

Integrated farming system

for improving sustainability in agriculture

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Modern agricultural practices and development have contributed a vast share towards advancements in agriculture and creation of stable economies around the globe and while these have been pivotal in establishment of agriculture as a major source of income, its beneficiaries have been limited to large-scale farmers capable of mass investments. This effectively left out a vast chunk of cultivators who were smaller or more marginal in scale. Apart from this, the unsustainable approach of conventional methods has taken a toll with increasing pollution and global climate crisis. In the wake of these events, integrated farming system provides a much-desired alternative that relies on synergies among different enterprises to curb the food needs of exponentially growing population while maintaining and enhancing ecosystem components with elements of effective waste management and reduced production costs. The present article discusses in detail the origins and possible applications of integrated farming systems with respect to a country heavily dependent upon agriculture as India.

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One of the major landmarks in the history of agriculture in India has been the green revolution, which, with its onset in the 60s, made the agriculture sector centre of development. The main focus of the revolution and many similar ones was to improve yield by the means of genetic modified crop varieties and application of agriculture machinery. The coming decades saw a further increase in agriculture research centered around mechanization and technology which proved pivotal in not only individual development but also in the upliftment of the economy as a whole. However, these preliminary research works left out a vast chunk of population relying on agriculture which could not, by any means, afford an investment into the newly evolved modern farming system which relied heavily on financial inputs for a profitable yield. It also subsequently failed to take into account the transient nature of

resources and the adverse impact of discriminate practices on the environment. The late 1980s was an era marked by research focused on sustainability and endeavours in agriculture to cater to current and future needs of the global population. These early discussions were in response to concerns about degradation of natural resources, accentuated upon the importance of conservation and judicious use of finite resources, and claimed that many conventional practices were deleterious to renewal of these resources. The integrated farming practices in India began with the advent of the global sustainability wave however; the system has still not been implemented as extensively as it should have.

Another factor that the concept of modern agriculture failed to incorporate was the shrinking size of farmlands and inability of greater investment in agriculture technologies by farmers. This too

posed a great challenge for the agriculture sector as a whole and one that to this day continues to have major impacts on development and financial yields of developing countries around the globe, which can be attributed to the long time it took for sustainability to imbue into agriculture. It holds especially true for a country like India where a vast diversity of farmers practice subsistence agriculture with profits barely enough to satisfy their personal needs which makes financial gains from agriculture a long shot for these small, marginal farmers. With an increase in global food demand and an even disconcerting increase in share of agricultural waste and equivalently resulting pernicious consequences in the form of greenhouse gas emissions from burning of stubble and similar inimical practices-embroils the cultivators in dilemma of personal, financial gain or sustainability which makes directing their limited

resources towards a wise choice more important than ever.

The alternative in such dire circumstances, remains vertical expansion achievable only by the means of integrated farming system, which amalgamates basics of ecology with biological components of agricultural ecosystems to meet the diversified needs of farming community through efficient use of farm resources without degrading the natural resource base and environmental quality. The concept has its origins in the 1987 where Clive A Edwards defined sustainable agriculture by integrated systems of agricultural production, with minimum dependence upon high inputs of energy, in the form of synthetic chemicals and cultivation that substitute cultural and biological techniques for these inputs. It should maintain, or only slightly decrease, overall productivity and maintain or increase the net income for the farmer on a sustainable basis, protecting the environment in terms of soil and food contamination, maintain ecological diversity and the long-term structure, fertility, and productivity of soils.

The definition of integrated farming system (IFS) has been subject to constant change depending on the context, varying in their action of synergies among components as can be seen from Okibo's (1995) definition of a mixed farming system consisting of at least two separate but logically interdependent parts of a crop and livestock enterprises studies which have interpreted it as a component of farming systems which focuses on increasing production whilst minimizing risk, simultaneously increasing profits and improving the utilization of organic wastes and crop residues. Regardless of the implied use, IFS utilizes by-products as raw materials from one or more enterprises and integrates them in context to the farming needs to efficiently reuse the waste materials and provide energy and cost-efficient alternatives guaranteeing financial net profits. Moreover, this system can ensure a substantial income generation to sustain the

livelihood of farmers over the meagre income from self-standing enterprises. Integrated farming systems offer unique opportunities for maintaining and extending biodiversity with emphasis on optimizing resource utilization rather than maximization of individual elements in the system.

Components of integrated farming system

The IFS relies heavily upon the kinship of involved enterprises, which then integrate to form a net positive result from the interaction. The involved components or enterprises can include crops, livestock and trees. Crops may include intercrop, mixed crop or multi-tier crop systems while livestock deals with poultry, bees, cows or goats sometimes expanding to fishes as well. Tree enterprises generally include timber or fruit trees. It is imperative for these components to be laid out in a manner that effectively enhances the net output of that farm. This is achieved by splitting the farm's system into inputs, processes and outputs.

Inputs: The active investments made into the farm, which may be of physical or human kind. Physical inputs consist of amount of rain; quality of soil etc. and human inputs comprise of capital investment and labour cost.

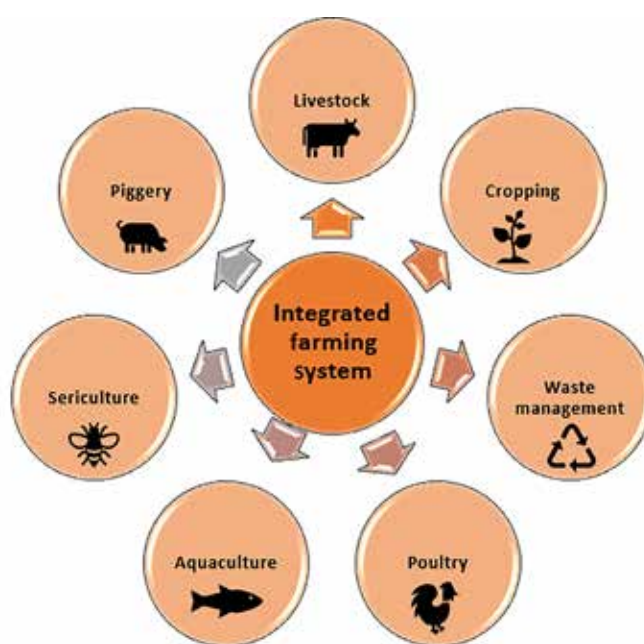
Processes: The sum cumulative of activities done to convert inputs into monetizable outputs, which include sowing, weeding, tillage, harvesting etc.

Outputs: The products from the farm system that result in financial gain like paddy, eggs, nectar, fruits etc.

The way an integrated farming system works is by using the components of different enterprises at varying stages and incorporating them into the workflow of some other enterprise in a way that generates a positive net result. The flow model is governed by (a) socio-economic inputs which include labour, capital and land which result in outputs that fulfil livelihood needs including health, knowledge and social-stability and, (b) Bio-physical inputs which include energy, fertilizers, biocontrol agents, crop residues, animal manure etc. Both of these flows run parallel and are important for the inter-related functioning of processes. The processes thus can be described as by-products of these interactions that result from coupling of both these flows creating an agro-ecosystem.

Enterprises associated with integrated farming system

Cropping systems: Climate, soil organic matter and water availability are the major factors that influence



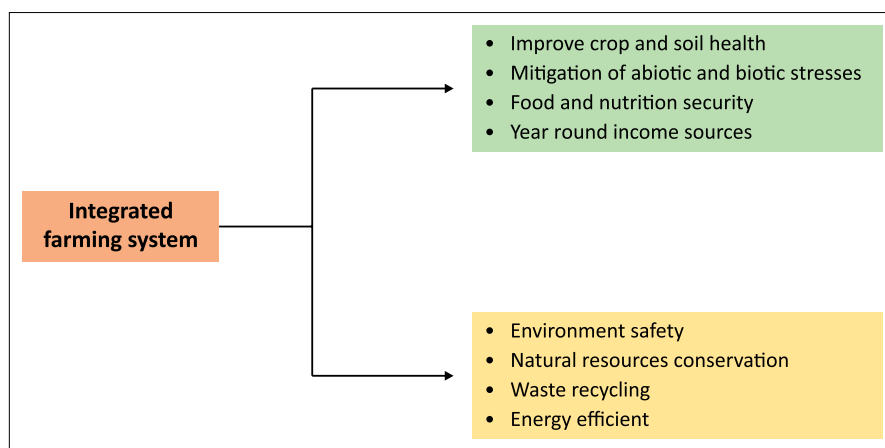
Enterprises and components under integrated farming system

the design of a cropping system that is specific to a farmland and needs to be evolved for realizing the potential production levels through efficient use of available resources. The effective modulation of these factors should develop a cropping system that not only sustains the needs of the family (subsistence) but also leaves material for input into other enterprises like fodder for the cattle. The crops also must be adequately managed whilst making environment conscious choices like an active use of bio-fertilizers instead of inorganic nitrogen and using biological control agents instead of pesticides.

Cattle rearing: It is often the most pursued component of IFS and consists of exotic, dairy and dual-purpose breeds of cattle managed by adequate housing and feeding roughage, fibre-rich diet. Handling practices must be sanitary especially for dairy breeds as udder infections resulting from neglect are quite common and translate into major losses. The outputs from this enterprise can be utilised as farm manure or to generate biofuel.

Poultry: Poultry practices are perhaps the fastest growing enterprises owing to increasing global demand for both egg breeds and broiler breeds. This one sector has seen major corporate investment from bigger franchisees leading to a vast population of farmers engaging in poultry farming motivated by the influx of investment and turning into commercial breeders. Common feed for poultry comprises cereals (Wheat, oats, rice, etc.), minerals (Oyster shell, salt, etc.) and meals (meat-meals, fish meals and oil cakes, etc.).

Aquaculture: Practiced in alkaline waters after soils have been tested for nitrogen and phosphorus content. This practice in India has been long coupled with cropping systems and cattle rearing where animal waste products have been used to feed the fish. Indian systems mainly use Catla (*Catla catla*), Rohu (*Labeo rohita*), Calbasu (*Labeo calbasu*), Common carp (*Cyprinus carpio*), Silver carp (*Hypophthalmichthys molitrix*), and Grass carp (*Cyrenus carpio*). A poly-fish culture is equally



Advantages of integrated farming system

prevalent that combines a variety of fish with different feeding habits in a composite fish-culture system. In addition to the few aforementioned enterprises, others like goat rearing, piggery, sheep rearing, sericulture, bee and duck keeping are major components of IFS that have been put to practice in farmlands resulting in overall financial gains.

Advantages of IFS

Sustainability: IFS enables the integration and utilization of process by-products into the linked enterprise thereby enabling a sustainable production base.

Waste management: Effective reuse and recycling of generated waste is enabled by using the waste of one enterprise as input of another and significantly reduces environmental burden.

Increase in productivity and profit: Coupling of enterprises in IFS increases economic yield per unit area per unit time and the adequate reuse and recycling ensures cost reduction at every step.

Employment: The commercialisation of IFS farms increases labour requirements thereby creating more jobs and will aid in development of agro-industries.

Round-the-year-returns: Interaction of cropping with enterprises that are active all year-round including poultry, milk and sericulture will generate a year-round income for the farmer and they will not have to rely on just the harvest season for a profit. This results in a higher net return

for the employed land and labour resources.

Diversification of income source: In an agriculture dependent country like India, where most often the farming families depend only on their farmland as a source of income, this diversification would help generate alternate sources of income preventing severe outcomes if any enterprise shall fail to deliver desired output.

Ecosystem sustainability: The virtues of IFS also lay in its sustainability and environment friendly practices- like use of organic manure to increase soil organic matter that translate to less fertilizer use, less insecticide use and thus a sharp decline in pollution resulting from agricultural practices. They can thus also be applied to approaches directed towards biological soil amendments and nutrient cycling.

Integrated farming system has had a real life impact in many studies that have been conducted in India and across the globe. In one such study, the integrated farming system consisting of pisciculture, field and horticultural crop (agroforestry), poultry, mushroom, apiculture and biogas enterprises generated a net income of ₹58,360 and an employment of 573-man days on a small piece of land (1.25 ha), ensuring a high standard of living for small and marginal farmers. Another study conducted with a wide range of crop inputs over 12 consecutive years (2006–2017), showed that the integrated systems with intercropping generate significant synergies increasing

annual crop yields by 15.6–49.9% and farm net returns by 39.2% and decreasing the environmental footprint by 17.3% as compared with traditional monoculture cropping.

Way forward

Adoption of integrated practices can complicate the formalised procedures of conventional crop husbandry, which are familiar to farmers. For example, a more diverse rotation demands knowledge of a wider range of diseases, insects and input regimes as well as markets. Certain techniques, such as delayed drilling or threshold spraying can expose the enterprise to greater risk and preventing them incurs cost.

In addition, some techniques are more demanding of management time. The complexity, risk and costs associated with them demand a greater input of external advice which is likely to be costly and of limited availability thus the way to go forward must also be focused towards indoctrination along with beneficial schemes and training programmes aimed at complexities of the adoption processes which comprise a number of distinct stages, including awareness, trial, evaluation and adoption.

SUMMARY

In integrated farming system, agriculture can be integrated

with livestock, poultry and fish maintained at same place to generate employment around the year and also get additional income. It provides a holistic approach towards effective use and management of farmlands to even the small and marginal farmers who face the challenges of not being able to invest in agriculture technology. It provides an effective alternative to the conventional methods of farming with its focus on development of alternate sources of income for such families and generation of resources for the community.

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