Integrated Farming Management

(22ZOONME32)

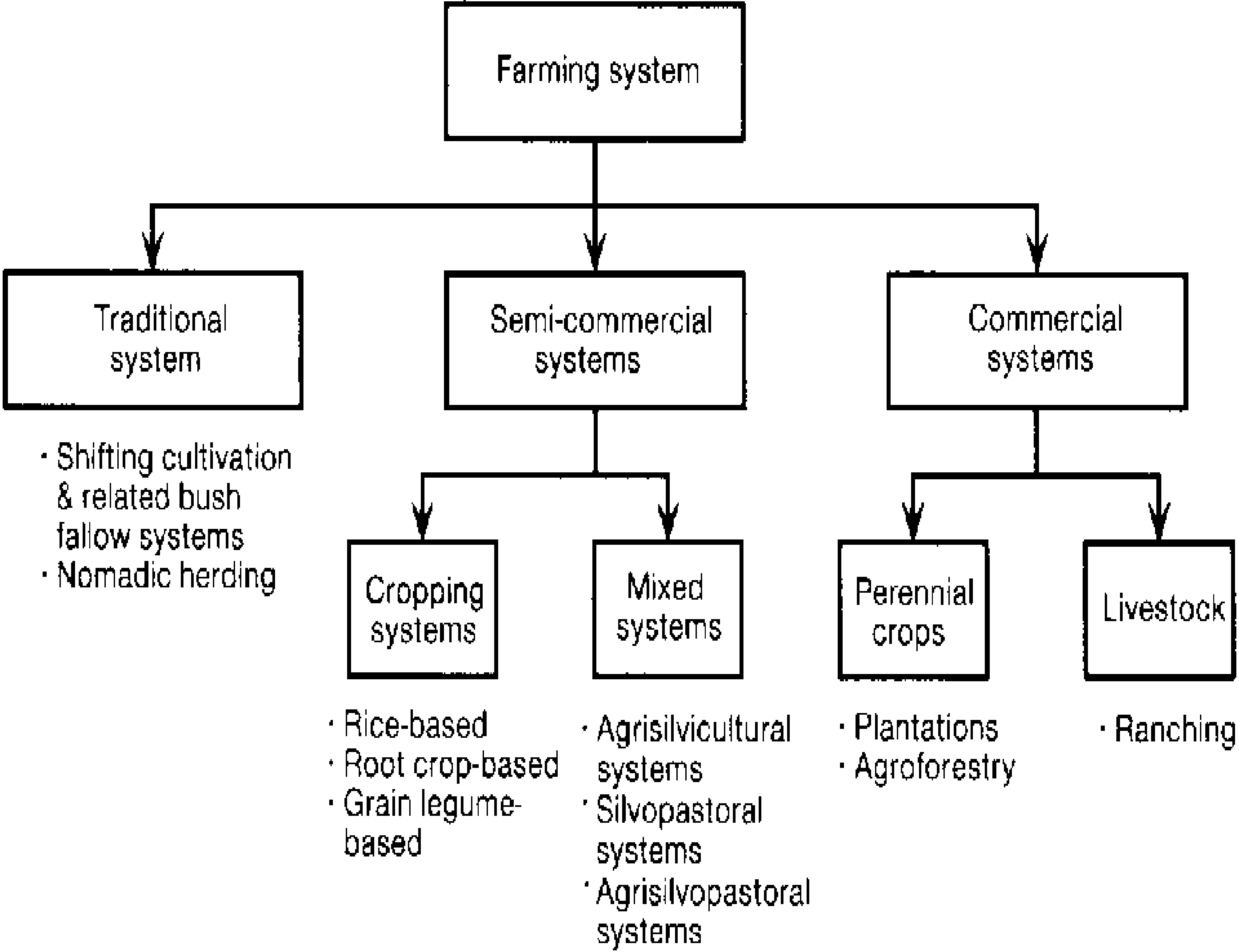
Farming Systems

FARMING SYSTEM

- A farming system is defined as a complex interrelated matrix of soil, plants ,animals, implements, power, labor, 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.

Types of farming

- Subsistence Farming. ...
- Intensive and extensive farming.
- Commercial farming.
- Plantation Farming.
- Dry Land Farming.
- Wetland farming.
- Mixed farming.
- Organic farming.


Farming system
Traditional system
Semi-commercial systems
Commercial systems
· Shifting cultivation & related bush fallow systems
· Nomadic herding
Cropping systems
Mixed systems
Perennial crops
Livestock
· Rice-based
· Root crop-based
· Grain legume-based
· Agrisilvicultural systems
· Silvopastoral systems
· Agrisilvopastoral systems
· Plantations
· Agroforestry
· Ranching

Type of Rotation:

- a) Lay system:
  - i) unregulated lay farming
  - ii) regulated lay system.
- b) Field system.
- c) Perennial crop system.

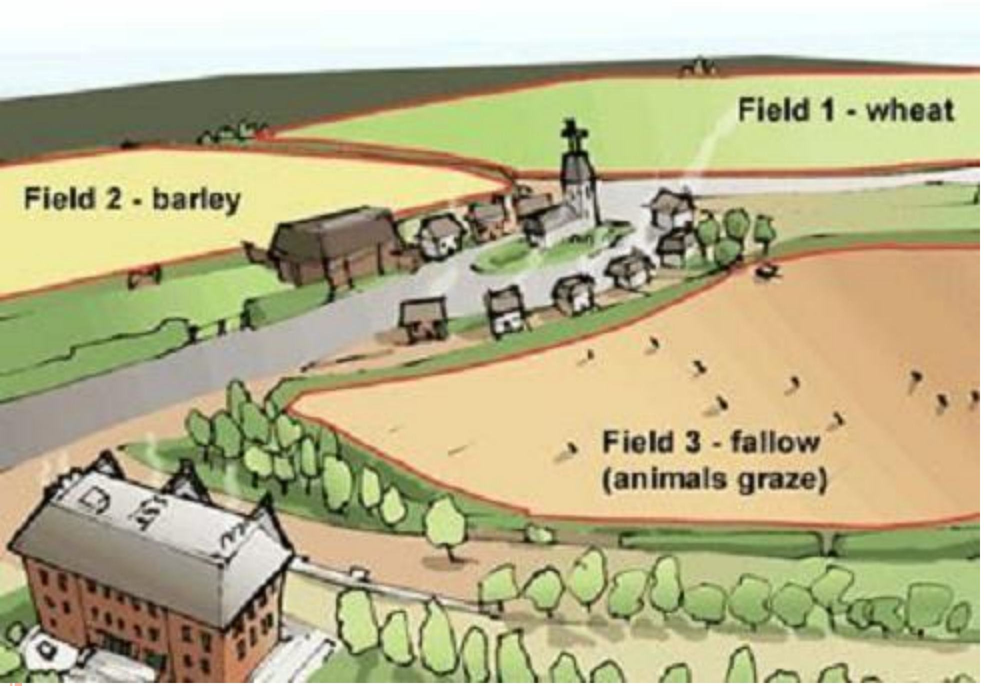
Types of rotation

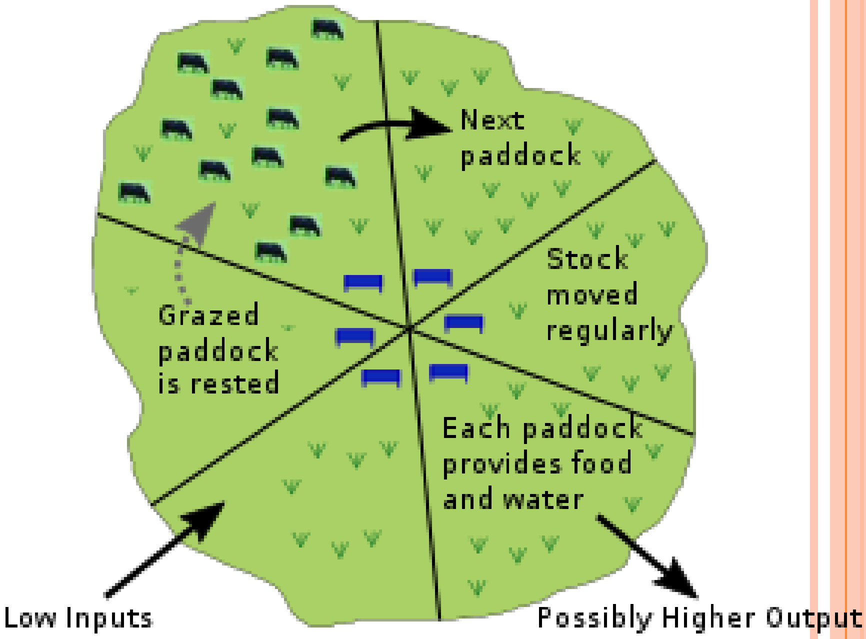
- There is long term alteration between various retypes of land use such as
  - arable farming,
  - tree farming,
  - grassland use etc.
- Rotation means the sequence of this basic type of land use on a given field.
- Within arable farming (only involves the cultivation of crops and it does not involve the rearing of animals) there is also the term crop rotation which means the short- term sequences of different arable crops on one field.
- **a) Lay System:**
- In this system, several years of arable farming are followed by several years of grassed and legumes utilized for livestock production.

- **i) Unregulated Lay Farming:**
  - In this system natural vegetation grasses, bushy growth on pasture is allowed to grow during the period of fallow.
  - This is an improved managed pasture.
- **ii) Regulated Lay System:**
  - During the period of fallow, certain types of grasses are grown or planted.
  - These are the well managed pasture with fencing and adopting rotational grazing system.

- **b) The field system:** is a regime of crop rotation in which a field is planted with one set of crops one year, a different set in the second year, and left fallow in the third year. A set of crops is rotated from one field to another.

- **c) Perennial Crop System:** The crop which covers the land for many years e.g. Tea, Coffee, sugarcane. In some cases tree crops (oil palm, rubber) are alternated with fallow in other with arable farming, grazing etc.


Field 1 - wheat
Field 2 - barley
Field 3 - fallow
(animals graze)


Next
paddock
Stock
moved
regularly
Grazed
paddock
is rested
Each paddock
provides food
and water
Low Inputs
Possibly Higher Output

Water system

- i) Rainfed farming.
  - Rainfed agriculture is a type of farming that relies on rainfall for water.
- ii) Irrigated farming.
  - Irrigate is to water crops by bringing in water from pipes, canals, sprinklers, or other man-made means, rather than relying on rainfall alone

RAINFED FARMING

- With large parts in India under rainfed farming it is imperative to focus on the **rainfed farming** to ensure betterment of the agriculture sector in India.
- Rain-fed areas produce nearly
  - **90% of millets,**
  - **80% of oilseeds and pulses,**
  - **60% of cotton**
  - **nearly 40% of our population** and
  - **60% of our livestock.**
- Rain-fed areas are ecologically fragile and hence vulnerable to climate change

Irrigation farming

- The amount of water required by the plant depends on the growth phases during the season.
- The highest need for water is during the **initial crop development, flowering, and fruit setting phases**.
- The lack of water during the growing season will lead to reduced yield and even possible failure of the entire crop production.
- Irrigation usually comes down to applying controlled amounts of water to assist in the production of crops.
- **Irrigated farming represents 20 percent of the total cultivated land,** but contributes to 40 percent of the total food produced worldwide.

- Irrigation should occur in a uniform and timely manner in order to minimize losses and damage to soil, water, air, plant, and animal resources.
- **Flood or furrow irrigation**;
  - entire soil surface is covered with water; it moves over the field by gravity flow

- **Sprinkler irrigation**;
  - crops are irrigated with high-pressure sprinklers set in the field; it can be solid or hand-moved

- **Drip irrigation**;
  - water is placed directly into the crop root zone from the low flow emitters, this usually also involves drip irrigation systems

- **Center Pivot irrigation**;
  - single central irrigation pipeline rotates around the pivot point. As it rotates, water sprinklers along the central pipe and irrigates crops

- Modern irrigation not only **saves time**, but also **saves water, improves crop growth, reduces weeds, and saves money.**
- **Classification According to Degree of Commercialization**
  a) Commercialized farming.
  b) Subsistence farming.
  c) Partly commercialized farming

- **Commercial farming include**
- **Crop farming**
  - crop farming is an important contributor to the global food supply, with the top five crops (wheat, rice, maize, soybeans, and potatoes).
  - production of grains, vegetables, and fruit for sale.
- **Livestock farming:**
  - This involves the production of animals, such as cows, pigs, chickens, and goats, for meat, milk, and other products.
- **Aquaculture:**
  - This type involves the cultivation of aquatic organisms, such as fish, shellfish, and seaweed, for food, medicine, and other products.
  - Aquaculture is an important source of protein and other nutrients for millions of people around the world

- **Horticulture:**
  - This involves the production of flowers, ornamental plants, and fruit and vegetables for sale.
  - Horticulture is an important contributor to the global food supply, with fruit and vegetables providing essential nutrients and contributing to a healthy diet.
- **Greenhouse farming:**
  - This involves the cultivation of crops in a controlled environment, such as a greenhouse, to optimize growing conditions and increase productivity.
  - Greenhouse farming is often used to produce high-value crops, such as tomatoes and peppers, and can be an important source of income for farmers in regions with challenging climates.

Subsistense farming

- A type of agriculture where cultivation takes place for the survival of the farmer.
- Subsistence agriculture can be classified into two types
  - Intensive subsistence agriculture and
  - Primitive subsistence agriculture.
- Subsistence agriculture is an agricultural system that aims to grow as many crops that meet all or almost all the needs of the farmer and his family, with little or no surplus products to market.
- Because of the high labour required in subsistence agriculture, it is a labour-intensive technique.
- **Partly Commercialized Farming:** More than 50% of the value of produce is for home consumption.

Agricultural enterprise

- **Agricultural enterprise** means a business primarily engaged in the production of food and fiber, ranch- ing and raising of livestock, aqua- culture and all other farming and agri- culture-related industries.
- **It is possible to define several types of agricultural enterprises.**
- Poultry; vegetables; pork; meatballs; meat; milk; wine.
- It is possible to separate factories and mills - sugar, canned food, milk powder and others.
- The Indian food processing industry accounts for 32% of the country's total food market, one of the largest industries in India and is ranked fifth in terms of production, consumption, export and expected growth.

Integrated Farming Management

(22ZOONME32)

Different IFS models

Criteria for selection of enterprises

- Climatic conditions
- Soil type
- Farmer's preferences
- Size of the farm
- Establishment of integrated farming systems to suit the global climate change
- Knowledge, skill and technology
- Storage, transport and marketing

IFS models for different agro ecosystems of Tamil Nadu are given below

Sl. No.	Name of the zone	Crop components	Other components
1.	North Eastern zone	Rice, sugarcane, bajra, ragi, groundnut	One or two buffaloes or jersy cross breed cows or one unit of 20 goats or sheep
2.	North Western zone	Ragi, groundnut, horsegram, rice, tapioca	Sheep or goat or poultry or dairy
3.	Western zone	Millets, cotton and rice	Dairy or poultry or sheep or goat
4.	Cauvery delta zone	Rice	Dairy or goat or duck or piggery

5.	Southern zone	Millets, cotton, pulses and rice	Sheep or goat or poultry or duck
6.	High rainfall zone	Rice, tapioca	Dairy or duck
7.	High altitude and hilly zone	Tea and coffee	Rabbit or goat or dairy

Feasible components for integration under different ecosystem

Wetland	Gardenland	Dryland
Cropping	Cropping	Cropping
Fishery	Milch cows	Goat
Poultry	Buffalo	Agroforestry
Forestry	Biogas	Horticulture
Pigeon	Spawn production	Tree
Goat	Mushroom	Pigeon
Duck	Homestead garden	Rabbit
Pig	Silviculture	Farm pond
Mushroom	Sericulture	Fish

IFS models for different land use

IFS models for wetland

- Crop + dairy + fish + duck + poultry
- Crop + Livestock+ Fish Farming
- Crop + poultry/pigeon/goat + fishery
- Crop + poultry+ fish system
- Crop + fish + poultry + mushroom

IFS models for Gardenland

- Crop + dairy + biogas
- Crop + dairy + biogas + mushroom
- Crop + Milch cow+ Goat + Vermicompost
- Crop + dairy + biogas + silviculture

- **IFS models for dryland**
- Crop + goat
- Crop +Goat + Agro forestry + Farm pond
- Crop + silvipasture + Goat + Vermicomposting

Revenue generation

In Tamil Nadu

- Rice-Rice-Black gram replaced with the IFS model of Rice-Rice- Cotton+Maize+Poultry/Fish -net profit by 207 %.
- Rice-Rice replaced with Rice-Rice-Azolla/Calotropis/Fish- net profit with marginal increase 14%
- Rice-Rice-Rice-Fallow – Pulse replaced with Rice-Rice-Rice-Fallow –Cotton + Maize + Duck cum Fish IFS enhanced the net profit by 74.8%

- IFS model with Cropping + Fish + Poultry, Cropping + Fish + Pigeon and Cropping + Fish + Goat enhanced the net profit by 270 %, 273 % and 362 %, respectively.
- Rice integrated with Fish, increased the profit by 24 %
- Rice integrated with Azolla and fish increased by 38 %.
- The fish pond stocked with 60,000 fingerlings per ha (20-30 g) of different species raised together with about 45-60 pigs/ha produced between 12-18 tons of fish and 4-7 tons of pigs (live weight) per ha/year.

- Replacing the Rice – Rice conventional system in 1 acre of land with the introduction of IFS with Rice – Rice (0.33 acre), Hybrid Maize – Sun Flower (0.20 acre), Vegetable (0.2 acre) Fodder + Goat (0.21 acre), Fish (0.06 acre) and poultry (0.005 acre) found to enhance the productivity and profitability by 26.3 and 32.3 per cent, respectively.

- IFS is also an eco - friendly approach.
- Waste of one enterprise becomes the input of another.
- Making efficient use of resources.
- It helps in improving the soil health, weed and pest control, increase water use efficiency and maintains water quality.
- This system minimizes the use of harmful chemical fertilizers, weed killers and pesticides and thus safeguards the environment from the adverse effects.

Integrated Farming Management
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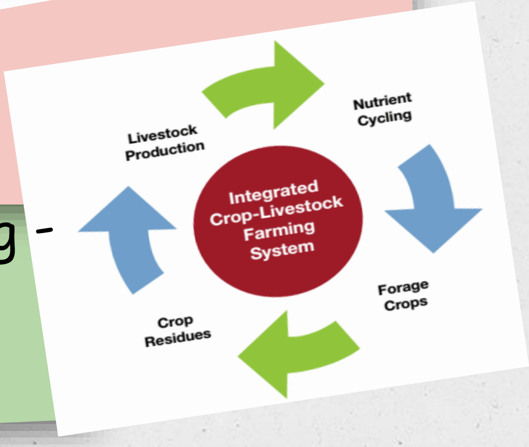
IFS - Production and Economics

Simulation models - Intercropping - Soil nutrients



Small and marginal farmers are the core of the **Indian rural economy** constituting **85% of the total farming community**.

A continuous increase of demand -

1. Food production,
2. Providing stability to the income and
3. Nutritional security - small and marginal farmers with limited resources

A solution!!

Integrated farming system (IFS)

Hindustan Times

Urging the small and marginal farmers to adopt Integrated Farming System developed by PAU, Ludhiana, vice-chancellor Satbir Singh Gosal said that it will go a long way in enhancing their income and providing balanced nutrition. (HT FILE PHOTO)

'All India Coordinated Research Project on Integrated Farming Systems (ICAR)' provides **income** round the year in addition to **meeting the domestic needs** (cereals, vegetables, oilseeds, pulses, fruits, and milk).

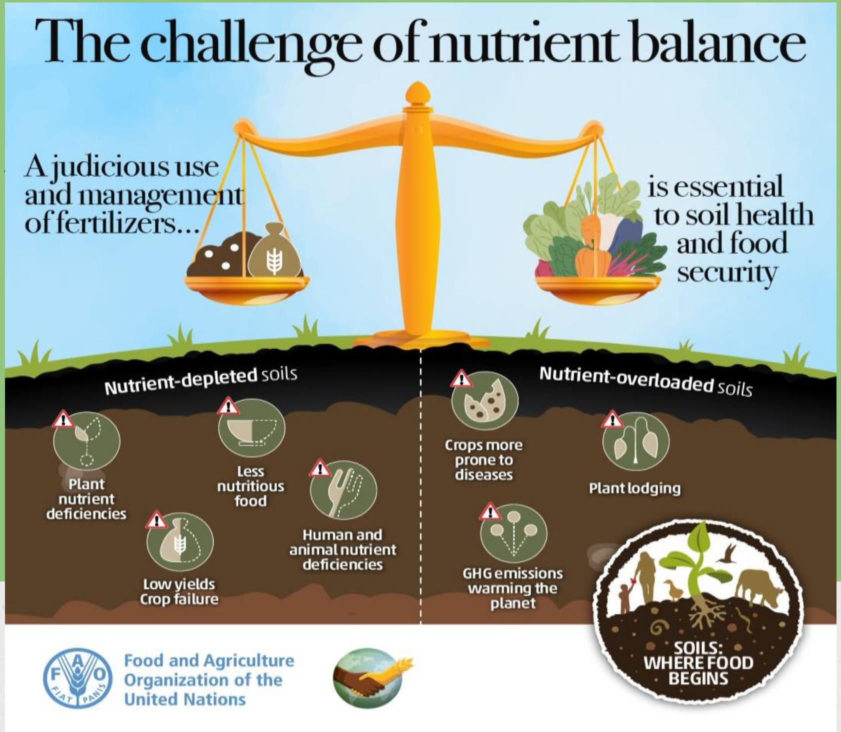
The combination of **crop cultivation, dairy farming, kitchen gardening,** and other secondary components can be adopted **depending on the location**.

https://www.hindustantimes.com/cities/others/ludhiana-pau-develops-integrated-farming-system-for-small-and-marginal-farmers-101671041912124.html

A long way in enhancing income and providing balanced nutrition.

Added bonus

- ➔ Sustained production,
- ➔ cost-effectiveness,
- ➔ meeting diverse requirements of farm hou
- ➔ optimal resource utilisation,
- ➔ waste material recycling,
- ➔ sufficient remuneration, and
- ➔ livelihood security of resource-deficient farmers

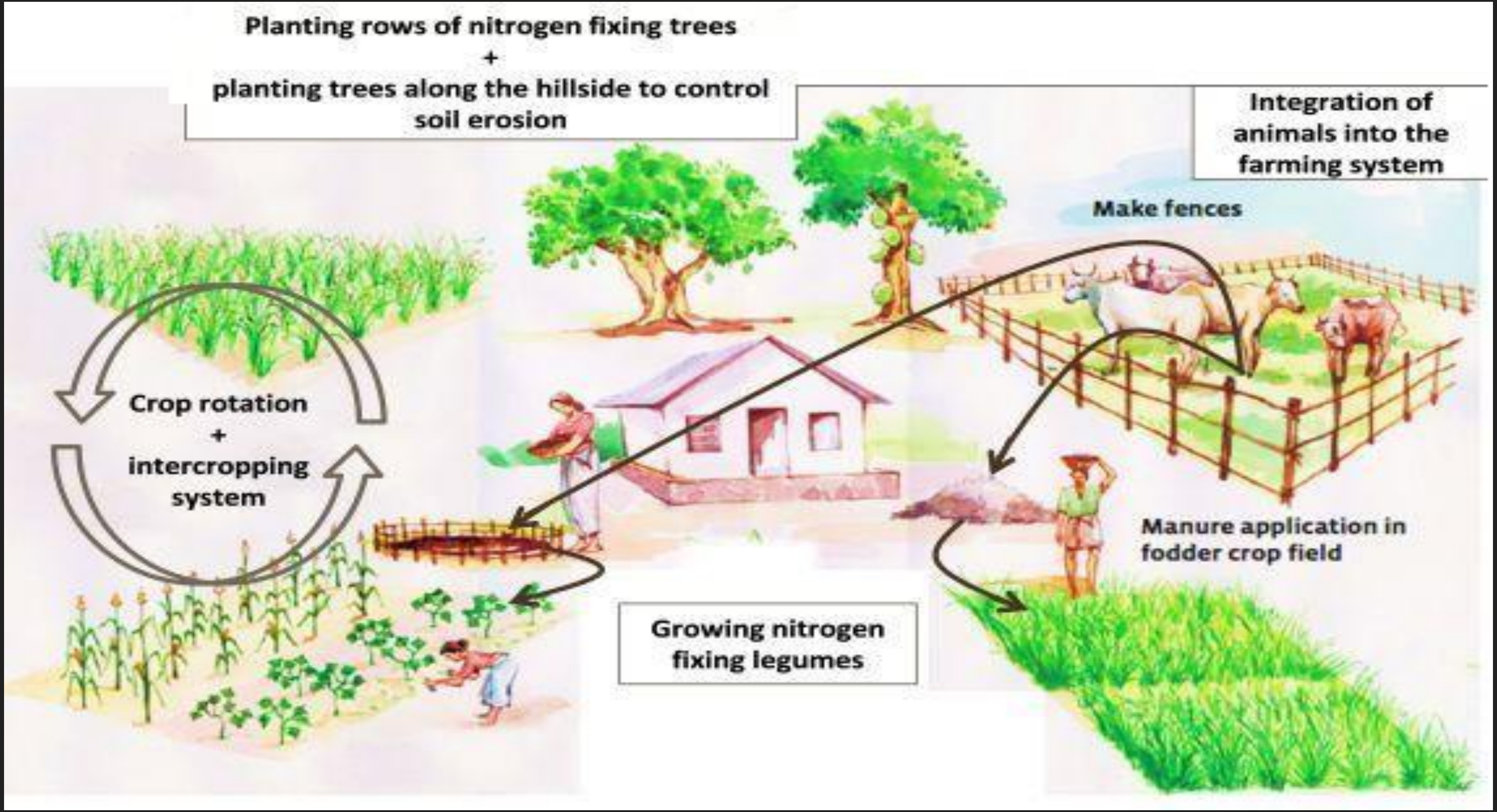


IFS - An **economically viable option**, an adequate **blend of**

- crops,
- livestock,
- aquaculture,
- agroforestry and
- agri-horticulture

It **ensuring**

- sustainability,
- profitability,
- balanced food availability, and
- employment generation.



https://www.pashudhanpraharee.com/integrated-farming-system-ifs-source-of-food-and-livelihood-security/

Principle of IFS model is developed such as

Wastes generated from one component becomes an input for other system and hence there is efficient recycling of farm and animal wastes in the integrated system.

There is increase in yield per unit area through intensification and diversification of crops.

Apart from this IFS helps in **controlling insect pests and diseases and weeds** through **natural cropping system management** and there is **less use of harmful agro-chemicals** for farm production.

IFS development model

It combines various compatible enterprises

- **Crops** (field crops, horticultural crops),
- **Agroforestry** (agri-silviculture, agri-horticulture, agri-pastoral, silvi-pastoral, horti- pastoral),
- **Livestock** (dairy, pigs, poultry, small ruminants),
- **Fishery**,
- **Mushroom** and
- **Bee culture** in an **synergistic way** so that the **wastes of one process become the input for other processes** for optimum farm productivity.

Advantages of IFS

- IFS increases productivity per unit area by virtue of intensification of crops and allied enterprises.
- Integration of different production systems provides an opportunity to solve malnutrition problems in our country.
- It improves soil fertility and soil physical structure from appropriate crop rotation and using cover crops and organic compost. It also minimizes the nutrient losses.
- It reduce weeds, insect pests and diseases through appropriate crop rotation.
- There is higher net returns to land and labour resources of the farming family.
- There is also regular stable income through the products like egg, milk, mushroom, vegetables, honey and silkworm cocoons from the linked activities in integrated farming.
- It reduces production cost of components through input recycling from the by-products of allied enterprises. The recycling of wastes for production helps to avoid piling of wates and consequent pollution.











Mango, Banana, Tomato, Bhendi, Brinjal, Radish, Gourds, Tapioca, Turmeric, Rose, Jasmine, Tuberose and Chrysanthemum.

INTERCROPPING

CROP SIMULATION MODEL FOR INTERCROPPING

1. Measurement - Biomass and growth rate / day (2009).
   Determining yield potential to improving pest, nutrient and water management (1980s), application at farm level - regional yield forecasting, regional land use studies (1990s).

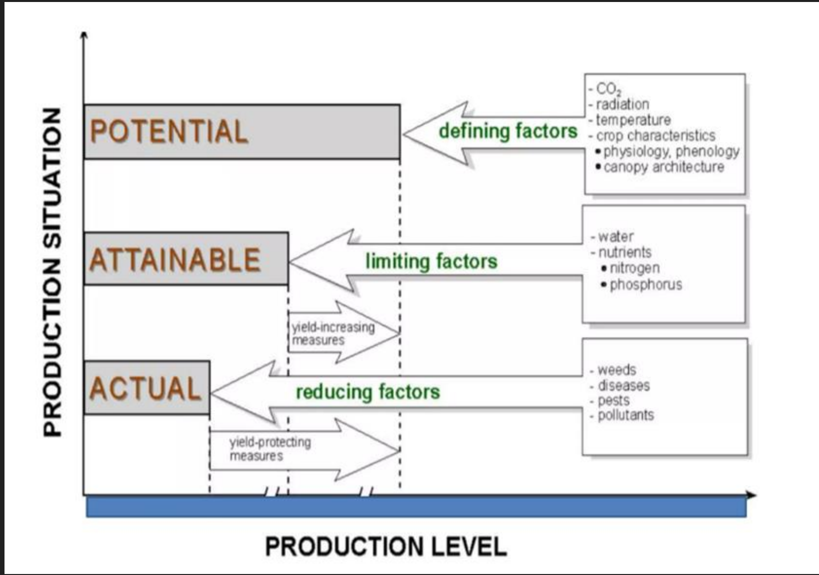
1. Flow of energy and mass between each component - solar radiation, wind speed, [CO2] - constant.

- Examples of such models include the Water Nutrient and Light Capture in Agroforestry Systems (**WaNulCas**)

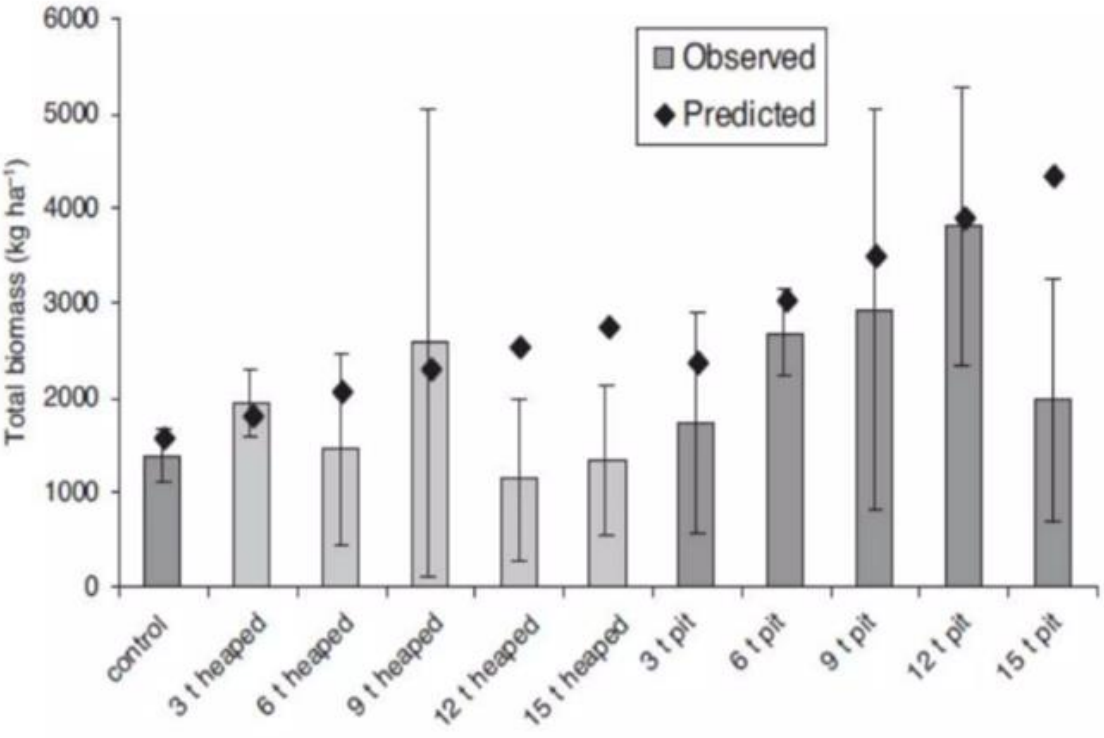
1. Variation in light attenuation - vertical, horizontal, diagonal (3D approach). Focus - plant growth & development - photosynthesis, ET and photomorphogenesis.

Intercrop models can be divided into three groups depending on spatial compartmentalization -:

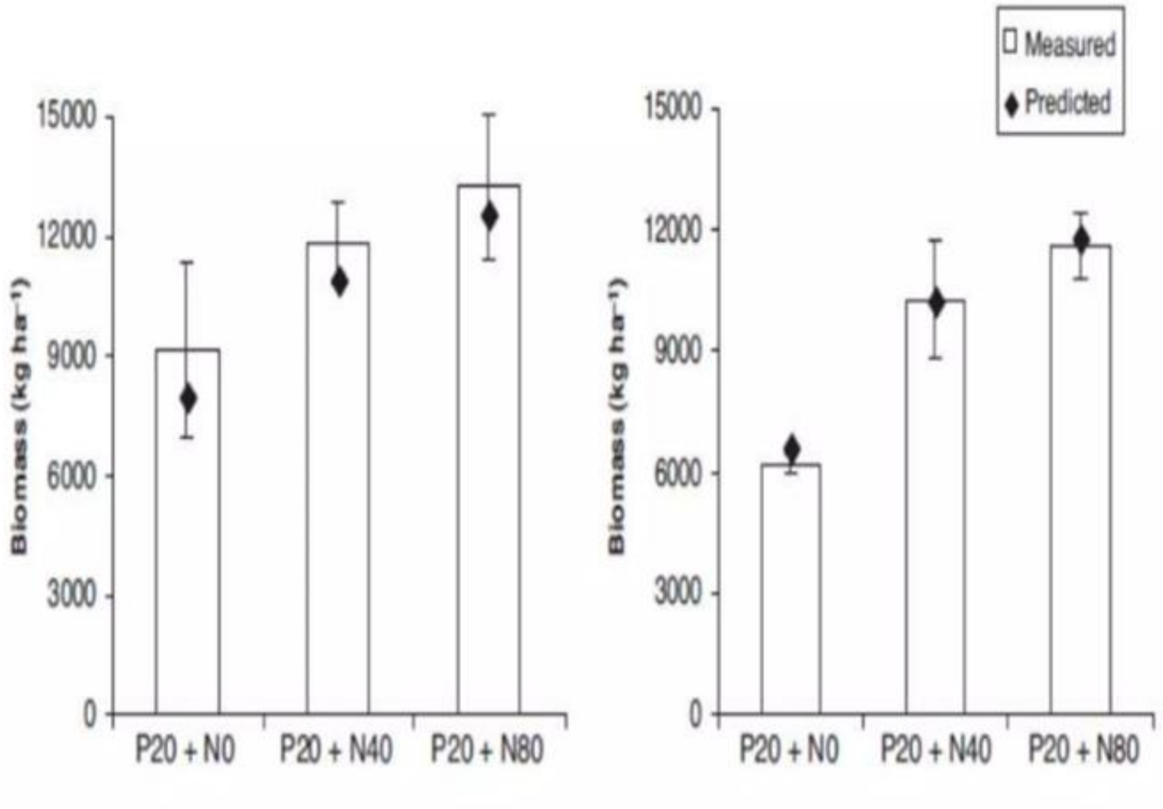
1. **de Wit approach**
2. **Discrete crop-based approach**
3. **Dual-species canopy approach**



ALMANAC, APSIM, AUSIM, GAPS, GROWIT, INTERCOM, STICS, WATERCOMP,

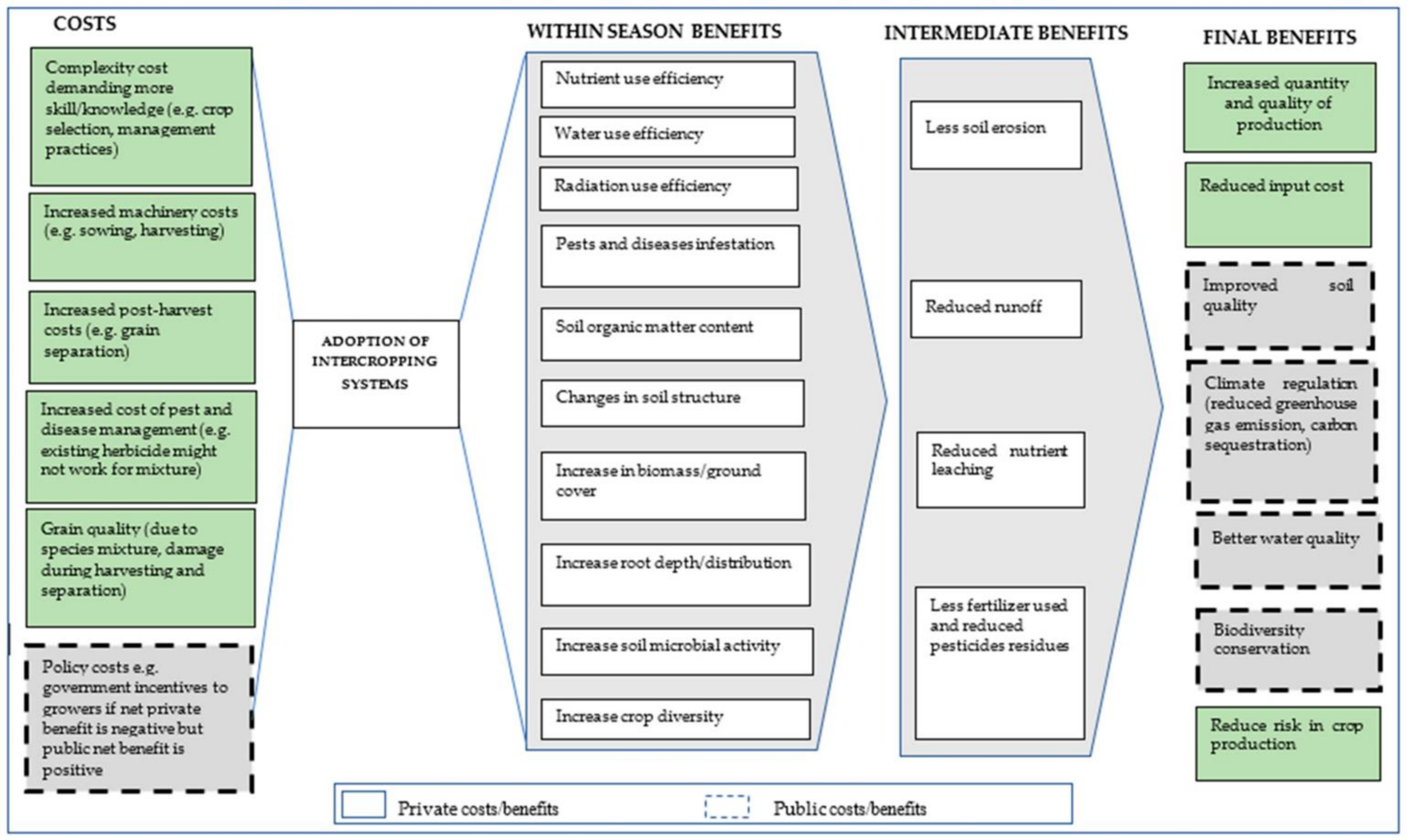


Observed and predicted effects of application rate (t ha–1) of heaped and pitted manure on maize yields



Measured and simulated values of sorghum and maize in intercropping of total crop biomass for rabi crops of different nutrient treatments.

Figure. Typical expected costs and potential benefits of adopting intercropping systems



InfoCrop v2.1: Indigenous Crop Simulator

Scientists at the Indian Agricultural Research Institute (IARI) conducted an experiment using InfoCrop version 2.1 to quantify the impact of hot weather on crop yield in Punjab and Haryana.

- India's only dynamic crop simulation model developed and released by the IARI in 2015 to study the long-term impact of climate change and crop management practices on yield.
- InfoCrop is more suited for India as it has the life cycle data for almost all the local varieties of 11 crops: **paddy, wheat, maize, sorghum, pearl millet, pigeon pea, chickpea, soybean, groundnut, potato and cotton.**

InfoCrop v2.1: Indigenous Crop Simulator

- Parameters are already calibrated to Indian crop varieties and they are updated at regular intervals by the institute.
- The parameters deal with aspects of-
  1. Weather (precipitation, temperature, radiation and others)
  2. Crop growth (phenology, grain characteristics, leaf growth, temperature and flooding sensitivity and others)
  3. Soil (texture and organic carbon, water holding characteristics and pH levels) and
  4. Pests and crop management (organic matter, fertiliser and irrigation).

Efficiency of InfoCrop model

- The model has an **85 % accuracy rate**.
- This is **on par with widely used dynamic models** such as the Decision Support System for Agrotechnology Transfer model, developed by the US, and Agriculture Production Systems sIMulator, developed by Australia.

Utility of this tool

- **Prevent on-field corruption:** India currently relies on field trials, which are expensive and resource-intensive as well as highly corrupt practise.
- **Crop insurance prediction:** Government and insurance companies can use this for climate impact projections and for pre- or in-season crop yield forecasts to improve accuracy.
- **Assess crop loss:** Besides forecasting, simulation models can be used to assess crop loss in the aftermath of an extreme weather event, which can then be used to provide relief packages.

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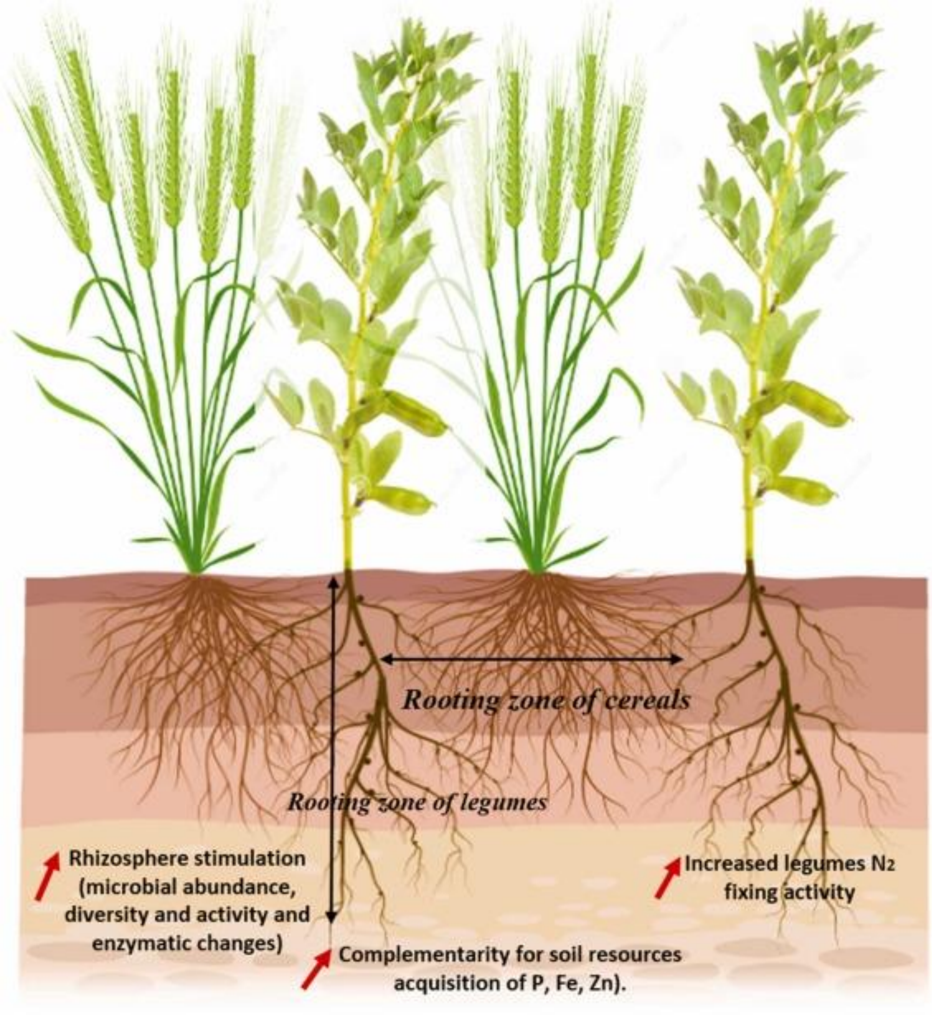
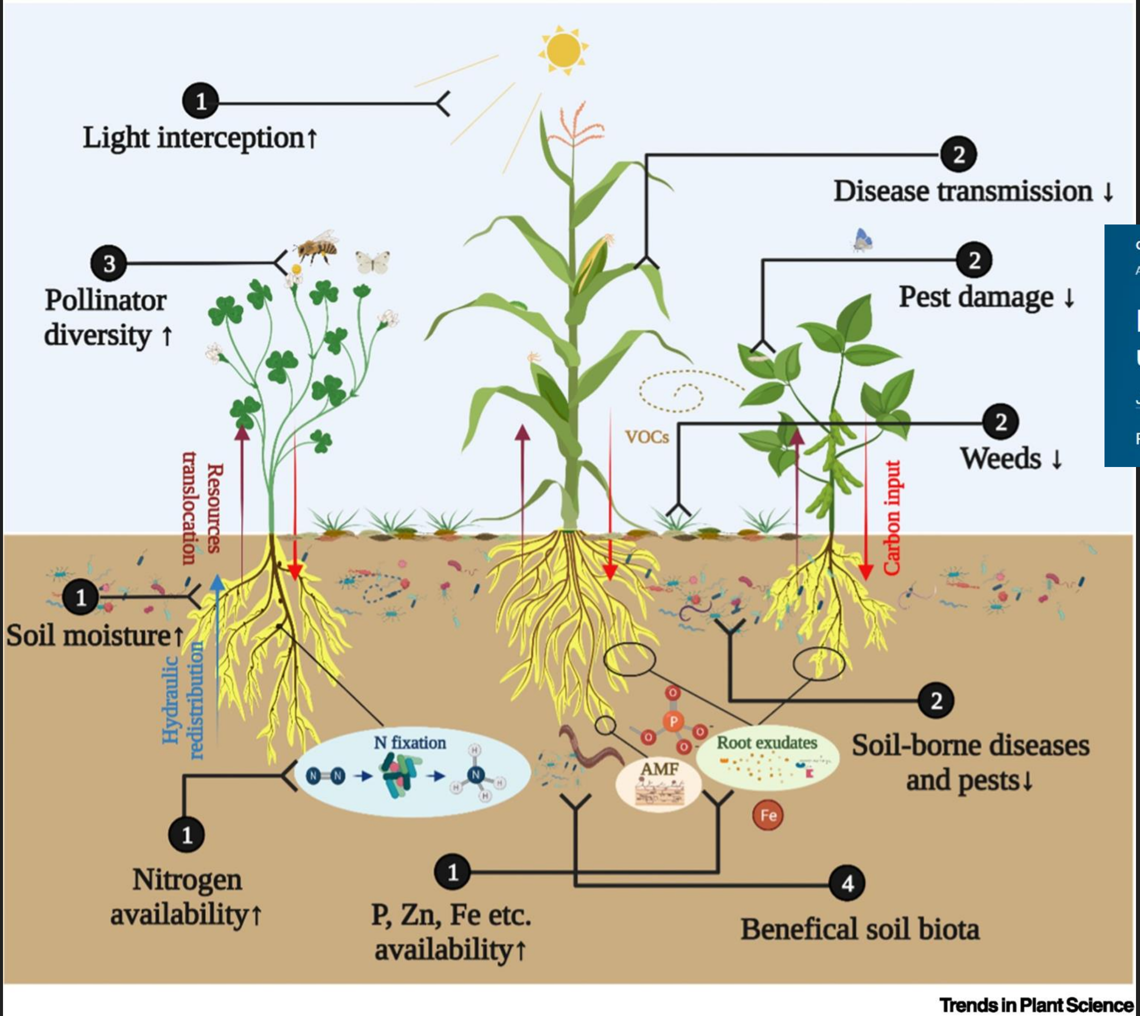


Highlights

- The incorporation of legumes in cropping systems improves the physico-chemico-biological properties, soil fertility and ameliorate the resource use efficiency.
- The intercropping based legumes enhance the chemotaxis and the behavior of beneficial root-associated bacteria in the rhizosphere.
- The intercropping legume positively influences the interactive mechanisms between legumes and non-legumes and rhizobial strains in favor of both crops.
- Adoption of legume-based intercropping systems and PGPR will sustainably improve crop agro-physiological performance.

https://www.sciencedirect.com/science/article/pii/S0926669022004411



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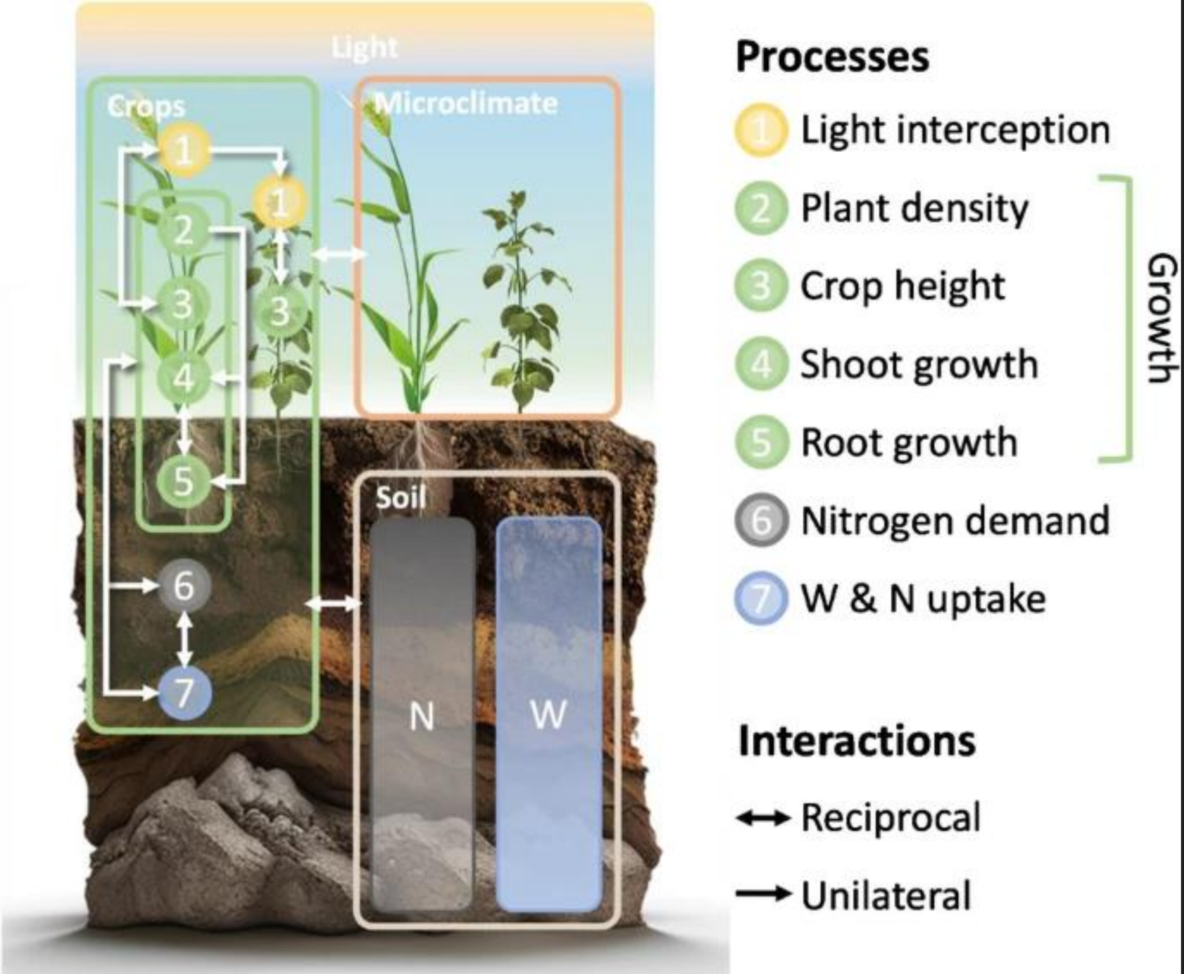
Legacies at work: plant–soil–microbiome interactions underpinning agricultural sustainability

Jingying Jing • Wen-Feng Cong • T. Martijn Bezemer

Published: June 11, 2022 • DOI: https://doi.org/10.1016/j.tplants.2022.05.007 • Check for updates

https://www.cell.com/trends/plant-science/fulltext/S1360-1385%2822%2900146-7



https://link.springer.com/article/10.1007/s13593-023-00917-5/figures/1

Conceptual diagram of the processes reviewed and modified in STICS for the interactions in the intercropping system.

The diagram does not represent all interactions in the model, only the ones that were investigated in this work, which include: light interception, crop height in response to the environment
(e.g. elongation), effect of plant density, shoot and root growth, microclimate, nitrogen (N) demand, and water (W) and N uptake.