



Sustainable Agriculture: Impact of LEISA and HEIA

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Abstract: This paper observed the effect of low external input agricultural farming system on the efficiency of resource poor farmer. In India majority of farmers are small scale entrepreneurs whose farm actions are performed with low input agricultural technologies. Majority of the technologies contained the refined indigenous information system. Farm size, labour inputs, capital inputs, planting materials and organic manure are the most determinants of the gross income of LEISA farmers. High external input Agriculture (HEIA) are technologies that apply high external inputs such as inorganic or chemical fertilizers to extend nutrient reduction from the soil, pesticides to manage pests and diseases, herbicides to regulate weeds and irrigation facilities for water management within the farms. Farmers inclinations for low input system vary significantly provisional upon the phase of crop production which include technologies for land groundwork use of draught animals, natural/organic substitute for inorganic pesticides and fertilizers, seed growth technologies, simple irrigation and drainage method, low input processing. There is also a substantial interest among farmers for low input methods for most phases of production. There is therefore the need for farmers to adopt these cost active agricultural technologies since they are not only readily available, but also they do not require too much skills and also poses the capacity of making the process of rural development more sustainable.

Keywords: Sustainable agriculture, low external input agriculture, high external input agriculture, farming system, resource poor farmer.

Introduction

The global population is currently predicted to reach 9.7 billion people by the year 2050, a 50% increase over the current level, after which it will level off due to falling fertility rates and family sizes (UN, 2019). This rise in population, together with a desire for a wider variety in diet brought about by greater purchasing power through a steady improvement in incomes, is foretold to increase food demand over the period 1990–2050 by 2.4 times in Asia, 1.9 times in Latin America and the Caribbean, and 5-fold in Africa (FAO, 1996). The increase in production essential to meet this demand will need to be attained with less water, less labour, and less land, and without unfavorably affecting the environment (Dowling et al., 1998).



Since 1960, the global population has doubled; despite this, food production has more than reserved step, resultant in a 24% increase in per capita world food production and a 40% reduction in food prices in real terms (although these figures do mask some arresting inequities — per capita food production has fallen 20% in Africa (Pretty, 1999; Cross on and Anderson, 2002). The total number of underfed people in the world has also tumbled significantly over the same period. This has been largely achieved by the use of “Green Revolution” technologies, i.e., high-yielding cereal varieties, together with high levels of inputs such as water from irrigation systems, fertilizer to offer the nutrients needed by the varieties, and pesticides to control any associated weeds, pests and diseases. These technologies generally need a relatively high capital investment, either by or on the part of farmers, and also need a well-functioning economic and physical infrastructure for effective implementation.

However, an estimated 30–35% of the world’s population (i.e.,1.9–2.1 billion people) do not have access to such infrastructures, are remote from markets, practice subsistence agriculture on marginal soils, and lack access to knowledge on how to improve their situation(Pretty, 1999). One school of thought is that a similar high external input agriculture (HEIA) approach as used in the last 40 years can also be used to address the demand for food in the next 50 years by improving the productivity of this group of subsistence farmers, perhaps using new emerging technologies such as genetic modification (e.g., Crosson and Anderson, 2002).

A second school of thought is that such an approach is not sustainable, and moreover, is damaging to the environment as the inputs of fertilizers and chemicals accrue in neighbouring ecosystems. Thus, technologies using low levels of external inputs readily available either on-farm or from nearby off-farm sources are seen by some specialists as more appropriate and sustainable (Pretty, 1995). This approach, often referred to as low external input agriculture (LEIA), emphasizes the use of techniques that integrate natural processes such as nutrient cycling, biological nitrogen fixation (BNF), soil regeneration and natural enemies of pests, into food production processes (Pieri, 1995; Snapp et al., 1998).

Sustainable Agriculture

Sustainable agriculture is focuses on producing long-term crops and livestock while having minimal effects on the environment. This type of agriculture attempts to find a good balance between the need for food making and the preservation of the ecological system within the environment. Sustainable agriculture also focuses on continuing economic stability of farms and helping farmers recover their techniques and quality of life.



LEISA

The world food production tremendously increased as a result of High external input agricultural practices introduced by green revolution. But as a result of the need for excessive capital, unsustainability of the systems and negative impact on the environment, the growers had to face many problems. Therefore development of an agriculture system using lesser external inputs, less expensive and environmental friendly has become a need of many countries. This System is abbreviated as LIESA is frequently for low external inputs and sustainable agriculture.

Definition: Low-External-Input and Sustainable Agriculture (LEISA) is agriculture which makes optimal use of locally available natural and human resources (such as soil, water, vegetation, local plants and animals, and human labor, knowledge and skill) and which is economically feasible, ecologically sound, culturally adapted and socially justice.

Objective: The objective of LIESA System is to maintain the agricultural production at an optimum level using less external inputs in a eco- friendly environment. To achieve this objective the LIESA practices concentrated heavily on the following factors:

- Maintaining a living soil.
- Creating biodiversity
- Recycling of resources
- Natural Pest management.
- Inclusion of forest trees

LIESA is based on the following principles:

1. Creating a favorable condition for growth and sustenance of plant by stimulating of soil microorganisms as far as possible and adding organic matter sufficiently.
2. Maintaining nutrient content at optimum level assuring the balance of nutrients in soil by Nitrogen Fixation, utilization of nutrients available in the deep layers, promotion of recycling process and addition of external fertilizer as and when necessary to complement deficient nutrient.
3. Controlling the micro climatic conditions to minimize loss of resources, due to sunlight, air and water. Use of biological and mechanical methods to prevent soil erosion.
4. Minimizing loss of resources caused by pests and diseases. Integration of Pest control methods giving priority to natural biological control of pests by natural enemies on the principle that prevention is better than eradication.
5. Promoting biodiversity.



Some LEISA Techniques and Practices

- a) **Soil and water management**
 - Terraces are other physical structures to prevent soil erosion
 - Contour planting
 - Hedgerows and living barriers
 - Conservation tillage
 - Mulches, cover crops.
- b) **Soil fertility enhancement**
 - Manures and composts
 - Biomass transfer and green manures
- c) **Controlling weeds and pests**
 - Intercrops and rotations
 - Integrated pest management

Low input technologies in crop sector

a) Land Preparation:

The uses of ruminant farm animals such as cattle sheep and goats to clear bushes and old stalk residues of harvested crops has been practiced in mixed farm yield low input technology.

b) Low input technologies organic farming crop enterprise:

Low input technologies used in soil fertility are ashing, cattle manure, green manure, mulching, urine-manure maintaining slurry etc..

(c) Intercropping

Intercropping is the growing of two or more crops on the same piece of land. The main advantages of intercropping are in reducing the risk of total crop failure, and in product diversification — food crops are often mixed with cash crops to help ensure both subsistence and disposable income.

(d) Cover crops and Green manures

- A cover crop is a crop grown to provide soil cover to prevent erosion by wind and water, regardless of whether it is later incorporated.



- Green manuring involves the incorporation of a crop while it is still mainly green into the soil for the purpose of soil improvement.
- Cover crops and green manures are generally annual, biennial, or perennial herbaceous plants grown in a pure or mixed stand during all or part of the year, and as such can be seen as a special case of intercropping
- Catch crops are cover crops that have been planted specifically to reduce losses of nutrients by leaching following a main crop.

(e) Cereals and pulses low input pest space control and storage.

- Items - pepper fruits, ash, lime leaf, neem seeds are active against pests of cereals and legumes such as weevils and beetles.
- A ground mixture of two or more of the items applied the rate of 10- 20g per kg of the stored product offers protection for about one year

(f) Crop residue management and conservation tillage

- These practices minimize nutrient loss, increase water storage capacity, crop damage, and improve soil quality.
- Some specific types of conservation tillage are minimum tillage, zone tillage, no-till, ridge-till, mulch-till, reduced-till, strip-till, rotational tillage and crop residue management.

(h) Integrated pest management (IPM)

- Use of resistant varieties
- Crop rotation
- Cultural practices
- Optimal use of biological control organisms
- Certified seed
- Protective seed treatments
- Disease-free transplants or rootstock
- Timeliness of crop cultivation
- Improved timing of pesticide applications

HEIA

The basic aspect of conventional agriculture was to maintain subsistence level production by using locally available resources. All resources had been naturally recycled and reused without wasting. But due to pressure of increasing population in developing countries steps were taken to expedite food production deviating from the traditional pattern.



The pressure of world population explosion exerted more on the people of developing countries. In order to confront the pressure of world population explosion the farmers as well as the researchers and extensionists were compelled to join the “Seed – Manure” revolution born with the label “Green Revolution” The aim of this “Revolution” was to provide food for the increasing population by enhancing the harvest per unit and the intensification of the number of cultivation seasons. In response to the “Green revolution practices, introduced in late 1960s our agricultural production increases significantly.

High yielding hybrid seeds which were introduced by green revolution were new to our environment. The growers had to practice new techniques to get higher production. Due to the fact that hybrid seeds were more sensitive to nutrients the growers were encouraged to use chemical fertilizer in large quantities as external inputs. As the new crops were foreign to the environment they were susceptible to pests and diseases. Consequently the necessity arose to apply chemicals, which became an additional burden to growers. Application of chemical fertilizers and pesticides increased the cost of production.

The hybrid varieties were dwarf in nature and could not compete with weeds. Application of weedicides or manual weeding was essential to mitigate the competition between hybrid varieties and weeds. From land preparations to harvesting all agricultural practices, related to hybrid varieties were more labor intensive.

Mechanization was an integral component of green revolution. To increase the working efficiency of the production system machinery like tractors have been introduced. These machines require fuel. The water consumption of new crops was also higher. Therefore it was necessary to improve irrigation facilities. The external resources were used extensively in this agricultural system many of the resources used in higher external input agriculture were not recycled. This system failed to add anything to enrich the soil.

Definition: High external input Agriculture (HEIA) are technologies that utilize high external inputs such as inorganic or chemical fertilizers to increase nutrient depletion from the soil, pesticides to control pests and diseases, herbicides to control weeds and irrigation facilities for water management in the farms. These technologies are often beyond the financial reach of the small - holder farmers.



Advantages of high external input agriculture (HEIA)

1. Agricultural Production could be rapidly increased to meet the demand for food for the increasing population.
2. As a result of availability of adequate food stuffs many problems related to diseases caused by mal-nutrition and deficiency were prevented or reduced.
3. New improved varieties gave yields within a short period of time.
4. Mechanization solves the problem of labour shortage.
5. Income and profit margins of the products were increased.
6. Productivity of land increased.
7. Increased market facilities for production.

Disadvantages of HEIA

1. Increase in soil erosion due to constant furrowing by machinery.
2. Dependence on imported machinery, chemical fertilizer, pesticides, hybrid seeds and other inputs.
3. Extensive use of pesticides disturbed the natural mechanism of controlling pest and diseases as the artificial pesticides kill both pests and their natural enemies.
4. Use of artificial agro-chemicals adversely affected the soil pH, cation exchange capacity, soil structure, soil texture and soil organisms. Consequently the microbial activities of the soil tend to reduce forming dead soil.
7. Although the need for high capital investment, large scale farmers benefited while small scale farmers who were short of capital ran into debit.
8. Neglecting environment friendly traditional varieties of seeds and their genetic resources faced extinction due to introduction of hybrid varieties. Conventional agricultural knowledge and techniques were neglected and extinguished.

At present many advantages gained from High external input agriculture are progressively diminishing and the yield per unit is decreasing. Therefore the farmer, researchers and extensionists are compelled to move towards a sustainable agriculture system free of high external inputs.



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