish due to its extensive water bodies and favorable climate. The state's agriculture is diversified with fruits, vegetables, and flowers, playing a vital role in its economy.

3rd Leading Agricultural State in India — Madhya Pradesh

Madhya Pradesh, known as the "Heart of India," is a leading agricultural state with significant production of soybeans and pulses. The state's diverse topography and climate support the cultivation of wheat, rice, and maize. MP is also a major producer of oilseeds, particularly soybeans, contributing to India's vegetable oil industry. Horticulture is another vital sector, with the state producing various fruits and vegetables, bolstering its agricultural output and rural economy.

4th Leading Agricultural State in India — Karnataka

Karnataka stands out for its diverse agricultural activities, notably the cultivation of coffee and spices in the Western Ghats region. The state is also a major producer of silk, earning it the title of India's "Silk State." Millets, rice, and sugarcane are other significant crops grown in Karnataka. Its favorable climate and varied geography enable the cultivation of a wide range of horticultural crops, including fruits and vegetables, supporting the state's agricultural economy.

5th Leading Agricultural State in India — Maharashtra

Maharashtra is a leading agricultural state, known for its significant production of cotton and sugarcane. The state's diverse agro-climatic zones also support the cultivation of rice, wheat, and pulses. Maharashtra is a major producer of fruits like grapes, oranges, and bananas, and has a robust horticulture sector. The state's dairy industry is well-developed, contributing to its agricultural output. Additionally, Maharashtra's progressive farming techniques and irrigation projects enhance its agricultural productivity.

6th Leading Agricultural State in India — Punjab

Punjab, often called the "**Granary of India**," is renowned for its extensive wheat and rice cultivation. The state's fertile soil and efficient irrigation systems make it a leading contributor to India's food grain production. Punjab also grows significant quantities of maize and barley. The dairy sector is strong, with substantial milk production. Punjab's agriculture is characterized by mechanization and high yields, making it a crucial player in ensuring national food security.

7th Leading Agricultural State in India — Andhra Pradesh

Andhra Pradesh is a key agricultural state, prominently producing rice, making it one of India's top rice producers. The state's favorable climate supports the cultivation of various crops, including tobacco, cotton, and chilies. Andhra Pradesh is also known for its horticulture, particularly the production of mangoes, bananas, and citrus fruits. The state's extensive coastline supports a thriving fishing industry, contributing to its diverse agricultural and allied activities.

8th Leading Agricultural State in India — Assam

Assam, located in northeastern India, is famous for its tea plantations, particularly in the Assam Valley, producing some of the finest teas in the world. The state's agriculture also includes the cultivation of rice, jute, and oilseeds. Assam's diverse agro-climatic conditions support horticulture, with significant production of fruits and vegetables. The state's abundant water resources contribute to a thriving fishery sector, making agriculture a vital part of Assam's economy.

9th Leading Agricultural State in India — Haryana

Haryana is a prominent agricultural state, known for its high yields of wheat and rice, contributing significantly to India's food grain stock. The state's well-developed irrigation system supports extensive cultivation of these staple crops. Haryana is also a major producer of milk, with a strong dairy industry. Other important crops include cotton, sugarcane, and oilseeds. The state's agricultural success is attributed to modern farming techniques and government support for the sector.

10th Leading Agricultural State in India — Gujarat

Gujarat is a leading agricultural state, particularly known for its cotton and groundnut production. The state's diverse climate and soil conditions support the cultivation of a variety of crops, including wheat, rice, and pulses. Gujarat also has a significant horticulture sector, producing fruits like mangoes and bananas. The state's dairy industry is robust, with the famous Amul cooperative headquartered here. Gujarat's progressive agricultural policies and infrastructure contribute to its agricultural prosperity.

Reference : <https://testbook.com/static-gk/top-10-leading-agriculture-states-of-india>.

Lecture No. 2

INCOME OF FARMERS AND RURAL PEOPLE IN INDIA

Farmers' Income

Posted On: 21 MAR 2023 6:09PM by PIB Delhi

Farmers' income is estimated through the survey conducted by National Sample Survey Office(NSSO). As per last "Situation Assessment Survey" conducted in 2012-13, Monthly Agricultural Household Income was estimated as Rs.6,426/- which increased to Rs.10,218/- as per the survey conducted in 2018-19.

Government had constituted an Inter-Ministerial Committee in April, 2016 to examine issues relating to "Doubling of Farmers Income (DFI)" and recommend strategies to achieve the same. The Committee submitted its final report to the Government in September, 2018 containing the strategy for doubling of farmers' income through various policies, reforms & programmes.

Agriculture being a State Subject, the State Governments take appropriate measures for development of agriculture and welfare of farmers in the State. However, Government of India supplements the efforts of States through appropriate policy measures and budgetary support and various schemes/ programmes. As per the strategy suggested by DFI Committee, Government has adopted and implemented several policies, reforms, developmental programmes and schemes for achieving higher incomes for the farmers. These include:

1. Unprecedented enhancement in budget allocation :

In the year 2013-14 the budget allocation of Ministry of Agriculture (including DARE) and Ministry of Fisheries, Animal Husbandry & Dairying was only 30223.88 crore. This has increased by more than 4.35 times to Rs. 1,31,612.41 crore in 2023-24.

2. Income support to farmers through PM KISAN :

Launch of PM-KISAN in 2019 -an income support scheme providing Rs. 6000 per year in 3 equal installments. More than Rs. 2.24 lakh crore has been released so far to more than 11 crore farmers as of now.

3. Pradhan Mantri Fasal Bima Yojana (PMFBY) :

Six year - PMFBY was launched in 2016 addressing problems of high premium rates for farmers and reduction in sum insured due to capping. In past 6 Years of

implementation – 37.66 crore farmer applications have been enrolled and over 12.38 crore (Provisional) farmer applicants have received claims. During this period nearly Rs. 25,174 crore were paid by farmers as their share of premium against which claims of over Rs. 1,30,185 crore (Provisional) have been paid to them. Thus for every 100 rupees of premium paid by farmers, they have received about Rs. 517 as claims.

4. Institutional credit for agriculture sector :

- i. Increased from Rs. 7.3 lakh crore in 2013-14 with a target to reach Rs. 18.5 lakh crore in 2022-23.
- ii. Benefit of concessional institutional credit through KCC at 4% interest per annum has also now been extended to Animal Husbandry and Fisheries farmers for meeting their short-term working capital needs.
- iii. A special drive has been undertaken since February 2020 to provide concessional institutional credit with focus on covering all PM-KISAN beneficiaries through Kisan Credit Cards (KCC). As on 30.12.2022, 389.33 lakh new KCC applications have been sanctioned with a sanctioned credit limit of Rs. 4,51,672 crore as part of the drive.

5. Fixing of Minimum Support Price (MSP) at one-and-a half times the cost of production :

- i. Government has increased the MSP for all mandated Kharif, Rabi and other commercial crops with a return of at least 50 per cent over all India weighted average cost of production from 2018-19.
- ii. MSP for Paddy (common) has increased to Rs. 2040 per quintal in 2022-23 from Rs. 1310 per quintal in 2013-14.
- iii. MSP for Wheat increased from Rs. 1400 per quintal in 2013-14 to Rs. 2125 per quintal in 2022-23.

6. Promotion of organic farming in the country :

- i. Paramparagat Krishi Vikas Yojana (PKVY) was initiated in 2015-16 to promote organic farming in the country. 32,384 clusters have been formed and an area of 6.53 lakh hectare has been covered benefitting 16.19 lakh farmers. In addition, Under Namami Gange Programme 1.23 lakh hectare area covered and under natural farming 4.09 lakh hectare area covered. Farmers in Uttar Pradesh, Uttarakhand, Bihar and Jharkhand have taken-up organic farming on either side

of the river Ganga to control river water pollution as well as to fetch additional income to farmers.

- ii. Government also proposes to promote sustainable natural farming systems through the scheme Bhartiya Prakratik Krishi Padhati (BPKP). The proposed scheme aims at cutting down cost of cultivation, enhancing farmer's income and ensuring resource conservation and, safe and healthy soils, environment and food.
- iii. Mission Organic Value Chain Development in North East Region (MOVCDNER) has been launched. 379 Farmer Producer Companies have been formed comprising of 1,89,039 farmers and covering 1,72,966 hectare area.

7. Per Drop More Crop :

Per Drop More Crop (PDMC) scheme was launched in the year 2015-16 which aims to increase water use efficiency, reducing cost of inputs and increasing productivity at the farm level through Micro Irrigation technologies i.e. drip and sprinkler irrigation systems. So far, an area of 72 lakh hectare has been covered under Micro irrigation through the PDMC scheme from the year 2015-16.

8. Micro Irrigation Fund :

A Micro Irrigation Fund of initial corpus Rs 5,000 crore has been created with NABARD. In the Budget Announcement for 2021-22, the corpus of the fund is to be increased to Rs.10,000 crore. Projects worth Rs 4,710.96 crore covering 17.09 lakh hectares have been approved.

9. Promotion of Farmer Producer Organisations (FPOs) :

- i. A new Central Sector Scheme for Formation & Promotion of new 10,000 FPOs launched by Hon'ble Prime Minister on 29th February, 2020 with budget outlay of Rs 6865 Crore till 2027-28.
- ii. As on 30.11.2022, 4028 no. of FPOs have been registered under new FPO scheme.
- iii. Equity Grant of Rs. 65.33 Crore has been released to 1,730 FPOs as on 31.12.2022.
- iv. As on 31.12.2022, Credit Guarantee Cover worth Rs. 101.78 crore issued to 583 FPOs.

10. A National Beekeeping and Honey Mission (NBHM) :

Has been launched in 2020 as part of the Atma Nirbhar Bharat Abhiyan to increase productivity of crops through pollination and increase in honey production as an additional source of income. Rs. 500 crore for the period 2020-2021 to 2022-2023 has been allocated for beekeeping sector. 114 projects for assistance of about Rs. 139.23 crore, approved/ sanctioned for funding under NBHM during 2020-21, 2021-22 & 2022-23 till date.

11. Agricultural Mechanization :

Agricultural mechanization is an extremely vital to modernize agriculture and reduce drudgery of farming operations. During the period from 2014-15 to March, 2022 an amount of Rs.5,490.82 crore have been allocated for agricultural mechanization. 13,88,314 numbers of machines and equipments have been provided to farmers on subsidy basis. 18,824 custom hiring centers, 403 high-tech hubs and 16,791 farm machinery banks have been established to make available agricultural machines and equipments to the farmers on rental basis. During the current year i.e. 2022-23, so far an amount of Rs. 585.50 crore have been released for distribution of around 75,391 machines on subsidy, establishment of 3,468 CHCs, 64 Hi-tech hubs and 2281 Village Level Farm Machinery Banks.

12. Providing Soil Health Cards to farmers :

Soil Health Card Scheme was introduced in the year 2014-15 to optimize usage of nutrients. The following numbers of cards have been issued to farmers;

- i. Cycle-I (2015 to 2017) – 10.74 crore
- ii. Cycle-II (2017 to 2019)- 12.19 crore
- iii. Model Village Programme (2019-20)- 23.71 lakh
- iv. In the year 2020-21- 11.52 lakh

13. Setting up of National Agriculture Market (e-NAM) extension Platform :

- i. 1260 mandis of 22 States and 03 UTs have been integrated to e-NAM platform.
- ii. As on 31.12.2022, more than 1.74 Crore Farmers & 2.39 Lakh traders have been registered on e-NAM portal.
- iii. Total volume of 7.07 Crore MT & 20.88 Crore numbers (bamboo, betel leaves, coconut, lemon & sweet corn) collectively worth approximately Rs. 2.42 lakh crore of trade has been recorded on e-NAM platform as on 31.12.2022.

14. Launch of the National Mission for Edible Oils – Oil Palm :

NMEO has been approved with a total outlay of Rs 11,040 crore. This will bring an additional area of 6.5 lakh hectare under Oil Palm plantation with 3.28 lakh hectare

in the north-eastern states and 3.22 lakh hectare in the rest of India in the next 5 years. The major focus of the Mission is to provide Viability Prices of fresh fruit bunches (FFBs) to the farmers linked with assured procurement by industry with a simpler price fixing formula.

15. Agri Infrastructure Fund (AIF) :

Since inception of AIF in the year 2020, the scheme has sanctioned an amount of Rs.16,117 crore worth agriculture infrastructure in the country for 22,354 projects. With the support of the scheme, various agriculture infrastructures were created and some of the infrastructure are at the final stage of completion. These infrastructures include 8,752 warehouses, 4,188 primary processing units, 2,635 custom hiring centres, 1,217 sorting & grading units, 859 cold store projects, 163 assaying units and around 4,257 other kinds of post-harvest management projects and community farming assets.

16. Improvement in farm produce logistics, Introduction of Kisan Rail :

Kisan Rail has been launched by Ministry of Railways to exclusively cater to movement of perishable agrihorti commodities. First Kisan Rail was started in July 2020. Till 31st December, 2022, 2359 services on 167 routes have been operated.

17. MIDH - Cluster Development Programmer :

The Cluster Development Programme (CDP) is designed to leverage geographical specialisation of horticulture clusters and promote integrated and market-led development of pre-production, production, post-harvest, logistics, branding, and marketing activities. DA&FW has identified 55 horticulture clusters, of which 12 have been selected for the pilot phase of the CDP.

18. Creation of a Start-up Eco system in agriculture and allied sector :

So far, 1102 Startups during FY 2019-20 to 2022-23 have been finally selected by different knowledge partners and agribusiness incubators of DA&FW. A total of Rs. 66.83 crore grants-in-aid has been released for funding to these Startups to the respective Knowledge Partners (KPs) & RKVY RAFTAAR Agri Business Incubator (R-ABIs) as grants-in-aid support by DA&FW.

19. Achievement in Export of Agri and Allied Agri- Commodities :

The country has witnessed emphatic growth in export of agri and allied commodities. As compared to previous year 2020-21, the Agri and allied export has increased from 41.86 billion USD in 2020-21 to 50.24 billion USD in 2021-22 i.e. an increase of 19.99%.

The efforts of Government at positive implementation of these schemes have yielded remarkable results towards augmenting the income of the farmers. As part of the '*Azadi ka Amrit Mahotsav*', Indian Council of Agricultural Research (ICAR) has released a book, which contains compilation of success stories of 75,000 farmers out of innumerable successful farmers who have increased their income more than two times.

A total amount of funds for Rs. 63,494.84 crore was surrendered by the Department of Agriculture and Farmers Welfare during the last 3 financial years i.e. 2019-20, 2020-21 and 2021-22 on account of following reasons:

- (i) Due to unspent balance with States/Implementing Agencies from release made earlier mainly Goa, Tamil Nadu, Bihar, Kerala, Uttar Pradesh etc.
- (ii) Due to delay in compliance of Department of Expenditure's guidelines for new procedure of fund release, States could not furnish various compliance statements and also there were unspent balance in State treasury. Single nodal account (SNA) mapping on PFMS portal for many states were also incomplete and various checklist, undertaking etc were not furnished by States/UTs. Therefore, funds were not released to many States/UTs.
- (iii) Utilization of mandatory 10% Gross Budgetary Support allocation for North Eastern States is constrained on account of low capacity, saturation in entitlement based scheme, less Gross Cropped Area as compared to the national average and community land holding in NE States.

This information was given by the Union Minister of Agriculture and Farmers Welfare, Shri Narendra Singh Tomar in a written reply in Lok Sabha today.

Reference : <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1909208>

Lecture No. 3

LIVELIHOOD-DEFINITION, CONCEPT AND LIVELIHOOD PATTERN IN URBAN & RURAL AREAS

- The dictionary definition of livelihood is a 'means to living'
- Livelihood can be defined as the activities, the assets and the access that jointly determine the living gained by an individual or household.
- A livelihoods comprises the assets (Natural, Physical, Human, Financial and Social Capital), the activities and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household (Chambers and Conway, 1992).
- Sustainable livelihood : A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base.
- Rural livelihood diversification : Rural livelihood diversification is defined as the process by which rural households construct an increasingly diverse portfolio of activities and assets in order to improve their standard of living.

“What is a livelihood”, few would struggle to answer.

“Making a living”, “supporting a family”, or “my job” all describe a livelihood. The term is well recognized as humans inherently develop and implement strategies to ensure their survival. The hidden complexity behind the term comes to light when governments, civil society, and external organizations attempt to assist people whose means of making a living is threatened, damaged, or destroyed. From extensive learning and practice, various definitions have emerged that attempt to represent the complex nature of a livelihood.

A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stress and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base. (Chambers & Conway, 1991)

In order to better understand how people develop and maintain livelihoods, the UK Department for International Development (DFID), building on the work of

practitioners and academics, developed the Sustainable Livelihoods Framework (SLF). This framework is an analysis tool, useful for understanding the many factors that affect a person's livelihood and how those factors interact with each other.

The SLF views livelihoods as systems and provides a way to understand:

1. the assets people draw upon
2. the strategies they develop to make a living
3. the context within which a livelihood is developed
4. and those factors that make a livelihood more or less vulnerable to shocks

and stresses

What is Urban Livelihood?

Urban areas, in a nutshell, are defined as areas where modernization took place. These areas generally consist of an extensive population. For instance, metropolitan cities such as Bangalore, New Delhi, Mumbai, and so on are urban areas. Livelihood, on the other hand, is simply defined as the lifestyle of an individual or their occupation. Thus, the civics chapter on rural and urban livelihood covers the basic details into distinguishing forms of urban livelihood. You will learn about the lifestyles of different people, jobs available in the industry, and the functioning of different urban areas or cities.

Types of Urban Livelihoods

1. Urban Livelihood of Street Workers

In cities and towns, you might often come across several individuals working in the streets. For instance, ice-cream sellers, vegetable vendors, rickshaw pullers, cobblers, and so on, are some of the working individuals that you may stumble across on streets. These are recognized as self-employed individuals. Moreover, they don't work in permanent shops. Their occupation is carried out from anywhere and anywhere. While some of these individuals move around in cycles, some of them live and maintain their work in shacks. About a majority of these workers briefly migrate from rural areas to earn money for a living and provide for their family.

2. Self Employed Business

Another type of urban livelihood is those of the self-employed business. Cloth stores, cafes, medicine shops, and other such businesses are run by self-employed

businesses. These are individuals that establish their own organizations. Several businessmen are even worth billions. For instance, businesses that established multinational corporations and even other small business owners. These businesses are categorized into the organized sector and unorganized sector. When it comes to occupation in urban areas, organized sector businessmen are those whose businesses and accounts are monitored. In unorganized sectors, small businesses invest money on their own and make profits steadily.

3. Organized Sector Workers

Most of the urban livelihood falls into this category of working professionals. For instance, civil engineers, doctors, and marketing managers are some of the workers that fall into this category. They are bound to earn the maximum salary annually in the city. However, they don't work on hourly wages like that of labourers. These workers have access to a wide range of perks, unlike the factory labourers. Some of these perks may be medical insurance, the company's retirement plan, paid leaves; and so on. Due to this, these types of jobs are in extreme demand. Cities consist of the rich and the poor. This extreme gap that coexists in urban livelihoods is rather unfortunate and saddening.

4. Factory Workers :

Lastly, urban Livelihoods also consist of factory workers. These individuals aren't formally employed. Due to this, they briefly are categorized into the unorganized sector. While you now know what is urban livelihood, factory workers are solely unofficially employed individuals for urban livelihood occupation. Occupation in urban areas is vast and comprehensive. Factory workers work at the convenience of the employer. They further earn a drastically small amount of income for the work they do. Labourers that lift Harvey packages, sewers in clothes factories, etc., are some examples of this type of urban livelihood.

RURAL LIVELIHOOD

Rural livelihood is the engagement of rural population in various economically productive occupations. The hallmark of rural livelihood is agriculture and allied occupations. Major livelihood activities for rural population are cultivation of food and cash crops, fish farming, cattle rearing, dairying, food processing, wood

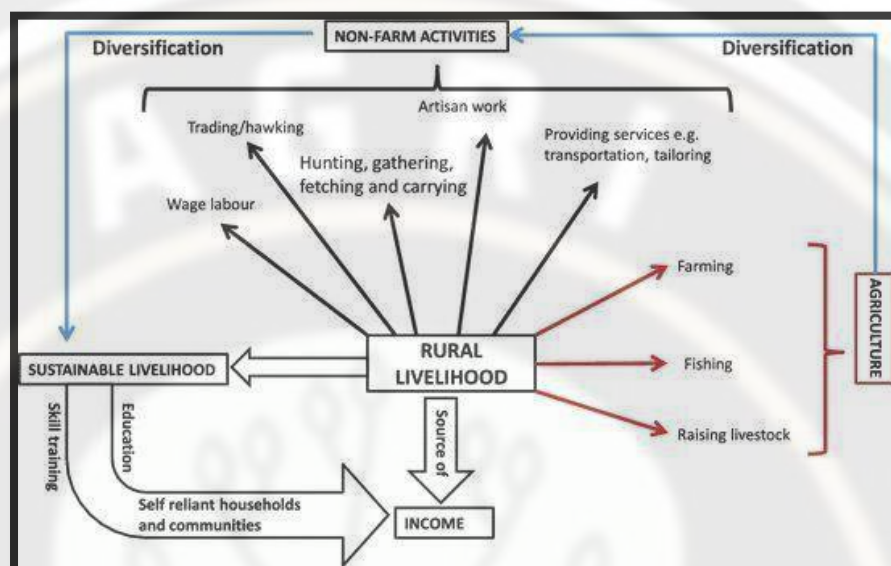
industries, organized plantation activities such as rubber, tea, cashew, coffee, cardamom, pepper etc. It can be seen that there is a gradual and increasing urbanization and industrialization of rural livelihood. There are several emerging occupations in the rural sector, such as, rural transportation, rural communication, rural health and education sector, rural infrastructure, export oriented organic farming, horticulture, floriculture etc. Increasing the rural and urban connectivity, such as, urban projects offers new avenues of rural livelihood.

There is close connection and collaboration between rural and urban livelihood. Knowingly or unknowingly we are following an urban model of economic development. While the government announces the smart city project, we should not forget that new towns and cities emerge from developed villages. Every village is in a process of transformation to city. There is constant rural urban as well as urban rural migration of skilled as well as unskilled people. Therefore, there is a common consideration for non-agricultural occupations in both rural and urban areas. In the context of urbanization of rural areas, division of nonagricultural occupations in the rural and urban sectors is arbitrary and unreasonable. What can be called typically rural livelihood is the agricultural and allied occupations.

Accepting the basic premise that, rural livelihood is what rural populations do, rural livelihood can broadly be grouped into agricultural and non-agricultural activities. Nonagricultural activities are similar to what urban populations are engaged in. Agricultural and allied occupations are typical of rural livelihood. There is a large number of people who are engaged in agriculture and allied activities like cattle rearing, fish farming, dairying etc. Landless people constitute the vast majority of rural mass who are engaged in agriculture and allied occupations. When we discuss about rural livelihood we should exclusively think about the agriculture and allied occupations. Rural livelihood is related to rural development.

Rural livelihood is just one key component of rural development. Rural development considers all the agricultural and non-agricultural livelihood options. In ideal situations, rural and urban development considerations are similar or ideally developed villages are similar to the ideally developed cities and towns. It is a challenge to distinguish rural and urban development factors. When we consider rural

livelihood independent of rural and urban development, we need to concentrate on purely agricultural and allied occupations, the factors influencing their promotion and the consideration for the sustainable rural livelihood.



Rural livelihoods as a source of income

Types of rural livelihoods:

1] Agriculture Labourers :

Agriculture labourers are those people in rural areas who work as labour in fields and get daily wages. They comprise two- fifths of the total rural population in India! These labourers do not own land of their own, thus are forced to work in the lands of richer farmers. Even if some labourers own land, it is extremely small and not enough for the family. These workers are sadly exploited by rich farmers, as they don't have any alternative ways to earn money and they come in plenty as 'cheap labour' for the fields.

2] Farmers :

This group consist of villagers who carry out farming activities in their own lands. They sow seeds, weed and harvest crops by themselves and also reap the profits themselves. However, eighty percent of these farmers also have very small land holdings and need to depend on other sources of income like having a poultry or dairy business. To earn enough money to barely survive, these farmers borrow money from money lenders for seeds, fertilisers, etc., and are at great risk of being in debt. This is why we hear of so many unfortunate news of farmer suicides in India.

3] Farmers with Other Sources of Income :

The farmers who do not earn enough from their land, or by working on other rich farmer's lands need other sources of income. They work in mills near the farms or sell milk of the cows that they own. Selling other by-products like sap, collecting wood, leaves of certain plants, fruits, etc., helps them to sustain and survive. Some farmers also seasonally go to the cities or towns to work as wage earners as there is more opportunity to earn money in cities.

4] Rich Farmers and Landowners :

The "rich" farmers that we have spoken about above are in a very small percentage in rural areas. They are the ones who own most of the land and hire agricultural labourers to work for them. They are also the exploitative village money lenders and also generally own the nearby mills and small factories.

5] Other Service Providers

In villages, apart from labourers, farmers and landlords, there are also people who provide basic services. Barbers, nurses, village teachers, etc., are small professionals who are found in villages. Some of them are self-employed and some are employed under government schools or hospitals.

Factors affect rural livelihood :

There are several personal, social, economic, cultural, religious, geographical, climatic and ecological factors that affect rural livelihood. These factors are important considerations when we have to promote sustainable livelihood.

1. Personal factors :

Most important factor in rural livelihood is personal interest and motivation. The recent trend in India is a fascination for urban livelihood. Seldom can we find educated and qualified manpower engaged in agricultural and allied occupations. Unless the rural population is sincerely interested in continuing cultivation, dairying, cattle rearing, fish farming and other allied occupations, rural livelihood options cannot be protected and promoted. These occupations constitute the primary economic activity. People show a gradual trend of shifting from primary sector to secondary and tertiary sectors of occupations. This shift is generally considered as sign of economic progress. In order to protect a nation's economic stability, we need to

reverse this false trend. We need to convince the people that investment and engagement in the secondary and tertiary sectors at the cost of the primary sector is harmful to the nation and its people. Government has to take measures to increase the personal interest, motivation, knowledge, skills and attitude of the people to turn towards primary sector and practice sustainable forms of agriculture such as organic farming, export oriented organic horticulture and floriculture. There are highly profitable agricultural and allied activities which will in the long run, stabilize our economy and economic growth. We need to leave behind the myth that increasing share of economy in the secondary and the tertiary sectors is the sign of economic progress. Increasing share of national economy in the secondary and tertiary sector is the indicator of national dependency on other people and nations for its survival and development. On the other hand, increasing share of primary sector in the national economy is the indicator of self-reliance, independence and sustainable progress.

2. Social factors :

Social factors constitute the demographic, gender, family, educational, caste and class factors. Often the rural livelihood is not the matter of personal choice, but a social obligation. One's social and demographic factors influence their particular livelihood options. There are traditional and household occupations, caste based occupations and socially imposed rural occupations in the agricultural and allied sectors. Government and civil society organizations have to take special care in dealing with these social factors that influence rural livelihood. There are both positive and negative impacts of social factors. Positively, these factors provide with social stability and collective responsibility. Negatively they conflict with individual aspirations, interests, abilities, talents and motivations. Maintaining a judicious balance between social change and social stability is the most challenging task in dealing with rural livelihood.

3. Economic factors :

Inheritance of wealth and the land resources in the rural areas is an important factor in rural livelihood. There is a vast majority of landless agricultural labourers who are engaged in rural livelihood options. They fluctuate between rural and urban

livelihood seasonally. Since most of the agricultural operations are seasonal by nature, they have no other option than shifting from one occupation to another. Since they seldom own rural resources such as land and cattle, they have limited opportunity in the agriculture allied engagements. They prefer to migrate seasonally to urban areas and engage in non-agricultural, unskilled occupations such as construction, domestic labour, daily wage, and casual labour in the industrial and manufacturing houses. Securing productive assets to the rural mass is a challenge for the civil authorities dealing with rural livelihood.

4. Cultural factors :

Cultural factors in the rural areas are mainly concerned with caste factors. Other cultural factors are linguistic and regional considerations. These factors have indelible impact on one's livelihood options in the rural areas. Cultural factors play the same role as that of social factors with regard to rural livelihood. Rural livelihoods for many are culturally determined and the individuals have limitations in the choice of a desired occupation. The government and civil society organisations have a challenging task to deal with all the cultural factors that interfere with the people's livelihood options.

5. Religious factors :

Religion is another important cultural factor which has significant influence upon rural livelihood. Certain occupations are considered meritorious from certain religious perspectives and certain others are considered undesirable. Religion sometimes interferes with the personal, social and national interests and the civil agencies as well as the government face great challenge to deal with such religious forces while dealing with rural livelihoods.

6. Geographical factors :

Geographic factors include the type of soil, availability of water, distance from the sea and the height from the sea level. All these factors affect all the agricultural and allied activities. They are the major considerations while dealing with rural livelihood. The government and non-government agencies working in the rural sector have to take due consideration of all these geographical factors while designing new

projects for protecting and promoting rural livelihood options. Conservation of soil and water is the chief geographical consideration in the context of rural livelihood.

7. Climatic factors

Climatic factors include the possibility of monsoon rainfall, wind, cyclone or flood conditions, severity of winter and summer etc. Climatic conditions are related to geography of a particular village. Therefore, geographical and climatic factors are often considered together and they have significant impact on rural livelihood. Climatic conditions are often beyond human control and we need to adapt to such conditions. Rural livelihood options have to take due consideration of all the climatic forces. For example, the cropping pattern, rotation of crops and farming schedules have to be in accordance with the climatic factors.

8. Ecological factors

Ecological factors refer to the environmental impacts of rural livelihood. It is related to the sustainability of the rural livelihood. Rural livelihood should not affect the ecological balance or endanger the environment. They should not pollute, water, air and soil resources. People need to engage in such economic activities that would protect the environment or inflict minimum damage to the natural resources. From ecological perspective, tribal livelihood options are most eco-friendly and the urban livelihood options are the least eco-friendly. Rural livelihoods are sometimes eco-friendly and sometimes ecologically harmful. Deforestation, soil erosion and water contamination (due to the use of pesticides) are often cited as harmful impacts of agricultural and allied activities. Farmers need to be taught about organic farming and the ways and means to practice rural livelihoods in harmony with nature. This is related to the sustainable rural livelihood.

Difference between rural livelihood and urban livelihood

| Sr. No. | Rural Society (Pre-industrial Society) | Urban Society (Industrial Society) |
|---------|---|--|
| 1. | Life in the society was very simple and reflected in the way of living, dressing, food habits, shelter and manners etc. | Life in the city is not simple but very complex and complicated. |
| 2. | The people in the society had homogeneity and thus enjoyed more or less the same social status. | The people in the city belong to different castes, creeds, religions and cultures, thus do not enjoy the same social status. |
| 3. | In the rural society there was very little scope for occupational mobility. | In cities there are many occupations, so occupational mobility is as well as frequent. |
| 4. | Here the family played a very significant and predominant | In the cities hold of families is not strong, and many functions which role. Its hold was very strong. the families used to perform have been taken away by other institutions and associations. |
| 5. | In villages there is no fast change and as such no necessity for social adaptability. | In the cities there must be fast mobility and adaptability to suit ever changing fast life. |
| 6. | In the rural society culture was very deep-rooted. Everyone loved culture and cultural heritage above everything else. | In the cities it is different to find pure culture. |
| 7. | In a rural society there is no division of labour. | In an urban community there is always division of labour and specialization in job allotment. |
| 8. | Rural society did not give due and proper respect to the womenfolk. | In urban communities women enjoys comparatively high social status. |
| 9. | In this society people loved nature and natural bounties. They were religious minded and afraid of gods and goddesses. | In cities, people have no time to stand and gaze at the nature. They are not religious minded but more materialistic. |
| 10. | There were very few chances of providing employment and incentives | The cities provide both incentive and employment to the people and to the unemployed by the society. thus frustrated villages find solace in the cities which respects ability and judges their worth. |

Lecture No. 4

DIFFERENT INDICATORS TO STUDY LIVELIHOOD SYSTEMS

In the agricultural sector, indicators are variables that can be measured or observed to reflect the state of a system. They can be used to assess the sustainability and condition of land, and to help identify problems and risks. Indicators can also help determine if current farming practices are effective.

Indicators are “**measurable variables**” for evaluating the performance of something (de Olde *et al.*, 2016).

Generally, indicators are part of a larger sustainability framework, which includes dimensions (e.g., environment, economic, and social) and themes (e.g., waste and greenhouse gas emissions) (de Olde *et al.*, 2016; Kouchner *et al.*, 2019). In both standard and assessment initiatives, indicators are the mechanism through which sustainability is operationalized in that they translate the various themes into measurable variables. Specifically, in assessment initiatives, indicators define the aspects of sustainability that farmers are to measure, and how they are to measure them. In standard initiatives, indicators delineate the sustainability practices, plans, and measurements farmers need to implement in order to be certified as sustainable.

Indicators that can be used to measure livelihood systems in India:

1] Accessibility to resources:

This includes access to education, credit, healthcare, and food.

Access to resources for livelihood in India is affected by a number of factors, including:

- **Institutions** : These include local administration, non-government organizations (NGOs), and state agencies, which determine rules and regulations, land tenure, and the market.
- **Social and political organization** : These include civil society, which influences access to resources through people and people's movements.
- **Social relations** : These include gender, class, age, and ethnicity, which affect how different groups within a community live.
- **Access to natural resources** : Access to land, water, forests, fisheries, and pastures is essential for sustainable poverty reduction.

- **Access to financial resources** : More secure access to financial resources can help improve livelihoods.
- **Access to education and training** : Improved access to education and training can help improve livelihoods.
- **Access to nutrition** : Improved access to nutrition can help improve livelihoods.
- **Social environment** : A more supportive and cohesive social environment can help improve livelihoods

2] Livelihood diversity:

This includes the number of livelihood options available to people.

Livelihood diversification in India is a process that helps rural families improve their standard of living by building a diverse portfolio of activities and social support systems. Here are some examples of livelihood diversification in India:

- **Mixed crop-livestock farming** : India practices mixed crop-livestock farming, with cattle, goats, and fowl being common.
- **Livestock** : Livestock provides stability in income, food security, transport, fuel, and nutrition for rural families.
- **Poultry** : Poultry accounts for the largest share of livestock in India.
- **Handicrafts** : Handicrafts are a significant source of income in rural areas, and include pottery making, basket making, weaving, printing, and painting.
- **Farm to non-farm** : Some people have diversified from farm to non-farm activities, such as trading milk, running tea stalls, and opening small restaurants.
- **Farm diversification** : Farm diversification is a strategy for fostering economic growth and development in hilly regions. This includes shifting from traditional crops to more valuable ones, and engaging in additional activities like dairy farming, poultry, and fishery.

3] Adaptive capacity:

This includes the ability of individuals to adapt to changing circumstances.

Adaptive capacity is the ability of a system or institution to adjust to and respond to potential damage. It is important because change is ongoing and uncertain,

and intentional transformation takes time. In India, studies have shown that adaptive capacity is inversely associated with vulnerability. This means that higher adaptive capacity is associated with lower vulnerability.

Here are some ways to enhance adaptive capacity:

- **Invest in protective actions** : Individuals can invest in actions to minimize future losses to assets, lives, health, income, and finance.
- **Access public goods** : Individuals can benefit from public goods created by the government or non-government institutions. These include disaster shelters, loan finance, and improved information dissemination on weather forecasts.
- **Improve infrastructure** : Physical and financial infrastructure development can help enhance adaptive capacity

4] Disaster risk reduction:

This includes the effectiveness of measures taken to reduce the risk of disaster.

Measures taken to mitigate disasters might be either structural (like flood dikes) or non-structural (e.g. land use zoning). Hazard mapping, Adoption, and enforcement of land use and zoning practices, and implementing and enforcing building codes are some disaster mitigation strategies.

- **Impacts of a Disaster :**

Natural disasters can drastically alter the lives of people and families fortunate enough to survive them. However, the impact of a natural disaster can frequently affect an entire nation as well as communities, cities, and states. Even when human communities are not significantly impacted, natural disasters can have a significant negative influence on the ecosystem.

Some of the severe impacts of disasters are

- Injuries
- Death
- Psychological distress
- Unemployment
- Loss of Livelihood
- Destruction of Physical Capital
- Loss of Financial Resources

- Social and economic Disruption
- Environmental Damage

Study in detail about [Biological Disaster Management](#) for UPSC preparation!

Disaster Management in India :

India has a history of being extremely vulnerable to natural disasters. Therefore, it is important to have proper natural disaster management in India. The Indian government has changed how disaster management is thought about during the last few years. The new strategy is based on the conviction that disaster mitigation must be included in the development process for development to be sustainable.

Image: Disaster Management Cycle in India

Check out the article on [Urban Flooding](#) with this link!

Elements of Disaster Management in India :

There are 4 elements of Disaster Management in India: Risk Reduction, Mitigation, Quick Response, and Recovery. These are also known as disaster management techniques in India. Let's discuss each element in detail.

- **Risk Reduction** : Risk is a measurement of the anticipated losses resulting from a hazardous occurrence of a specific size occurring in a given location over a defined time frame. Disaster risk reduction is the idea and practice of lowering the risks associated with disasters by systematic attempts to identify and reduce the causes of disasters.
- **Mitigation** : Disaster mitigation strategies remove or reduce the consequences and risks of hazards by preventative actions performed before an emergency or disaster happens. Measures taken to mitigate disasters might be either structural (like flood dikes) or non-structural (e.g. land use zoning). Hazard mapping, Adoption, and enforcement of land use and zoning practices, and Implementing and enforcing building codes are some disaster mitigation strategies.
- **Quick Response** : Quick response is an important element of disaster management in India. It is associated with emergency response systems and reduces or avoids the damages caused by disasters.

- **Recovery** : The implementation of short-term actions that restore essential information and records together with the return of regular business operating procedures and practices is part of the recovery phase. In this phase, the damage is evaluated, stabilisation and recovery methods are used, records, information, and equipment are restored, and operations are resumed.

Disaster Management in India: Stages

Disaster management in India constitutes 3 important phases:

- **Pre Disaster** : To reduce the probability that hazards may cause losses to people, property, or the environment and to make sure that these losses are reduced during a disaster.
- **During a Disaster** : To reduce victims' suffering by ensuring the satisfaction of victims' needs and necessities.
- **Post Disaster** : To accomplish a quick and lasting recovery that does not repeat the initial vulnerable circumstances

5] Survival and livelihoods protection threshold:

This includes the percentage of households that have enough food, cash, and income to meet their survival needs.

The survival and livelihoods protection thresholds in India are the minimum income required to cover basic needs and sustain livelihoods:

- **Survival threshold** : The total income needed to cover the minimum food energy needs, food preparation and consumption costs, and water for human consumption.
- **Livelihoods protection threshold** : The total expenditure needed to ensure basic survival, maintain access to basic services, and sustain livelihoods in the medium to longer term. When a household's total income falls below the livelihoods protection threshold, it may indicate that the household is forgoing necessary investments in their regular income generating activities and basic services.

6] Ownership and access to productive assets :

This includes the percentage of households that are able to protect, replace, increase, or improve their productive assets. Physical assets include land, buildings,

livestock, agricultural implements & machinery, non-farm business equipment, transport equipment and household durables while shares, deposits, cash & kind dues receivable and cash in hand were considered under financial assets.

7] Productivity enhancement :

This includes the percentage of households that improve their production through new practices, technology, or training.

There are several ways to enhance productivity in India, including:

- **Agricultural research and extension** : Strengthening agricultural research and extension systems is important for agricultural growth. This includes reforming systems, replacing aging researchers, and providing access to new technologies.
- **Irrigation** : Expanding and using small- and large-scale irrigation can increase agricultural productivity.
- **Cooperative farming** : Uniting scattered lands under a cooperative farming system can encourage farmers and increase productivity.
- **Agricultural education** : Promoting distance education and organizing "Kisan Choupal" to solve farmers' problems can help improve agricultural productivity.
- **Mechanization** : Providing subsidies on agricultural machinery can help interested farmers.
- **Organic farming** : Promoting organic farming can help ensure sustainable farming.
- **National Food Security Mission** : The National Food Security Mission has increased the production and productivity of oilseeds, reducing the import burden.
- **Livestock development and fisheries** : Enhancing income through livestock development and fisheries can help improve food security.
- **Food management** : Using technology in food management and computerizing the targeted public distribution system can help improve food security.

8] Access to livelihoods support services and markets :

This includes the availability of services and markets that support livelihoods.

Here are some initiatives in India that provide access to livelihoods support services and markets:

- *Access Livelihoods Consulting India (ALC India)* : A social enterprise that offers services to marginalized producers, including small and marginal farmers, weavers, tribals, and small livestock holders. ALC India's services include:
- *Access Tribal Livelihood Services (ATLS)*: Offers professional services, including consulting and incubation services, to promote tribal enterprises.
- *Risk management solutions* : Helps organizations avoid, mitigate, and identify risks, and recommend risk protection solutions.
- *Infrastructure services* : Helps with infrastructure needs assessment, planning, financing, and vendor identification.
- *IT consulting and application development* : Helps stakeholders in the livelihoods sector understand technology and realize new possibilities.

National Rural Livelihoods Mission (NRLM) :

Also known as Aajeevika, this mission aims to create platforms for poor rural people to increase their household income. It provides access to financial services and sustainable livelihood enhancements.

Deendayal Antyodaya Yojana-National Rural Livelihoods Mission (DAY-NRLM) :

This mission aims to link the rural poor to sustainable livelihood opportunities and financial services.

Lecture No. 5

AGRICULTURAL LIVELIHOOD SYSTEMS (ALS) :

MEANING, APPROACH, APPROACHES AND FRAMEWORK

An agricultural livelihood system (ALS) is a livelihood system mainly based on agricultural activities such as crop and livestock production.

Agricultural livelihood system (ALS) processes are crop production, livestock production, aquaculture, forestry, organic fertilizer production (with or without energy recovery), stocks, household consumption, and agricultural trades (Van den Bosch *et al.*, 1998).

An agricultural livelihood is the work of farmers who grow food to support themselves, and it can also include other activities in the agricultural value chain:

- **Farming**: Farmers use their knowledge of natural resources to grow food through activities like sowing, weeding, and harvesting.
- **Processing**: Farmers process agricultural products.
- **Trading**: Farmers trade agricultural products.
- **Marketing**: Farmers market agricultural products.
- **Wage labor**: People provide wage labor on farms.
- **Small businesses**: People work in small businesses that support the agricultural value chain.

The goal of agricultural livelihood is to support sustainable agricultural development. This includes: Optimizing the use of resources, Contributing to social and economic sustainability, Addressing technical challenges, Being aware of the social context of livelihood decisions, and Being sensitive to institutional challenges.

Systems approach :

In system approach all the components and activities are linked, they affect each other. It is not sensible to look at one component by itself without recognizing that what it does and what happens to it will affect other parts of the system.

For example consider what happens when you stub your toe: the whole body may react and different parts may respond differently. Eyes may water, the voice may make appropriate sounds, the pulse rate may increase and hands may try to rub the

damaged toe. It would be very rash to alter any component of a system without regard to the consequences and reactions elsewhere.

You cannot, for example, improve a car (system) by doing research on one wheel and then making it rather bigger than the rest. Or increase the power and size of the engine without regard to the ability of the chassis to support it.

These things are common sense in such familiar contexts- they also apply to biological and agricultural systems.

In agriculture, management practices were usually formulated for individual crop. However, farmers are cultivating different crops in different seasons based on their adaptability to a particular season, domestic needs and profitability. Therefore, production technology or management practices should be developed in view all the crops grown in a year or more than one year if any sequence or rotation extends beyond one year. Such a package of management practices for all crops leads to efficient use of costly inputs, besides reduction in production cost. For instance, residual effect of manures and fertilizers applied and nitrogen fixed can considerably bring down the production cost if all the crops are considered than individual crops.

AGRICULTURAL LIVELIHOOD SYSTEMS APPROACHES :

There are multiple approaches to agricultural livelihood systems, including the Sustainable Livelihoods Framework and the Farming Systems Approach:

A] Sustainable Livelihoods Framework :

This framework considers the wider context of people's livelihoods, including their assets, vulnerability, and the policies and institutions that affect them. It also considers the different livelihood strategies and outcomes that determine how assets can be used. The framework can be used to plan new development activities and assess existing activities.

B] Farming Systems Approach :

This approach emphasizes the importance of farmer participation in understanding their goals and objectives. It also ensures that scientific results are adapted to be acceptable to farmers. The approach also produces knowledge about farming systems and tools to help farmers change.

C] Livelihood and Farming System Approach :

This approach can be applied to farm-level data to define a local typology of farming systems. It can also help identify other relevant options for generating income and subsistence, such as hunting, fishing, or gathering.

A] SUSTAINABLE LIVELIHOODS FRAMEWORK

- A framework is a ‘particular way of viewing the world’.
- The livelihoods framework is a way of understanding how households derive their livelihoods by drawing on capabilities and assets to develop livelihood strategies composed of a range of activities.
- The framework defines and categorizes the different types of assets and entitlements which households have access to.
- The framework looks at the connections between the local or micro situation and actors, institutions and processes at work in the wider world.

Conceptual framework :

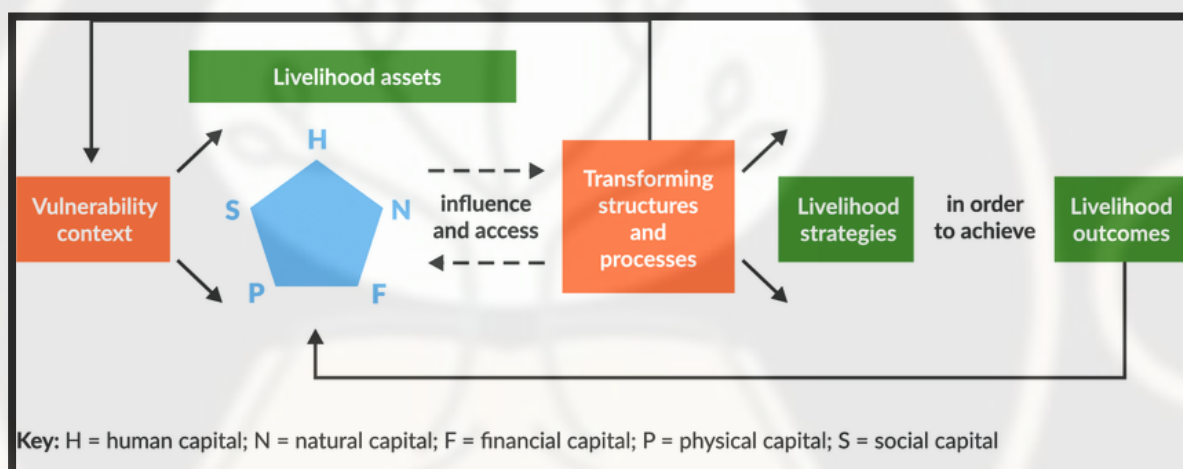
Conceptual framework is a set of ideas that are organized to provide a coherent approach to analyzing and understanding an issue or problem.

- It also spells out the assumptions and values which underlie the concepts.
- The livelihoods framework examines the different elements that contribute to people’s livelihood strategies.
- It analyses how forces outside the household or community in ‘the external environment’ affect them.
- The livelihood framework is a tool to improve our understanding of livelihoods, particularly the livelihoods of the poor.
- It presents the main factors that affect people’s livelihoods, and typical relationships between these.
- It can be used in both planning new development activities and assessing the contribution to livelihood sustainability made by existing activities.

Despite differences in emphasis by different practitioners, the livelihoods framework helps us to:

- Identify (and value) what people are already doing to cope with risk and uncertainty;

- Make the connections between factors that constrain or enhance their livelihoods on the one hand, and policies and institutions in the wider environment;
- Identify measures that can strengthen assets, enhance capabilities and reduce vulnerability.
- **In particular, the framework:**
 - Provides a checklist of important issues and sketches out the way these link to each other;
 - Draws attention to core influences and processes; and
 - Emphasizes the multiple interactions between the various factors which affect livelihoods.



The framework shows how, in different contexts, sustainable livelihoods are achieved through access to a range of livelihood resources (natural, economic, human and social capitals) which are combined in the pursuit of different livelihood strategies (agricultural intensification or extensification, livelihood diversification and migration).

1. Livelihood assets :

- People and their access to assets are at the heart of livelihoods approaches.
- In the original DFID framework, five categories of assets or capitals are identified, although subsequent adaptations have added others, such as political capital (power and capacity to influence decisions).
- The original five categories are :

- **Human capital:** skills, knowledge, health and ability to work
 - **Social capital:** social resources, including informal networks, membership of formalized groups and relationships of trust that facilitate co-operation
 - **Natural capital:** natural resources such as land, soil, water, forests and fisheries
 - **Physical capital:** basic infrastructure, such as roads, water and sanitation, schools, ICT; and producer goods, including tools and equipment
 - **Financial capital:** financial resources including savings, credit, and income from employment, trade and remittances
- Assets can be destroyed or created as a result of the trends, shocks and seasonal changes in the vulnerability context within which people live.
 - Policies, institutions and processes can have a great influence on access to assets - creating them, determining access, and influencing rates of asset accumulation.
 - Those with more assets are more likely to have greater livelihood options with which to pursue their goals and reduce poverty.

2. Vulnerability Contexts :

- The vulnerability context within which people pursue their livelihoods includes: –
 - Trends:** such as economic trends, resource trends
 - **Shocks:** such as conflict, economic shocks, health shocks and natural shocks such as earthquakes
 - **Seasonality:** seasonal fluctuations in prices, production, health, employment opportunities
- These factors can have a direct impact on people's assets and the options available to them to pursue beneficial livelihood strategies.
- Shocks can destroy assets directly or force people to abandon or prematurely dispose of them as part of their coping strategies – for example selling off livestock in the face of drought or to pay for medical care.

- Not all trends are negative or cause increased vulnerability – for example new technologies, medical advances or positive economic trends can help improve people's livelihoods.
- The vulnerability context of poor people's livelihoods is usually influenced by external factors (outside their direct control and is dependent on wider policies, institutions and processes).
- To support people to be more resilient to the negative effects of trends, shocks and seasonality, development policy-makers and practitioners can support people's access to assets and help ensure that critical policies, institutions and processes are responsive to the needs of the poor.

3. Livelihood strategies :

- Livelihood strategies are the combination of activities that people choose to undertake in order to achieve their livelihood goals.
- They include productive activities, investment strategies and reproductive choices.
- The choice of strategies is a dynamic process in which people combine activities to meet their changing needs.
- For example, in farming households, activities are not necessarily confined to agriculture but often include non-farm activities in order to diversify income and meet household needs.
- Migration, whether seasonal or permanent, is one common livelihood strategy.
- A major influence on people's choice of livelihood strategies is their access to assets and the policies, institutions and processes that affect their ability to use these assets to achieve positive livelihood outcomes.
- People are often forced to compete for limited resources: fundamental to livelihoods approaches is the principle that development support aimed at improving the livelihood strategies of some should not disadvantage those of others now or in the future.

- Social protection programs can support the extreme poor to achieve their own positive livelihoods outcomes in cases where they are unable to compete with those with greater access to assets.

4. Policies, Institutions and Processes (PIPs) :

The PIPs element of the livelihoods framework covers the complex social, economic and political context within which people pursue their livelihoods strategies.

PIPs include the inter-related issues of :

- **Social relations** : The way in which gender, ethnicity, culture, history, religion and kinship affect the livelihoods of different groups within a community
- **Social and political organization** : Decision-making processes, civic bodies, social rules and norms, democracy, leadership, power and authority, rent-seeking behavior
- **Governance** : The form and quality of government systems including structure, power, efficiency and effectiveness, rights and representation
- **Service delivery** : The effectiveness and responsiveness of state and private sector agencies engaged in delivery of services such as education, health, water and sanitation
- **Resource access institutions** : The social norms, customs and behaviors (or 'rules of the game') that define people's access to resources
- **Policy and policy processes** : The processes by which policy and legislation is determined and implemented and their effects on people's livelihoods
- PIPs operate at global, national, regional, district and local levels.
- Key to understanding their impact on local livelihoods is an analysis of the operation, or absence, of links between micro, meso and macro levels.
- Given its complexity, there have been several attempts to 'unpack the PIPs box' to improve understanding of the institutional context, including exploring the links between rights-based and livelihoods approaches, and trying to sharpen our comprehension of the role of governance in sustainable livelihoods.

5. Livelihood outcomes :

- Livelihood outcomes are the goals to which people aspire, the results of pursuing their livelihood strategies.
- Livelihoods approaches stress the importance of understanding and supporting poor people's efforts to achieve these goals.
- Examples of livelihoods outcomes might include: – increased income – reduced vulnerability – increased well-being – improved food security – more sustainable use of natural resources
- Livelihoods outcomes are important because they help us understand:
 - the results of peoples' livelihoods strategies in a particular context
 - why people pursue particular strategies and what their priorities are
 - how people are likely to respond to new opportunities or constraints
- In its simplest form, the framework depicts stakeholders as operating in a Context of Vulnerability, within which they have access to certain Assets.
- These gain their meaning and value through the prevailing social, institutional and organizational environment (Transforming Structures and Processes).

B] Farming system approach :

Farming systems approach relates to the whole farm rather than individual elements; it is driven as much by the overall welfare of farming households as by goals of yield and profitability. Farming systems are closely linked to livelihoods because agriculture remains the single most important component of most rural people's living and also plays an important role in the lives of many people in semi-urban areas. Farming systems involve a complex combination of inputs, managed by farming families but influenced by environmental, political, economic, institutional and social factors. Research and extension institutions are increasingly aware that a holistic approach, drawing on both local and external knowledge, is necessary if they are to be effective in addressing poverty and sustainability. “

Farming System is defined as a complex inter related matrix of soil, plants, animals, implements, power, labour capital and other inputs controlled in part by farming families and influenced to varying degrees by political, economic, institutional and social forces that operate at many levels. The farming system

therefore, refers to the farm as an entity of inter dependent farming enterprises carried out on the farm". The farm is viewed in a holistic manner. The farmers are subjected to many socioeconomic; biophysical, institutional, administrative and technological constraints.

Need for Farming System Approach :

The need for Farming Systems Approach in the present scenario is mainly due to high cost of farm inputs, fluctuation in the market price of farm produce, risk in crop harvest due to climatic vagaries and biotic factors. Environmental degradation, depletion in soil fertility & productivity, unstable income of the farmer, fragmentation of holdings and low standard of living add to the intensity of the problem.

What it is and What it does :

It is an approach for developing farm-household systems, built on the principles of productivity, profitability, stability and sustainability. All the components are complimentary and supplementary to each other. And the development process involves the participation of rural communities. The farming system approach emphasizes understanding of farm household, community inter linkages, reviews constraints and assesses potentials. And it combines improvements desired from better technology. It needs efficient support services and requires better policies. It is continuous, dynamic and interactive learning process based on analysis, planning, testing, monitoring and evaluation.

Why Farming Systems Approach :

- To develop farm – house hold systems and rural communities on a sustainable basis
- To improve efficiency in farm production
- To raise farm and family income
- To increase welfare of farm families and satisfy basic needs.

An intensive integrated farming system addresses two issues, reduction in risk with the monoculture activities and promoting enterprise diversification, value addition and development of alternative income sources with efficient utilization of farm resources. And it brings about enterprise diversification for sustainability and additional benefits, better management of important farm resources like land, labor

and capital etc. Provides an opportunity for effective recycling of the product and by-products, helps to generate flow of cash to the farmers round the year by way of disposal of milk, fruits, fuel, manure etc., beside other agricultural output.

Farming Systems Strategy :

In view of serious limitations on horizontal expansion of land and agriculture, only alternative left is for vertical expansion through various farm enterprises required less space and time but giving high productivity and ensuring periodic income specially for the small and marginal farmers located in rainfed areas, dry lands, arid zone, hilly areas, tribal belts and problem soils.

The following farm enterprises could be combined :

Agriculture alone with different crop combinations

- Agriculture + Livestock
- Agriculture + Livestock + poultry
- Agriculture + Horticulture + Sericulture
- Agro-forestry + Silviculture
- Agriculture (Rice) + Fish culture
- Agriculture (Rice) + Fish + Mushroom cultivation
- Floriculture + Apiary (beekeeping)
- Fishery + Duckery + poultry

For meaningful execution of integrated farm-enterprises, the following activities should be undertaken by a multi-disciplinary team of extension professionals with farmer's participation and involvement at all stages.

- Thorough understanding of existing farming systems and their components
- Assessment of resource availability in the farm environment and identification of bio-physical, socio-economic, institutional, administrative and technological constraints
- Developments of economic viable and efficient integrated farming systems suitable for various domains
- Diffusion of improved technology and receiving 'feed back' for further improvement of the system as a whole.

- Continuous improvement in components technology to fit into a given farming system
- Improvement in quality of farming system
- Research Extension linkage through “On farm Adaptive Research”
- Development of National and International linkages

C] Livelihood and Farming System Approach :

A livelihood and farming system (LFS) approach is a way to understand the livelihoods of people in rural areas, and to identify strategies that can help reduce poverty and hunger:

- **Recognize diversity :** The LFS approach recognizes that the livelihoods of people in rural areas are diverse, including farmers, pastoralists, and fishing families.
- **Identify constraints :** The LFS approach helps identify constraints and assess potential, and can help improve technology.
- **Consider other income sources :** The LFS approach considers other sources of income, such as hunting, fishing, or gathering, which can be as important as farming for ecosystem management and conservation.
- **Identify best options :** The LFS approach can help identify the best options for local land managers by applying farm-level data on inputs and outputs.
- **Consider socio-economic factors :** The LFS approach can help identify the factors that drive livelihood systems, such as household-level socio-economic factors.
- **Consider biophysical conditions :** The LFS approach can help identify the factors that drive farming systems, such as village-level biophysical conditions.

The LFS approach can help governments, civil society organizations, and the private sector create the right environment and incentives to help farm households achieve agricultural growth and poverty reduction

Lecture No. 6

DEFINITION OF FARMING SYSTEM AND FARMING BASED LIVELIHOOD SYSTEM

Farming system :

1. Farming system refers to the *farm as an entity of interdependent farming enterprises carried out on the farm.*
2. Farming system is a decision making unit comprising the farm, household, cropping and livestock systems that transform land, capital and labour into useful products that can be consumed or sold (Fresco and Westphal, 1988).
3. Farming system represent integration of farm enterprises such as cropping system, animal husbandry, fisheries, forestry etc. for optimal utilization of resources bringing prosperity to the farmer.
4. It is a resource management strategy to achieve economic and sustained production to meet divers requirement of farm household while a system preserving resource base and maintaining high level environmental quality (Lal and Millar, 1990).
5. Farming system are characterized by their physical, biological and socio-economic setting and by the farm families, goals and other attributes access to resources, choices of productive enterprises and management practices.

Farming system concept :

'Farming' is a process of harnessing solar energy in the form of economic plant and animal products. 'System' implies a set of interrelated practices and processes organized into functional entity i.e. an arrangement of components or parts that interact according to some process and transform inputs into outputs. Farming system is therefore, designed as a set of agricultural activities organized into functional unit(s) to profitable harness solar energy while preserving land productivity and environmental quality and maintain desirable level of biological diversity and ecological stability. The emphasis is more on system rather than gross output. In other words 'farming system' is a resources management strategy to achieve economic and sustained production to meet diverse requirement of farm household while a system preserving resource base and maintaining high level environmental quality (Lal and Millar, 1990).

In farming system all the activities, decision, management, input/output, purchase/sale and resources utilized make the matrix of farming system which interacts with socio-economic and bio-physical environment for purchasing the necessary inputs and disposing the outputs by utilizing the natural resources (land, water, air, sunshine etc.) effectively. Sustainability is the objective utilization of inputs without impairing the quality of environment with which it interacts. Therefore, it is clear that farming system is process in which sustainability of production is the objectives.

Objectives of farming system :

Overall objective evolve technically feasible and economically viable farming system models by integrating cropping with allied complementary enterprises for irrigated, rainfed, hilly and coastal areas with a view to generate income and employment from the farm. The specific objectives are :

1. To identify existing farming systems in specific area and assess their relative viability.
2. To formulate farming system models involving main and allied enterprises for different farming situation.
3. To ensure optional utilization and conservation of available resources and effective recycling of farm residues within system.
4. To maintain sustainable production system without damaging resources base/environment.
5. To raise overall profitability of farm household by complementing main/allied enterprises with each other.

Scope of farming system :

Farming enterprises include crop, livestock, poultry, fish tree crops, plantation crops, sericulture etc. a combination of one or more enterprises with cropping, when carefully chosen, planned and executed, gives greater dividends than single enterprises, especially for small and marginal farmers. Farm a unit is to be considered and planned for effective integration of the enterprises to be combined with crop production activity. Integration of farm enterprises depends on many factors such as

- Soil and climatic features of the selected area.
- Availability of the resources, land, labour and capital.
- Present level of utilization of resources.

- Economics of proposed integrated farming system.
- Decision-making skill of the farmer.

Classification of farming system :

For the purpose of agricultural development and devise meaningful measures in agricultural policy, it is advisable to group of farms with similar structural properties into classes. It is important in this context that relevant criteria for purpose of classification used and no single criterion allows the formation of means classes.

1. Collective Farming System :

It includes direct collection of farm products from non arable lands. It may include either regular or irregular harvesting of uncultivated plants. Hunting and fishing usually go hand in hand with collection. In pre historic times, activities of this kind were major sources of food supply. In some region these activities still provide rather important additions to the subsistence food grained from organized production in arable farming and husbandry. Only in few cases the wild oil-palms in some parts of West Africa, the gum Arabic of the Sudan, the wild honey of Tanzania is collecting a major cash earning activity.

2. Cultivation Farming :

In this system farming community cultivates the land for growing crops for obtaining maximum production per unit area. Cultivation farming is major farming system and further classified into different groups based on different criteria.

A] On the basis of type of rotation :

The word rotation has two meanings according to the time period involved. There a long term alternation between various types of land use such as arable farming, tree farming, grass land use, fallow etc. rotation means the sequence of these basic types of land use on given field. Within arable farming, there is also a term crop rotation which means short term sequence of arable crops on one field.

- a) **Natural fallow system** : describes a situation where cultivation alternates with an uncultivated fallow. The natural fallow vegetation may be following forms.
 - i. A forest fallow : comprises woody vegetation with trunks and a closed canopy in which trees are ecologically dominant.
 - ii. A bush fallow : comprises dense wood vegetation without trunks.
 - iii. A savanna fallow : comprises a mixture of fire resistant tree and grasses in which the grasses are ecologically dominant.

iv. Agrass fallow : comprises grasses without woody vegetation.

b) **Ley system** : In this system several years of arable farming are followed by several years of grasses and legumes utilized for livestock production.

i. Unregulated ley : In this system natural vegetation of various grasses, bushy growth on pasture is allowed to grow during the period of fallow. This is improperly managed pasture.

ii. Regulated ley system : During the period of fallow certain types of grasses are grown or planted. These are well management pastures with fencing and adopting rotational grazing system.

iii. Field system : In this system arable land and grassland are clearly separated from each other. The grassland associated with field systems is usually treated as permanent grassland, whether it is rough or well cared.

iv. Perennial crop system : Crops that cover the land for many years are grown. Perennial field crops like sugarcane and sisal, bush crops like tea and coffee and tree crops like oil-palm and rubber.

B] On the basis of intensity of rotation :

It is denoted by 'R'. A relatively simple and appropriate criteria for classification in the relationship between crop cultivation and fallowing within the total length of one cycle of land utilization.

$$R = \frac{\text{Number of years of cultivation}}{\text{Length of cycle of land utilization}} \times 100 \quad (\text{Joosten, 1962})$$

The length of cycle = Number of years of arable farming + number of fallow years

'R' indicates the proportion of the area under cultivation in relation to the total area available for arable farming e.g. if 40% of available land in one holding is cultivated then $R = 40$.

a) **Shifting cultivation** : Because of shifting of fields within a broad area of wild vegetation many fallow years follow a short period of cultivation 'R' is very small i.e. <33 .

b) **Fallow farming** : Percentage of area cultivated annually is higher in relation to the total area available for arable farming. 'R' reaches or exceeds the value 33.

$R < 66$ and > 33

- c) **Permanent cultivation** : When land is cultivated nearly every years or even more often.

$R > 66$

Permanent cultivation again classified according to degree of multiple cropping.

- d) **Multiple cropping** : In this system more than one crop is cultivated on the same piece of land.

If 'R' = 150 means 50% area under two crops in years

If 'R' = 300 means three crops in years are grown.

C] According to the water supply :

Farming practices with or without irrigation is categorised as

- a) **Rainfed farming** : Farming without irrigation is widely referred to as rainfed or dry farming. Crops are sown taking into consideration annual rainfall of the region.
- b) **Irrigated farming** : Water is applied through external sources in addition to natural sources.

D] On the basis of cropping pattern and animal activities :

The farms are grouped according to the leading crops and the livestock activities of the holding. Each activity has different requirements as to climate, soils, markets and inputs. Therefore those farms can be grouped together whose gross returns (sales + household consumption + changes in stock) are similarly constituted e.g. coffee-banana holding, rice-jute holding etc.

E] On the basis of implements used for cultivation :

In various parts of the world land is cultivated with implement or without implement or a very simple tools are used. In Sahara, millet is sown without land preparation by few nomads. Shifting cultivators frequently sow in ashes without touching the soil. Rice growers in Madagascar, Sri Lanka and Thailand using animals for land preparation. A large number of cattle's are driven across the moist field to trample down the soil until it becomes ready for planting. In some parts of the world planting sticks and digging sticks are used. However, with the exception of these pre-technical methods it is classified as

- i. Hoe farming or spade farming
- ii. Farming with plough and animal traction
- iii. Farming with plough and tractors

F] On the basis of degree of commercialization :

- a) **Subsistence farming** : Where no sale of crop and animal product is done.
- b) **Partly commercialized farming** : Where more than 50% of the value of produce is for home consumption.
- c) **Commercialized farming** : Where more than 50% of the produce is for sale.

G] On the basis of grass land utilization :

This system involves the rearing of animals of economic production. It is classified on the basis of degree of nomadism.

- a) **Total nomadism** : System in which animal owners do not have permanent place of residence. They do not practice regular cultivation and their families move with the herds.
- b) **Semi-nomadism** : Animal owners have a permanent place of residence near which supplementary cultivation is practiced. However, for long periods of time they travel with their herds to distinct grazing areas.
- c) **Transhumance** : Under this system farmers with a permanent place of residence send their herds with herdsmen for long period of time to distinct grazing areas.
- d) **Partial nomadism** : Farmers have permanent residence and who have herds at their disposal which remain in the vicinity.
- e) **Stationary animal husbandry** : Where the animals remains on the holding or in the village throughout the entire year.

H] On the basis of size of farm and share of gross income received from different sources :

When farms in group are quite similar in kind and production of the crops and livestock that are produced and the methods, practices used in production the group is called as type of farming.

- | | | |
|---|---|---|
| 1. According to the size of farm | : | i. Small scale farming ii. Large scale farming |
| 2. According to the proportion of land, labour and capital investment | : | i. Intensive farming. ii. Extensive farming |
| 3. According to the value of products or income | : | i. Specialized farming ii. Mixed farming iii. Diversified farming |
| 4. According to the supply of irrigation | : | i. Irrigated farming ii. Dry farming |
| 5. According to the nature of produce | : | i. Crop farming ii. Livestock raising |

1] According to the size of farm :

- a) **Small scale farming** : Farming is done on a small size of holding. Capital and labour risk is small and scale of production said to be small.

Advantages :

1. Intensive cultivation is possible.
2. Per unit output is more.
3. Loss is less due to natural calamities
4. Farms is easy to manage

Disadvantages :

1. More per unit cost of production
2. Mechanization is not possible
3. No employment throughout the year

- b) **Large scale farming** : When farming is done on large scale with large amount of capital, labour organization and risk is called as large scale farming. In India 40-50 ha land holding may be called as large scale farming.

Advantages :

1. Production is more economical
2. Per unit production cost is less
3. Mechanization on farm is possible
4. Better marketing of agricultural products
5. Subsidiary occupations are possible
6. Increases bargaining power of farmers

Disadvantages :

1. More loss in case of less demand and more production
2. More loss in case of labour strike and natural calamities
3. Difficult to manage the farm

- c) **Diversified farming** : Farming having several enterprises or sources of income but no source of income equals as much as 50% of the total receipt.

Advantages :

1. Better use of land, labour and capital
2. Farmer get regular income throughout the year
3. Provides employment throughout the year
4. Risk of failure of crop due to natural calamities or market price is less.

Disadvantages :

1. Due to more crop diversification competition for resources within crops increases.
2. Maintaining various types of machineries for various crops is not possible.
3. Supervision on various enterprises is difficult

d) **Mixed farming** : Farming in which crop production is combined with raising of livestock.

Advantages :

1. More efficient utilization of land, labour and other resources
2. By-product of crops are useful fed for livestock
3. Balance food is available
4. Provides money thought the year
5. Maintaining soil fertility through manure.

2] According to the value of product – Specialized farming :

The farm on which 50 per cent or more income is received from a single source (Crops, livestock, dairy, poultry).

Advantages :

1. Better use of land
2. Better marketing
3. Less labour and equipment's are needed
4. Costly and efficient machinery can be kept
5. Efficiency and skill is increased

Disadvantages :

1. Greater risk
2. Land, labour and capital not fully utilized
3. By-products cannot be fully utilized due to insufficient livestock
4. Knowledge of farm enterprises becomes limited.

3] According to the land labour and capital investment :

- a) **Extensive cultivation** : When more are is brought under cultivation to increase the output.
- b) **Intensive cultivation** : More inputs are used to increase the production on same land. Land remained fixed, however, inputs are increases.

4] On the basis of type of ownership (Corporate, non-corporate and co-operative farming) :

1. **Family farming** : All agricultural operations are carried out by family members. Management of inputs and farm is also done by the family members. The income is distributed by the head of the family as per family need.
2. **Co-operative farming** : All the members have ownership in the business. They pool required resources voluntarily to run the business. The income is distributed according to their share. Members are force to level the society of any time without losing ownership right.
 - a) **Co-operative better farming** : Farming is done by the members independently. They have ownership on the land. The follow recommended plan of cultivation. They obtained all the inputs from society. At the end of year profit is distributed amongst the members.
 - b) **Co-operative joint farming** : The members have ownership on the land and cultivation is done jointly. Cultivation plan is prepared by the managing committee and accordingly the work is carried out. Net profit is distributed amongst the members according to inputs pooled by them.
 - d) **Co-operative tenant farming** : Land is owned by the co-operative society on freehold or loose hold basis. Whole land is divided into sub plots and distributed amongst the members on rent. Members have no ownership on the land. The cultivation plan is prepared by the co-operative society and members have to follow it. The society supplying all the inputs and arrange for marketing of the produce. The profit is distributed to the members in proportion to rent paid to society.
 - e) **Co-operative collective farming** : The land is acquired by the society either as freehold or leasehold. But the farming is done collectively by the members. Members

have no ownership on the land. The profit is distributed according to inputs arranged by the members.

3. **Institutional farming** : Farms are used for conducting research/demonstration by an institute. Farming is not done on commercial scale. Farm is well laid out and equipped.
4. **Capitalistic farming** : Land is owned by businessman/capitalist. All the investment is made by capitalist. Labourers are employed and paid. Intensive and improved methods of cultivation are adopted. Profit/loss of the business is borne by the capitalist.
5. **State farming** : Farming is done by Govt. Farm manager and other staff is appointed for agricultural operations and day to day working. Farm may be mechanized or unmechanized depending upon the size. Govt. fixes the policy and provides finance for salary and contingencies. The profit/loss entirely borne by the government.
6. **Personal farming** : Farmers have ownership on the land and farming is done independently. The right of ownership is heritable and transferable. Farmers have small holding and they grow crops as per family requirement. Profit/loss is borne by farmers himself.
7. **Collective farming** : The members surrender their land, livestock and implement to the society. The members of the society elect a managing committee which is responsible for allocation of work, distribution of income, marketing etc.
8. **Corporate farming** : This is just like a capitalistic system of farming out the right of ownership is on the basis of shares taken by the members. The profit/loss is shared by members proportionately.

7. Prevalent Farming systems in India contributing to livelihood.

Farming in India is a significant contributor to the nation's economy and livelihoods, particularly for rural populations. Agriculture provides employment to around 50-60% of India's workforce, and a variety of farming systems are practiced across the country, depending on factors like geography, climate, soil types, and socio-economic conditions. These farming systems not only produce food and cash crops but also play a crucial role in shaping rural livelihoods, ensuring food security, and contributing to environmental sustainability.

1. Traditional or Subsistence Farming

Overview: Traditional farming in India is largely subsistence-based, where the primary objective is to produce enough food for the family's consumption. It is most commonly practiced by smallholder farmers in rural and tribal areas.

Characteristics:

- **Small Landholdings:** Farms are typically small, often less than 1 hectare, with limited access to modern inputs.
- **Manual Labor:** The farming system is heavily dependent on family labor, with little or no mechanization.
- **Traditional Practices:** Use of organic or traditional farming practices, such as crop rotation, mixed cropping, and composting, with minimal reliance on external chemical inputs.
- **Rainfed Agriculture:** Many traditional farming systems depend on rainfall for irrigation, making them vulnerable to changes in weather patterns.

Livelihood Contribution:

- **Food Security:** Ensures basic food requirements for the household, with little surplus for the market.
- **Limited Income:** The income from subsistence farming is minimal, and often, farmers engage in off-farm activities to supplement household income.
- **Resilience to Local Shocks:** These systems are highly resilient to local socio-economic and climatic conditions, but lack the means to absorb large shocks (e.g., droughts, price fluctuations).

Challenges:

- Vulnerable to climatic extremes, limited market access, and low yields due to traditional methods.
- Small farm sizes restrict economies of scale, leading to low income and limited resource use.

2. Commercial Farming

Overview: Commercial farming refers to large-scale, market-oriented farming where the primary goal is to produce crops or livestock for sale in local, national, or international markets. This system has become more prominent in states like Punjab, Haryana, and Maharashtra.

Characteristics:

- **Cash Crops:** Focuses on high-value crops such as cotton, sugarcane, tobacco, oilseeds, fruits, vegetables, and spices.
- **Use of Modern Technology:** Commercial farms employ mechanization, chemical fertilizers, pesticides, and genetically modified (GM) seeds to enhance productivity.
- **Large Landholdings:** Often involves large, consolidated landholdings, or contract farming models where farmers work under agreements with larger agribusiness firms.
- **Irrigation:** The system is heavily reliant on irrigation, which is often sourced from canal systems, groundwater, or surface water.

Livelihood Contribution:

- **Higher Income:** Commercial farming generates higher income due to the large-scale production of cash crops. However, income is dependent on the price of the crops in the market.
- **Employment Creation:** Provides employment opportunities in agriculture-related sectors like transportation, agro-processing, and retail.
- **Market Integration:** Increases farmers' integration with national and global markets, boosting export potential for crops like cotton and spices.

Challenges:

- **Environmental Degradation:** Intensive use of water, chemical fertilizers, and pesticides can lead to soil degradation, groundwater depletion, and pollution.
- **High Capital Intensity:** Commercial farming requires significant investment in machinery, seeds, and inputs, which small-scale farmers may not be able to afford.

3. Mixed Farming

Overview: Mixed farming is a system where crops and livestock are integrated on the same farm. This system is practiced widely in areas with small and medium landholdings, especially in parts of Uttar Pradesh, Bihar, and Andhra Pradesh.

Characteristics:

- **Crop-Livestock Integration:** Farmers grow food crops (e.g., wheat, rice, maize, pulses) and raise livestock (e.g., cows, goats, poultry) on the same farm.
- **Diversified Production:** A combination of farming activities helps spread risk, as the failure of one crop can be mitigated by the sale or consumption of other products (e.g., milk, eggs, meat).
- **Organic Inputs:** Manure from animals is often used to fertilize crops, reducing the need for synthetic fertilizers.

Livelihood Contribution:

- **Risk Mitigation:** The system is more resilient to environmental and economic shocks because

farmers have multiple sources of income.

- **Sustained Income:** Income is generated year-round from both crops and livestock, providing a steady stream of revenue.
- **Nutritional Security:** Mixed farming provides a balanced diet for the household, with a variety of food products available.

Challenges:

- **Labor Intensive:** Requires significant manual labor for both crop production and animal husbandry.
- **Inadequate Infrastructure:** In some areas, lack of infrastructure like cold storage, veterinary care, and marketing channels can limit profitability.

4. Agroforestry

Overview: Agroforestry is the practice of integrating trees into agricultural landscapes. It combines crops, livestock, and trees to create a more diverse and sustainable farming system. This system is gaining popularity in states like Uttar Pradesh, Tamil Nadu, and Himachal Pradesh.

Characteristics:

- **Integration of Trees and Crops:** Farmers plant trees (e.g., fruit trees, timber species) alongside agricultural crops (e.g., cereals, legumes).
- **Soil Fertility:** Trees help improve soil fertility by preventing soil erosion, fixing nitrogen, and enhancing water retention.
- **Sustainable Land Use:** Agroforestry systems are typically low-input systems that emphasize sustainability over high yields.

Livelihood Contribution:

- **Diversified Income:** Provides income from both timber and non-timber forest products (NTFPs) like fruits, nuts, resins, and medicinal plants.
- **Long-Term Sustainability:** The system enhances long-term land productivity by conserving soil, water, and biodiversity.
- **Risk Reduction:** The integration of various components (trees, crops, and livestock) reduces the financial risk from crop failure or market fluctuations.

Challenges:

- **Slow Returns:** Trees take years to mature, so income from agroforestry may not be immediate.
- **Knowledge and Expertise:** Effective agroforestry requires specialized knowledge about plant species, agroecological conditions, and management practices.

5. Dairy Farming

Overview: Dairy farming plays a crucial role in rural economies, especially in regions like Gujarat, Punjab, Maharashtra, and Uttar Pradesh, where milk production is a major activity.

Characteristics:

- **Animal Husbandry Focus:** Dairy farming involves the breeding, feeding, and care of milch animals like cows, buffaloes, and goats.
- **Market-Oriented:** Milk and milk products (e.g., ghee, curd, butter, cheese) are produced for sale in local and urban markets.
- **Varied Scale:** Dairy farming can range from small, household-level dairying to large-scale commercial operations.

Livelihood Contribution:

- **Steady Income:** Dairy farming provides a reliable and continuous source of income through milk sales, often providing cash flow even during the off-season for crops.
- **Employment Generation:** The dairy industry supports various other sectors, including feed production, veterinary care, and milk processing.
- **Nutritional Security:** Dairy products contribute significantly to the nutritional needs of rural households, offering proteins, fats, and vitamins.

Challenges:

- **Cost of Inputs:** Dairy farming can be capital-intensive, particularly in terms of animal feed, veterinary care, and infrastructure.
- **Animal Health Management:** Ensuring the health and productivity of dairy animals requires regular veterinary care and management practices, which can be expensive for small-scale farmers.

6. Horticulture

Overview: Horticulture involves the cultivation of fruits, vegetables, spices, and flowers. It is an increasingly important sector in Indian agriculture due to the growing demand for fresh produce, both in domestic and export markets.

Characteristics:

- **High-Value Crops:** Includes the production of crops like mangoes, tomatoes, bananas, onions, chilies, and other fruits and vegetables.
- **Irrigation-Dependent:** Horticultural crops typically require reliable irrigation sources, as many are sensitive to water stress.
- **Seasonal and Year-Round Crops:** Some crops are seasonal, while others (e.g., tomatoes, cucumbers) can be grown year-round in controlled environments (e.g., greenhouses).

Livelihood Contribution:

- **High Income Potential:** Horticulture provides higher returns per unit of land compared to staple crops like cereals.
- **Employment in Value Chains:** The sector generates employment in processing, packaging, transportation, and retail of fresh produce.
- **Export Opportunities:** India is one of the largest producers and exporters of fruits and

vegetables, contributing to foreign exchange earnings.

Challenges:

- **Market Volatility:** Prices of horticultural produce can fluctuate significantly, affecting farmer incomes.
- **Post-Harvest Losses:** Without proper storage and transportation infrastructure, a significant portion of the produce is lost.

7. Rice-Wheat Farming System (Rice-Wheat Cropping Pattern)

This system is predominant in the Indo-Gangetic plains, where rice is grown in the kharif season (monsoon) and wheat in the rabi season (winter).

- **Characteristics:**
 - Rice and wheat are staple crops in India, and this system allows farmers to cultivate two crops in a year.
 - It relies on irrigation and intensive use of fertilizers and pesticides.
 - High input-output system.
- **Livelihood Contribution:**
 - The system provides stable and continuous food production for domestic consumption and market sale.
 - Generates income from both rice and wheat production, contributing significantly to the economy in the northern plains.

This system, however, faces challenges like declining soil fertility, groundwater depletion, and dependence on external inputs.

8. Water-Intensive Crop Farming

Certain regions of India, such as the coastal regions of Tamil Nadu, Kerala, and Andhra Pradesh, focus on water-intensive crops like paddy, sugarcane, and jute.

- **Characteristics:**
 - Requires significant irrigation, often from rivers, lakes, or canals.
 - Common in areas with a reliable water source.
- **Livelihood Contribution:**
 - These crops contribute to both food security and commercial markets.
 - Generates income for farmers and supports the agro-processing industry.

However, water-intensive farming is unsustainable in areas facing water scarcity or erratic rainfall, and it can lead to depletion of water resources.

9. Organic Farming

With growing awareness about health and sustainability, organic farming has gained popularity in India

in recent years, particularly in states like Sikkim, Himachal Pradesh, and Uttarakhand.

- **Characteristics:**

- Avoids synthetic chemicals and fertilizers, focusing instead on natural inputs like compost, vermiculture, and crop rotation.
- Requires more labor but can be more sustainable in the long run.

- **Livelihood Contribution:**

- Provides a premium market for organic produce, both locally and internationally.
- Reduces input costs by relying on organic manure and local resources.

Organic farming is beneficial for sustainable livelihoods, but it requires careful management of soil health and pest control.

8.Types of traditional & modern farming systems.

Types of Traditional and Modern Farming Systems in India

Farming systems in India can be broadly categorized into **traditional** and **modern farming systems**. These systems differ significantly in terms of technology, scale, inputs, and the level of commercialization. Both traditional and modern farming systems contribute substantially to the livelihoods of Indian farmers, but they operate within different contexts and environments.

I. Traditional Farming Systems in India

Traditional farming systems are often practiced in rural and semi-urban areas, where farming is more subsistence-oriented, with limited use of external inputs, technologies, and capital. These systems are generally based on indigenous knowledge and local resources, and they have evolved over centuries to suit the local climate, soil types, and socio-economic conditions.

1. Subsistence Farming

Overview: This is the most common type of traditional farming system in India. Farmers produce food primarily for their own consumption, with little or no surplus for sale. It is prevalent in remote rural areas with small landholdings.

Characteristics:

- **Small Landholdings:** Farmers typically own or lease less than 1 hectare of land.
- **Labor-Intensive:** Farming relies mostly on family labor, with minimal mechanization.
- **Rainfed:** Dependent on seasonal rainfall, with little or no access to irrigation.
- **Traditional Tools and Methods:** Farmers use hand tools, animal power, and traditional farming practices (e.g., crop rotation, mixed cropping).
- **Diverse Crops:** A mix of food crops such as cereals (rice, wheat, maize), legumes, vegetables, and sometimes small livestock.

Livelihood Contribution:

- **Food Security:** Ensures basic food and nutritional security for the household.
- **Low Income:** Income is limited, primarily providing for daily needs, with little surplus for sale or investment.
- **Cultural and Social Value:** These systems often play an important role in the cultural and social life of rural communities.

Challenges:

- Vulnerable to weather patterns, pests, and diseases.
- Low productivity due to limited use of modern inputs.
- Risk of food insecurity in case of poor harvests or climate variability.

2. Shifting Cultivation (Jhum Farming)

Overview: Shifting cultivation, commonly known as **Jhum farming**, is practiced in the hilly and forested regions of northeastern India, as well as in parts of Madhya Pradesh, Orissa, and Andhra Pradesh. It involves clearing a forested area, cultivating it for a few years, and then moving on to a new plot.

Characteristics:

- **Forest Clearing:** Farmers clear a patch of forest land by slash-and-burn techniques to grow crops like rice, millet, and vegetables.
- **Crop Rotation:** The land is used for several seasons, but after a few years, soil fertility declines, and the plot is abandoned.
- **Low Input:** No external fertilizers or chemical pesticides are used.
- **Self-Sufficiency:** This system is focused on food security rather than market production.

Livelihood Contribution:

- **Food Security:** The system provides food primarily for the household.
- **Nomadic Lifestyle:** This method allows tribal and indigenous communities to sustain their traditional way of life, based on mobility and forest resources.
- **Cultural Significance:** Shifting cultivation is integral to the culture and lifestyle of many indigenous groups in India.

Challenges:

- **Soil Degradation:** Continuous use of land without proper fallow periods leads to soil erosion and reduced fertility.
- **Unsustainable:** Increased population pressure and reduced forest cover make shifting cultivation unsustainable in the long term.
- **Legal Issues:** In some regions, forest laws restrict shifting cultivation practices.

3. Integrated Farming Systems (IFS)

Overview: This is a more sustainable traditional farming system where crop cultivation is integrated with livestock and sometimes aquaculture or agroforestry. It is common in regions with medium to large landholdings, particularly in the southern and eastern parts of India.

Characteristics:

- **Crop-Livestock Integration:** Crops such as rice, wheat, pulses, or vegetables are grown alongside livestock (e.g., cows, goats, chickens, or buffaloes).
- **Use of Organic Inputs:** Animal manure and crop residues are used for fertilizing soil.
- **Sustainability:** The system is designed to be environmentally friendly and efficient in resource use.
- **Diverse Income Streams:** Farmers benefit from multiple sources of income – crop sales, milk production, egg production, etc.

Livelihood Contribution:

- **Food and Nutritional Security:** The combination of crop and livestock farming ensures diverse food sources.
- **Steady Income:** Regular income is generated throughout the year from both crops and livestock.
- **Resilience:** The system helps mitigate risks by diversifying income sources and reducing

dependence on any one enterprise.

Challenges:

- **Labor Intensive:** Requires significant labor for both crop cultivation and animal husbandry.
- **Knowledge-Intensive:** Requires specialized knowledge to manage the integration of different components effectively.

II. Modern Farming Systems in India

Modern farming systems are characterized by the use of advanced technologies, high-input farming, and commercialization of agriculture. These systems have become more widespread in regions with better access to irrigation, markets, and infrastructure.

1. Commercial Agriculture

Overview: Commercial farming is the cultivation of crops primarily for sale in local, national, or international markets. It involves large-scale farming, often with mechanization, advanced irrigation, and the use of high-yielding varieties (HYVs) of seeds.

Characteristics:

- **High Input:** Commercial farming relies on high inputs, including chemical fertilizers, pesticides, and herbicides.
- **Mechanization:** Use of tractors, harvesters, and other machinery to reduce labor and increase efficiency.
- **Cash Crops:** Focus on high-value crops like cotton, sugarcane, oilseeds, fruits, and vegetables.
- **Irrigation:** Extensive use of irrigation, including groundwater, canal systems, and drip irrigation.

Livelihood Contribution:

- **High Income:** Generates higher revenue per hectare, especially when linked to global markets (e.g., cotton, spices, fruits).
- **Employment:** Creates employment in the agro-processing sector, transport, retail, and other related industries.
- **Market Integration:** Commercial farming ties farmers to domestic and international markets, increasing their economic prospects.

Challenges:

- **Capital Intensive:** Requires significant investment in infrastructure, machinery, and inputs, which small farmers may struggle to afford.
- **Environmental Impact:** Overuse of chemical inputs, water depletion, and soil degradation can result from intensive farming practices.

2. Precision Agriculture

Overview: Precision agriculture uses advanced technologies such as GPS, drones, sensors, and data analytics to monitor and optimize crop production, making farming more efficient and resource-efficient.

Characteristics:

- **Technology-Driven:** Use of GPS, remote sensing, drones, and Internet of Things (IoT) devices to monitor crop health, soil moisture, and other parameters.
- **Data Analytics:** Collection and analysis of real-time data to make informed decisions about irrigation, fertilization, pest control, and harvesting.
- **Variable Rate Application:** Use of precision techniques to apply inputs (fertilizers, pesticides) only where needed, reducing wastage and environmental impact.

Livelihood Contribution:

- **Increased Efficiency:** Precision farming reduces input costs and increases crop yield through optimal resource use.
- **Sustainability:** By using fewer chemicals and optimizing water use, precision farming is more sustainable than conventional commercial farming.
- **Cost Savings:** By reducing the use of excess inputs, farmers can achieve cost savings while improving productivity.

Challenges:

- **High Initial Investment:** Requires a significant upfront investment in technology and training.
- **Limited Adoption:** The adoption of precision agriculture is still limited due to the high cost and lack of access to technology in rural areas.

3. Organic Farming

Overview: Organic farming focuses on growing crops without synthetic fertilizers or pesticides, relying instead on natural inputs like compost, manure, and crop rotation. It is practiced as an alternative to chemical-intensive conventional farming.

Characteristics:

- **No Chemicals:** Avoids the use of synthetic fertilizers, pesticides, and herbicides.
- **Natural Fertilization:** Utilizes compost, manure, green manures, and biofertilizers.
- **Crop Rotation and Intercropping:** Rotating crops and growing multiple crops together to maintain soil health and prevent pest buildup.
- **Soil Health Focus:** Emphasis on soil fertility management through organic means rather than chemical inputs.

Livelihood Contribution:

- **Premium Market Access:** Organic produce often commands higher prices in local, national, and international markets.
- **Sustainability:** It offers long-term sustainability by reducing environmental pollution and improving soil health.
- **Reduced Input Costs:** Farmers save on chemical fertilizers and pesticides, relying on locally available organic inputs.

Challenges:

- **Lower Yields:** Organic farming can have lower yields compared to conventional farming, particularly in the short term.
- **Market Barriers:** Organic certification and market access can be expensive and complicated for

small farmers.

4. Hydroponics and Aquaponics

Overview: Hydroponics and aquaponics are soilless farming techniques that use water as a medium to grow crops, often in controlled, indoor environments. Aquaponics additionally combines fish farming with crop production.

Characteristics:

- **Soilless Systems:** Crops are grown in a nutrient-rich water solution instead of soil, reducing

Differences Between Traditional and Modern Farming Systems

While both **traditional** and **modern farming systems** are central to India’s agricultural landscape, they differ significantly in their methods, scale, inputs, technologies, and socio-economic impacts. Below is a **comprehensive comparison** based on various factors:

| 1. Scale of Operation | | |
|-------------------------------------|--|---|
| Aspect | Traditional Farming Systems | Modern Farming Systems |
| Landholding Size | Typically practiced on small landholdings (less than 1 hectare) | Operated on larger landholdings or commercial scales (can exceed 10 hectares) |
| Farm Size | Small-scale, family-operated, with limited resources | Large-scale, sometimes industrialized farming involving mechanization and advanced technologies |
| 2. Farming Practices and Technology | | |
| Aspect | Traditional Farming Systems | Modern Farming Systems |
| Technology Use | Primarily manual tools (plows, sickles) and animal labor | Advanced machinery (tractors, harvesters), high-tech inputs (drones, sensors) |
| Crop Varieties | Predominantly local, traditional varieties of crops | Use of high-yielding varieties (HYVs) and genetically modified (GM) crops |
| Input Use | Minimal inputs—organic fertilizers (manure, compost), minimal chemical use | Heavy reliance on chemical fertilizers, pesticides, herbicides, and synthetic inputs |
| Irrigation | Rainfed, occasional use of traditional irrigation methods | Modern irrigation systems like drip, sprinkler, and canal irrigation |

3. Crop Diversification

| Aspect | Traditional Farming Systems | Modern Farming Systems |
|-----------------------|---|---|
| Crop Variety | Mixed cropping —multiple crops grown together to ensure food security and biodiversity | Monoculture —growing a single crop (e.g., cotton, rice, wheat) for commercial purposes |
| Livestock Integration | Integrated farming with crops, livestock (cattle, goats, poultry) | Sometimes involves specialized farming (crop-only or livestock-only operations) |
| Farm Diversification | Often self-sustaining with a wide range of crops, vegetables, and animals | Market-driven systems, typically focused on cash crops or livestock |

4. Input and Resource Management

| Aspect | Traditional Farming Systems | Modern Farming Systems |
|---------------------------|---|--|
| Soil Fertility Management | Use of organic farming practices —manure, compost, crop rotation | Chemical fertilizers and synthetic pesticides to manage soil fertility and pests |
| Water Management | Primarily rainfed agriculture ; limited irrigation techniques | Advanced irrigation (e.g., drip, sprinkler, canal-based), sometimes high water usage |
| Labor Intensity | High labor input —reliant on family labor and manual labor | Mechanized farming reduces human labor, relies on machinery and equipment |
| Energy Consumption | Minimal external energy usage, mostly human and animal power | High energy consumption , especially with mechanization and chemical inputs |

5. Economic Factors

| Aspect | Traditional Farming Systems | Modern Farming Systems |
|--------------------|---|--|
| Capital Investment | Low investment —small-scale, less capital-intensive | High capital investment in machinery, fertilizers, and advanced technologies |
| Market Orientation | Predominantly subsistence farming (produces for household consumption) | Primarily commercial farming —focused on producing for local, national, and international markets |
| Revenue Generation | Limited income —mainly for household consumption with minimal surplus for sale | Higher revenue potential, especially with cash crops and market-driven farming |
| Risk Exposure | Low risk due to diversification but vulnerable to local environmental shocks | Higher risk —susceptible to price fluctuations, climate change, and market uncertainties |

6. Sustainability and Environmental Impact

| Aspect | Traditional Farming Systems | Modern Farming Systems |
|----------------------|--|---|
| Environmental Impact | Low environmental impact —uses organic practices, minimal use of chemicals | Higher environmental impact —soil degradation, water depletion, pollution from chemicals |
| Biodiversity | Higher biodiversity due to mixed cropping, agroforestry, and integration of livestock | Lower biodiversity due to monoculture cropping systems |
| Soil Health | Maintained soil health through organic inputs and crop rotation | Soil degradation from overuse of chemical fertilizers and pesticides |
| Water Usage | Efficient use of local water resources (rainwater harvesting, traditional irrigation) | High water consumption —often leads to groundwater depletion |

7. Social and Cultural Factors

| Aspect | Traditional Farming Systems | Modern Farming Systems |
|-----------------------|--|---|
| Labor | Family and community-based labor —children, women, and elders play key roles | Contract labor or hired workers, reducing family labor involvement |
| Cultural Significance | Strong cultural and community ties —agriculture is closely linked to traditions, festivals, and local knowledge | Less cultural integration —focused on profit, commercialization, and industrial practices |
| Social Structure | Self-sufficiency —most people work on their own farms or in nearby farms | Dependency on external inputs and markets , creating more urban-rural linkages and labor migration |

8. Adoption of New Practices

| Aspect | Traditional Farming Systems | Modern Farming Systems |
|--------------------|--|--|
| Innovation | Limited innovation —based on historical knowledge and practices passed down through generations | Constant innovation —use of genetic engineering, hybrid seeds, and cutting-edge technologies |
| Knowledge Base | Indigenous knowledge —traditional farming methods passed down through generations | Scientific knowledge —based on research institutions, universities, and private agribusinesses |
| Extension Services | Limited access to modern agricultural extension services, though some regions have traditional knowledge-sharing mechanisms | Government and private sector-driven extension services —focused on technology, market access, and new farming techniques |

Summary: Traditional vs. Modern Farming Systems

| Feature | Traditional Farming Systems | Modern Farming Systems |
|-----------------------------|---|--|
| Scale | Small, family-oriented, low external input | Large-scale, commercial, high external input and mechanized |
| Technological Use | Low tech, manual labor, traditional tools | High tech, mechanized, heavy use of fertilizers and pesticides |
| Crop Diversity | High diversity, subsistence-focused, integrated crops and livestock | Monoculture, market-oriented, single crop focus |
| Economic Role | Low income, food security, local markets | High income, market-driven, cash crops, commercial focus |
| Environmental Impact | Low environmental footprint, sustainable practices | High environmental footprint, risks of over-exploitation |
| Sustainability | More sustainable, ecological balance, organic practices | Often unsustainable, relies on external inputs, monocropping |

9.Components of farming system/ farming-based livelihood systems- Crops and cropping systems, Livestock, (Dairy, Piggery, Goatry, Poultry, Duckry etc.), Horticultural crops, Agro--forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc.,

Farming system components

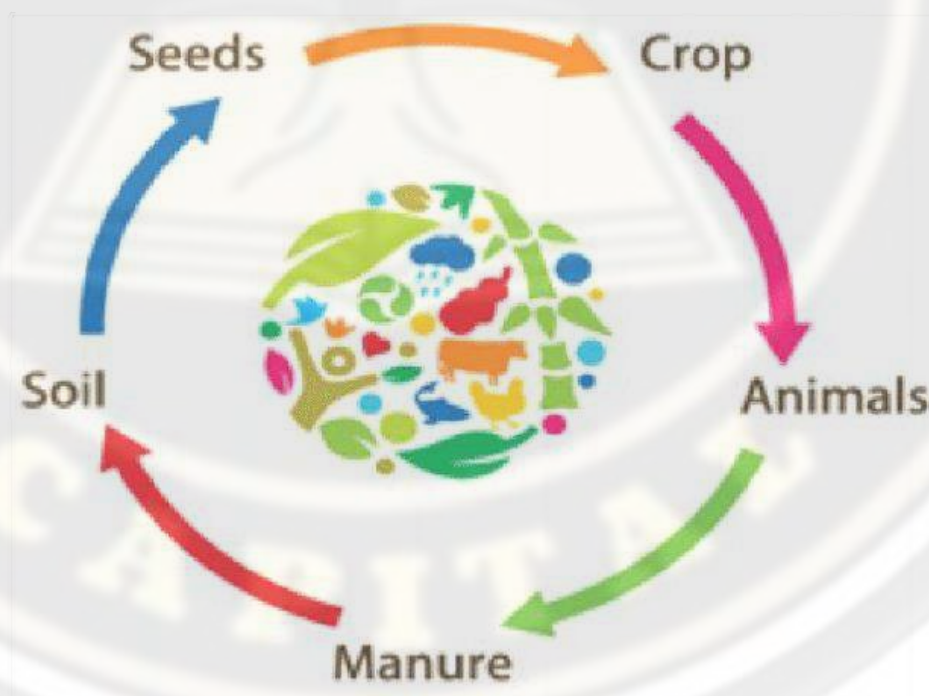
A farming system is made up of various components that work together to achieve sustainable agriculture. These components include:

1. **Crops:** The crops grown in a farming system are the primary source of food and income for farmers. To maintain the crop component, farmers need to use sustainable farming practices such as crop rotation, intercropping, and the use of organic fertilizers.
2. **Livestock:** Livestock plays an important role in farming systems by providing milk, meat, and manure for crop production. To maintain the livestock component, farmers need to provide adequate feed and water, maintain good animal health through vaccination and treatment, and manage grazing lands to prevent overgrazing.
3. **Soil:** Soil is the foundation of any farming system and is essential for crop growth. To maintain the soil component, farmers need to use sustainable soil management practices such as conservation tillage, use of cover crops, and appropriate use of fertilizers and pesticides.
4. **Water:** Water is a vital component of farming systems and is necessary for crop growth and livestock production. To maintain the water component, farmers need to use sustainable water management practices such as efficient irrigation methods, rainwater harvesting, and proper management of water resources.
5. **Farm machinery and equipment:** Farm machinery and equipment are essential for efficient and effective farming. To maintain the machinery and equipment components, farmers need to follow proper

maintenance procedures, ensure regular servicing, and use appropriate safety measures.

6. **Human resources:** The human component of a farming system includes the farmers, their family members, and other labourers. To maintain the human resource component, farmers need to provide adequate training, fair wages, and safe working conditions.
7. **Infrastructure:** Infrastructure components of a farming system include buildings, fences, roads, and other facilities necessary for farm operations. To maintain the infrastructure component, farmers need to ensure regular maintenance and repair of these structures.

farming-based livelihood systems- Crops and cropping systems



Farming-Based Livelihood Systems in India: Crops and Cropping Systems

Agriculture in India is largely dependent on crops, which serve as the primary source of food, income, and employment for millions of people, especially in rural areas. The farming system and the type of crops grown significantly influence the livelihood of farming communities. Cropping systems refer to the combination of different crops and the sequences in which they are grown in a specific region or field.

In India, a wide variety of crops are grown, and the cropping systems used vary depending on factors such as geography, climate, water availability, soil type, and market demand. Below is a detailed breakdown of the **components of crops** and **cropping systems** in India:

1. Types of Crops in India

India produces a wide range of crops, which can be categorized into different groups based on their use, growing seasons, and environmental requirements. These include:

a. Food Crops

These crops are primarily grown to meet the food requirements of the population and are staple foods in the diet of most Indian families.

- **Cereals:**
 - **Rice:** The staple food crop, grown in regions with abundant water like the **Indo-Gangetic Plain** and parts of the **Eastern and Southern India**.
 - **Wheat:** Grown mainly in the **Northern Plains**, including states like Punjab, Haryana, Uttar Pradesh, and Madhya Pradesh.
 - **Maize:** Grown in the **Central, Eastern, and Southern India**. It is a food as well as fodder crop.
 - **Barley and Millets:** These include **jowar, bajra, and ragi**, which are important in dry regions like **Rajasthan, Maharashtra, and Karnataka**.
- **Pulses:** Leguminous crops like **gram (chickpeas), lentils, pigeon peas (toor dal), and mung beans**. India is the largest producer of pulses, and these crops are important for their protein content.
- **Oilseeds:** These include **groundnut (peanut), mustard, soybean, and sunflower**, which are crucial for producing edible oils for both domestic use and export.

b. Cash Crops

Cash crops are grown primarily for sale in the market to generate income rather than for consumption. These crops usually have higher market demand and value.

- **Cotton:** Majorly grown in **Maharashtra, Gujarat, Andhra Pradesh, and Telangana**.
- **Sugarcane:** Predominantly grown in **Uttar Pradesh, Maharashtra, Karnataka, and Tamil Nadu**.
- **Tobacco:** Mainly cultivated in **Andhra Pradesh, Karnataka, and Gujarat**.
- **Tea and Coffee:** These crops are grown in **West Bengal, Assam, Kerala, and Karnataka**.
- **Spices:** India is one of the largest producers of spices like **cardamom, black pepper, turmeric,**

and **chili**.

c. Fiber Crops

Fiber crops are grown primarily for their fiber, which is used in various industries, especially textiles.

- **Cotton:** The major fiber crop, and India is one of the leading producers of cotton globally.
- **Jute:** Grown in the **Ganges Delta region** (West Bengal, Assam), used in making bags, ropes, and mats.

d. Horticultural Crops

These crops are grown for their fruits, vegetables, flowers, and medicinal plants, contributing significantly to both food security and income generation.

- **Fruits:** Mangoes, bananas, apples, citrus fruits, guavas, and papayas are important fruit crops grown across various states.
- **Vegetables:** Potatoes, tomatoes, onions, carrots, spinach, cabbages, peas, and cauliflowers are grown mainly in Himachal Pradesh, Punjab, Maharashtra, Haryana, and Karnataka.
- **Flowers:** Marigold, rose, jasmine, chrysanthemum, and lotus are cultivated for local markets and export.
- **Spices:** India is a major producer of spices like chili, turmeric, ginger, cardamom, and black pepper.

2. Cropping Systems in India

Cropping systems refer to the planning and management of crops in a way that optimizes land, water, and labor resources while ensuring higher productivity, sustainability, and profitability. Several cropping systems are practiced across the country, depending on environmental conditions, economic viability, and social needs.

a. Types of Cropping Systems

1. Mono-cropping

- **Definition:** Growing a single crop on the same piece of land for one or more seasons.
- **Examples:**
 - **Rice monoculture:** Common in areas with abundant water, especially in the eastern, northern, and southern states.
 - **Wheat monoculture:** Prominent in regions like Punjab, Haryana, and Uttar Pradesh.
- **Advantages:** Easier to manage for farmers as only one crop is cultivated.
- **Disadvantages:** Increases vulnerability to pest attacks and disease; can lead to soil nutrient depletion.

2. Multiple Cropping

- **Definition:** Growing more than one crop in a year on the same piece of land. This can include double cropping, triple cropping, or more.
- **Examples:**
 - **Double cropping:** Growing two crops in a year, such as rice and wheat or rice

and pulses.

- **Triple cropping:** Growing three crops, such as **maize, pulses, and mustard**.
- **Advantages:** Maximizes the use of available land and increases productivity.
- **Disadvantages:** Requires more inputs (fertilizers, irrigation) and higher labor input.

3. Intercropping

- **Definition:** Growing two or more crops simultaneously on the same piece of land in a row or a mixed manner.
- **Examples:**
 - **Maize + Groundnut or Maize + Soybean:** Crops that complement each other in nutrient requirements and growth cycles.
 - **Rice + pulses:** Rice is grown along with pulses like mung beans or urad dal to enhance soil fertility through nitrogen fixation.
- **Advantages:** Reduces the risk of crop failure, improves biodiversity, and enhances soil fertility.
- **Disadvantages:** Requires careful planning and management to prevent competition for water and nutrients.

4. Crop Rotation

- **Definition:** Growing different crops in a particular sequence on the same land to improve soil health and reduce pest and disease cycles.
- **Examples:**
 - **Wheat – rice – legumes (like chickpeas):** A common rotation system in the north-western states.
 - **Rice – mustard – pulses:** Used to maintain soil fertility and prevent nutrient depletion.
- **Advantages:** Improves soil fertility, breaks pest cycles, and reduces the need for chemical inputs.
- **Disadvantages:** Requires a more diverse set of seeds and can complicate farm management.

5. Agroforestry

- **Definition:** The integration of trees or shrubs with crops or livestock in a mutually beneficial way.
- **Examples:**
 - **Tree crops + food crops:** Growing **mangoes** or **cashews** alongside crops like **pulses** or **vegetables**.
 - **Agroforestry with livestock:** Integrating **cattle** or **sheep** with fruit orchards or timber crops.
- **Advantages:** Enhances biodiversity, improves soil health, provides additional income from timber, fruit, or fodder.
- **Disadvantages:** Higher initial investment and land management complexity.

6. Integrated Farming Systems (IFS)

- **Definition:** A holistic approach where multiple components, such as crops, livestock, fish farming, and agroforestry, are combined in a sustainable and synergistic manner.
- **Examples:**
 - **Rice-fish farming:** Growing rice while raising fish in the same field.
 - **Dairy + poultry + fish:** A diversified approach where milk production, poultry farming, and fish culture are combined to reduce risk and increase profitability.
- **Advantages:** Provides multiple sources of income, enhances resource use efficiency, improves soil health, and is more resilient to market and climatic shocks.
- **Disadvantages:** Complex management and requires significant knowledge and skills in multiple farming practices.

7. Sustainable and Organic Farming Systems

- **Definition:** Systems focused on maintaining soil health and ecological balance without relying on chemical fertilizers or pesticides.
- **Examples:**
 - **Organic vegetable farming:** Growing vegetables using natural fertilizers and pest control methods.
 - **Agroecological farming systems:** Incorporating practices like mulching, composting, and integrated pest management.
- **Advantages:** Promotes long-term sustainability, reduces environmental pollution, and meets the growing market demand for organic produce.
- **Disadvantages:** Lower yields initially, higher labor costs, and difficulty in transitioning from conventional farming.

3. Factors Influencing Cropping Systems (Continued)

The choice of cropping system depends on various factors, such as:

1. Climate and Weather:

- **Temperature, Rainfall, and Humidity:** Crops like **rice** require high water availability and grow well in regions with consistent rainfall, while **wheat** thrives in cooler climates with dry conditions. Understanding regional climate patterns is crucial in determining which cropping system is most appropriate.
- **Monsoon Dependency:** In regions dependent on the monsoon (e.g., **Eastern India**), crops like **paddy** and **maize** are grown. In dryland areas (e.g., **Rajasthan, Madhya Pradesh**), farmers may adopt **drought-resistant crops** like **millet**s, **sorghum**, or **legumes**.

2. Soil Type and Fertility:

- **Soil Fertility:** Fertile soils are conducive for high-value crops like **vegetables** and **cash crops** (e.g., **cotton, sugarcane**). In contrast, **sandy soils** or **marginal soils** are more suitable for **millet**s, **pulses**, and **oilseeds** that require lower nutrient inputs.
- **Soil pH and Texture:** Cropping systems are also influenced by the soil's pH and texture.

For example, crops like **pulses** prefer slightly acidic soils, while **wheat** and **maize** thrive in neutral soils.

3. Water Availability:

- **Irrigated vs. Rainfed Systems:** Cropping systems are highly influenced by water availability. **Irrigated regions** support **high-water-demand crops** like **rice** and **sugarcane**, while **rainfed regions** may rely on crops that are more drought-resistant, like **millets**, **groundnut**, and **pulses**.
- **Water Management:** Efficient water management, such as the use of drip irrigation or rainwater harvesting, can help extend cropping seasons and enhance crop productivity.

4. Market Demand and Economic Viability:

- **Cash Crops:** The demand for **cash crops** like **cotton**, **sugarcane**, **tea**, and **coffee** drives farmers to adopt cropping systems that are suited for large-scale production.
- **Local Consumption:** In rural areas, farmers may grow **food crops** (e.g., **rice**, **pulses**, **vegetables**) for local consumption to meet household needs while also selling surplus produce in local markets.
- **Export Markets:** In regions where crops like **spices** or **fruits** (e.g., **mangoes**, **apples**) are grown, the cropping system may be oriented toward meeting export demand.

5. Labor Availability and Management:

- **Labor-Intensive Systems:** Some cropping systems, such as **vegetable farming** or **fruit orchards**, are labor-intensive and require significant manual intervention. Availability of cheap and skilled labor is crucial in these systems.
- **Mechanized Systems:** Large-scale systems like **wheat** and **rice monocropping** can benefit from mechanization, reducing labor costs and increasing efficiency.

6. Pest and Disease Management:

- **Pest and Disease Resistance:** Crop rotation and mixed cropping systems are often employed to reduce the incidence of pests and diseases. For instance, rotating **cereals** with **legumes** helps in breaking pest cycles, and intercropping can reduce pest damage.

7. Government Policies and Support:

- **Subsidies and Price Support:** Government incentives like subsidies on inputs (fertilizers, seeds), minimum support prices (MSP) for staple crops like **rice** and **wheat**, and crop insurance schemes can influence farmers' choices of crops and cropping systems.
- **Rural Development Programs:** Schemes for improving irrigation, soil health, and market access help improve the economic viability of certain cropping systems.

4. Importance of Crops and Cropping Systems in Livelihoods

Crops and cropping systems are integral to the livelihoods of rural communities, impacting food security, income generation, environmental sustainability, and rural development. Below are some key ways in which crops and cropping systems contribute to farming-based livelihoods:

a. Food Security and Nutrition

- **Staple Crops:** Crops like **rice**, **wheat**, and **millets** provide the primary source of calories for households in rural areas.
- **Diversification of Diet:** The inclusion of **vegetables**, **fruits**, **legumes**, and **pulses** in cropping systems helps provide essential vitamins, minerals, and proteins, improving the nutritional security of farming families.
- **Year-Round Availability:** Well-planned cropping systems (e.g., **multiple cropping** or **intercropping**) ensure that food is available year-round, reducing the risk of hunger and malnutrition during off-seasons.

b. Income Generation

- **Cash Crops for Market Sales:** Crops like **cotton**, **tobacco**, and **sugarcane** are often grown for sale in national and international markets, contributing significantly to the income of farmers.
- **High-Value Crops: Horticultural crops**, such as **fruits** (e.g., mangoes, bananas) and **vegetables** (e.g., tomatoes, onions), are high-value crops that can provide substantial income to farmers. The growing export demand for Indian fruits and vegetables has created new economic opportunities.
- **Diversified Farming:** Integrated systems that combine crops with livestock, poultry, and fisheries can provide multiple sources of income, reducing risk and increasing profitability. For example, **dairy + vegetable** farming, **poultry + vegetables**, or **fish farming + rice** offer diversified income sources and create opportunities for local markets.

c. Sustainability and Resource Use Efficiency

- **Soil Fertility Maintenance:** Crop rotation and intercropping help in improving soil health by replenishing nutrients, enhancing organic matter, and reducing the need for synthetic fertilizers. For example, **legumes** fix nitrogen in the soil, improving soil fertility for subsequent crops.
- **Water Conservation:** Cropping systems like **dryland farming**, which focuses on drought-resistant crops (e.g., **millets**, **groundnuts**), or systems that use **rainwater harvesting** techniques, help in conserving water resources and making farming viable in water-scarce regions.
- **Biodiversity Enhancement:** Agroecological practices, such as agroforestry and intercropping, can enhance biodiversity, support pollinators, and reduce pest pressures.

d. Risk Reduction and Resilience

- **Diversified Systems:** Cropping systems that combine different types of crops, livestock, and trees reduce the risk of total crop failure due to pests, diseases, or climatic events (e.g., droughts or floods). Integrated farming systems (IFS), where crops and livestock are integrated, increase resilience by providing multiple avenues for income.
- **Crop Insurance and Government Support:** Governments in India provide subsidies, insurance, and minimum support prices (MSP) for certain crops, which helps reduce the risk farmers face due to price fluctuations or crop failure.

e. Employment Generation

- **Labor-Intensive Cropping Systems:** Cropping systems that involve **vegetable farming, orchard cultivation, or high-value crops** generate significant employment opportunities for local labor, both in farming and post-harvest activities (e.g., packaging, marketing).
- **Rural Employment:** When cropping systems are diversified (e.g., **rice-fish farming, dairy-poultry systems**), they create job opportunities in various sectors, providing additional income for rural families and reducing rural-urban migration.

5. Challenges and Future Outlook

While cropping systems contribute significantly to the livelihood of rural communities in India, there are several challenges and areas for improvement:

1. **Climate Change:** Unpredictable weather patterns, changing rainfall distribution, and extreme temperatures are increasing the vulnerability of farmers. Cropping systems need to adapt to these changes through resilient crop varieties and improved water management techniques.
2. **Soil Degradation:** Continuous mono-cropping and improper farming practices are leading to soil erosion, depletion of organic matter, and loss of soil fertility. Transitioning to sustainable systems like agroecology, organic farming, and agroforestry can help restore soil health.
3. **Market Access and Infrastructure:** Farmers in rural areas often struggle with inadequate access to markets, lack of cold storage facilities, and transportation constraints, which affect the profitability of crops. Improving rural infrastructure is crucial for enhancing farmers' market access.
4. **Policy Support:** Ensuring better policy support for diversification, organic farming, and farmer cooperatives can help improve the resilience and profitability of cropping systems.

Livestock Farming Based System-(Dairy, Piggery, Goatry, Poultry, Duckry etc.)

Livestock Farming-Based Systems in India: Dairy, Piggery, Goatry, Poultry, Duckry, and More

Livestock farming is an integral part of agriculture in India, contributing significantly to the livelihood of rural communities. The development and diversification of **livestock-based farming systems** can enhance income, improve food security, and promote sustainable agricultural practices. The system integrates crop and livestock production, providing diverse sources of income and enhancing the resilience of farmers to market and climatic fluctuations.

India has a rich tradition of animal husbandry, and livestock farming is practiced across different regions, with each system designed to optimize local resources and meet the specific needs of farmers. Below is a detailed analysis of various livestock farming systems in India, such as **dairy farming**, **piggery**, **goat farming (goatry)**, **poultry farming**, and **duck farming**.

1. Dairy Farming-Based System

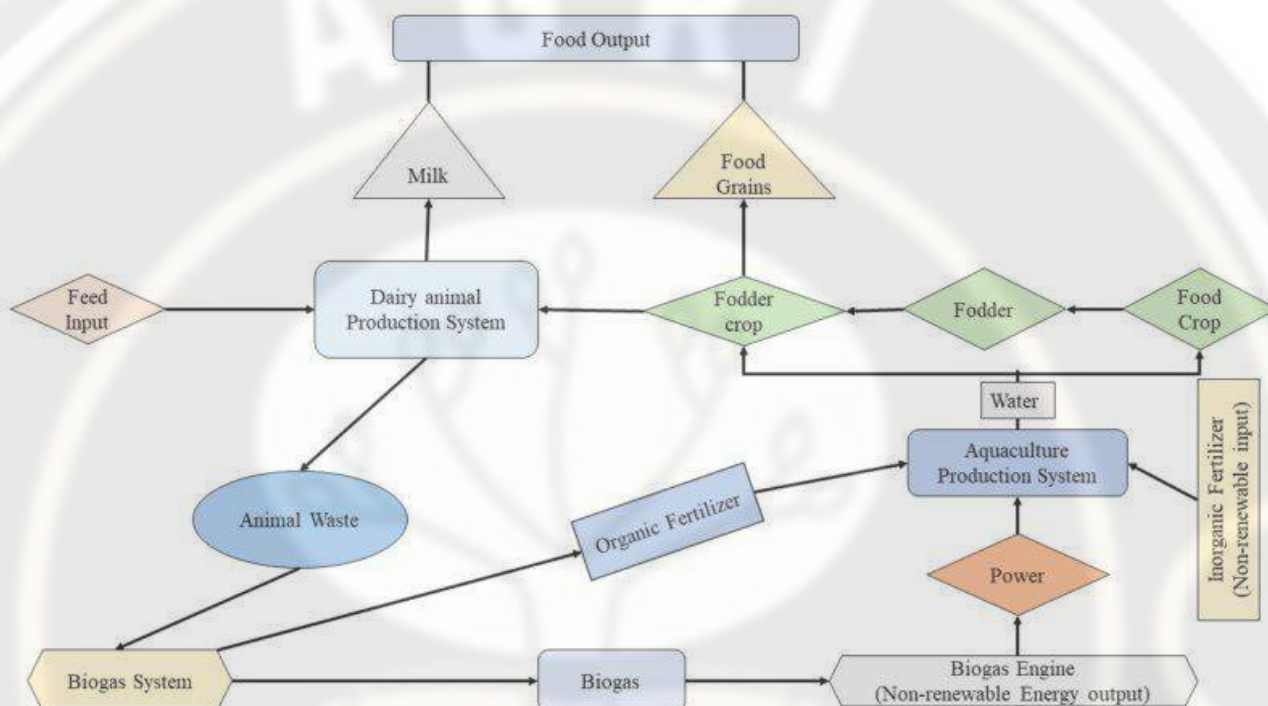
Dairy farming is one of the most important forms of livestock-based farming in India. India is the world's largest producer of milk, and dairy farming is a significant source of income for millions of rural families, particularly in smallholder and subsistence farming systems.

Key Features of Dairy Farming in India:

- **Cattle Breeds:** India has a large variety of indigenous breeds like **Gir, Sahiwal, Red Sindhi**, and **Tharparkar**, along with crossbred and exotic breeds like **Holstein Friesian, Jersey**, and **Ayrshire**. Indigenous breeds are well adapted to the hot and humid climate and are often more disease-resistant.
- **Milk Production:** Dairy farming involves the care of **milch animals** (cows and buffaloes) for milk production. **Buffaloes** (e.g., **Murrah, Nili-Ravi**) are also highly valued for their milk, which has higher fat content than cow's milk.
- **Systems of Dairy Farming:**
 - **Traditional/Small-Scale:** This system is common in rural areas where farmers keep a small number of cows or buffaloes, often combined with crop farming. Milk produced is primarily for family consumption, with surpluses sold in local markets.
 - **Commercial Dairy Farming:** Large-scale dairy farming, where farmers have a substantial number of animals, often involves mechanized milking, cold storage, and milk processing (e.g., into **paneer, ghee, cheese**). This system is prevalent in regions like **Punjab, Haryana, Maharashtra, and Gujarat**.
- **Management Practices:**
 - **Feeding:** Dairy cattle are fed a combination of roughages (like **green fodder, silage**) and concentrates (like **grain-based feed**). The nutritional requirements vary based on the

animal's age, breed, and stage of lactation.

- **Health Management:** Proper vaccination, deworming, and regular veterinary care are crucial to ensure the health of dairy animals.
- **Economic Significance:** Dairy farming provides regular income to farmers and contributes to employment generation, especially in rural areas. It also serves as a buffer against crop failures and fluctuating market prices for agricultural produce.



Challenges in Dairy Farming:

- **High Input Costs:** The cost of feed, veterinary care, and maintenance of infrastructure can be high.
- **Market Access:** Farmers often face challenges in accessing fair markets for their milk and dairy products.
- **Low Productivity:** Indigenous breeds may have lower milk yields compared to exotic breeds, though they are more disease-resistant.

2. Piggery Farming-Based System

Piggery farming (raising pigs) has gained popularity in India due to its relatively low cost of maintenance, high reproductive rate, and short gestation period. It is primarily practiced in regions with limited access to land for large-scale farming.

Key Features of Piggery Farming:

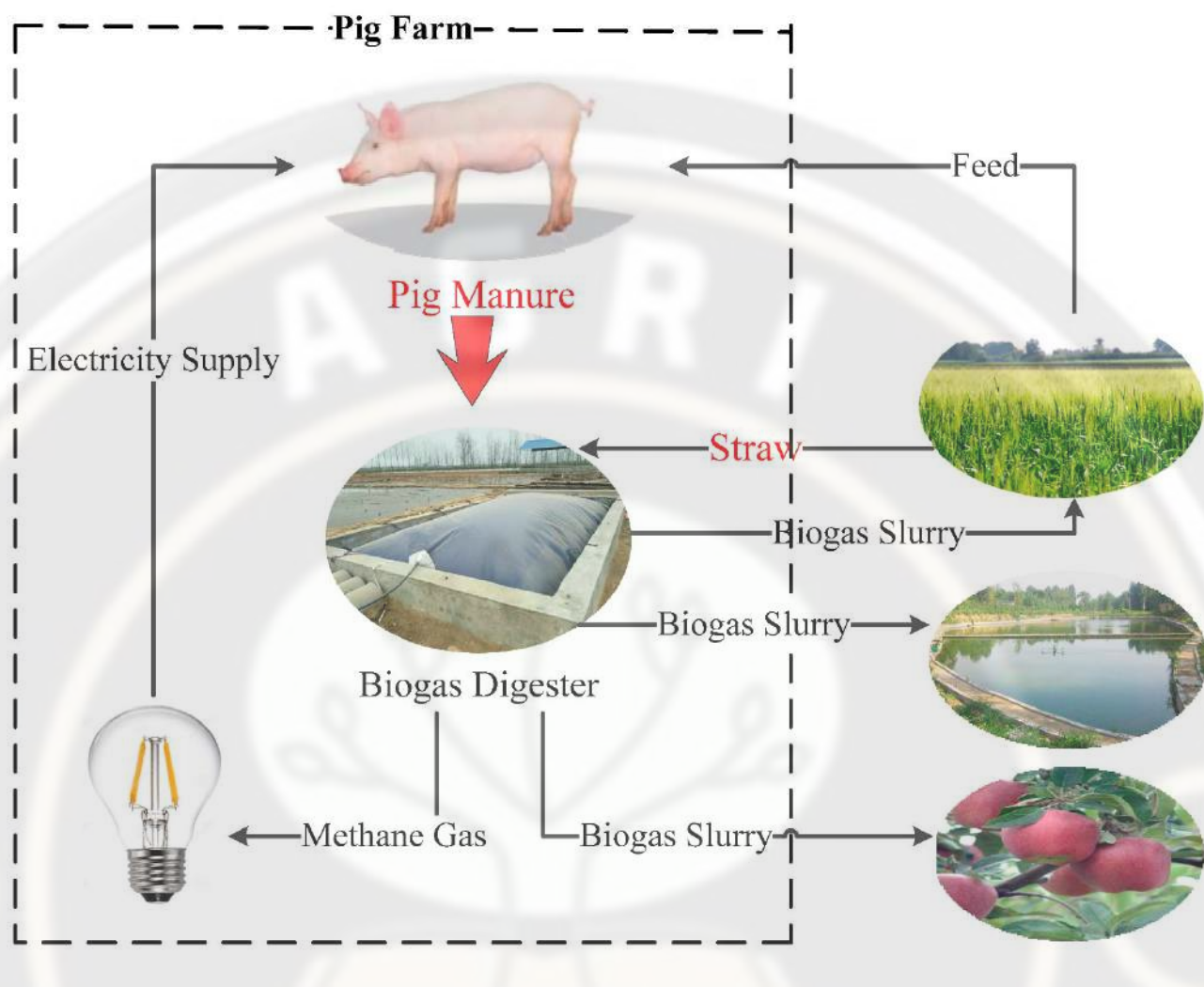
- **Breeds of Pigs:** The major breeds raised in India include **Desi pigs** (indigenous breeds), as well as **exotic breeds** like **Landrace**, **Yorkshire**, and **Large White**. Crossbreeding is often done to improve productivity.
- **Pig Production Systems:**
 - **Small-Scale Production:** Many smallholder farmers in rural areas keep a small number

of pigs for household consumption and local market sales. This is a source of additional income and protein for rural families.

- **Commercial Piggery:** Larger-scale pig farming operations focus on intensive breeding, feeding, and production systems, often involving mechanized feed management and modern housing systems. States like **Kerala, West Bengal, Assam, and Bihar** have significant pig farming operations.
- **Management Practices:**
 - **Feeding:** Pigs are fed a balanced diet consisting of **grains** (like maize, rice bran), **vegetable waste**, and **protein-rich supplements**. Commercial pig farms may use formulated feeds.
 - **Breeding:** Pigs reproduce quickly, with a gestation period of about 114 days, and they can produce up to 10-12 piglets per litter. **Artificial insemination** is sometimes used in commercial farms to improve genetics.
- **Economic Significance:** Pig farming contributes significantly to rural incomes, especially in **Eastern India** and **Northeastern states**, where pork is a major part of the diet. It is also an important source of meat for the growing domestic and export markets.

Challenges in Piggery Farming:

- **Disease Management:** Pigs are prone to diseases such as **swine fever** and **foot-and-mouth disease**, which require stringent biosecurity measures.
- **Feeding Costs:** The cost of feed can be high, especially in areas where high-quality feed ingredients are scarce.
- **Market Constraints:** There are limited organized marketing channels for pork in some areas, and price fluctuations can affect farm profitability.



4. Goat Farming-Based System (Goatry)



Goat farming (Goatry) is widely practiced across India due to the relatively low cost of investment and management. Goats are resilient animals that thrive in diverse climates and can be raised on marginal lands with minimal care.

Key Features of Goat Farming in India:

- **Breeds of Goats:** India has several indigenous goat breeds, including the **Beetal**, **Jamunapari**, **Barbari**, **Sirohi**, and **Black Bengal**. Crossbreeds are also used for improved meat and milk production.
- **Goat Production Systems:**
 - **Small-Scale Farming:** Most goat farming in India is done on a small scale, where farmers keep a small herd for meat and milk production. Goats are often integrated into mixed farming systems, where they are raised alongside crop cultivation or other livestock.
 - **Commercial Goat Farming:** Commercial goat farms focus on breeding high-yielding animals for meat (**chevon**) or milk. Such systems are increasingly common in **Maharashtra**, **Uttar Pradesh**, and **Rajasthan**.
- **Management Practices:**
 - **Feeding:** Goats are browsers and can thrive on a wide variety of feeds, including **shrubs**, **grasses**, and **tree leaves**. In commercial systems, supplemental feeding with concentrates may be necessary.
 - **Health Management:** Regular vaccination, deworming, and good shelter are critical for maintaining the health of goats.
- **Economic Significance:** Goat farming is a major source of meat (chevon) and milk in rural India. Goats are also a source of **fiber** (such as **cashmere**) and **manure** for fertilizing crops.

Challenges in Goat Farming:

- **Disease Control:** Goats are susceptible to diseases like **foot-and-mouth disease**, **PPR (Peste**

des petits ruminants), and enterotoxemia.

- **Limited Market Access:** Farmers face challenges in accessing organized markets for goat products and often depend on local markets, which can have variable prices.
- **Predation:** In certain regions, goats are vulnerable to attacks by wild animals (e.g., wolves and dogs).

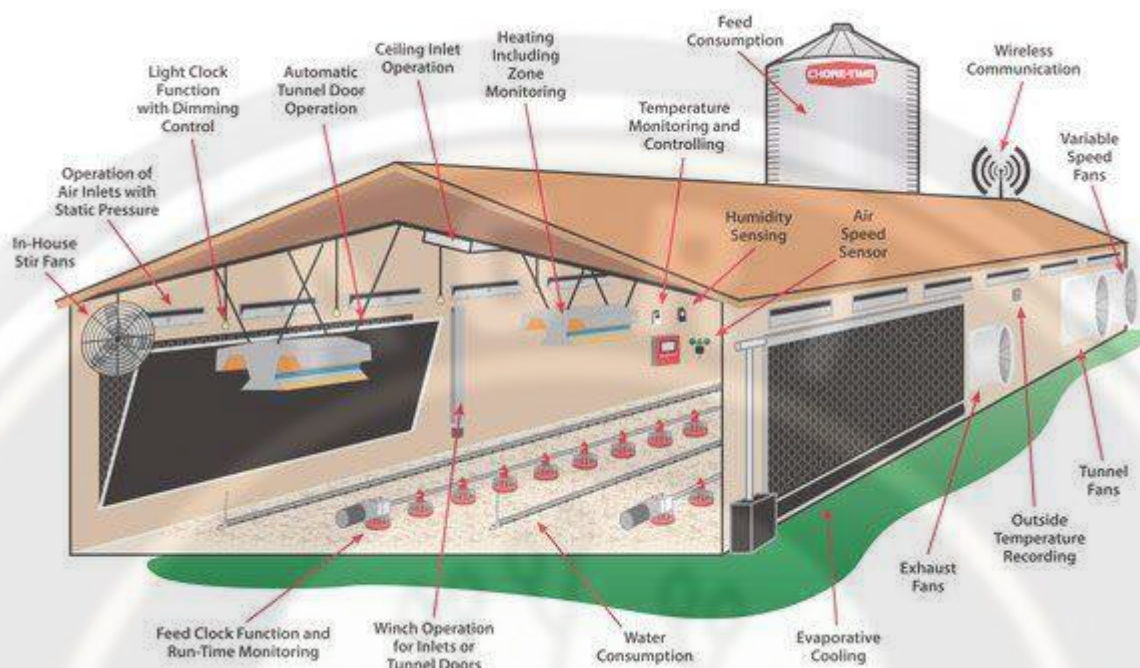


4. Poultry Farming-Based System

Poultry farming (raising chickens, ducks, etc.) is one of the fastest-growing sectors in Indian agriculture. It plays a key role in meeting the demand for meat and eggs and provides employment and income for millions of rural households.

Key Features of Poultry Farming in India:

- **Types of Poultry:**
 - **Broilers:** Raised for meat production, broiler farming has become a highly commercialized sector in India.
 - **Layers:** Raised for egg production, layer farming involves keeping chickens specifically for egg-laying purposes.
 - **Desi Poultry:** Indigenous breeds are raised for meat and eggs in rural areas. These birds are known for their hardiness, resistance to diseases, and good adaptation to local conditions.
- **Systems of Poultry Farming:**
 - **Backyard Poultry:** Small-scale poultry farming is prevalent in rural households, where chickens are raised for self-consumption and local market sales.
 - **Commercial Poultry:** Larger-scale commercial farms are highly organized, often with controlled environments for broiler and layer production. Poultry farming is widely practiced in **Andhra Pradesh, Tamil Nadu, West Bengal, and Kerala.**
- **Management Practices:**
 - **Feeding:** Poultry are fed nutritionally balanced feeds, which may include **corn, soybean, fishmeal, and minerals.** Commercial farms use specialized feed formulations to maximize productivity.



Horticultural crops farming system

Horticultural crops play a significant role in the farming systems of India, contributing to both food security and income generation for farmers. Horticulture includes the cultivation of fruits, vegetables, flowers, spices, medicinal plants, and aromatic crops. India's diverse climate allows for the cultivation of a wide range of horticultural crops, and these crops form an essential part of **agricultural diversification**, enhancing farmers' income and livelihood.

The horticultural farming system often integrates **crop production** (fruits, vegetables) with **livestock**, **agroforestry**, and sometimes **aquaculture**, thus promoting **sustainable farming** practices. Let's break down the **horticultural farming system** in detail:

1. Types of Horticultural Crops in India

India's horticulture sector is diverse, and different crops are suited to different agro-climatic zones. These include:

- **Fruits:** Apples, mangoes, bananas, citrus fruits, papaya, guava, grapes, and pomegranate.
- **Vegetables:** Tomatoes, potatoes, onions, carrots, cabbage, cauliflower, brinjal, peas, spinach, and cucumbers.
- **Flowers:** Marigold, jasmine, roses, gerbera, and tuberose.
- **Spices:** Chili, turmeric, ginger, cardamom, pepper, and coriander.
- **Medicinal Plants:** Aloe vera, ashwagandha, tulsi, and turmeric.
- **Aromatic Plants:** Lavender, lemongrass, and mint.

2. Importance of Horticultural Crops in Farming Systems

Horticultural crops contribute significantly to:

- **Diversification of income sources:** Horticulture provides an opportunity to diversify farm income, reducing dependency on staple crops like rice or wheat.
- **Food Security:** Vegetables and fruits are important sources of nutrients, vitamins, and minerals in the diet of rural households.
- **Employment:** Horticultural farming creates employment in the cultivation, processing, and marketing of produce.
- **Export Earnings:** India is one of the largest exporters of horticultural products, such as **mangoes, grapes, and spices.**

3. Horticultural Farming System Components

A **horticultural farming system** involves various components that work synergistically to optimize productivity and sustainability:

1. **Crops:** Fruits, vegetables, spices, flowers, and medicinal plants.
2. **Water Management:** Effective irrigation systems such as drip irrigation, sprinkler systems, and rainwater harvesting.
3. **Soil Health:** Use of organic farming practices, crop rotation, green manuring, and integrated pest management (IPM) to maintain soil fertility.
4. **Agroforestry and Agroecology:** Integration of tree crops like **mango, pomegranate,** and **papaya** with other crops, as well as integrating livestock like **goats** and **poultry.**
5. **Post-Harvest Management:** Techniques like cold storage, drying, and packaging to preserve the shelf life of perishable crops.
6. **Market Linkages:** Effective supply chains and market access for farmers, ensuring fair prices for the produce.

4. Types of Horticultural Farming Systems

a. Mixed Horticulture Farming

- **Concept:** Involves the cultivation of multiple crops, including fruits, vegetables, and flowers,

within the same farm.

- **Benefits:** Reduces risk, improves farm income, and ensures year-round availability of produce.
- **Example:** A farm growing **tomatoes, onions, marigolds, and papaya**.

b. Commercial Horticulture Farming

- **Concept:** Large-scale farming dedicated to the production of high-value crops such as **grapes, mangoes, floriculture, or spices**.
- **Benefits:** Focuses on intensive production for market sales, both domestic and export markets.
- **Example:** Large-scale **grape farming** in **Maharashtra**, **floriculture** in **Karnataka**, or **mango cultivation** in **Uttar Pradesh**.

c. Agroforestry and Horticulture

- **Concept:** Integration of horticultural crops with **tree-based farming systems**.
- **Benefits:** Increases biodiversity, improves soil fertility, and provides multiple income sources.
- **Example:** Growing **papaya** or **guava** under **mango trees** or combining **spices** like **pepper** and **vanilla** with **fruit orchards**.

d. High-Value Crop Farming

- **Concept:** Cultivating niche crops like **flowers, spices, or medicinal plants**.
- **Benefits:** High profit potential and growing demand, both domestically and for export.
- **Example:** **Gerbera** cultivation for floriculture or **turmeric** for the spice market.

5. Horticultural Crop Production Practices

Effective **crop management** is key to the success of horticultural farming systems. The following practices are essential:

- **Land Preparation:** For crops like fruits and vegetables, proper land preparation is crucial. This includes **plowing, harrowing, and levelling** the field to make the soil conducive for planting.
- **Soil Fertility Management:** Organic inputs like **compost, vermicompost, and green manure** help improve soil quality, enhance microbial activity, and maintain a healthy ecosystem.
- **Irrigation Management:** Since many horticultural crops have high water requirements, efficient irrigation systems like **drip irrigation** and **sprinklers** are used to conserve water and ensure optimal crop growth.
- **Integrated Pest Management (IPM):** Since horticultural crops are highly susceptible to pests and diseases, **IPM** techniques (like biological control, mechanical control, and the use of organic pesticides) are commonly applied to minimize crop loss.
- **Crop Rotation:** Growing different crops in succession (e.g., rotating vegetables with spices) helps break pest cycles, reduce disease spread, and maintain soil fertility.

6. Horticultural Farming Systems and Livelihoods

Horticultural farming plays a key role in improving **livelihoods** by:

- **Diversifying income sources:** Farmers growing high-value crops can tap into premium markets and reduce dependence on traditional crops.

- **Enhancing food security:** Regular production of **vegetables** and **fruits** boosts nutrition and food availability year-round.
- **Creating employment:** Horticultural farms offer jobs in areas such as **nursery management**, **harvesting**, **packing**, **marketing**, and **post-harvest handling**.
- **Export potential:** India is a major player in the **export of fruits** (mangoes, bananas), vegetables (onions, potatoes), and **spices** (turmeric, chili), providing foreign exchange and international market access.

7. Challenges in Horticultural Farming

While horticulture offers immense potential, there are several challenges faced by farmers:

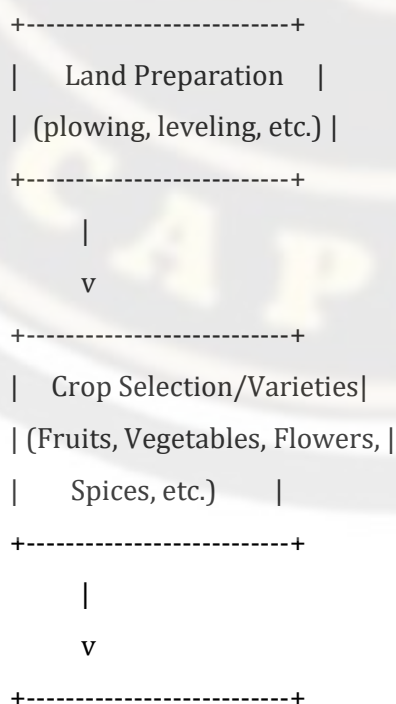
- **Climatic Variability:** Unpredictable weather patterns, such as unseasonal rains, droughts, and temperature extremes, can affect the yield and quality of horticultural crops.
- **Water Scarcity:** Some areas, especially in the **dryland regions**, face challenges in accessing adequate irrigation.
- **Market Access:** Lack of proper infrastructure and market linkages often results in **post-harvest losses** and poor price realization for farmers.
- **High Input Costs:** The cost of seeds, fertilizers, pesticides, and labor can sometimes be prohibitively high, especially for small farmers.
- **Pest and Disease Management:** Horticultural crops are vulnerable to diseases and pests, requiring careful management to avoid losses.

8. Flow Chart of Horticultural Crops Farming System

Here's a flow chart that outlines the typical stages and components of a **horticultural farming system**:

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| Soil Fertility & |
| Irrigation Management |
| (organic inputs, drip, etc.)|

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| Pest & Disease Control |
| (IPM practices) |

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| Crop Growth & Harvest |
| (Regular monitoring, |
| harvesting, etc.) |

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| Post-Harvest Handling |
| (Packaging, Processing, |
| Storage, Marketing) |

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| Marketing & Sales |
| (Local, Export Markets) |

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Agro--forestry systems

Agroforestry is a land-use management system where trees or shrubs are deliberately integrated with agricultural crops or livestock on the same land unit. This system has been practiced for centuries in various forms across the world, but it has gained more importance in recent decades due to its ability to improve **soil fertility**, **enhance biodiversity**, **increase farm income**, and **contribute to environmental sustainability**.

In India, agroforestry systems have been adopted in both smallholder and commercial farms, particularly in regions where **traditional farming systems** need diversification or where **marginal lands** are utilized. Agroforestry integrates both **agriculture** and **forestry**, providing a diverse range of benefits to farmers, including **soil conservation**, **carbon sequestration**, **income diversification**, and **improved water management**.

1. Key Components of Agroforestry Systems

Agroforestry involves the integration of various **biological and ecological components**, including trees, crops, and livestock. The key components are:

1.1 Trees

- Trees are the central component of agroforestry systems and provide a variety of products, such as **timber**, **firewood**, **fruits**, **fodder**, **medicinal plants**, **oilseeds**, and **bamboo**.
- Commonly used tree species in India include **Acacia**, **Leucaena**, **Eucalyptus**, **Mango**, **Guava**, **Casuarina**, **Pine**, and **Teak**.

1.2 Crops

- Agricultural crops such as **pulses**, **cereals**, **vegetables**, and **fruits** are cultivated under or between the trees. These crops can be annual or perennial.

1.3 Livestock

- In some agroforestry systems, livestock (like **goats**, **cattle**, **poultry**) are also incorporated. Livestock can graze in the system, help manage undergrowth, and provide additional income.

1.4 Other Components

- **Soil:** Proper soil management practices are essential for agroforestry, including **mulching**, **crop rotation**, and the use of **green manures**.
 - **Water Management:** Efficient irrigation and water conservation methods are critical, especially for regions where water scarcity is a concern.
 - **Microclimates:** Agroforestry systems create **microclimates** that protect crops from extreme weather conditions like winds, heat, and excessive rain.
-

2. Types of Agroforestry Systems in India

Agroforestry systems vary depending on **location**, **climate**, **land availability**, and **resources**. Based on

the integration of trees, crops, and livestock, the following types of agroforestry systems are commonly practiced in India:

2.1 Taungya System

- **Definition:** In this system, **trees** are planted in conjunction with **food crops**. The crops are grown for the first few years while the trees are establishing.
- **Common Practice:** It is practiced in forest areas where trees like **Teak, Sal, and Eucalyptus** are planted, and farmers grow **crops** like **pulses, vegetables, or tobacco** for the first 5-10 years.
- **Benefit:** This system helps farmers earn income from crops while the forest is being developed, especially in the early stages of tree growth.

2.2 Silvopastoral System

- **Definition:** This system integrates **trees** with **livestock grazing** on the same land. Trees provide **fodder** and **shade** for animals.
- **Common Practice:** Trees like **Leucaena, Acacia, and Gmelina** are planted alongside grazing fields to provide additional income from timber and fuelwood.
- **Benefit:** It improves livestock productivity and soil fertility while allowing farmers to use the land for both grazing and tree production.

2.3 Agri-silvicultural System

- **Definition:** This system integrates **agriculture** (crops) with **forestry** (trees). Crops are grown during the initial years before trees are fully mature.
- **Common Practice:** Crops like **pulses, cereals, and vegetables** are grown alongside tree species such as **Acacia, Teak, and Mango**.
- **Benefit:** Provides early income from agricultural crops while trees mature and become productive.

2.4 Agrisilvopastoral System

- **Definition:** Combines **agriculture, forestry, and livestock** on the same piece of land.
- **Common Practice:** Crops such as **pulses** and **vegetables** are grown, and **fodder trees** like **Leucaena** or **Gliricidia** are planted along with grazing areas for livestock.
- **Benefit:** This system offers diversified income sources from crops, trees, and livestock, reducing the risk for farmers.

2.5 Homestead Agroforestry

- **Definition:** Smallholder farmers integrate trees and crops in their homestead gardens, with a focus on domestic and commercial purposes.
- **Common Practice:** In addition to common crops such as **vegetables** and **pulses**, farmers plant **fruit trees** (e.g., **papaya, banana, citrus**) and timber species around their homes.
- **Benefit:** Provides food security, income diversification, and sustainable land use.

3. Benefits of Agroforestry Systems

Agroforestry provides **multiple benefits** for farmers, the environment, and society:

3.1 Economic Benefits

- **Diversification of Income:** Agroforestry allows farmers to generate income from various sources, including **crops, timber, firewood, fruits, fodder, and livestock**.
- **Market Opportunities:** Products like **spices, medicinal plants, and timber** offer farmers access to both local and international markets.

3.2 Environmental Benefits

- **Soil Fertility:** Trees like **Leucaena** and **Gliricidia** fix nitrogen in the soil, improving its fertility and reducing the need for chemical fertilizers.
- **Soil Erosion Control:** The root systems of trees prevent soil erosion, especially on sloped lands.
- **Carbon Sequestration:** Agroforestry systems help in carbon capture, mitigating the impact of climate change by acting as carbon sinks.

3.3 Social Benefits

- **Biodiversity Conservation:** Agroforestry supports **wildlife habitats** and increases **biodiversity** by creating a variety of niches for plants and animals.
- **Livelihood Improvement:** It provides a steady source of employment for rural communities, especially women and landless laborers.
- **Climate Resilience:** The presence of trees and crops together helps create a more resilient farming system that can withstand **extreme weather conditions** like droughts and floods.

4. Challenges in Agroforestry Systems

Despite its benefits, agroforestry faces several challenges:

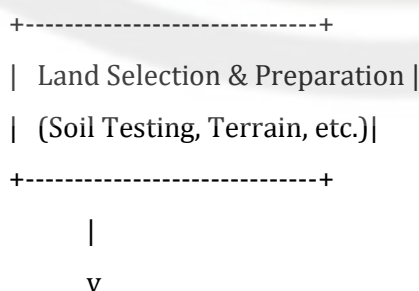
- **Land Tenure Issues:** Farmers may hesitate to adopt agroforestry practices if land ownership is insecure.
- **High Initial Investment:** Agroforestry requires significant initial investment in terms of **land preparation, tree planting, and irrigation**, with returns coming in the long term.
- **Lack of Knowledge:** Farmers may not have enough information on **best practices** for agroforestry, and traditional farming systems may be easier to adopt.
- **Market Access:** Selling tree products like timber, fruits, and firewood may require farmers to establish new market channels, which can be difficult without support.

5. Flowchart of Agroforestry Systems

Below is a flowchart that explains the steps involved in **setting up an agroforestry system**:

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| Choice of Tree Species |

| (Timber, Fruit, Fodder, etc.)|

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| Crop Selection & Planning |

| (Cereals, Pulses, Vegetables)|

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| Integration of Livestock |

| (Grazing, Manure, etc.) |

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| Land Use Management & Care |

| (Soil Fertility, Irrigation,|

| Pest Control, etc.) |

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| Harvesting & Post-Harvest |

| (Timber, Fruits, Crops, etc.)|

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| Marketing & Sale of Products|

| (Timber, Fruits, Crops) |

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| Income Diversification & |

Aquaculture, Duck/Poultry cum Fish Farming:

The integration of **duck/poultry farming** with **fish farming** is an innovative and sustainable farming system known as "**Aquaculture Duck/Poultry-cum-Fish Farming**". This system allows farmers to maximize land use, diversify income sources, and promote ecological balance. It is particularly suitable for areas with adequate water resources, and it can be implemented on **small-scale** or **large-scale farms**.

This **integrated farming system** benefits both the animals (ducks, poultry, fish) and the environment, offering several economic and ecological advantages. It utilizes the natural interaction between ducks, poultry, and fish to create a symbiotic relationship where each component supports the others.

1. Concept of Aquaculture Duck/Poultry-cum-Fish Farming

The primary idea behind this system is the integration of **fish farming (aquaculture)** with **poultry (ducks or chickens)**. Here's how it works:

- **Fish Farming (Aquaculture):** Fish are raised in ponds or tanks, and the water quality and environment are managed carefully.
- **Poultry/Duck Farming:** Ducks or poultry are raised in close proximity to the fish ponds or in the same system. Ducks or poultry help manage pests and weeds in the pond and provide organic manure for the water, improving fish growth.

2. Key Components of the System

2.1 Fish Component (Aquaculture)

- **Fish Species:** Common fish species raised in integrated aquaculture systems include **Tilapia, Catla, Rohu, Mrigal, Carp, and Pangasius**.
- **Fish Farming Method:** Fish are grown in **ponds, tanks, or cages**. Proper management of water quality, oxygen levels, and feeding is necessary.
- **Water Quality Management:** Fish require clean and oxygenated water, and good water management ensures that they grow in a healthy environment. It's also important to monitor the water for parameters like pH, temperature, ammonia levels, and oxygen levels.

2.2 Duck/Poultry Component

- **Duck/Poultry Types:** Both **ducks** and **chickens** can be integrated into the system. Ducks are commonly used because they are natural foragers and help in controlling pests and algae in the ponds.
- **Feeding:** Ducks or poultry are fed a balanced diet that may consist of commercial feed or farm-sourced food like grains, vegetables, and grains.
- **Waste Recycling:** Ducks and poultry produce manure that is rich in nutrients, which is a valuable resource for enhancing water fertility and fish growth.

2.3 Pond or Tank Setup

- **Pond Setup:** A **fish pond** is set up to allow **fish to swim** and grow, while **ducks/poultry** may have **access to the pond** either to forage or be housed nearby.
- **Stocking Density:** The number of fish and poultry should be balanced to ensure that each component gets enough resources and the system remains sustainable.

3. Functional Interactions in the System

3.1 Benefits for Fish

- **Nutrient Enrichment:** The waste (manure) from ducks or poultry, along with their leftover feed, serves as a natural fertilizer for the pond, enriching the water with essential nutrients like nitrogen and phosphorus. These nutrients help boost the productivity of the pond by promoting **algal growth**, which serves as **natural food** for the fish.
- **Improved Water Quality:** Ducks and poultry help **stir up** the pond water while foraging, which promotes **aeration**. This process helps improve oxygen distribution in the water, benefiting the fish.

3.2 Benefits for Ducks/Poultry

- **Pest Control:** Ducks and poultry eat pests such as insects, larvae, and weeds in and around the pond, which reduces the need for chemical pesticides.
- **Waste Recycling:** The droppings of ducks and poultry can also be used as a **natural fertilizer** to improve the fertility of nearby agricultural fields or even be composted to improve soil quality.

3.3 Benefits for the Farmer

- **Diversified Income:** By combining fish farming with poultry or duck farming, the farmer has two or more sources of income, reducing economic risks.
- **Sustainable Farming:** This system reduces dependence on artificial fertilizers, chemicals, and feed inputs. It promotes a more **natural, sustainable cycle** of farming.
- **Efficient Use of Resources:** Water, land, and feed resources are optimally utilized. Fish benefit from nutrients produced by the poultry, while the ducks/poultry help maintain a clean and healthy pond environment.

4. Benefits of Aquaculture Duck/Poultry-Cum-Fish Farming

- **Environmental Sustainability:** The system reduces the need for synthetic fertilizers and pesticides, using organic waste from animals and plants to sustain fish health and pond

productivity.

- **Higher Productivity:** Integrating fish and poultry can increase overall farm productivity per unit area and water, leading to greater farm income.
- **Feed Cost Reduction:** Poultry and ducks feed on natural forage, reducing the need for expensive commercial feed.
- **Waste Management:** Manure from ducks and poultry is efficiently used to fertilize the pond, reducing waste and improving farm sustainability.
- **Biodiversity Promotion:** This system promotes biodiversity by integrating different types of species, both aquatic and terrestrial.

5. Step-by-Step Guide for Setting Up an Aquaculture Duck/Poultry-Cum-Fish System

1. Site Selection and Pond Construction

- Choose a location with a steady water supply.
- Construct a **fish pond** that provides ample space for fish to swim, and ensure there are provisions for oxygenation and water exchange.
- Ducks or poultry housing can be situated nearby or within the pond's vicinity, depending on the setup.

2. Stocking the Pond

- **Stock fish** in the pond (e.g., **Catla**, **Rohu**, or **Tilapia**).
- Introduce ducks or poultry in the vicinity of the pond or allow them to forage in the pond area.
- Maintain a balanced stocking density of both fish and ducks/poultry.

3. Water Quality Management

- Regularly check the **water quality** for parameters like pH, oxygen levels, and ammonia.
- Ensure there is enough aeration for fish and proper filtration systems to maintain healthy water.

4. Feeding the Fish and Poultry

- **Fish feeding:** Provide fish feed, including **pelleted** or **natural food sources** like plankton or algae.
- **Duck/Poultry feeding:** Provide a balanced feed and let them forage in and around the pond.

5. Waste Management

- Ducks and poultry produce **manure** that is used to fertilize the pond, improving nutrient levels for fish and promoting plant growth.
- The ducks can be allowed to roam freely in the pond, stirring up sediment and promoting aeration.

6. Harvesting

- Fish are harvested once they reach marketable size.
- Ducks or poultry can also be harvested for eggs or meat, depending on the type of bird.

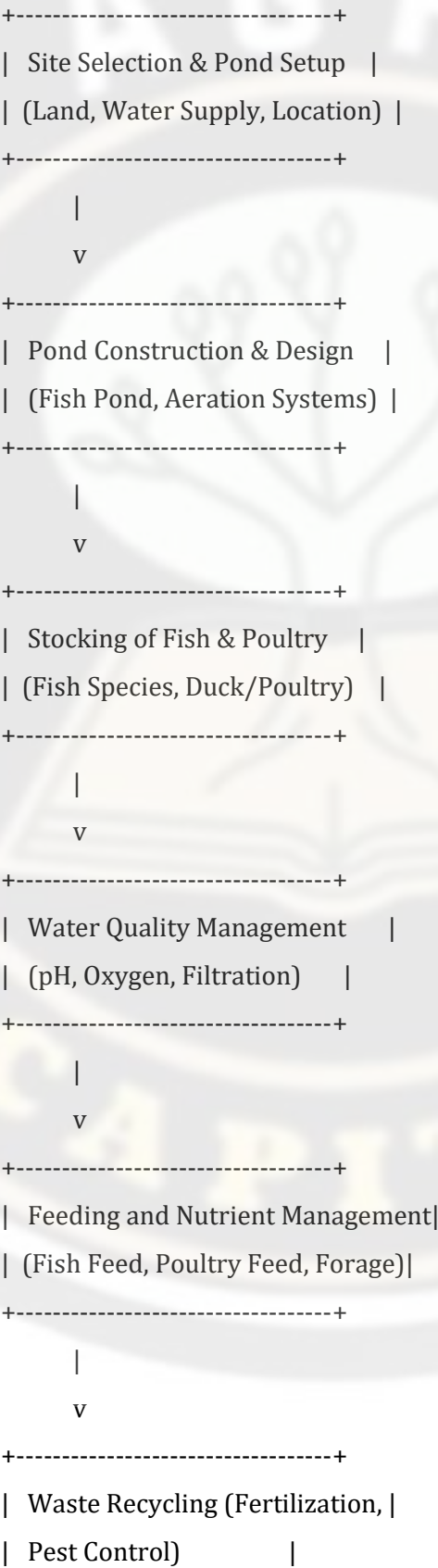
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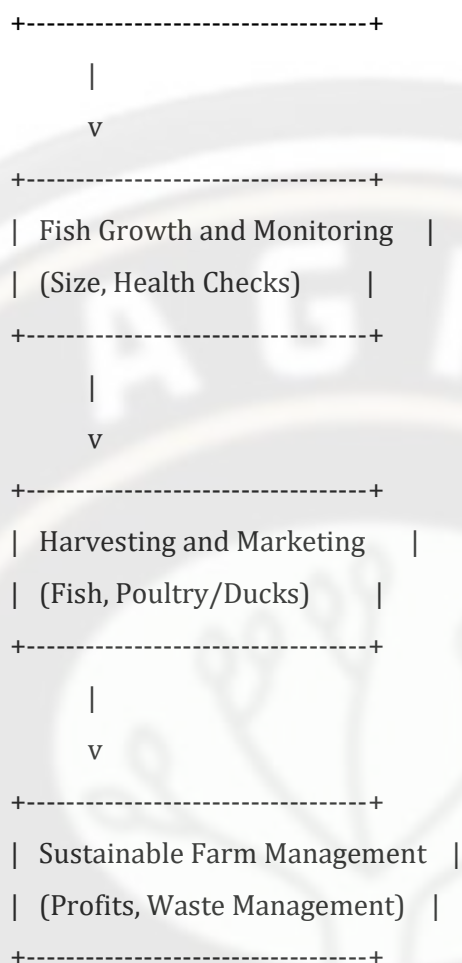
6. Flowchart of the Aquaculture Duck/Poultry-Cum-Fish System

Here's a **dramatic flowchart** that outlines the key processes in setting up and operating this system:

lua

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Dairy-Cum-Fish Farming and Piggery-Cum-Fish Farming:

Integrating **livestock farming** (like **dairy** or **piggery**) with **fish farming** is a sustainable approach to **multi-species farming systems**, which maximizes land and resource utilization, improves farm income, and promotes ecological balance. These systems are examples of **Integrated Farming Systems (IFS)** that combine **agriculture**, **livestock**, and **aquaculture** to provide farmers with diversified income streams and sustainable farming practices.

In **Dairy-Cum-Fish Farming** and **Piggery-Cum-Fish Farming**, the **waste** generated by livestock is utilized in fish farming, while fish farming provides additional economic benefits, thus creating a **symbiotic relationship** that benefits both livestock and aquaculture production.

1. Dairy-Cum-Fish Farming System

This integrated system involves raising **dairy cattle** for milk production along with **fish farming** (aquaculture) in ponds. The waste products from dairy cattle (manure and leftover feed) are used to

fertilize the fish pond, providing nutrients for fish growth.

Key Components of Dairy-Cum-Fish Farming

- **Dairy Cattle:** These cattle provide **milk**, which is the primary product. Additionally, **manure** produced by the cattle can be used as **organic fertilizer** for the fish pond.
- **Fish Pond:** A fish pond is stocked with fish species such as **Catla, Rohu, Tilapia, or Mrigal**. Fish ponds can be stocked with a variety of fish that thrive in nutrient-rich water.
- **Manure and Waste:** The manure from dairy cattle contains nitrogen, phosphorus, and potassium, which are essential nutrients for aquatic plants and phytoplankton in the fish pond. This contributes to increased productivity in fish farming.
- **Water Quality Management:** Maintaining the right water quality in the pond is crucial to fish health. Regular monitoring of pH levels, oxygen levels, and ammonia concentrations is essential.
- **Feeding:** Fish are fed with supplementary feed, and dairy cattle are fed with a balanced diet, which includes silage, hay, concentrates, and green fodder.

Steps Involved in Dairy-Cum-Fish Farming

1. **Site Selection & Pond Construction**
 - Select land with a good water supply and proper drainage.
 - Construct a fish pond or tank and ensure proper aeration and water management systems.
 - Ensure that the pond is designed to allow water to be enriched by the nutrients from dairy cattle manure.
2. **Dairy Farming Setup**
 - Set up dairy cattle sheds with sufficient space for milking, feed storage, and manure collection.
 - Dairy cattle should be fed a balanced diet and managed to ensure healthy milk production.
3. **Stocking Fish in the Pond**
 - Stock the pond with appropriate fish species based on water quality and climate.
 - The stocking density should be optimal to avoid overcrowding and maintain a healthy ecosystem.
4. **Water Quality Management**
 - Monitor and manage water quality parameters, including oxygen, pH, temperature, and ammonia concentration.
 - Regular water changes and aeration are essential to maintain a good environment for both fish and dairy cattle.
5. **Manure Management**
 - Dairy cattle manure is collected and used as a fertilizer in the pond to enrich the water.
 - Proper management of manure ensures that the fish pond receives sufficient nutrients without overloading the system.
6. **Feeding & Harvesting**

- Fish are fed supplementary food based on their growth stage and species.
- Regular harvesting of fish once they reach market size is done, while dairy cattle continue to be milked.

2. Piggery-Cum-Fish Farming System

This system involves integrating **pig farming** with **fish farming** in a similar way to dairy-cum-fish farming. The **manure** produced by the pigs is used to fertilize the fish ponds, promoting the growth of phytoplankton and aquatic plants, which provide food for the fish.

Key Components of Piggery-Cum-Fish Farming

- **Piggery:** Pigs are raised for meat (pork), and their **manure** is used to fertilize fish ponds.
- **Fish Pond:** The fish pond is stocked with fish species that benefit from nutrient-rich water. **Carp species** (e.g., **Rohu**, **Catla**, **Mrigal**) are commonly used, as they thrive in such systems.
- **Manure and Waste:** Pigs produce **nitrogen-rich manure** that can be composted or directly applied to the fish pond, enriching the water.
- **Water Quality Management:** Maintaining proper water quality is crucial for fish health and the success of the system. Monitoring of water parameters such as **oxygen levels**, **pH**, and **temperature** is essential.
- **Feeding:** Fish are provided with supplementary feed in addition to natural food produced by the manure in the pond. Pigs are also fed a balanced diet of grains, vegetables, and commercial feed.

Steps Involved in Piggery-Cum-Fish Farming

1. **Site Selection & Pond Construction**
 - Select land that has access to adequate water resources for fish farming.
 - Build a fish pond with good aeration systems to ensure the health of the fish and efficient waste recycling.
2. **Piggery Setup**
 - Construct pig pens with adequate space for pigs, and provide them with good quality feed and water.
 - Ensure the collection of pig manure, which will be used in the fish pond as fertilizer.
3. **Stocking Fish in the Pond**
 - Stock the fish pond with species like **Carp** (Catla, Rohu, Mrigal) or other suitable freshwater fish.
 - Optimal stocking density should be maintained to avoid overcrowding and to ensure healthy growth.
4. **Water Quality Management**
 - Regularly monitor water quality and provide necessary aeration to prevent oxygen depletion.
 - The water quality should be maintained at an optimal level for both the fish and the manure's role as fertilizer.
5. **Manure Management**

- Use pig manure to fertilize the pond, providing nutrients like nitrogen, phosphorus, and potassium.
- Manure should be distributed evenly to avoid water contamination and maintain balance in the ecosystem.

6. Feeding & Harvesting

- Supplement the fish's diet with proper feed to ensure healthy growth.
- Harvest fish once they reach marketable size and continue to manage the pig farm for pork production.

3. Benefits of Dairy-Cum-Fish and Piggery-Cum-Fish Farming

Economic Benefits:

- **Diversified Income:** Farmers earn from both **livestock** (milk/pork) and **fish**. This diversification reduces financial risk.
- **Reduced Feed Costs:** Manure from livestock reduces the need for chemical fertilizers in the fish pond, lowering production costs.
- **Increased Productivity:** By combining two or more agricultural systems, the farmer maximizes land and water use, increasing overall productivity.

Environmental Benefits:

- **Nutrient Recycling:** Livestock manure provides natural nutrients for the pond, enhancing fish growth.
- **Sustainable Resource Use:** This system minimizes the need for artificial fertilizers and chemicals, promoting sustainability.
- **Waste Management:** Manure from dairy cattle or pigs is recycled as fertilizer for the pond, reducing waste and promoting ecological balance.

Social Benefits:

- **Job Creation:** The integration of multiple farming activities creates more employment opportunities.
- **Improved Rural Livelihoods:** Farmers benefit from diverse income streams, increasing their economic stability.

4. Flowchart for Dairy-Cum-Fish and Piggery-Cum-Fish Farming Systems

Dairy-Cum-Fish Farming Flowchart:

sql

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```
+-----+
| Site Selection & Pond Construction |
| (Water Supply, Pond Design, etc.) |
+-----+
```

|

v

-----+
 | Dairy Farming Setup |
 | (Feed, Milking, Manure Collection) |
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|

v

-----+
 | Stocking Fish in the Pond |
 | (Fish Species, Pond Density) |
 -----+

|

v

-----+
 | Water Quality Management |
 | (Oxygen, pH, Filtration) |
 -----+

|

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 | Manure Management & Fertilization |
 | (Using Dairy Manure for Fertilizing) |
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 | Feeding Fish & Harvesting |
 | (Supplementary Feed, Market Size) |
 -----+

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 | Milk Production & Sales |
 | (Milk Sales, Dairy Products) |
 -----+

Piggery-Cum-Fish Farming Flowchart:

lua

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AGRI CAPITAL

| Site Selection & Pond Construction |
| (Water Supply, Pond Design, etc.) |
+-----+

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| Piggery Setup |
| (Feed, Manure Collection, Pig Health) |
+-----+

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+-----+
| Stocking Fish in the Pond |
| (Fish Species, Pond Density) |
+

10.Small, medium and large enterprises including value chains and secondary enterprises as livelihood components for farmers,

Small, Medium, and Large Enterprises in Agriculture: Value Chains and Secondary Enterprises for Farmers

In agriculture, farmers can benefit from integrating small, medium, and large enterprises into their operations. These enterprises can range from primary agricultural production (like crops and livestock) to secondary and value-added enterprises (processing, packaging, marketing, etc.). This approach helps diversify income, increases profitability, and strengthens resilience against market fluctuations.

This integrated model can create a comprehensive value chain for farmers, linking primary production to secondary processing and tertiary services. These value chains play a critical role in ensuring that farmers not only sell raw products but also gain value from processing, branding, and packaging their goods. Below is a detailed look into the different sizes of enterprises and how they contribute to agricultural livelihoods.

1. Small Enterprises (Smallholder Farming)

Small enterprises often focus on local markets and are typically operated by family units or small groups of farmers. These enterprises are essential for poverty alleviation, food security, and job creation in rural areas.

Key Features of Small Enterprises

- **Size and Scope:** Small enterprises generally have low capital investment and small-scale operations. These businesses often involve limited processing, and products are primarily sold in local markets.
- **Labor:** Labor is typically provided by family members or local workers, making the enterprises labor-intensive.
- **Revenue Model:** The revenue model is based on direct sales of agricultural products (fresh produce, meat, dairy, eggs) or basic processed products (such as jams, dried fruits, or small-scale processed milk).
- **Productivity:** Productivity is often low due to limited access to technology and inputs, but smallholder farming is highly flexible and adaptable.

Examples of Small Enterprises in Agriculture

1. Small-scale Crop Farming:

AGRI CAPITAL

- **Vegetables (tomatoes, peppers, etc.)**
 - **Fruit production (bananas, papayas, etc.)**
 - **Spices (chili, garlic, etc.)**
- 2. Small-scale Livestock Farming:**
- **Poultry farming (eggs, broilers)**
 - **Dairy farming (milk, cheese, butter)**
 - **Goat and sheep farming (milk, meat)**
- 3. Value Addition Activities:**
- **Cottage industries: Small-scale processing of raw products (like milling flour, packaging, or drying fruit).**
 - **Handicrafts and products from animal by-products (such as leather, wool, or bone products).**

Value Chain for Small Enterprises:

java

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Primary Production (Crops/Livestock)

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On-Farm Processing (Washing, Drying)

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Packaging and Local Marketing (Farm Gate Sales, Farmers Markets)

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Final Consumer (Local/Regional Market)

2. Medium Enterprises

Medium enterprises are characterized by a larger capital investment, more formal operations, and the ability to engage in more substantial processing and marketing activities. These enterprises usually serve regional or national markets.

Key Features of Medium Enterprises

- **Size and Scope:** Medium enterprises are typically capital intensive and can employ a mix of family labor and hired workers. They often have access to better technology and resources than small enterprises.
- **Market Reach:** These businesses often target regional or national markets and have a better distribution network.
- **Revenue Model:** The revenue model is based on higher-volume sales, bulk processing, and value-added products.
- **Production Capacity:** The production capacity is higher than small enterprises, allowing

for economies of scale.

Examples of Medium Enterprises in Agriculture

- 1. Medium-scale Crop Farming:
 - Cereal crops (wheat, maize, rice)
 - Cash crops (coffee, cocoa, tobacco)
 - Orchards (apple, citrus, etc.)
- 2. Medium-scale Livestock Farming:
 - Dairy farms with milk processing (cheese, yogurt production)
 - Pig farming (meat production and secondary products)
 - Poultry farming with meat and egg production.
- 3. Value Addition Activities:
 - Food Processing: Milling (flour, maize, rice), canning, bottling, and packaging.
 - Agri-Processing: Transformation of raw materials into finished goods (like tomato paste, fruit jams, etc.).
 - Beverage Production: Producing fruit juices, wine, or dairy-based drinks.

Value Chain for Medium Enterprises:

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Primary Production (Crops/Livestock)

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Intermediate Processing

(Milling, Canning, Pasteurizing)

|

v

Packaging and Branding

|

v

Distribution to Regional/National Market

|

v

Final Consumer (Retail Outlets, Supermarkets)

3. Large Enterprises

Large enterprises involve substantial capital investment and are capable of international marketing and industrial-scale operations. These enterprises dominate in their sector, with significant production capacities and the ability to access global markets.

Key Features of Large Enterprises

- Size and Scope: Large enterprises are highly capital-intensive, often operating on

industrial scales. These enterprises employ hundreds or thousands of workers and require advanced infrastructure (warehouses, factories, etc.).

- **Market Reach:** These businesses target international or large national markets, and have established supply chains, logistics, and marketing.
- **Revenue Model:** Revenue comes from bulk sales, brand recognition, and global distribution channels.
- **Innovation:** Large enterprises have the resources to invest in research and development, advanced technologies, and marketing strategies.

Examples of Large Enterprises in Agriculture

1. Large-Scale Crop Farming:

- **Monoculture farming** (e.g., large-scale rice, cotton, or maize production)
- **Global horticulture** (such as large farms growing fruits like bananas, berries, etc.)
- **Agro-industrial farms** with mechanized farming practices.

2. Large-Scale Livestock Farming:

- **Industrial-scale dairy farming** (multiple cows, automated milking systems, large-scale cheese or butter production).
- **Large-scale pig farming** with mechanized systems for breeding, growing, and processing pork products.
- **Commercial poultry farming** (broilers and layers, processed and packaged products).

3. Value Addition Activities:

- **Food and Beverage Manufacturing:** Large companies manufacturing processed food, canned vegetables, beverages (e.g., soft drinks, dairy products).
- **Agro-chemical production:** Fertilizers, pesticides, and herbicides manufacturing for the agricultural industry.
- **Exporting Finished Products:** Exporting packaged agricultural products (e.g., coffee, tea, processed fruits, grains).

Value Chain for Large Enterprises:

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Primary Production (Crops/Livestock)

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Industrial Processing (Automated Plants)

|

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Packaging, Branding, and Marketing

|

v

Distribution (Retail Chains, Supermarkets, International Export)

|

v

Final Consumer (Global/International Market)

4. Secondary Enterprises as Livelihood Components for Farmers

Secondary enterprises refer to businesses that add value to the raw agricultural products produced by farmers. These enterprises involve activities like processing, packaging, and branding that increase the market value of the products.

Examples of Secondary Enterprises for Farmers

1. Food Processing:

- Juices, jams, and sauces made from fruits and vegetables.
- Canning of vegetables and fruits for preservation.
- Milk Processing: Cheese, butter, yogurt production from milk.

2. Packaging and Branding:

- Packaging products like grains, cereals, and vegetables into retail packages.
- Branding local produce to increase marketability and prices (e.g., organic branding).

3. Agri-Tourism:

- Farm stays, tourism related to farming (e.g., guided farm tours).
- Farm-based educational activities for schools and communities.

4. Logistics and Distribution:

- Cold storage facilities for perishable goods.
- Transporting goods to local or international markets.

11. Factors affecting integration of various enterprises of farming for livelihood.

The integration of various enterprises in farming, often referred to as **Integrated Farming Systems (IFS)**, involves combining different agricultural activities like crop cultivation, livestock farming, poultry, fishery, agroforestry, and others to optimize the use of available resources and increase farm income. Integrating different farming enterprises can help improve the resilience, productivity, and sustainability of agricultural systems, enhancing farmers' livelihoods. However, several factors can affect how effectively these enterprises can be integrated. Below are the key factors affecting the integration of various farming enterprises:

1. Resource Availability

- **Land:** The size and quality of land available for farming play a critical role in determining the feasibility of integrating various enterprises. Small farms with limited land may find it challenging to diversify, while larger farms may have the space to integrate multiple activities.
- **Water:** Adequate water supply is essential for crop irrigation, livestock, and aquaculture. Regions with unreliable water sources or water scarcity may face difficulties integrating water-intensive enterprises.
- **Labor:** The availability and skill of labor are crucial. Integrated farming requires diverse skills and additional labor for managing different enterprises. If labor is scarce or expensive, it could hinder integration.
- **Capital:** Financial resources are necessary for investment in infrastructure, equipment, seeds, livestock, and other inputs. Lack of capital can limit the scope of integration and may make it difficult for small-scale farmers to diversify.

2. Knowledge and Skills

- **Technical Knowledge:** Successful integration of farming enterprises requires specialized knowledge in each domain (e.g., crop management, livestock care, aquaculture, etc.). Farmers must be trained or knowledgeable in managing multiple activities simultaneously.
- **Extension Services:** Access to extension services (government or private) that provide technical advice, training, and support is vital. Without expert guidance, farmers may face challenges in integrating practices effectively.
- **Traditional Knowledge:** In many rural areas, farmers rely on traditional knowledge that may be limited or incompatible with modern agricultural practices. Integrating new farming methods with traditional ones can be a challenge but also an opportunity for sustainable practices.

3. Market Access and Demand

- **Market Infrastructure:** The availability of markets and transportation facilities significantly affects the success of integrated farming. Farmers must be able to access markets for selling their diversified products, whether it is crops, milk, eggs, or fish.
- **Demand for Products:** The demand for diverse products (such as milk, poultry, fish, fruits, or

vegetables) must exist in local or regional markets. If market demand is weak, farmers may struggle to sell their products, making integration unprofitable.

- **Price Fluctuations:** Unstable prices in various agricultural sectors can create financial uncertainty. For example, a sudden drop in the price of milk or crops can negatively impact the overall profitability of an integrated farming system.

4. Economic Factors

- **Cost of Inputs:** The cost of seeds, fertilizers, pesticides, feed, machinery, etc., impacts the economic feasibility of integration. High costs can limit the ability of farmers to adopt multiple enterprises.
- **Subsidies and Support:** Government policies, subsidies, and support systems can influence farmers' decisions to integrate enterprises. Financial incentives, subsidies for inputs, or loans can make it easier for farmers to diversify their activities.
- **Profitability and Risk:** Integrated systems may reduce overall risk by spreading it across multiple enterprises. However, if one enterprise (such as livestock or a certain crop) faces a loss due to disease, pests, or price volatility, the entire system may be affected. The profitability of each enterprise must be carefully considered when planning integration.

5. Environmental Factors

- **Soil Quality:** Soil health and fertility directly affect crop yields. Integrating livestock or agroforestry with crop farming can help improve soil organic matter and fertility. However, poor soil conditions may limit integration.
- **Climate and Weather:** Climate conditions, including temperature, rainfall, and seasonal changes, affect crop and livestock productivity. In regions with unpredictable weather patterns or climate change effects, farmers may struggle to maintain consistent yields across different enterprises.
- **Biodiversity and Pest Management:** Integrated systems can benefit from biodiversity by reducing pest and disease pressures through natural control mechanisms. However, the integration of various species needs careful planning to avoid creating conditions that favor pests or disease spread.

6. Policy and Institutional Support

- **Government Policies:** National or local government policies related to agriculture, subsidies, support for sustainable farming, and rural development can either encourage or discourage the integration of enterprises. For example, incentives for agroforestry or organic farming could encourage integration.
- **Land Ownership and Tenure:** In some regions, land ownership laws or the practice of land leasing can affect how long-term investments, like livestock or agroforestry, are planned. Security of land tenure provides farmers with the confidence to invest in multiple enterprises.
- **Access to Credit:** Availability of credit from banks or microfinance institutions is essential for investment in equipment, seeds, or livestock. Limited access to credit can restrict the ability of farmers to diversify.

7. Social and Cultural Factors

- **Cultural Practices:** In some regions, traditional agricultural practices may prioritize certain crops or livestock species. Resistance to change or the need to adhere to community norms can hinder the adoption of integrated farming systems.
- **Social Support:** The role of family and community in farming can affect the success of integration. If farm families are willing and able to take on multiple tasks and support each other, integration is more likely to succeed.
- **Gender Roles:** In many rural areas, farming responsibilities are divided along gender lines, which can affect how different farming activities are integrated. Women may traditionally manage certain enterprises like poultry or small livestock, while men may focus on crop farming. Gender dynamics can influence the choice of activities and the degree of integration possible.

8. Technological Advancements

- **Innovative Practices:** Advances in farming technology, such as drip irrigation, automated feeding systems for livestock, or integrated pest management techniques, can help make integration more efficient and productive. Farmers need access to and knowledge of these technologies to optimize their farming systems.
- **Information Technology:** The use of mobile phones, apps, or other ICT tools to access weather forecasts, market prices, and farming advice can help farmers make informed decisions, aiding the integration of diverse enterprises.

9. Institutional and Organizational Support

- **Cooperatives and Farmer Groups:** Farmer cooperatives and organizations can facilitate the integration of multiple enterprises by providing access to shared resources like machinery, feed, or market networks. These groups can also provide a collective bargaining power to secure better prices for produce.
- **Research and Development (R&D):** Access to R&D on integrated farming practices, improved crop varieties, and better animal husbandry techniques can significantly improve the success of farming enterprises. Research institutions can play a vital role in making integration more effective and sustainable.

10. Risk Management

- **Diversification of Risks:** Integrated farming systems help reduce the risk of loss from a single enterprise by spreading risk across different activities. However, the integration must be planned carefully to avoid the creation of new risks, such as conflicts between different enterprises (e.g., crops and livestock competing for resources).
- **Climate Change and Environmental Risks:** Climate change may introduce new risks (e.g., droughts, floods, or changing pest patterns) that could impact different enterprises differently. Farmers need to adapt to these risks and plan for resilience.

The **feasibility of different farming systems** in various agro-climatic zones depends on a wide range of factors, including climate, soil types, water availability, and the socio-economic characteristics of the region. Agro-climatic zones are geographical areas defined by specific climate conditions, rainfall patterns, temperature ranges, and soil types that influence the type of crops and farming systems that are viable in that region. Various farming systems such as **crop-based systems**, **livestock-based systems**, **agroforestry**, and **integrated farming systems** can be adapted depending on the specific needs and resources available in each agro-climatic zone.

Here's a detailed discussion on the feasibility of different farming systems for various agro-climatic zones:

1. Tropical Zones (Wet and Humid Climate)

- **Characteristics:**
 - **Temperature:** High, typically above 20°C throughout the year.
 - **Rainfall:** Abundant, with annual rainfall of more than 1000 mm, often with distinct wet and dry seasons.
 - **Soil:** Rich in organic matter but may suffer from leaching due to heavy rainfall, leading to nutrient deficiencies.
- **Feasible Farming Systems:**
 - **Crop-based systems:**
 - **Rice-Pulses Systems:** In regions with abundant water, rice can be grown in flooded fields followed by pulses like lentils, chickpeas, or groundnut.
 - **Intercropping/Poly-cropping:** Growing multiple crops together (e.g., maize with legumes or vegetables) is common, enhancing land use efficiency and reducing pest outbreaks.
 - **Tree-crop systems:** Cash crops like cocoa, coffee, rubber, and oil palm are commonly grown in tropical climates, benefiting from the warm temperatures and abundant rain.
 - **Agroforestry:** Integrating trees with crops such as cocoa or coffee under shady conditions, which helps improve soil fertility and prevent erosion.
 - **Livestock-based systems:** Raising cattle, goats, and poultry alongside crops (particularly for smallholder farming), as these zones often have abundant grass and water sources.
 - **Aquaculture:** In regions with abundant water, fish farming in ponds or wetlands is increasingly popular.
- **Challenges:**
 - Soil erosion and leaching due to heavy rainfall.

- Pest and disease management due to warm, humid conditions.
- Poor infrastructure and access to markets in remote areas.

2. Arid and Semi-Arid Zones (Dry Climate)

- **Characteristics:**

- **Temperature:** High, often above 30°C during the day, with large diurnal temperature variations.
- **Rainfall:** Low, often below 500 mm per year, with occasional droughts.
- **Soil:** Sandy or clayey, often with poor water-holding capacity and low organic matter content.

- **Feasible Farming Systems:**

- **Crop-based systems:**
 - **Drought-resistant crops:** Sorghum, millet, and maize, which are more tolerant to water stress, are ideal crops. Also, pulse crops like chickpeas and pigeon peas are grown during low rainfall periods.
 - **Drip irrigation and conservation agriculture:** Efficient irrigation systems, such as drip or sprinkler irrigation, are important for improving water use efficiency.
- **Agroforestry:**
 - **Silvopasture systems:** Trees such as Acacia and Prosopis can be integrated with grazing lands for forage and shade for livestock.
- **Livestock-based systems:**
 - **Small ruminants and camel farming:** These animals are better suited to the hot, dry conditions due to their ability to withstand high temperatures and water scarcity. Goats, sheep, and camels are commonly raised.
- **Water harvesting and soil conservation:** Techniques like rainwater harvesting, mulching, and soil contouring can enhance water retention and improve soil fertility.
- **Aquaculture (where feasible):** In regions with access to water bodies or ponds, fish farming can be practiced with efficient water management techniques.

- **Challenges:**

- Water scarcity and reliance on irrigation.
- Soil degradation and desertification due to poor land management.
- Limited access to inputs and financial support.
- Climate variability, leading to droughts.

3. Temperate Zones (Moderate Climate)

- **Characteristics:**

- **Temperature:** Moderate, ranging from 10°C to 20°C, with distinct seasons (winter and summer).
- **Rainfall:** Moderate to high, typically between 500 mm and 1500 mm annually.
- **Soil:** Fertile soils with a good balance of nutrients and organic matter.

- **Feasible Farming Systems:**

- **Crop-based systems:**

- **Cereal and grain-based systems:** Wheat, barley, oats, and maize are dominant crops. These zones also support cereal-pulse rotations.
 - **Vegetable and fruit farming:** Fruits like apples, cherries, and pears, and vegetables such as tomatoes, potatoes, and carrots, are commonly grown.

- **Agroforestry:**

- **Forest-based systems:** In hilly or forested areas, agroforestry combining tree crops with understory crops can be highly beneficial.

- **Livestock-based systems:**

- **Dairy and meat production:** Large-scale dairy farming, along with beef and sheep production, is prevalent. Livestock farming is typically integrated with crop farming for rotational grazing.

- **Mixed farming systems:** Combining crop production (grains, vegetables) with livestock (cattle, sheep) for diversified income and improved sustainability.

- **Challenges:**

- Weather variability and the impact of late frosts on crops.
 - Need for crop diversification and soil fertility management to sustain high productivity.
 - Market fluctuations for perishable produce.

4. Cold Zones (High-altitude or Snowy Climate)

- **Characteristics:**

- **Temperature:** Low temperatures, often below 10°C with harsh winters, snow, and short growing seasons.
 - **Rainfall:** Often low, with significant snowfall in winter.
 - **Soil:** Often acidic or shallow, with lower fertility compared to other zones.

- **Feasible Farming Systems:**

- **Cold-tolerant crop systems:**

- **Barley, rye, and wheat** are grown in temperate cold climates. In the higher altitudes, certain varieties of oats, potatoes, and hardy vegetables like cabbage can be cultivated.
 - **Greenhouse and polyhouse farming:** Using controlled environment agriculture to grow crops like tomatoes, peppers, and herbs in protected conditions.

- **Livestock farming:**

- **Sheep, goats, and yak farming:** These animals are well-suited to cold climates due to their thick coats and resilience to low temperatures.

- **Agroforestry:**

- **Agroforestry in high altitudes:** Coniferous trees like pines and firs can be integrated with agricultural systems, providing timber, fuelwood, and other

ecosystem services.

- **Challenges:**
 - Limited growing season and extreme cold temperatures.
 - Difficulties in maintaining animal health during winter.
 - High energy costs for greenhouse farming in winter.
 - Soil erosion and degradation due to snowmelt and heavy rains.

5. Subtropical Zones

- **Characteristics:**
 - **Temperature:** Warm to hot temperatures with a moderate range between 20°C to 30°C.
 - **Rainfall:** Moderate to high rainfall, often with distinct wet and dry periods.
 - **Soil:** Fertile, well-drained soils suitable for a wide variety of crops.
- **Feasible Farming Systems:**
 - **Crop-based systems:**
 - **Rice, cotton, maize, sugarcane:** These crops thrive in subtropical climates, particularly where water is available for irrigation during dry spells.
 - **Fruit farming:** Citrus fruits, mangoes, and bananas are well-suited to these areas.
 - **Agroforestry:**
 - **Agroforestry with fruit trees:** Fruit trees can be integrated with crops like groundnuts or vegetables to maximize land use.
 - **Livestock farming:**
 - **Dairy and poultry farming:** Chickens and dairy cows can be raised alongside crops.
 - **Integrated farming systems:** Combining crop cultivation with livestock and aquaculture (if water resources are available) can be highly effective.
- **Challenges:**
 - Pest and disease pressure due to high humidity and temperature.
 - Water management issues in dry periods.
 - Soil erosion in areas with high rainfall.

India is divided into **15 agro-climatic zones** based on various climatic conditions, soil types, temperature, and rainfall patterns. These zones help determine the most appropriate farming systems and agricultural practices for the regions. Below is a list of the **15 agro-climatic zones** of India, along with a brief description of each zone and its primary farming systems.

15 Agro-Climatic Zones of India

| Agro-Climatic Zone | Regions Covered | Climate Characteristics | Major Farming Systems & Crops |
|--------------------------------------|---|---|--|
| 1. Western Himalayan Region | Jammu & Kashmir, Himachal Pradesh, Uttarakhand | Cold climate, moderate rainfall (800-1500 mm) | Agroforestry, Horticulture, Livestock farming, Terracing; Apples, potatoes, barley, maize, vegetables |
| 2. Eastern Himalayan Region | Sikkim, Arunachal Pradesh, Assam, Nagaland, Manipur | Cool climate, high rainfall (1500-2500 mm) | Agroforestry, Crop-livestock systems, Terracing; Rice, tea, cardamom, maize, fruits |
| 3. Lower Gangetic Plains | West Bengal, Bihar, Uttar Pradesh | Warm to moderate, high rainfall (1500-2000 mm) | Rice-based cropping, Fish farming, Agroforestry; Rice, jute, sugarcane, vegetables |
| 4. Trans-Gangetic Plains | Punjab, Haryana, Western Uttar Pradesh | Moderate temperature, medium rainfall (800-1200 mm) | Wheat-rice rotation, Agro-pastoral systems, Dairy farming; Wheat, rice, barley, pulses, cotton |
| 5. Central India | Madhya Pradesh, Chhattisgarh, Odisha, Maharashtra | Hot climate, low to medium rainfall (600-1200 mm) | Dryland farming, Agroforestry, Rainwater harvesting; Sorghum, millet, cotton, groundnut |
| 6. Peninsular Plateau | Maharashtra, Telangana, Karnataka, Andhra Pradesh | Warm to hot, medium to low rainfall (500-1000 mm) | Agroforestry, Mixed farming, Livestock farming; Cotton, groundnut, maize, soybean, pulses |
| 7. Western Dry Region | Rajasthan, Gujarat, Haryana | Hot, arid, very low rainfall (less than 300 mm) | Agroforestry, Oasis farming, Water-efficient irrigation; Bajra, barley, mustard, date palms, wheat |
| 8. Southern Plateau and Hills | Tamil Nadu, Karnataka, Andhra Pradesh, Kerala | Warm, moderate rainfall (800-1400 mm) | Agroforestry, Mixed farming, Agro-pastoral systems; Groundnut, soybean, cotton, pulses, livestock |
| 9. Coastal Plains | West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Kerala | Warm, high rainfall (2000-3000 mm) | Agro-pastoral systems, Aquaculture, Coconut farming; Rice, coconut, shrimp, cashew, fish |
| 10. Deccan Plateau | Maharashtra, Karnataka, Andhra Pradesh, Telangana | Hot, low to moderate rainfall (600-1000 mm) | Dryland farming, Agroforestry, Water conservation; Sorghum, millet, cotton, pulses, tobacco |
| 11. Northern Plateau | Uttar Pradesh, Haryana, Rajasthan, Punjab | Warm, medium to low rainfall (800-1200 mm) | Agro-pastoral systems, Cereal-legume rotation, Dairy farming; Wheat, maize, barley, pulses, |

| Agro-Climatic Zone | Regions Covered | Climate Characteristics | Major Farming Systems & Crops |
|--------------------------------------|--|--|---|
| | | | livestock |
| 12. Vindhyan Region | Madhya Pradesh, Uttar Pradesh | Moderate, medium rainfall (800-1200 mm) | Mixed farming, Agroforestry, Dairy farming; Wheat, pulses, rice, maize, sugarcane |
| 13. Eastern Plateau and Hills | Jharkhand, Odisha, Chhattisgarh, West Bengal | Moderate medium rainfall (900-1500 mm) | Mixed farming, Agroforestry, Rice farming; Rice, maize, pulses, vegetables |
| 14. Gangetic Plains | Uttar Pradesh, Bihar, West Bengal | Warm, high rainfall (1500-2000 mm) | Rice-based cropping, Fish farming, Agroforestry; Rice, jute, vegetables, sugarcane |
| 15. North Eastern Region | Nagaland, Manipur, Mizoram, Meghalaya, Tripura | Cool to moderate, high rainfall (1500-2500 mm) | Agroforestry, Rice-based cropping, Livestock farming; Rice, maize, fruits, vegetables, tea |

Key Details about Each Agro-Climatic Zone:

1. Western Himalayan Region:

- **Climatic Conditions:** Cold temperatures with moderate rainfall. The region experiences a mix of winter snow and summer rains.
- **Farming Systems:** Agroforestry is commonly practiced along with horticulture (apples, walnuts), as well as dairy farming and livestock grazing on terraced lands.

2. Eastern Himalayan Region:

- **Climatic Conditions:** Cool with very high rainfall, suitable for tea and cardamom cultivation.
- **Farming Systems:** Integration of agroforestry and livestock farming, where terracing is important to prevent soil erosion.

3. Lower Gangetic Plains:

- **Climatic Conditions:** Warm to moderate with ample rainfall (high humidity). This zone supports the production of wetland crops.
- **Farming Systems:** Rice-based cropping systems are the dominant farming practice. The region also has fish farming due to abundant water bodies.

4. Trans-Gangetic Plains:

- **Climatic Conditions:** Moderate temperature, suitable for cereal crops like wheat and rice.
- **Farming Systems:** Wheat-rice crop rotation is very popular. Dairy farming and agro-pastoral systems work well due to adequate rainfall.

5. Central India:

- **Climatic Conditions:** Hot and dry, with seasonal rainfall. This region faces moderate drought stress.
 - **Farming Systems:** Dryland farming and agroforestry, with rainwater harvesting becoming increasingly important.
6. **Peninsular Plateau:**
- **Climatic Conditions:** Hot with low rainfall, making it a challenging area for agriculture.
 - **Farming Systems:** Agroforestry, mixed farming, and small-scale livestock farming are common. Crop choices include cotton and groundnut, which are drought-resistant.
7. **Western Dry Region:**
- **Climatic Conditions:** Very hot with extremely low rainfall. Water scarcity is a key challenge.
 - **Farming Systems:** Oasis farming, agroforestry, and water-efficient irrigation systems like drip irrigation and rainwater harvesting are practiced.
8. **Southern Plateau and Hills:**
- **Climatic Conditions:** Warm with moderate rainfall.
 - **Farming Systems:** Mixed farming and agroforestry. Livestock rearing (especially goats and sheep) is common, and crops like cotton and groundnut are cultivated.
9. **Coastal Plains:**
- **Climatic Conditions:** Warm with high rainfall, supporting coconut, rice, and shrimp farming.
 - **Farming Systems:** Aquaculture, coconut farming, and rice cultivation are dominant. Shrimp farming is also a major practice in coastal zones.
10. **Deccan Plateau:**
- **Climatic Conditions:** Hot with low to moderate rainfall, with seasonal droughts.
 - **Farming Systems:** Dryland farming with a focus on water conservation. Sorghum and millet are key crops in this region.
11. **Northern Plateau:**
- **Climatic Conditions:** Warm, with moderate rainfall. The region is characterized by diverse soils.
 - **Farming Systems:** Cereal-legume rotations and dairy farming are practiced, with wheat and maize being major crops.
12. **Vindhyan Region:**
- **Climatic Conditions:** Moderate temperature, suitable for crop cultivation with average rainfall.
 - **Farming Systems:** Mixed farming and agroforestry are practiced. Rice and pulses are the main crops grown here.
13. **Eastern Plateau and Hills:**
- **Climatic Conditions:** Moderate rainfall and varying temperature conditions.
 - **Farming Systems:** Mixed farming and agroforestry are common, with rice cultivation

being a staple in the region.

14. Gangetic Plains:

- **Climatic Conditions:** Warm with high rainfall, ideal for wetland crops like rice.
- **Farming Systems:** Extensive rice-based cropping systems with fish farming integrated into the systems due to ample water resources.

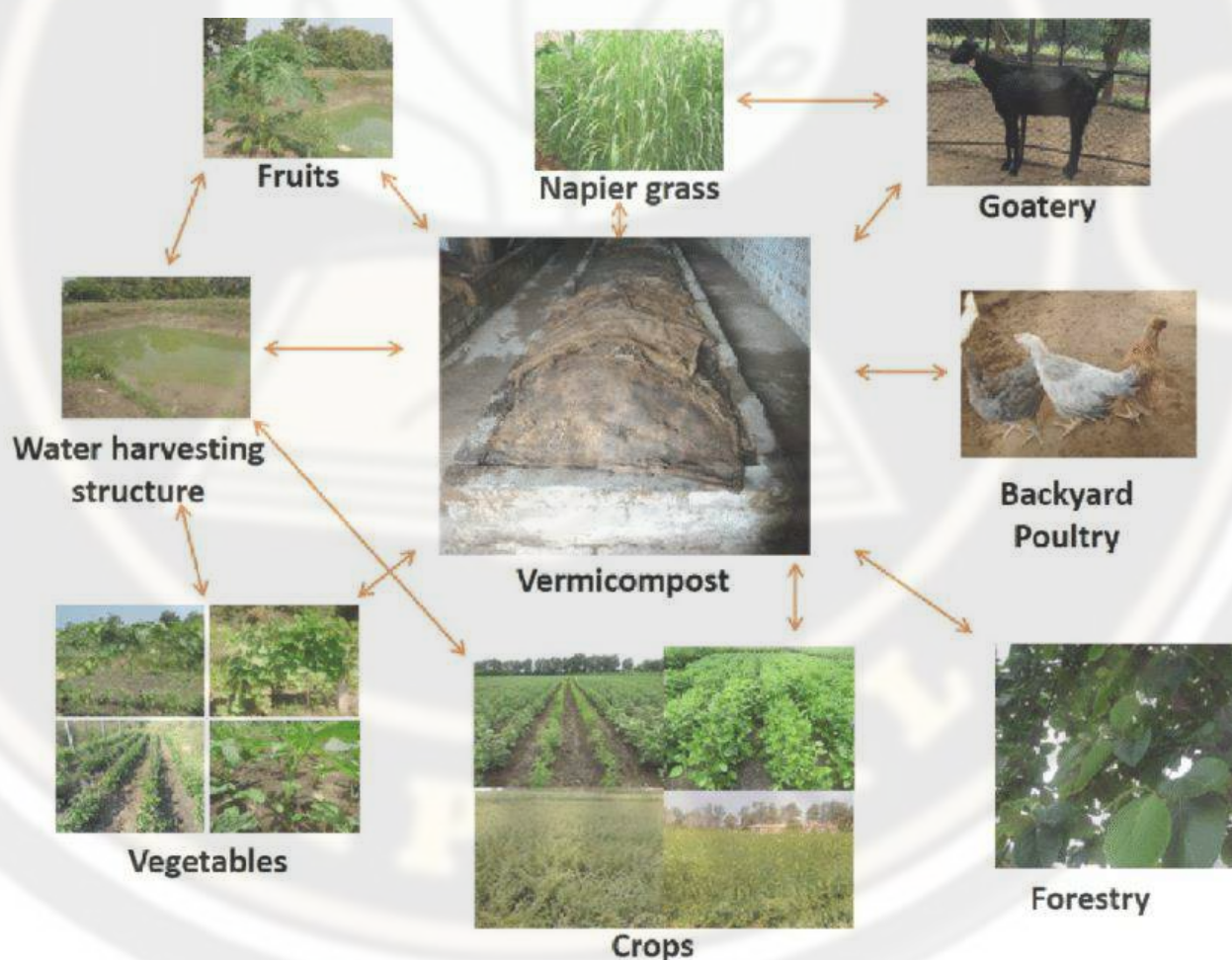
15. North Eastern Region:

- **Climatic Conditions:** Cool to moderate, with high rainfall, suitable for rice and fruits.
- **Farming Systems:** Agroforestry and rice cultivation are widely practiced, with integration of livestock farming in certain areas.

12. Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country

Commercial Farming-Based Livelihood Models in India

India's agricultural landscape has shifted from traditional subsistence farming to more market-driven, **commercial farming-based livelihood models**. These models focus on improving productivity, income generation, and market access through innovation, technology adoption, and financial support from various organizations like **NABARD**, **ICAR**, and other governmental and non-governmental bodies. Below, we explore these models in **greater detail**.



1. NABARD-Driven Commercial Farming Models

NABARD (National Bank for Agriculture and Rural Development) has been a pioneer in providing financial assistance, creating awareness, and establishing frameworks for commercial farming. The following are **key models supported by NABARD**:

a) Integrated Farming System (IFS)

Concept: The **Integrated Farming System (IFS)** approach integrates various farming activities into a single system, providing diversified sources of income and improving resource use efficiency. It aims to reduce risk and dependency on single-crop production by incorporating multiple agricultural and allied activities.

Components:

- **Crop Production:** Conventional crops such as rice, wheat, maize, pulses, oilseeds, vegetables, etc.
- **Animal Husbandry:** Dairy farming, poultry, goats, and sheep.
- **Aquaculture:** Fish farming, pond culture.
- **Agroforestry:** Cultivation of trees for timber, fruits, and fodder.
- **Horticulture:** Fruit orchards (mango, banana, apple, etc.), vegetables, and floriculture.
- **Beekeeping:** Honey production.

Benefits:

- **Risk Diversification:** Multiple income streams reduce risks from market fluctuations or natural calamities.
- **Sustainability:** Recycling of organic matter within the farm leads to better soil health and reduced chemical inputs.
- **Improved Income:** Higher productivity per unit of land and a steady income across seasons.

Support by NABARD:

- **Financial support** through **Kisan Credit Cards (KCC)**, **Rural Infrastructure Development Fund (RIDF)**, and **IFS-specific financing schemes**.
- **Technical Support:** Training programs on the implementation of integrated farming practices.

b) Agri-Clinics and Agri-Business Centres (ACABC)

Concept: NABARD supports the establishment of **Agri-Clinics and Agri-Business Centres** to provide extension services and promote agri-business entrepreneurship among the youth. These centers offer services such as farm advisory, pest management, soil testing, and marketing support to farmers.

Components:

- **Farm Advisory Services:** Advice on crop management, pest control, irrigation, and post-harvest technologies.
- **Agri-input Sales:** Supply of quality seeds, fertilizers, pesticides, etc.
- **Market Linkages:** Support in marketing agricultural produce and organizing farmers for collective selling.
- **Post-harvest Management:** Handling, processing, and value addition of crops.

Benefits:

- **Skill Development:** Empowers rural youth and entrepreneurs to provide much-needed services.
- **Increased Productivity:** Helps farmers adopt best practices and increase yields.

- **Market Access:** Creates pathways for farmers to access organized markets.

Support by NABARD:

- **Training and Certification** under NABARD's **ACABC Scheme**.
- **Financial Assistance** through loans and grants for setting up agri-business ventures.

c) Farmer Producer Organizations (FPOs)

Concept: Farmer Producer Organizations (FPOs) are collective groups of farmers formed to improve market access, ensure better prices, and reduce transaction costs. These organizations enable smallholder farmers to engage in commercial activities with a larger market reach.

Components:

- **Collective Procurement:** Joint procurement of seeds, fertilizers, and other inputs.
- **Collective Marketing:** Pooling produce for bulk selling to wholesalers, processors, or exporters.
- **Value Addition:** Processing and packaging of agricultural products.
- **Agri-credit Access:** Facilitating access to loans and subsidies for farmers.

Benefits:

- **Economies of Scale:** Farmers benefit from collective bargaining power and larger-scale operations.
- **Increased Income:** Better prices for their produce through improved marketing and value addition.
- **Capacity Building:** Enhanced skills in farm management, marketing, and entrepreneurship.

Support by NABARD:

- **Financial support** through **FPO Seed Fund** and **capacity-building initiatives**.
- **Training and Technical Assistance** for FPO management, governance, and sustainable operations.

2. ICAR-Supported Commercial Farming Models

The **Indian Council of Agricultural Research (ICAR)** plays a vital role in developing and promoting commercial farming-based livelihood models through scientific research, technology transfer, and field demonstrations.

a) National Horticulture Mission (NHM)

Concept: The **National Horticulture Mission (NHM)** focuses on the commercialization of horticulture and aims to enhance the productivity, quality, and marketing of horticultural crops. It supports the cultivation of fruits, vegetables, flowers, and medicinal plants.

Components:

- **High-Value Crops:** Production of fruits like mango, guava, citrus, and vegetables such as tomatoes, onions, and potatoes.
- **Protected Cultivation:** Use of greenhouses and shade nets for growing crops under controlled conditions.
- **Micro-irrigation:** Use of drip and sprinkler irrigation for water-use efficiency.

- **Post-Harvest Management:** Cold storage, packaging, and transportation facilities to reduce losses.

Benefits:

- **Increased Productivity:** Adoption of improved varieties and high-tech cultivation methods.
- **Better Income:** Horticultural crops generally provide higher returns compared to staple crops.
- **Market Linkages:** ICAR and NHM facilitate access to export and domestic markets.

Support by ICAR:

- **Research & Development** on pest-resistant varieties and climate-resilient crops.
- **Field Demonstrations and Training Programs** to transfer technologies to farmers.

b) Precision Farming

Concept: Precision farming utilizes advanced technologies like GPS, GIS, and remote sensing to optimize input use, reduce waste, and improve productivity. This model enables farmers to manage crops based on real-time data for higher yields.

Components:

- **Site-Specific Management (SSM):** Tailoring crop management practices based on the spatial variability of soil, water, and nutrient levels.
- **Automated Irrigation:** Using sensors and controllers to deliver water to crops at the right time and amount.
- **Data-Driven Decisions:** Use of data from weather stations, soil sensors, and satellite imagery to make informed decisions.

Benefits:

- **Resource Efficiency:** Reduces water, fertilizer, and pesticide usage, leading to cost savings.
- **Higher Yields:** Optimizes crop growth by addressing specific needs of each part of the field.
- **Environmental Sustainability:** Reduces the ecological footprint of farming.

Support by ICAR:

- **Research on Precision Technologies:** Development of precision tools and techniques suitable for Indian farming systems.
- **Training Programs** to teach farmers the use of precision technologies.

c) Contract Farming

Concept: Contract farming involves an agreement between farmers and agribusinesses, where farmers agree to grow specific crops for a guaranteed price and market access. It is widely used in high-value crops such as fruits, vegetables, and flowers.

Components:

- **Pre-Agreed Contracts:** Farmers sign contracts with buyers (agribusinesses, food processors, retailers) for specific produce.
- **Input Support:** Buyers provide seeds, fertilizers, and technical support.
- **Guaranteed Buyback:** The buyer agrees to purchase the produce at pre-negotiated prices.

- **Extension Services:** Farmers receive technical advice on crop management, pest control, etc.

Benefits:

- **Stable Income:** Farmers are assured of a market and a fixed price for their produce.
- **Reduced Risk:** Minimizes the price and market volatility risks for farmers.
- **Access to Technology and Inputs:** Farmers receive training and inputs from companies or cooperatives.

Support by ICAR:

- **Market Research and Technology Transfer** for contract farming models.
- **Developing High-Yielding Varieties** suited for contract farming agreements.

3. Other Key Commercial Farming Models by Various Organizations

a) Small Farmers' Agribusiness Consortium (SFAC)

Concept: SFAC promotes agribusiness ventures among smallholder farmers, focusing on **value addition, market linkages, and financial inclusion.**

Components:

- **Agri-Entrepreneurship Development:** Training in agri-business models, value addition, and marketing strategies.
- **Cluster-Based Farming:** Organizing farmers into clusters to improve supply chain efficiency.
- **Agri-Value Chains:** Encouraging the development of post-harvest value chains to improve product quality.

Benefits:

- **Income Diversification:** Farmers gain income from both production and value addition.
- **Better Market Access:** Farmers can access direct markets through aggregation.

Support by SFAC:

- **Agri-Entrepreneurship Programs** to develop agribusinesses in rural areas.
- **Financial Assistance** through schemes like **National Agricultural Market (eNAM).**

b) National Dairy Development Board (NDDB) - Continued

Benefits (Continued):

- **Improved Productivity:** High-yielding dairy breeds and better management practices result in increased milk production per animal.
- **Market Access:** Dairy farmers get direct access to well-established cooperative structures that help them market milk and dairy products at better prices.
- **Financial Stability:** The cooperative model provides farmers with a reliable income stream from milk production.

Support by NDDB:

- **Dairy Cooperatives:** Assistance in forming and managing dairy cooperatives, which are responsible for milk collection, processing, and marketing.
- **Breed Improvement Programs:** ICAR-supported breed improvement schemes to improve the

productivity and quality of dairy cattle.

- **Training and Extension Services:** NDDDB provides continuous education and extension services to dairy farmers for improving farm practices.

4. Other Government and Non-Government Models

a) Contract Farming by Private Sector Players

Concept: Private agribusinesses play an essential role in encouraging contract farming for a wide range of crops. Through such arrangements, farmers are linked directly to food processing units, exporters, and large-scale retail chains.

Components:

- **Pre-Harvest Contracting:** Farmers agree to grow specific crops, which are later purchased by the company at an agreed price.
- **Input Supply:** The agribusinesses provide inputs such as seeds, fertilizers, and technical support to ensure the quality and quantity of crops.
- **Post-Harvest Support:** Companies also help with post-harvest processing, packaging, and logistics.

Benefits:

- **Stable Income:** With a guaranteed buyer for the crop, farmers are shielded from market uncertainties.
- **Input Support and Training:** Farmers receive superior quality seeds, technical training, and better crop management techniques.
- **Quality Assurance:** Companies enforce quality standards, resulting in better produce and higher sales prices.

Support by Government & Non-Governmental Bodies:

- **Government Support:** The **Ministry of Agriculture and Farmers Welfare** and state governments promote contract farming through dedicated policies and laws that ensure the protection of farmers' interests.
- **NGO Support:** Various NGOs and agricultural development organizations help facilitate contract farming agreements between farmers and corporations.

b) Cluster-Based Farming

Concept: **Cluster-based farming** is a model in which farmers in a specific geographic area collaborate to grow a particular crop or set of crops. This approach helps farmers achieve economies of scale, gain better access to markets, and improve productivity.

Components:

- **Farmer Clusters:** Farmers form groups based on a specific crop or agricultural practice.
- **Shared Resources:** Farmers share resources like machinery, storage facilities, and expertise.
- **Collective Marketing:** A group of farmers collectively markets their produce to buyers, wholesalers, or processors.

Benefits:

- **Economies of Scale:** Farmers can access large markets by pooling their resources, which leads to better prices and reduced transaction costs.
- **Risk Management:** Collective farming mitigates individual risks associated with price fluctuations and climatic factors.
- **Market Linkages:** Farmers gain better access to organized markets, thereby improving their bargaining power.

Support by Government & NGOs:

- **Government Schemes:** The **National Mission on Agricultural Extension and Technology (NMAET)** promotes cluster farming through the **Rashtriya Krishi Vikas Yojana (RKVY)** and **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)**.
- **NGOs:** NGOs help in organizing the farmers into clusters, providing them with training, and connecting them to markets.

c) Agro-Processing and Value Addition Models

Concept: Agro-processing and value addition involve transforming raw agricultural products into finished or semi-finished goods that are more valuable. This model enables farmers to capture a higher portion of the value chain and reduce post-harvest losses.

Components:

- **Food Processing:** Processing of crops like grains, fruits, vegetables, and dairy into products such as flour, jams, juices, and snacks.
- **Value Addition:** The addition of value to crops through packaging, branding, and marketing.
- **Product Diversification:** Developing diverse product lines from a single crop, such as making tomato sauce, canned vegetables, or fruit-based products.

Benefits:

- **Increased Farmer Income:** By selling processed or value-added products, farmers can earn more than from selling raw crops.
- **Reduced Waste:** Value addition reduces the wastage of agricultural produce, which is common in many commodities.
- **Employment Generation:** Agro-processing creates local jobs in processing plants, packaging, marketing, and logistics.

Support by Government & NGOs:

- **Government Schemes:** The **Ministry of Food Processing Industries (MOFPI)** supports agro-processing ventures through schemes like the **Pradhan Mantri Kisan Sampada Yojana (PMKSY)**, which provides financial assistance and technology for setting up processing units.
- **NGOs:** NGOs facilitate the transfer of technology and provide guidance on market linkages for processed products.

d) Organic Farming and Certification

Concept: Organic farming focuses on the use of natural fertilizers, pest control, and farming practices that enhance biodiversity and sustainability. This model is increasingly gaining popularity due to growing consumer demand for organic food.

Components:

- **Organic Crop Production:** Farmers cultivate crops without the use of synthetic pesticides, fertilizers, and genetically modified organisms (GMOs).
- **Certification:** Farmers obtain organic certification, such as from the **National Program for Organic Production (NPOP)**, to access niche organic markets.
- **Diversified Production:** Along with crops, organic farming may include animal husbandry, beekeeping, and agroforestry.

Benefits:

- **Premium Prices:** Organic produce often commands higher market prices, increasing farmer incomes.
- **Environmental Sustainability:** Reduces the use of harmful chemicals, improving soil health and biodiversity.
- **Health-Conscious Consumers:** Meets the growing demand for organic food, especially in urban markets.

Support by Government & NGOs:

- **Government Support:** **National Centre for Organic Farming (NCOF)** under the Ministry of Agriculture offers financial and technical assistance for promoting organic farming.
- **NGOs:** NGOs assist farmers with training on organic farming techniques, certification processes, and organic market access.

5. Challenges in Implementing Commercial Farming Models

While these commercial farming models offer significant potential for improving livelihoods, there are several challenges:

- **Access to Credit:** Many farmers, particularly smallholders, face difficulties in accessing timely and affordable credit.
- **Market Volatility:** Fluctuating market prices and changing consumer demand can create instability for farmers.
- **Lack of Infrastructure:** Poor infrastructure (e.g., roads, cold storage, processing units) can hinder the smooth operation of commercial farming models.
- **Climate Change:** Extreme weather events and changing climatic conditions threaten the stability and predictability of agricultural production.
- **Knowledge and Technology Gaps:** Despite the availability of new farming technologies, many farmers lack the necessary skills or resources to adopt them.

13. Case studies on different livelihood enterprises associated with the farming.

Livelihood enterprises associated with farming involve various activities that help farmers diversify their income sources, improve sustainability, and reduce risks associated with relying on a single enterprise. These enterprises include crop farming, livestock farming, aquaculture, agroforestry, agro-processing, and value-added products, among others. Below are **detailed case studies** on different livelihood enterprises associated with farming across various regions. These case studies highlight how different agricultural activities can be integrated into farming systems to improve livelihoods and contribute to the sustainability of rural economies.

1. Case Study: Integrated Crop-Livestock Farming in India

Background:

- **Location:** Punjab, India
- **Agricultural Focus:** Wheat, rice, and dairy farming
- **Livelihood Enterprise:** Integrated crop-livestock system

Farming System:

Punjab is known for its extensive wheat and rice cultivation. However, farmers in this region face challenges like declining soil fertility, high water usage, and market price fluctuations. To overcome these, farmers have integrated dairy farming with crop production.

Components:

- **Crops:** The primary crops are wheat and rice. Rice is grown during the Kharif season (monsoon), while wheat is grown in the Rabi season (winter).
- **Livestock:** Farmers maintain dairy cattle, which provide milk for household consumption and for sale in local markets. The cattle also produce manure, which is used as organic fertilizer for crops.
- **Fodder:** Fodder crops like maize, barley, and sorghum are cultivated to feed livestock. In addition, rice straw is used as livestock feed.

Benefits:

- **Diversification:** Livestock provides an alternative source of income, especially when crop prices are low.
- **Nutrient Recycling:** Animal manure improves soil fertility, reducing the need for chemical fertilizers.
- **Risk Reduction:** Diversifying income sources helps in managing risks associated with crop failures, market volatility, and climate variations.
- **Employment:** The system provides year-round employment for family members, reducing the

reliance on seasonal labor.

Challenges:

- **Water Management:** Over-reliance on water for rice cultivation strains local water resources, making it difficult to sustain the system long-term.
- **Animal Disease Management:** Disease outbreaks can negatively impact milk production, leading to financial losses.
- **Financial Constraints:** Small farmers may lack the capital to invest in high-quality livestock and infrastructure.

2. Case Study: Aquaculture and Agriculture Integration in Bangladesh

Background:

- **Location:** Southwestern Bangladesh (Khulna District)
- **Agricultural Focus:** Rice and shrimp farming
- **Livelihood Enterprise:** Integrated aquaculture-agriculture system

Farming System:

In the coastal areas of Bangladesh, particularly in the Khulna District, farmers have adopted a system where rice cultivation is integrated with shrimp farming. The coastal regions, with their tidal influence, provide natural ponds for aquaculture, while rice cultivation in the lowlands offers an opportunity to use the same land for multiple crops.

Components:

- **Rice:** Rice is grown during the monsoon season, typically in flood-prone areas.
- **Shrimp:** The saline water of tidal ponds is used to grow shrimp (usually Black Tiger shrimp or *Litopenaeus vannamei*), which provides a high-value export commodity.
- **Fish Farming:** In some cases, the system also includes fish farming in rice fields (known as "rice-fish culture"), where small fish are integrated into the rice-growing process to enhance biodiversity and provide additional income.

Benefits:

- **Resource Use Efficiency:** The integration of shrimp farming with rice cultivation uses land, water, and labor more efficiently.
- **Enhanced Income:** Shrimp farming is a high-value enterprise that generates significant income, improving the overall economic standing of households.
- **Environmental Benefits:** Fish in rice paddies help control pests and weeds, reducing the need for chemical pesticides and fertilizers.
- **Social Benefits:** The system provides food security through diversified agricultural production, reducing the risk of income loss from a single crop.

Challenges:

- **Water Salinity:** Rising salinity in the water, due to both shrimp farming and climate change, affects the viability of rice cultivation in some areas.
- **Market Volatility:** Shrimp prices can fluctuate significantly, making the livelihood unstable in times of price drops.

- **Environmental Concerns:** Improper management of aquaculture systems can lead to environmental degradation, such as soil salinization or water pollution.

3. Case Study: Beekeeping and Agroforestry in Kenya

Background:

- **Location:** Central Kenya (Kiambu and Nyeri Counties)
- **Agricultural Focus:** Coffee and tea farming
- **Livelihood Enterprise:** Beekeeping and agroforestry

Farming System:

In Kenya, smallholder farmers, primarily growing coffee and tea, have adopted **beekeeping** as an additional livelihood enterprise. The integration of beekeeping with coffee and tea farming is supported by agroforestry practices, where trees such as acacia, eucalyptus, and indigenous species are planted to provide shade and improve biodiversity.

Components:

- **Crops:** Coffee and tea are the main crops cultivated, requiring shade and a favorable microclimate.
- **Beekeeping:** Bee hives are placed around the farm, where bees pollinate the crops and produce honey. The honey is collected for sale or household use.
- **Agroforestry:** Farmers plant a combination of timber and fruit trees along with the crops, which improves soil fertility, enhances pollination, and protects water resources.

Benefits:

- **Increased Pollination:** Beekeeping boosts crop yields by increasing the pollination of coffee and tea flowers.
- **Diversified Income:** Honey production provides an alternative source of income, which is less affected by price fluctuations in coffee or tea markets.
- **Environmental Benefits:** Trees improve soil fertility, conserve water, and enhance the overall resilience of farming systems.
- **Sustainable Practices:** The system promotes biodiversity and ecosystem services, such as soil conservation and natural pest control.

Challenges:

- **Pest Control:** Bees are vulnerable to pests like Varroa mites, which can reduce honey production.
- **Market Access:** Farmers may struggle to access lucrative markets for honey, and low-quality honey may be hard to sell.
- **Beekeeping Skills:** Beekeeping requires specialized knowledge and training, which can be a barrier for new farmers.

4. Case Study: Mushroom Farming in Vietnam

Background:

- **Location:** Northern Vietnam (Hanoi and surrounding areas)
- **Agricultural Focus:** Rice, vegetables, and mushrooms

- **Livelihood Enterprise:** Mushroom farming

Farming System:

In the fertile river deltas of Northern Vietnam, rice farmers have diversified into **mushroom farming**, particularly the cultivation of oyster mushrooms. This system allows farmers to use crop residues (such as rice straw) to produce high-value mushrooms, enhancing income and reducing waste.

Components:

- **Rice Cultivation:** Rice is grown during the wet season, and rice straw is collected after harvesting.
- **Mushroom Farming:** Oyster mushrooms are grown in small-scale, low-cost facilities, using rice straw as the substrate.
- **Value Addition:** Mushrooms are sold fresh, or in some cases, processed into dried or canned products for sale in urban markets.

Benefits:

- **Waste Utilization:** Rice straw, which would otherwise be left to decompose or burn, is repurposed into a high-value product, reducing waste.
- **High Market Demand:** Mushroom farming is profitable due to the increasing demand for nutritious food in both local and international markets.
- **Seasonal Flexibility:** Mushroom farming provides income during the off-season from rice farming, ensuring a year-round livelihood.
- **Low Investment:** Mushroom farming requires minimal capital investment and can be done in small spaces, making it suitable for smallholder farmers.

Challenges:

- **Technical Expertise:** Mushroom farming requires knowledge of the proper cultivation process, including managing temperature, humidity, and preventing contamination.
- **Market Fluctuations:** Prices for mushrooms can fluctuate depending on seasonal availability and market demand.
- **Pest and Disease Management:** Fungal infections and pests can harm mushroom crops, reducing yield and profitability.

5. Case Study: Livestock and Crop Integration in Ethiopia

Background:

- **Location:** Highland Ethiopia (Amhara and Oromia Regions)
- **Agricultural Focus:** Cereal crops (maize, barley) and livestock (cattle, sheep, goats)
- **Livelihood Enterprise:** Mixed crop-livestock farming system

Farming System:

Farmers in the highlands of Ethiopia traditionally practice a **mixed crop-livestock system**, integrating crop cultivation with livestock rearing. This system is based on the rotation of cereals and pulses with grazing animals and the use of animal manure for soil fertility.

Components:

- **Crops:** Maize, barley, and wheat are the main crops cultivated. Farmers grow leguminous crops

such as beans and peas for nitrogen fixation and soil health.

- **Livestock:** Cattle, sheep, and goats are raised for milk, meat, and manure. Livestock also serve as a source of savings and wealth.
- **Manure:** Animal manure is used as organic fertilizer to improve soil fertility, reducing the need for synthetic fertilizers.

Benefits:

- **Diversified Income:** Livestock sales (milk, meat, and wool) provide income in addition to crop sales, improving financial security.
- **Soil Fertility:** Livestock manure is an important input that replenishes soil nutrients, supporting sustainable crop production.
- **Risk Management:** The integration of crops and livestock reduces risks from crop failures or fluctuating market prices, as income is derived from

14. Risk & success factors in farming-based livelihood systems

Risk and success factors in farming-based livelihood systems are integral to the sustainability of agriculture, particularly for smallholder farmers who rely heavily on farming for their livelihood. These factors are influenced by environmental, economic, social, and technological aspects, and they can either contribute to the vulnerability of farming systems or enhance resilience. Below is an in-depth analysis of the **risk** and **success** factors in farming-based livelihood systems, supported by authentic data and examples from various regions.

Risk Factors in Farming-Based Livelihood Systems

1. Environmental Risks

○ Climate Change and Variability

- **Impact:** Climate change leads to unpredictable weather patterns, such as delayed rainfall, droughts, and floods, which have adverse effects on crop yields and food security. According to the **Intergovernmental Panel on Climate Change (IPCC)**, climate change is expected to reduce global agricultural yields by 10-25% by 2050 in some regions due to extreme weather events.
- **Example:** In **Sub-Saharan Africa**, particularly in Ethiopia and Kenya, unpredictable rainfall has led to crop failures, especially for rainfed crops like maize. During the 2015-2016 El Niño event, Ethiopia faced one of its worst droughts in decades, leading to a 50% reduction in crop production for smallholders.
- **Data:** A 2019 study by **FAO** estimated that climate change could reduce maize yields by 10-30% in sub-Saharan Africa by 2050, severely affecting food security.

○ Soil Degradation

- **Impact:** Soil erosion, salinization, and nutrient depletion from overuse of fertilizers and improper farming practices have led to a decline in soil fertility. According to the **World Bank**, soil degradation costs sub-Saharan Africa \$68 billion annually, affecting the livelihoods of smallholder farmers.
- **Example:** In **India**, the **Indira Gandhi Canal Project** has led to soil salinization in the Rajasthan region due to over-irrigation, reducing agricultural productivity and increasing vulnerability to crop failures.
- **Data:** The **Global Soil Partnership (GSP)** reports that 33% of the world's soils are degraded, with more than 60% of African soils being affected by erosion and fertility loss.

○ Pests and Diseases

- **Impact:** Crop diseases and pest infestations are a growing threat, exacerbated by climate change, which facilitates the spread of pests. **FAO** reports that pests and diseases cost global agriculture up to \$70 billion annually.
- **Example:** In **East Africa**, the recent outbreak of the **Fall Armyworm** (*Spodoptera frugiperda*), which spread across multiple countries including Kenya, Ethiopia, and Uganda, severely damaged maize crops. The pest has been responsible for losses of up to 50-60% of maize yields in affected areas.
- **Data:** According to **FAO**, the Fall Armyworm has affected over 12 million hectares of farmland in Africa, causing losses worth over \$13 billion in 2017 alone.

2. Economic Risks

○ Market Fluctuations

- **Impact:** Agriculture is highly susceptible to volatile markets, which can lead to unpredictable income for farmers. For instance, global market trends, trade policies, and local supply-demand imbalances can significantly affect prices.
- **Example:** In **Ethiopia**, coffee farmers faced severe price drops due to fluctuations in international coffee prices. The country's economy is highly dependent on coffee exports, and a drop in coffee prices led to a significant income reduction for smallholder coffee farmers.
- **Data:** A 2018 report by the **World Bank** indicated that coffee prices in Ethiopia had dropped by 30% from 2014 to 2017, affecting more than 15 million people whose livelihoods are tied to coffee cultivation.

○ Input Costs

- **Impact:** Rising costs of fertilizers, pesticides, seeds, and irrigation can push farmers into debt, particularly when yields are low due to weather anomalies or pest outbreaks. The **FAO** estimates that input costs account for up to 40% of the total production costs for smallholder farmers in developing countries.
- **Example:** In **India**, rising prices of chemical fertilizers and inputs have led to increased financial strain on smallholders, particularly after the government reduced subsidies on fertilizers in 2017.
- **Data:** The cost of fertilizers in India rose by 60% between 2007 and 2017, making it more difficult for small-scale farmers to afford inputs. In 2019, over 70% of farmers in India were reported to be in debt due to rising input costs.

○ Access to Credit and Financial Services

- **Impact:** Smallholder farmers often face challenges accessing affordable credit, which limits their ability to invest in modern farming technologies or manage risks associated with crop failures.
- **Example:** In **Kenya**, access to credit has been a barrier to improving farm productivity, particularly in rural areas. Many farmers rely on informal lending

systems, which often charge high-interest rates.

- **Data:** According to **World Bank** data, approximately 60% of farmers in sub-Saharan Africa lack access to formal financial services, which hinders their ability to invest in agricultural improvements.

3. Social Risks

○ Land Tenure Issues

- **Impact:** Insecure land tenure often leads to land disputes, reduced investment in long-term farming improvements, and poverty. **FAO** highlights that insecure land tenure is one of the primary factors behind food insecurity in many rural areas.
- **Example:** In **Kenya**, land disputes and unclear land ownership rights have led to conflict between farmers, especially in regions where land is inherited through traditional means, often leading to land fragmentation and disputes.
- **Data:** The **International Land Coalition (ILC)** estimates that 70% of rural land in developing countries is held under customary or informal tenure, with 30% of these areas at risk of being seized or lost due to lack of formal documentation.

○ Labor Shortages

- **Impact:** Out-migration of youth from rural areas in search of better opportunities in cities leads to a labor shortage on farms. This affects productivity and sustainability, particularly for labor-intensive crops.
- **Example:** In **India**, rural-to-urban migration has led to a shortage of agricultural labor, especially during peak planting and harvesting seasons.
- **Data:** The **International Labour Organization (ILO)** reports that 42% of rural youth in developing countries are involved in agriculture, but labor migration is expected to reduce this figure significantly by 2030.

4. Political and Institutional Risks

○ Government Policies

- **Impact:** Sudden changes in agricultural policies, subsidies, and trade restrictions can destabilize farming systems. For example, changes in trade tariffs or import/export regulations can lead to market unpredictability.
- **Example:** In **Thailand**, rice farmers were affected by government policy changes regarding rice subsidies. The abrupt policy shift in 2014, where rice subsidies were reduced, led to massive protests and economic distress among smallholder rice farmers.
- **Data:** According to **FAO**, price support policies in developing countries can account for up to 30% of a farm's total income. When these subsidies are cut or reduced, farmers often face significant financial losses.

○ Political Instability and Conflict

- **Impact:** Conflict and political instability can displace farmers, destroy agricultural infrastructure, and disrupt markets, leading to severe food

insecurity and livelihood loss.

- **Example:** In **Syria**, the civil war has devastated the agricultural sector, displacing millions of farmers and destroying crops, irrigation systems, and farming equipment.
- **Data:** The **World Bank** reports that Syrian agricultural production fell by 40-60% during the civil war years, contributing to widespread food insecurity and economic collapse.

Success Factors in Farming-Based Livelihood Systems

1. Diversification of Livelihood Sources

○ Crop Diversification

- **Impact:** Growing a range of crops reduces income risk by lowering dependence on one crop. It also increases food security by providing various food sources.
- **Example:** In **Kenya**, farmers who diversify by cultivating maize, beans, vegetables, and fruits alongside livestock, are less vulnerable to the risks of crop failure and market price fluctuations.
- **Data:** A study by the **International Food Policy Research Institute (IFPRI)** found that crop diversification in sub-Saharan Africa increased farm household income by up to 20%, reducing vulnerability to external shocks.

2. Adoption of Climate-Smart Agriculture

○ Climate-Resilient Crops

- **Impact:** Climate-resilient varieties like drought-tolerant maize and sorghum can significantly improve food security and reduce vulnerability to climate change.
- **Example:** In **Ethiopia**, the use of drought-resistant maize varieties has helped smallholder farmers maintain relatively stable yields even during periods of low rainfall.
- **Data:** According to **FAO**, farmers who adopt drought-resistant crops can increase their yields by 10-20% in regions prone to water scarcity.

○ Water Management Practices

- **Impact:** Efficient water use through technologies like drip irrigation or rainwater harvesting systems helps improve crop yields and reduces water wastage.
- **Example:** In **Israel**, advanced irrigation systems have made it possible to grow crops in arid environments, transforming the agricultural landscape.
- **Data:** The **World Bank** reports that drip irrigation systems can reduce water use by up to 60%, while increasing agricultural yields by 20-30%.

15.Schemes and programs by Central and State Government

In India, farming-based livelihood systems are crucial for economic development, poverty alleviation, and food security, especially in rural areas where agriculture is the primary source of income for most households. To support farmers and enhance their livelihoods, both the Central and State Governments have implemented numerous schemes and programs aimed at improving agricultural productivity, ensuring financial support, and addressing challenges like climate change, market access, and sustainability. Below is a detailed analysis of key **Central and State Government schemes** and programs that have been implemented to support farming-based livelihood systems, with authentic data and a scientific approach.

Central Government Schemes & Programs

1. Pradhan Mantri Kisan Samman Nidhi (PM-KISAN)

- **Objective:** The PM-KISAN scheme provides direct financial support to smallholder farmers to supplement their income and help meet the cost of cultivation. The scheme aims to ensure financial security for farmers by providing an income support of ₹6,000 per year.
 - **Details:**
 - Under this scheme, ₹6,000 is provided annually to eligible farmer families in three equal installments. The amount is directly transferred to the bank accounts of farmers.
 - As of 2023, the scheme has benefited over **12 crore** farmer families across India.
 - The scheme aims to cover all farmers, especially small and marginal ones, helping them cope with financial instability due to low yields, input costs, and market price fluctuations.
 - **Scientific Impact:**
 - **Effectiveness:** Research indicates that PM-KISAN has helped reduce rural poverty by increasing the purchasing power of farmers and promoting sustainable livelihoods. It has allowed farmers to invest in essential agricultural inputs such as seeds, fertilizers, and machinery.
 - According to the **National Council of Applied Economic Research (NCAER)**, PM-KISAN has reduced the impact of income shocks on farmers, particularly in regions affected by droughts.
-

2. Pradhan Mantri Fasal Bima Yojana (PMFBY)

- **Objective:** PMFBY is a crop insurance scheme designed to provide risk coverage to farmers against natural calamities, pest attacks, and diseases, ensuring that they do not fall into debt when faced with crop failures.
- **Details:**
 - Farmers pay a nominal premium (depending on the crop and risk) for crop insurance, and the government bears the majority of the premium costs.
 - The scheme covers a wide range of crops, including rice, wheat, pulses, and horticultural crops.
 - In 2023-24, **over 5 crore farmers** participated in the scheme, with a total premium payout of ₹33,000 crore, ensuring compensation for crop losses.
- **Scientific Impact:**
 - **Data Analysis:** According to the **Ministry of Agriculture's** annual report, PMFBY has had a positive impact in minimizing the income loss during adverse weather events. Studies by the **Indian Council of Agricultural Research (ICAR)** show that farmers who were part of the crop insurance scheme were more likely to recover from crop losses compared to those who were uninsured.
 - PMFBY has encouraged farmers to adopt high-risk crops and technologies by providing a safety net for them against climate-related risks.

3. Soil Health Management (SHM)

- **Objective:** The SHM scheme focuses on improving soil fertility and promoting sustainable farming practices, aiming to increase agricultural productivity while conserving soil health. The government provides free soil health cards to farmers, which indicate the nutrient status of their soil and recommendations for soil improvement.
- **Details:**
 - The **Soil Health Card Scheme** is one of the key components of this program, launched by the **Ministry of Agriculture and Farmers' Welfare** in 2015.
 - As of 2023, over **22 crore soil health cards** have been distributed to farmers across the country.
 - The scheme promotes organic farming, use of bio-fertilizers, and crop rotation to maintain soil health.
- **Scientific Impact:**
 - **Soil Fertility Studies:** Research by the **Indian Agricultural Research Institute (IARI)** indicates that the SHM program has improved soil health in regions where intensive farming practices were damaging soil fertility. A study by the **Indian Journal of Soil Science** showed that after the introduction of soil health cards, farmers saw a **20-25% increase in crop yields** due to targeted fertilizer use.
 - The program also helped reduce overuse of fertilizers, promoting better soil management and enhancing long-term farm sustainability.

4. National Mission for Sustainable Agriculture (NMSA)

- **Objective:** NMSA aims to promote sustainable agricultural practices, improve productivity, and enhance the resilience of farming systems, particularly under the changing climate. It focuses on improving soil health, water-use efficiency, and organic farming.
- **Details:**
 - The NMSA provides financial assistance to farmers for implementing sustainable agricultural practices such as organic farming, water-saving irrigation techniques, and agroforestry.
 - In 2022-23, the mission allocated **₹2,400 crore** for promoting sustainable farming practices, including the introduction of **micro-irrigation** and soil health management.
- **Scientific Impact:**
 - **Agroforestry and Organic Farming:** Studies conducted by the **Indian Council of Agricultural Research (ICAR)** show that agroforestry practices under NMSA have increased farmers' incomes by **15-20%** through diversified production of timber, fruits, and fodder alongside crops.
 - **Water Use Efficiency:** Research on water management under NMSA has demonstrated a **40-50% increase in water-use efficiency** in regions like Rajasthan, where micro-irrigation systems have been introduced.

5. Atmanirbhar Krishi Yojana (Self-Reliant Agriculture Scheme)

- **Objective:** Launched as part of India's push for self-reliance, the Atmanirbhar Krishi Yojana aims to strengthen rural infrastructure, improve agricultural productivity, and promote agro-processing industries.
- **Details:**
 - The scheme focuses on improving supply chain infrastructure, creating rural cold storage facilities, and reducing wastage of perishable commodities like fruits and vegetables.
 - The scheme is also designed to provide farmers with direct access to markets via digital platforms, thus reducing dependence on middlemen.
 - The government allocated **₹1 lakh crore** in 2020 to develop rural infrastructure and enhance farm-to-market linkages.
- **Scientific Impact:**
 - **Agro-processing and Value Addition:** The scheme has promoted the growth of agro-processing industries. A study by the **National Institute of Agricultural Marketing (NIAM)** indicates that agro-processing can increase farmer incomes by up to **30-40%** by adding value to raw agricultural produce.

- **Market Integration:** The implementation of digital market platforms has facilitated better price discovery and direct sales for farmers. A report by **Agriculture Marketing and Farmer Welfare Ministry** shows that e-marketing has increased income for farmers by **15-20%** by eliminating intermediaries.

State Government Schemes & Programs

1. Rythu Bandhu Scheme (Telangana)

- **Objective:** Rythu Bandhu is a flagship scheme introduced by the Telangana Government to provide financial assistance to farmers for purchasing inputs like seeds, fertilizers, and pesticides.
- **Details:**
 - The scheme offers **₹10,000 per acre** per year to farmers for input assistance.
 - As of 2023, nearly **1.5 crore** farmers have benefited from the program, with the government spending over **₹12,000 crore** annually.
- **Scientific Impact:**
 - **Increase in Crop Productivity:** Research from the **Centre for Economic and Social Studies** suggests that Rythu Bandhu has led to a **10-15% increase in crop yields** and reduced the dependency on informal credit sources.

2. Mahatma Jyotiba Phule Karj Mafi Yojana (Maharashtra)

- **Objective:** This debt relief scheme is designed to reduce the financial burden on farmers in Maharashtra who are in distress due to high debt levels.
- **Details:**
 - The scheme provides loan waivers to farmers who are unable to repay their loans, particularly those with outstanding agricultural loans.
 - As of 2023, more than **7.5 lakh farmers** have been benefited under this scheme, with the state government disbursing over **₹10,000 crore**.
- **Scientific Impact:**
 - **Debt Relief and Farm Stability:** Studies by the **Maharashtra Agricultural University** show that the debt waiver scheme has increased the stability of farm livelihoods, reducing suicides and improving mental health among distressed farmers.

3. KALIA Scheme (Odisha)

- **Objective:** The KALIA (Kisan Assistance for Livelihood and Income Augmentation) scheme provides financial assistance to landless farmers, tenant farmers, and smallholders to support their farming activities and improve income.
- **Details:**
 - The scheme offers **₹10,000 per year** to smallholder farmers in two equal

installments for crop cultivation.

- Over **50 lakh farmers** have benefited from this scheme since its inception in 2018, with the government allocating **₹5,000 crore** for this initiative.
- **Scientific Impact:**
 - **Improvement in Livelihoods:** Research from **Agricultural Economics Research Review** indicates that the KALIA scheme has improved the livelihoods of smallholder farmers by enabling them to invest in agriculture and reduce financial distress.

Rajasthan State Schemes and Status on Farming-Based Livelihood Systems

Rajasthan, a predominantly agrarian state in India, has implemented a variety of state-specific schemes and programs to improve farming-based livelihoods and promote agricultural sustainability. With large portions of the state being arid or semi-arid, the challenges of water scarcity, soil degradation, and climatic variability are critical factors influencing farming. To counter these challenges, the Rajasthan government has introduced a range of innovative schemes aimed at enhancing agricultural productivity, improving farm incomes, and ensuring food security for its population.

Key Schemes and Programs in Rajasthan

1. Mukhya Mantri Kisan Kalyan Yojana (MMKKY)

- **Objective:** This scheme aims to provide financial assistance to farmers in the form of input subsidies to improve agricultural productivity and help in farm welfare. It is designed to benefit all farmers in Rajasthan, with a particular focus on small and marginal farmers.
- **Details:**
 - The scheme provides **₹1,000 per acre** of assistance to farmers for purchasing inputs like seeds, fertilizers, and pesticides.
 - It also covers **irrigation facilities** and offers subsidies on farm machinery and equipment.
 - In the 2022-23 fiscal year, Rajasthan allocated **₹5,000 crore** for the scheme, benefiting more than **70 lakh farmers** across the state.
- **Impact:**
 - **Increased Crop Yields:** Research by the **Rajasthan Agricultural University** indicates that MMKKY has led to an increase in yields, particularly in drought-prone regions, by enabling farmers to purchase quality inputs.
 - **Scientific Impact:** A study from **Agricultural Economics Research Review** found that the scheme helped reduce the financial strain on farmers, particularly in areas facing erratic rainfall, by ensuring they had access to necessary agricultural inputs.

2. Rajeev Gandhi Krishi Vikas Yojana (RGKVY)

- **Objective:** The RGKVY is aimed at promoting sustainable agricultural practices and improving farm productivity through better irrigation, soil management, and the adoption of modern technologies. The scheme targets small and marginal farmers, providing them access to financial assistance for infrastructure development and input subsidies.
- **Details:**
 - The scheme focuses on **water conservation, soil health management, and climate-resilient agriculture**.
 - It also provides **subsidies for drip irrigation** systems, organic farming initiatives, and promotes agroforestry practices.
 - A total of **₹2,500 crore** was allocated in the 2021-22 budget to support the state's agriculture sector under this initiative.
- **Impact:**
 - **Water Use Efficiency:** The introduction of **drip irrigation** in Rajasthan under RGKVY has led to **20-30% savings in water use** and has helped farmers grow crops like vegetables, pulses, and horticulture plants in water-scarce regions.
 - **Organic Farming:** The state has seen an increase in organic farming areas, with more than **1 lakh hectares** of land being converted to organic farming since 2015.

3. Rajasthan State Crop Insurance Scheme

- **Objective:** This scheme offers financial protection to farmers against crop losses due to natural calamities, pest attacks, and diseases. It is aimed at reducing the financial distress faced by farmers after crop failure.
- **Details:**
 - The scheme is a part of the broader **Pradhan Mantri Fasal Bima Yojana (PMFBY)** but has state-specific provisions to make insurance more accessible to farmers in Rajasthan.
 - **Subsidy on Premium:** The state government pays a subsidy of up to **50% of the premium** to farmers, particularly smallholders and marginal farmers.
 - In 2022-23, more than **30 lakh farmers** were covered under the scheme, with claims exceeding **₹1,000 crore** for crop damages caused by floods, droughts, and hailstorms.
- **Impact:**
 - **Risk Mitigation:** According to a report by **ICAR**, the Rajasthan crop insurance scheme has helped farmers mitigate risks associated with extreme weather events, ensuring that they have a financial buffer to recover.
 - **Data Analysis:** An evaluation conducted by the **Ministry of Agriculture** in Rajasthan showed that **65% of insured farmers** were able to recover losses and re-invest in subsequent cropping seasons, improving long-term farm sustainability.

4. Rajasthan Agricultural Marketing Board (RAMB) – E-Market Linkages

- **Objective:** The Rajasthan government has been working to create a more efficient marketing

system through digital platforms that connect farmers with markets directly, reducing the role of intermediaries and ensuring better price discovery for agricultural produce.

- **Details:**
 - The **e-Market system** aims to provide a transparent platform for farmers to access real-time market prices and sell their produce directly to buyers.
 - As of 2023, the state has launched **Rajasthan State Agriculture Marketing Portal (RSAMP)**, through which farmers can sell produce like fruits, vegetables, and grains at optimal prices.
 - The scheme has benefited **over 50,000 farmers** by providing them better market access and improving their profit margins by **10-15%** compared to traditional market systems.
- **Impact:**
 - **Market Efficiency:** The introduction of e-marketing in Rajasthan has reduced farmers' dependency on local traders, leading to better price realization and improved income.
 - **Farmer Empowerment:** A study conducted by the **Rajasthan Agricultural University** found that farmers who used digital marketing platforms saw an increase in their incomes by at least **₹2,000-5,000 per month**, depending on the crop and market conditions.

5. Rajasthan Irrigation Projects and Water Conservation Programs

- **Objective:** Water scarcity is one of the biggest challenges faced by farmers in Rajasthan. To address this, the state government has introduced several irrigation projects and water conservation schemes to promote efficient water use in agriculture.
- **Details:**
 - Rajasthan has undertaken large-scale projects like the **Indira Gandhi Canal Project**, which brings water to the desert regions of western Rajasthan, including Jodhpur, Barmer, and Bikaner.
 - The state also focuses on **rainwater harvesting** and has incentivized the installation of **water conservation techniques** like **ponds, check dams, and water-efficient irrigation systems**.
 - **₹2,500 crore** has been allocated for irrigation schemes in the 2023-24 budget.
- **Impact:**
 - **Increased Crop Area:** The expansion of irrigation infrastructure has enabled farmers to cultivate crops year-round, which was previously not possible due to water scarcity. In areas like **Barmer and Jaisalmer**, irrigation projects have increased crop cultivation by **40-50%**.
 - **Water Use Efficiency:** A study conducted by **Rajasthan Agricultural University** found that the use of drip irrigation systems and water harvesting methods increased water-use efficiency by **25-30%** in drought-prone areas.

6. Mukhyamantri Chiranjeevi Yojana (Health and Welfare for Farmers)

- **Objective:** Although not directly related to farming, this welfare scheme addresses the health and well-being of farmers, which is crucial for their livelihood. The scheme provides farmers with access to **free medical treatment, insurance, and health services**.
- **Details:**
 - It covers medical expenses for farmers, especially for severe diseases, accidents, and health emergencies.
 - The scheme also provides financial support for **hospitalization**, ensuring that farmers do not fall into poverty due to medical costs.
 - In 2022-23, over **30 lakh** farmers and their families were covered under the scheme.
- **Impact:**
 - **Health Security:** According to a survey conducted by the **Rajasthan Rural Health Mission**, over **80% of farmers** expressed relief from the financial burden of healthcare costs, leading to increased farm productivity.
 - **Social Protection:** This scheme has improved social protection for rural families, especially in remote areas, by offering them access to essential healthcare services.

16. Public and Private organizations involved in promotion of farming-based livelihood opportunities

Public and Private Organizations Involved in the Promotion of Farming-Based Livelihood Opportunities

Farming-based livelihoods are crucial for rural economies in India. Various organizations, both public and private, play an essential role in improving agricultural productivity, providing market access, offering financial support, and promoting sustainable farming practices. These organizations focus on several key areas, such as training, technology, irrigation, crop insurance, financial inclusion, and agricultural exports. Below is a detailed overview of both public and private organizations involved in promoting farming-based livelihood opportunities in India.

Public Organizations

1. Ministry of Agriculture and Farmers' Welfare (MoAFW)

- **Role:** The Ministry of Agriculture and Farmers' Welfare is the central body responsible for formulating and implementing agricultural policies and programs in India. The ministry works to increase agricultural productivity, ensure food security, and enhance farmers' welfare.
- **Key Initiatives:**
 - **National Food Security Mission (NFSM):** Aimed at increasing the production of essential crops such as wheat, rice, pulses, and coarse cereals. It encourages the adoption of improved farming techniques and technology for enhancing productivity.
 - **Pradhan Mantri Kisan Samman Nidhi (PM-KISAN):** Direct income support of ₹6,000 per year is provided to small and marginal farmers in three equal installments. This helps in improving their financial stability and livelihoods.
 - **Pradhan Mantri Fasal Bima Yojana (PMFBY):** A crop insurance scheme that provides financial support to farmers in case of crop failure due to natural calamities, pest attacks, or diseases.
 - **National Mission for Sustainable Agriculture (NMSA):** Promotes sustainable agricultural practices that reduce dependency on external inputs and are climate-resilient.
- **Impact:**
 - These programs have directly impacted over 14 crore farmers, with significant improvements in crop insurance uptake and income support under PM-KISAN.
 - The NFSM and NMSA have helped increase food grain production and promote organic farming practices in various parts of India.

2. National Bank for Agriculture and Rural Development (NABARD)

- **Role:** NABARD is the leading financial institution in India responsible for promoting sustainable rural development and supporting agricultural and rural infrastructure projects. It provides credit support, training, and technical assistance for farm-related enterprises.
- **Key Initiatives:**
 - **Rural Infrastructure Development Fund (RIDF):** NABARD finances the creation of rural infrastructure such as irrigation facilities, warehouses, cold storage, and rural roads to enhance farming-based livelihoods.
 - **Microfinance and Self-Help Groups (SHGs):** NABARD supports SHGs, particularly in rural areas, enabling access to financial resources and promoting income-generating activities like agriculture, dairy farming, and poultry.
 - **Farmer Producer Organizations (FPOs):** NABARD has been instrumental in the formation and strengthening of FPOs, which help farmers aggregate their produce, access markets, and benefit from economies of scale.
- **Impact:**
 - NABARD's initiatives have led to the establishment of over **5,000 FPOs** across India, empowering farmers to access better market prices and reduce their dependency on intermediaries.
 - NABARD's funding has helped establish irrigation systems in drought-prone areas, leading to improved water availability and agricultural productivity.

3. Indian Council of Agricultural Research (ICAR)

- **Role:** ICAR is an autonomous body under the Ministry of Agriculture responsible for coordinating agricultural research and technology in India. It develops new agricultural practices, technologies, and crop varieties that contribute to increased productivity and sustainability.
- **Key Initiatives:**
 - **Varietal Development:** ICAR develops high-yielding, pest-resistant, and drought-tolerant crop varieties that cater to India's diverse agro-climatic zones.
 - **Technology Transfer:** ICAR plays a major role in transferring new agricultural technologies and practices to farmers through extension services, demonstrations, and training programs.
 - **Sustainable Agriculture:** ICAR is actively promoting conservation agriculture, organic farming, and integrated pest management (IPM) to enhance long-term soil health and reduce environmental impact.
- **Impact:**
 - ICAR's work has led to the development of several high-yielding varieties of crops such as wheat, rice, and pulses, which have helped improve farm productivity.
 - The adoption of ICAR technologies in various parts of India has resulted in increased

agricultural output and enhanced farmer incomes, particularly in drought-prone and rainfed areas.

4. Food and Agriculture Organization (FAO)

- **Role:** The FAO is a specialized agency of the United Nations that leads international efforts to defeat hunger and promote sustainable agriculture. FAO collaborates with the Indian government to implement programs that promote food security, agriculture, and rural development.
 - **Key Initiatives:**
 - **Sustainable Agriculture:** FAO promotes the adoption of climate-smart agriculture (CSA) practices in India, which aim to increase productivity, resilience to climate change, and reduce carbon emissions.
 - **Livelihood Diversification:** FAO supports farmers in diversifying their livelihoods through activities such as agroforestry, livestock management, and small-scale agro-processing.
 - **Disaster Risk Reduction:** FAO works on building resilience in farming communities to mitigate risks from natural disasters, including floods, droughts, and pest outbreaks.
 - **Impact:**
 - FAO's initiatives in India have contributed to the development of sustainable farming systems, particularly in water-scarce regions.
 - FAO has helped introduce risk-reducing measures such as drought-resistant crops and water-efficient irrigation technologies, improving the livelihoods of vulnerable farmers.
-

5. Agricultural and Processed Food Products Export Development Authority (APEDA)

- **Role:** APEDA is responsible for promoting the export of agricultural products, especially processed foods, fruits, vegetables, and organic products. It helps farmers access global markets, thereby improving their incomes through export opportunities.
- **Key Initiatives:**
 - **Organic Certification:** APEDA facilitates organic certification for farmers, enabling them to access premium markets in India and abroad.
 - **Market Linkages:** The agency helps farmers link directly with international buyers, ensuring better price realization and reducing reliance on middlemen.
 - **Export Promotion:** APEDA conducts training programs for farmers on export norms, quality standards, and packaging, helping them meet international market demands.
- **Impact:**
 - APEDA has helped Indian farmers expand their market reach globally, particularly for products such as **mangoes, spices, rice, and tea**, boosting their incomes significantly.
 - The increase in organic farming, supported by APEDA, has enabled farmers to command higher prices for their produce.

Private Organizations Involved in Promoting Farming-Based Livelihood Opportunities

1. Mahindra Agribusiness

- **Role:** Mahindra Agribusiness, part of the Mahindra Group, focuses on enhancing agricultural productivity and supporting rural livelihoods through a range of services, including farm equipment, technology, and financial services.
 - **Key Initiatives:**
 - **Farm Equipment:** Mahindra manufactures tractors, harvesters, and irrigation equipment, which helps farmers increase productivity and reduce labor costs.
 - **Digital Platforms:** Mahindra's **Samriddhi** platform provides farmers with information about weather, market prices, and agricultural practices to improve decision-making.
 - **Agri-Value Chains:** The company works with farmers to improve agricultural value chains, from production to marketing, to ensure higher income generation.
 - **Impact:**
 - Mahindra's initiatives have provided **over 1 million farmers** with access to high-quality farm machinery, which has improved productivity and reduced post-harvest losses.
 - Through **Samriddhi**, Mahindra has helped farmers increase their incomes by **10-15%** through better market access and improved farming practices.
-

2. ITC Limited – Agri Business Division

- **Role:** ITC Limited is a leading conglomerate in India, and its Agri Business Division focuses on improving farmers' livelihoods through contract farming, market access, and value chain development.
- **Key Initiatives:**
 - **Contract Farming:** ITC's **e-Choupal** initiative links farmers directly to the company, providing them with inputs, training, and better price realization for their produce.
 - **Agri-Value Chains:** ITC works with farmers to enhance agricultural value chains in crops such as **wheat, maize, and soybean**.
 - **Farmer Empowerment Programs:** ITC provides farmers with technical expertise, weather forecasts, and advice on farming techniques through its **e-Choupal** platform.
- **Impact:**
 - ITC's contract farming model has enabled farmers to increase their incomes by up to **20-30%** through improved access to markets and better prices for their produce.
 - Through **e-Choupal**, ITC has empowered **over 4 million farmers**, providing them with a range of services, from training on sustainable farming practices to access to financial resources.

3. Tata Trusts – Rural Development and Agriculture Program

- **Role:** Tata Trusts plays a significant role in rural development, with a focus on improving

farming-based livelihoods, water management, agriculture, and sustainable practices.

- **Key Initiatives:**

- **Sustainable Agriculture:** Tata Trusts supports the promotion of organic farming, water-efficient agricultural practices, and natural resource management through training, capacity-building, and farmer mobilization programs.
- **Watershed Development:** The Trusts work on watershed management projects to improve water availability and implement water conservation measures like check dams, ponds, and rainwater harvesting, which directly support farming activities in drought-prone areas.
- **Livelihood Diversification:** Tata Trusts also promotes livelihood diversification by encouraging activities such as **dairy farming, poultry farming**, and small-scale agro-processing. These initiatives help farmers reduce dependence on a single crop and create additional income streams.
- **Capacity Building & Knowledge Transfer:** They run several training programs, workshops, and demonstrations on better farming techniques, organic practices, and climate-resilient farming.

- **Impact:**

- Through initiatives like watershed development, Tata Trusts has helped improve water access and agricultural productivity in **over 200,000 hectares** of land in various parts of India.
- Their support in organic farming and water-efficient practices has led to increased yields and resilience against climate variability for thousands of farmers, particularly in regions vulnerable to droughts and water scarcity.

4. Agri-Tech Startups and Digital Platforms

Agri-tech startups have increasingly emerged as key players in supporting farming-based livelihoods through technology-driven solutions. These startups provide a range of services that include access to information, improved market linkages, better farming practices, and financial inclusion for farmers.

- **Role:** Agri-tech startups focus on providing innovative solutions to address challenges faced by farmers in terms of productivity, market access, crop insurance, and resource management.
- **Key Initiatives:**
 - **Market Linkage and E-Commerce Platforms:** Startups like **Ninjacart, AgroStar**, and **DeHaat** are providing digital platforms that connect farmers directly to buyers, allowing them to sell produce at better prices, bypassing middlemen, and reducing post-harvest losses.
 - **Agri-inputs and Farm Advisory:** Companies like **AgroStar** and **Farmizen** offer digital platforms for providing agricultural inputs (seeds, fertilizers, pesticides) and advisory services to farmers. These platforms provide farmers with recommendations based on weather data, soil health, and best practices.

- **Insurance and Finance:** Platforms like **AcrePay** and **Fasal** offer crop insurance and financing solutions based on real-time data, which helps mitigate risks due to weather-related events or pest infestations.
- **Precision Agriculture:** Startups such as **CropIn Technology** offer solutions based on data analytics, IoT devices, and AI to help farmers increase yields through precision farming, better crop management, and resource optimization.
- **Impact:**
 - Agri-tech solutions have empowered **millions of farmers** with access to real-time market prices, farm inputs, weather forecasts, and agronomic advice, leading to better decision-making and increased incomes.
 - Platforms like **Ninjacart** have helped **over 500,000 farmers** by connecting them directly to retailers and improving their income by cutting down intermediaries.

17. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy

Role of Farming-Based Livelihood Enterprises in the 21st Century in View of Circular Economy

In the 21st century, farming-based livelihood enterprises are increasingly being integrated into the concept of **circular economy**, which focuses on creating sustainable systems that minimize waste, optimize resource use, and enhance environmental and economic resilience. Traditional farming systems are being reimagined with circular economy principles in mind to promote **sustainable agriculture, resource efficiency, and environmental conservation**.

The role of farming-based livelihood enterprises in the circular economy involves transforming farming practices and agricultural value chains to be more sustainable and regenerative. Below is an in-depth look at how farming-based livelihoods contribute to and benefit from circular economy principles, with authentic data supporting these practices.

What is a Circular Economy?

A **circular economy** is an economic model that emphasizes reusing, recycling, and regenerating resources, as opposed to the traditional linear economy, which follows the "take-make-dispose" model. In the context of agriculture, this translates into:

- **Closing the loop of agricultural waste** through composting, recycling, and reusing.
- **Sustainable resource management**, where materials like water, energy, and nutrients are continuously cycled back into the system.
- **Promoting regenerative practices**, such as organic farming, agroforestry, and soil health restoration.

Role of Farming-Based Livelihood Enterprises in the Circular Economy

1. Sustainable Agricultural Practices

Farming-based livelihood enterprises play a significant role in promoting **sustainable agriculture**, which is the foundation of a circular economy. In sustainable farming, resources are efficiently managed, and there is a reduction in reliance on synthetic inputs such as fertilizers, pesticides, and water.

- **Agroecology**: Agroecological practices, which integrate ecological principles into farming, aim to reduce environmental impacts. For example, **crop rotation, intercropping, and companion planting** are sustainable methods that increase biodiversity and help maintain soil fertility, contributing to a more resilient food production system.
- **Organic Farming**: Organic farming eliminates synthetic chemicals and emphasizes natural

inputs, such as compost, manure, and biological pest control. This aligns with the principles of the circular economy, as it aims to regenerate soils and ecosystems.

Data: According to a report by the **Food and Agriculture Organization (FAO)**, **agroecological approaches** can increase soil organic matter, enhance water retention, and reduce input costs, while improving productivity over the long term.

2. Waste Minimization and Resource Recycling

Farming-based livelihood enterprises in the circular economy actively focus on minimizing waste and promoting the recycling of organic waste into valuable products like compost, biogas, and animal feed.

- **Agro-waste Recycling:** Crop residues, animal waste, and food processing by-products are recycled into bioenergy (such as biogas), compost, or used as animal feed. These practices reduce environmental pollution and provide valuable resources for the farm.
 - **Biogas Production:** Waste from livestock (manure) can be converted into biogas, which can be used as a renewable source of energy for cooking or lighting. This reduces dependence on fossil fuels, while also generating economic value.
 - **Composting:** Organic farm waste such as crop residues, leaves, and kitchen waste can be composted to create nutrient-rich organic fertilizers, reducing the need for chemical fertilizers and promoting soil health.

Data: According to a study by **Indian Agricultural Research Institute (IARI)**, converting agricultural residues into **biogas** could reduce **11 million tons** of CO₂ emissions annually in India, while also providing rural households with a source of renewable energy.

3. Energy Efficiency and Renewable Energy in Farming

Farming-based livelihood enterprises are increasingly adopting **renewable energy sources**, such as solar power, to reduce their dependence on conventional energy and improve energy efficiency in agriculture. This is essential for reducing the carbon footprint and making agriculture more sustainable.

- **Solar Irrigation:** Solar-powered irrigation systems have been widely adopted in regions with limited access to electricity. These systems reduce dependency on diesel or grid-based electricity for irrigation, which helps lower energy costs and minimize emissions.
- **Solar Drying:** Solar dryers are used for drying crops like fruits, vegetables, and grains, improving the shelf life of produce and reducing food wastage.

Data: The **National Bank for Agriculture and Rural Development (NABARD)** reports that **over 2,000 solar irrigation projects** have been implemented across India, providing energy-efficient solutions to farmers while improving water management.

4. Regenerative Agriculture and Soil Health Restoration

Soil health restoration is a key principle of the circular economy. By using regenerative practices, farming-based livelihood enterprises can contribute to improving soil fertility, increasing carbon sequestration, and reducing soil erosion.

- **Agroforestry:** Integrating trees into agricultural systems not only improves soil health but also helps in carbon sequestration. Trees improve soil structure, reduce erosion, and provide habitat for biodiversity, contributing to the sustainability of the entire farm ecosystem.

- **Cover Cropping and Green Manuring:** These practices help to fix nitrogen in the soil, reduce soil erosion, and improve water retention, thus enhancing the productivity of the soil without external chemical inputs.

Data: A study by the **International Food Policy Research Institute (IFPRI)** indicates that **regenerative farming** practices can increase soil carbon content by up to **25%** and improve crop yields by **15-30%** over time, leading to more sustainable and profitable farming systems.

5. Circular Economy in Livestock Farming

Livestock farming is another important area where circular economy principles can be applied. Integrating livestock farming into a circular economy helps improve farm productivity while minimizing environmental impacts.

- **Integrated Livestock Systems:** Livestock, including cattle, goats, and poultry, are integrated into farming systems where manure is used for composting or biogas production, reducing the need for synthetic fertilizers and promoting nutrient cycling.
- **Agro-Processing:** The circular economy can also help in processing by-products from livestock farming (such as hides, wool, and dairy waste) to create value-added products like biofertilizers, leather, and compost, reducing waste and generating additional income streams for farmers.

Data: According to the **National Dairy Development Board (NDDB)**, integrating livestock in mixed farming systems has resulted in improved yields for both crops and livestock by up to **20-30%**, while also reducing the cost of production.

6. Circular Economy and Market Access for Farmers

A circular economy approach also enhances **market linkages**, ensuring that farmers can access sustainable markets for their produce, including organic and value-added products.

- **Farmer Producer Organizations (FPOs):** These organizations help farmers aggregate their produce and negotiate better prices, ensuring fair compensation for their efforts. FPOs also help in reducing waste by enabling farmers to collectively store, process, and distribute their products, thus reducing post-harvest losses.
- **Supply Chain Efficiency:** Circular economy principles encourage the development of short supply chains that focus on local sourcing, which can reduce transportation emissions and ensure fresher produce for consumers.

Data: According to the **Ministry of Agriculture**, FPOs have improved the incomes of farmers by **30-40%** due to better market access and reduced post-harvest losses.

Challenges and Opportunities for Farming-Based Livelihood Enterprises in the Circular Economy

Challenges:

1. **Knowledge and Training:** Many farmers still lack access to knowledge and training on sustainable practices, which hinders the adoption of circular economy principles in agriculture.
2. **High Initial Investment:** Adopting renewable energy systems (like solar) or implementing resource-efficient technologies can be capital-intensive, making it difficult for smallholder farmers to access such solutions.

3. **Supply Chain Issues:** Lack of infrastructure and organized supply chains can reduce the effectiveness of circular economy practices, particularly in rural areas where access to markets and storage facilities is limited.
4. **Policy and Regulatory Support:** There is a need for clearer and more supportive policies that encourage circular economy practices, especially in the agriculture sector.

Opportunities:

1. **Government Support and Schemes:** The Indian government has been promoting **sustainable farming** through various schemes like **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)** for irrigation and **National Mission for Sustainable Agriculture (NMSA)** for enhancing soil health.
2. **Technological Innovation:** Advances in agri-tech, such as **precision farming** and **drone-based monitoring systems**, provide opportunities to optimize resource use and reduce waste in farming.
3. **Consumer Demand for Sustainable Products:** Growing consumer awareness of environmental issues and the demand for organic and sustainably produced food presents an opportunity for farmers to tap into new markets.

Role of Farming-Based Livelihood Enterprises in the 21st Century in View of Green Economy

A **green economy** is one that prioritizes **sustainable development**, focusing on reducing environmental risks and ecological scarcities while promoting social equity and economic growth. In the context of **farming-based livelihood enterprises**, the green economy emphasizes practices that reduce environmental degradation, increase resource efficiency, and promote the conservation of natural resources.

The 21st century has witnessed the need to incorporate **green economy principles** into farming practices to address challenges such as climate change, soil degradation, and loss of biodiversity, while enhancing the resilience of farming systems. This integration leads to **sustainable livelihoods** for farmers, particularly in rural and agrarian communities.

What is a Green Economy?

A **green economy** is one that strives for:

- **Sustainable agriculture** that ensures food security while maintaining ecological balance.
- **Resource efficiency** where the inputs (like water, energy, and nutrients) are used optimally and waste is minimized.
- **Climate-smart farming** practices to reduce the impacts of climate change.
- **Biodiversity conservation** by maintaining and restoring ecosystems that support agricultural production.
- **Equitable growth** that fosters social inclusion and improves the livelihoods of farmers.

In the context of farming, a green economy is rooted in promoting sustainable agriculture practices, including organic farming, agroforestry, water conservation, biodiversity enhancement, and renewable energy utilization.

Role of Farming-Based Livelihood Enterprises in a Green Economy

1. Adoption of Climate-Smart Agricultural Practices

Farming enterprises are adopting **climate-smart agriculture (CSA)** to increase resilience to climate change while minimizing the carbon footprint. CSA integrates sustainable farming practices that adapt to climate change, reduce greenhouse gas emissions, and increase productivity.

- **Zero-Tillage Farming:** Reduces soil erosion, improves water retention, and decreases fuel use. This is a major step towards reducing the carbon footprint of farming.
- **Agroforestry:** Planting trees alongside crops improves soil fertility, conserves water, and sequesters carbon. This also helps in diversifying income by providing timber, fruits, and other resources.
- **Water-Efficient Irrigation:** Practices such as **drip irrigation** and **rainwater harvesting** help reduce water usage, thus conserving a vital resource in agriculture, especially in regions prone to drought.

Data: According to the **Food and Agriculture Organization (FAO)**, climate-smart agricultural practices can help increase agricultural productivity by **20-30%** and reduce greenhouse gas emissions by up to **30%**.

2. Promoting Organic and Regenerative Farming

Green economy principles emphasize the shift from chemical-based agriculture to **organic farming** and **regenerative agriculture**, which restore soil health, conserve biodiversity, and reduce reliance on synthetic inputs.

- **Organic Farming:** Organic farming eliminates the use of synthetic chemicals, pesticides, and fertilizers, focusing on natural inputs like compost, biological pest control, and crop rotations. This method significantly reduces pollution and preserves ecosystems.
- **Regenerative Agriculture:** Practices such as cover cropping, rotational grazing, and holistic land management are used to restore degraded land, improve soil health, increase carbon sequestration, and enhance water retention.

Data: According to **IFOAM – Organics International**, the global market for organic products has grown by **around 8% annually**, demonstrating the increasing demand for environmentally friendly farming methods.

3. Waste Management and Resource Recycling

A core component of the green economy is **resource circularity**—minimizing waste, recycling nutrients, and reusing agricultural by-products. This reduces waste, improves farm productivity, and contributes to environmental conservation.

- **Composting:** Organic waste from crops, food processing, and livestock can be composted and used as organic fertilizer, reducing the need for chemical fertilizers and promoting soil health.
- **Biogas Production:** Livestock waste can be converted into biogas for cooking and heating, reducing dependency on fossil fuels and providing renewable energy.
- **Waste-to-Value:** The creation of value-added products from agricultural waste, such as bioplastics, animal feed, or natural fibers, helps reduce environmental impact and creates

additional income streams for farmers.

Data: A study by the **Indian Council of Agricultural Research (ICAR)** shows that **organic farming** practices can lead to an **8-10% increase in farm productivity** and a **20-30% reduction in water usage** when integrated with rainwater harvesting and efficient irrigation systems.

4. Enhancing Biodiversity and Ecosystem Services

Farming-based enterprises that adopt green economy principles contribute to maintaining and enhancing **biodiversity** and **ecosystem services**, which are essential for long-term agricultural productivity.

- **Agro-Biodiversity:** By planting a variety of crops, livestock, and trees, farmers can help preserve biodiversity and ecosystem services such as pollination, pest control, and soil fertility.
- **Pollinator-Friendly Farming:** Supporting the health of pollinators (such as bees) through reduced pesticide use and diverse farming systems can improve crop yields and preserve ecosystems.
- **Wetland Restoration and Watershed Management:** Protecting and restoring natural wetlands and watersheds ensures water quality and availability, which is vital for farming sustainability.

Data: The **United Nations Environment Programme (UNEP)** reports that biodiversity-enhancing farming practices can increase **pollination** efficiency, contributing to higher yields and improved food security for farmers.

5. Renewable Energy Adoption

The green economy encourages the use of **renewable energy** sources to reduce dependence on fossil fuels in farming operations. Solar, wind, and biogas technologies are increasingly being adopted by farming-based livelihood enterprises.

- **Solar-Powered Irrigation:** Farmers in regions with abundant sunlight are increasingly turning to **solar pumps** for irrigation, which reduces costs and eliminates the need for fossil-fuel-powered pumps.
- **Biogas Plants:** Livestock farming operations often generate large amounts of waste. Converting this waste into biogas for energy can reduce emissions and generate clean energy for rural communities.

Data: According to the **Ministry of New and Renewable Energy (MNRE)**, India has over **150,000 solar irrigation pumps** deployed across rural areas, providing affordable, clean energy for farmers.

6. Sustainable Food Systems and Market Linkages

In a green economy, farming-based livelihood enterprises are increasingly focusing on **sustainable food systems** that include **local food production**, **short food supply chains**, and **fair-trade practices**.

- **Local Food Production:** Farmers are encouraged to grow a variety of crops suited to local climates and markets, reducing dependency on imported food and minimizing the environmental footprint of long-distance transportation.
- **Fair Trade and Organic Certification:** Promoting fair trade and organic certification allows farmers to access higher-value markets, providing better incomes and supporting sustainable

farming practices.

Data: According to the **Fair Trade International** report, the global fair trade market has grown by **10% annually**, reflecting increasing consumer demand for ethically produced and environmentally sustainable food products.

Challenges and Opportunities for Green Economy in Farming-Based Livelihood Enterprises

Challenges:

1. **Initial Investment and Capital:** Green economy practices, such as organic farming or renewable energy systems, often require substantial initial investments. Farmers, particularly smallholders, may struggle to afford these upfront costs.
2. **Knowledge and Skills:** There is often a lack of technical knowledge or training for farmers to implement sustainable farming practices effectively. Farmers may also be resistant to change due to unfamiliarity with green technologies.
3. **Market Access:** While demand for organic and sustainable products is growing, many farmers face challenges in accessing markets that offer fair prices for their produce.
4. **Policy Support:** Although there is some support from governments, green farming initiatives still lack cohesive and widespread policy frameworks that can incentivize widespread adoption.

Opportunities:

1. **Government Schemes:** Government initiatives such as **PM-KISAN** (Pradhan Mantri Kisan Samman Nidhi), **National Mission for Sustainable Agriculture (NMSA)**, and **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)** provide financial support, technology, and knowledge transfer to encourage green farming.
2. **Increasing Consumer Awareness:** The growing demand for **organic, locally sourced, and fair-trade** products provides farmers with better market access and higher income potential.
3. **Technological Innovation:** Advances in agri-tech, such as **precision farming, drones, and remote sensing**, are making it easier to adopt green practices and increase farm productivity.

18.Climate Change, Digitalization, and Changing Lifestyles

Climate Change, Digitalization, and Changing Lifestyles in Farming-Based Livelihoods:

Farming-based livelihoods, particularly in developing countries, have long been a backbone of rural economies. However, three critical forces—**climate change**, **digitalization**, and **changing lifestyles**—are reshaping these systems, introducing both challenges and opportunities. In this detailed exploration, we will examine how each of these factors is influencing farming-based livelihoods, how they interact with one another, and the potential pathways for adaptation and growth.

1. Climate Change and Its Impact on Farming-Based Livelihoods

Climate change refers to long-term shifts in temperature, weather patterns, and climate conditions that are affecting ecosystems and societies globally. Farming, which is highly dependent on natural resources, is particularly vulnerable to these changes. Here's how climate change is influencing agricultural systems:

a. Changing Weather Patterns and Extreme Events

- **Droughts:** Prolonged periods of low rainfall, combined with higher temperatures, lead to droughts that reduce the availability of water for irrigation. In many regions, especially those dependent on rainfed agriculture, this can devastate crop production.
- **Flooding and Unpredictable Rainfall:** Irregular rainfall patterns, heavy storms, and floods have become more frequent in several areas. These events can destroy crops, erode soil, and disrupt planting and harvesting schedules, all of which threaten food security and farmers' incomes.
- **Temperature Extremes:** Increasing temperatures impact crop growth, especially those sensitive to heat. Crops like wheat, rice, and maize are struggling in regions experiencing heatwaves, with yields declining as the growing season shortens or becomes inconsistent.

b. Shifting Growing Seasons

Farmers are used to planting and harvesting based on traditional weather patterns, but with climate change, these cycles are no longer predictable. Seasons are becoming more erratic, affecting the timing of planting and harvesting, which in turn impacts crop yields. For instance, in many regions, the monsoon seasons are either delayed or occur too heavily at once, leading to poor crop establishment or flooding.

c. Water Scarcity and Irrigation Challenges

Water is essential for irrigation, livestock, and crop growth. In many parts of the world, climate change is exacerbating existing water scarcity issues, particularly in arid and semi-arid regions. Rivers and groundwater levels are drying up, reducing the availability of water for farming and increasing competition for this vital resource.

d. Increased Pests and Diseases

Warmer temperatures, higher humidity, and fluctuating rainfall patterns create ideal conditions for pests and diseases to thrive. Crop diseases like rusts, blights, and fungal infections spread more rapidly under these conditions, damaging crops and reducing yields.

e. Adaptation Strategies

Farmers are adopting various strategies to mitigate climate risks:

- **Climate-Resilient Crops:** Farmers are shifting to drought-resistant, heat-tolerant, and pest-resistant varieties. Genetically modified (GM) crops or hybrid seeds may become increasingly important.
- **Agroecology and Agroforestry:** Sustainable farming methods that integrate trees and diverse cropping systems can help protect the soil, increase biodiversity, and provide resilience against extreme weather events.
- **Water-Saving Technologies:** Drip irrigation systems, rainwater harvesting, and other water-efficient technologies can help reduce water consumption, especially in areas where water resources are limited.
- **Early Warning Systems and Climate Data:** Access to real-time climate data through weather forecasting services, satellite imagery, and early warning systems can help farmers plan ahead, avoiding crop losses by adapting planting schedules based on climate predictions.

2. Digitalization in Agriculture

The digital revolution is transforming every sector, and agriculture is no exception. Digital technologies—ranging from simple mobile apps to complex AI-powered systems—are revolutionizing how farmers manage their operations. These technologies help farmers address the challenges posed by climate change, improve productivity, and access new markets.

a. Precision Agriculture

- **Sensors, Drones, and GPS Technology:** Farmers use satellite-based GPS technology, drones, and soil sensors to monitor soil health, crop growth, and field conditions in real time. This data allows for more precise farming practices, optimizing the use of resources (water, fertilizers, pesticides) and maximizing yields.
- **Variable Rate Technology (VRT):** VRT systems enable farmers to apply fertilizers, pesticides, and irrigation water at variable rates based on field conditions, reducing input costs and minimizing environmental impact.

b. Mobile Applications and Access to Information

- **Weather Forecasting and Pest Control Apps:** Farmers now have access to weather forecasts, real-time pest alerts, and crop management advice on their smartphones, enabling them to make informed decisions and act quickly in response to changing conditions.
- **Financial and Market Information:** Mobile apps provide real-time market prices, enabling farmers to make better decisions about when and where to sell their produce, maximizing profits. Digital financial services also help farmers access credit, insurance, and subsidies.

c. Digital Marketplaces and E-Commerce

- **Direct-to-Consumer Platforms:** Digital platforms allow farmers to bypass traditional supply chains, directly selling their produce to consumers via online marketplaces. This can lead to better prices and more efficient transactions.
- **Blockchain for Transparency:** Blockchain technology is used to ensure traceability and transparency in food supply chains. Consumers can trace the origin and quality of products, while farmers gain more reliable access to markets that value sustainable, certified produce.

d. Benefits and Challenges of Digitalization

- **Benefits:** Digital tools can boost agricultural productivity, reduce costs, improve decision-making, and open new markets. They enable smallholder farmers to access global supply chains and connect with consumers directly.
- **Challenges:** There is a significant digital divide in rural areas, where access to the internet and smartphones is limited. The costs of acquiring digital tools and training farmers to use them may also hinder adoption, especially among small-scale farmers.

3. Changing Lifestyles and Their Influence on Farming-Based Livelihoods

Changing consumer preferences, urbanization, and shifts in societal values are altering the landscape of agriculture. These trends are both challenging and offering new opportunities to farmers.

a. Urbanization and Migration

As cities grow, rural populations shrink as young people migrate to urban centers in search of better employment opportunities. This trend results in an aging farming population, with fewer people available to work on the land. The shift from rural to urban living also reduces the availability of labor for agriculture, affecting productivity.

b. Shifts in Consumer Preferences

- **Health and Sustainability Trends:** Consumers are increasingly seeking healthier, sustainable, and organic food options. There is rising demand for organic produce, free-range meat, and sustainably sourced goods.
- **Demand for Processed Foods:** In contrast, urban populations are also driving the demand for processed foods, packaged goods, and convenience foods. This may lead farmers to adopt more intensive farming methods to meet these demands.

c. Local Food Movements and Sustainable Agriculture

- **Farm-to-Table and Direct-to-Consumer Trends:** There is a growing interest in local food systems, which is benefiting farmers who engage in direct sales, such as through farmers' markets, community-supported agriculture (CSA), and food cooperatives.
- **Organic and Regenerative Agriculture:** With increasing concerns about environmental degradation, organic farming and regenerative agriculture practices are gaining popularity. These methods focus on soil health, biodiversity, and minimal chemical use, aligning with consumer values around sustainability.

d. New Opportunities for Smallholder Farmers

Smallholder farmers can find new income opportunities in niche markets that demand organic, fair-trade, and sustainably produced goods. However, entering these markets requires meeting higher standards, obtaining certifications, and often higher upfront investments.

e. Pressure to Diversify

In response to changing diets and market demands, farmers are diversifying their production. This could mean growing new crops, introducing agroforestry systems, or even diversifying into value-added products like jams, juices, or processed foods to capture higher value from their produce.

4. Interactions and Synergies Between Climate Change, Digitalization, and Changing Lifestyles

The interplay between climate change, digitalization, and changing lifestyles is complex, but can create synergies that benefit farmers:

- **Climate Change + Digitalization:** Digital technologies, like precision agriculture tools and weather forecasting apps, can help farmers adapt to climate change by enabling better decision-making, more efficient resource use, and improved risk management strategies.
- **Climate Change + Changing Lifestyles:** As consumers demand more sustainable products, there is an incentive for farmers to adopt climate-smart practices. Sustainable, climate-resilient farming practices can provide a competitive edge in the growing organic and eco-friendly food market.
- **Digitalization + Changing Lifestyles:** Digital platforms and e-commerce allow farmers to meet the demand for locally sourced, organic, and sustainably grown food, tapping into the increasing consumer preference for these products.

FARMING BASED LIVELIHOOD SYSTEMS

AGR-112

Credit (2+1) = 3

Compiled By:

TEAM AGRI CAPITAL

BY Mr. MAHI CHOUDHARY BHU

Mr. ISHWAR CHOUDHARY PDKV



