**INDICATORS OF SUSTAINABILITY:**

Indicators are a composite set of attributes or measures that embodies a particular aspect of agriculture. Indicators are quantified information, which help to explain how things are changing over time. Sustainability indicators look at economic, social and environmental information in an integrated manner. Three criteria guide the development of sustainability indicators:

1. POLICY RELEVANCE: Indicators should address the issues of primary concern to a country and receive the highest priority. In some cases policy makers may already share concern about an aspect of sustainability (e.g. Land degradation) and be ready to use indicator information for addressing the issue.
2. PREDICTABILITY: To allow a forward looking perspective that can promote planning and decisions on issues before they become too severe. Anticipatory decision-making is at least as important to sustainability agriculture as is recognition of existing problems.
3. MEASURABILITY: To allow planners and analysts the means to assess how the indicator was derived, either quantitatively or qualitatively, and decide how it can best be applied in the planning and decision-making process.

The most widely accepted framework for sustainability is referred to as pressure/state/response (PSR framework).

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| **ISSUE** | **PRESSURE****(driving force)** | **STATE****(resulting condition)** | **RESPONSE****(mitigating action)** |
| Soil erosion | Hillside farming | Declining yield | Terracing, perennial cropping |
| Water quality | Agro-industrial processing | Fish die-off | Water treatment |
| Condition of grassland | Livestock grazing | Soil erosion | Rotation, terracing |

**The Low External Input Sustainable Agriculture (LEISA):**

 It relies mostly on the inputs from the local farm, village or region and deliberate action is taken to ensure sustainability. The principles are:

1. Securing favourable soil conditions for plant growth particularly managing organic matter and enhancing soil life.
2. Optimizing the nutrient availability and balancing the nutrient flow, particularly by means of nitrogen fixation, nutrient acquisition and complementary use of external fertilizers.
3. Minimizing the losses due to plant and animal pests by means of prevention and safety treatment.
4. Minimizing losses due to flows of solar radiation, air, water by way of microclimate management, water management and erosion control.

Ecological Principles of LEISA:

1. **A living soil**: Soil can be regarded as a non-renewable resource, as soil formation is such a slow process. The soil provides a medium to anchor plant roots, but is also a very complex ecosystem. A productive agricultural soil is full of life, with millions of microorganisms which all interact chemically and physically with their soil environment. These processes regulate the release of nutrients from minerals and organic matter to feed the plants. A living soil has a better structure and can absorb and retain more water and air than a sterile soil. Good practices, which can help improve the condition of the soil, are: (i) Growing legumes to fix nitrogen from the air and provide it to the following crop, (ii) Feeding the soil with as much organic matter as possible through green manure, compost, cover crops, returning of non-toxic organic wastes and agro forestry; (iii) Keeping the soil covered at all times with mulch or cover crops.
2. **Biological diversity**: The diversity of different species of plants and animals, and the genetic variation within each species, provides the vital resource of biological diversity, which enables life on earth. Healthy ecosystems are relatively stable and the diversity they contain enables them to adapt to changing circumstances. For many small-scale farmers the available agro biodiversity is the basis of survival. A mix of different locally adapted crops and animals and different varieties of the same increases on-farm diversity, increasing the chances of producing something even under adverse conditions. Some examples of such practices are: (i) intercropping in time and space: planting different crops together in different combinations or formations, or in sequence, can optimize the use of available resources and reduce the pressure of pests. (ii) Different plant species can also be used to support the ecological functioning of the whole farm system: examples are trees or bushes for windbreaks
3. **Water**: Infiltration can be improved by keeping the soil covered, through minimum disturbance of the soil, adding organic matter from cover crops and mulching. When introduced, water-harvesting systems are generally multi-purpose.
4. **Animal-Plant Interaction**: In nature, nothing functions in isolation; everything depends on the other factors present. In animal production, to optimize the performance of cattle, it is very important that management practices should enhance the ecological functioning of the web of living organisms within the production system - climate, soil and soil life, vegetation and cattle - by influencing their interactions. For cattle production, it is important that the breed is selected first, then the pasture suited to that breed and finally the soil is corrected with proper fertilizer or amendment (if needed) to make the pasture grow. This order has to be reversed. The pasture has to be adapted to the soil and the cattle to the pasture, and all of it has to fit the climate. In addition, the forage crops are to be grown. Of course, in dry areas, forage yields depend strongly on the availability of water. In a well-structured soil, roots are able to explore a larger soil volume for more water and nutrients. Integrating deep-rooting crops and trees into the pasture system will further increase the production of biomass and the overall performance of the system.

**LEISA Techniques and Practices:**

1. Nutrient management: Nutrient management is managing the amount, source, placement, form, and timing of the application of nutrients and soil amendments to ensure adequate soil fertility for plant production and to minimize the potential for environmental degradation. Soil fertility traditionally dealt with supplying and managing nutrients to meet crop production requirements, focusing on optimization of agronomic production and economic returns to crop production.
2. Integrated pest management (IPM): IPM is an ecologically based approach to pest (animal and weed) control that utilizes a multi-disciplinary knowledge of crop/pest relationships, establishment of acceptable economic thresholds for pest populations and constant field monitoring for potential problems. Management may include such practices as • use of resistant varieties; • crop rotation; • cultural practices; • optimal use of biological control organisms; • certified seed; • protective seed treatments; • disease-free transplants or rootstock;
3. Crop Residue Management and Conservation Tillage: Conservation tillage is a term that covers a broad range of soil management systems that leave residue cover on the soil surface, substantially reducing the effects of soil erosion from wind and water. These practices minimize nutrient loss, improve water storage capacity, crop damage, and improve soil quality. The soil is left undisturbed from harvest to planting except for nutrient amendment. Weed control is accomplished primarily with herbicides, limited cultivation, and, in more sustainable systems, with cover crops.
4. Green Manuring and Cover Crops: Green manure and cover crop species should fit the agro ecological condition. In general, these crops should have the characteristics as: easy establishment, vigorous growth under local conditions, ability to cover weeds quickly, ability to either fixes atmospheric nitrogen.
5. Converting Farm Wastes into useful Organic Manure: The ingredients required are green leaves, dry leaves, weeds from adjacent farms, cow dung and urine, fodder wastes from cattle sheds, these items are put in alternate layers (cow dung in between layers) in a heap and left for 45-60 days to convert into manure.

**HIGH EXTERNAL INPUT AGRICULTURE:**

1. The farming pattern depends heavily on external and chemical inputs.
2. The focus of agricultural development and research has mainly been on maximizing yields coupled with increasing specialization of production.
3. There is great damage to the environment.
4. The continuing drop in prices of farm produce and the rising costs of agricultural inputs have made farming increasingly unprofitable.
5. HEIA depends on the higher production and profit, without consideration of the local needs and local market.
6. Lack of diversity in the farming practices as a result there is greater risk of failure and price fluctuations.
7. Under HEIA system soil quality deteriorates, and there is resurgence of pests, lack of resilience in the soil-plant system.
8. In HEIA, there is lack of use of indigenous technologies.

**LOW EXTERNAL INPUT AGRICULTURE:**

1. LEIA relies on the optimal use of natural processes and the focus is on the sustainability of farming system.
2. Environmentally sound and that have the potential to contribute to the long-term sustainability of agriculture.
3. Greater emphasis is on the long term sustenance and balance between the profit and livelihood.
4. Sustainable ecological practices depend largely on local agro-ecological conditions and on local socio-economic circumstances as well as on farmer’s individual needs.
5. One way of LEIA is to diversification of farms; with a range of crops and/or animals, farmers will suffer less from price fluctuations or drops in yields of single crop. Maintaining diversity will also provide a farm family with a range of products to eat or sell throughout a large part of the year.
6. LEIA maintains a healthy soil, recycling nutrients on the farm, and utilizing approaches such as integrated pest management (IPM).
7. Use of technologies, such as soil and water conservation (terraces, ditches and vegetation strips on sloping land), better timing of operations, improved crop spacing, manure or compost and water application based on local conditions.