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Agro-ecological crisis faced by the farmers of dryland agriculture: threat to sustainable agriculture

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"Agro ecology is at the heart of all alternative farming systems. Agro ecology is a way of life to live in harmony with nature in an agro-ecosystem"

Introduction

By focusing on sustainable agriculture and agro-ecological peasant production, we can make sure that food prices aren't affected by financial games and can help restore land damaged by chemical farming. This approach also allows for the production of healthy local food for urban dwellers. Agro-ecology isn't just good for family farmers, it's good for everyone. It's key for achieving food sovereignty and resilience in the face of climate change, even though it goes against the interests of big corporations. By embracing agro-ecology, we can benefit food producers worldwide, urban consumers, and our environment. Let's protect our planet for future generations by learning from these innovative practices and improving mainstream agricultural research.

So, in order for farmers to understand and embrace the latest technological and institutional advancements in sustainable agriculture, we need to raise awareness and educate them about the benefits and ecological reasons behind these innovations. It is crucial to conduct a systematic study to analyze and comprehend the actual ecological reasons behind these contemporary advancements. The farming sector has been facing a crisis in the past two decades, resulting in ecological problems such as loss of biodiversity, degradation of natural resources, and declining productivity. In response to this crisis, various technological and institutional innovations have emerged throughout the country, showing promising results. These innovations, like organic farming and sustainable agriculture, have been developed through scientific problem-solving approaches and the practical knowledge of farmers who have survived in their specific agro-ecosystems. Although these innovations are essentially indigenous, they have been tested and improved by interested researchers and farmers, making them contemporary innovations.

Contemporary innovation developed by farmers to face agro-ecological crises

Appropriate technologies should be based on indigenous knowledge and rationale, economically viable, accessible and based on local resources, environmentally friendly, and socially, culturally, and gender-sensitive. They should also be adaptable to different circumstances and enhance overall farm productivity and stability. These modern innovations from the non-formal sector haven't really been studied by researchers who focus on innovation systems. It would be helpful to learn from these innovations so that the mainstream agricultural research and extension system can improve and become more relevant, resilient, and sustainable. Instead of a top-down approach where farmers passively receive information, there should be a focus on farmers exchanging information within farmer networks, supported by organizations committed to farmers' needs. The importance of sustainability lies in preserving natural resources for the benefit of present and future farm families. Sustainable agriculture means farming systems that can maintain their productivity and usefulness to society indefinitely. These systems must be resource-conserving, socially supportive, commercially competitive, and environmentally sound. The goal is to provide a more profitable farm income, promote environmental stewardship, and create stable and prosperous farms for families and communities. Farmers need to understand the scientific problem-solving approaches behind these contemporary agricultural innovations that they have developed during times of crisis. Some technological and institutional innovations have been developed by research institutes to support farmers during these crises. This allows farmers to survive, even if only at a subsistence level. Contemporary innovations refer to new integrated technologies and practices developed by farmers and a few researchers in the present time. Examples include organic farming, non-chemical soil and plant nutrition techniques, on-farm resource use, sustainable agriculture with low external inputs, non-pesticidal crop management, mixed and intercropping, water harvesting and sharing, and community mobilization. An in-depth analysis of these alternative solutions to agrarian crises has shown that agro-ecology is at the core of all these alternative farming systems. Therefore, farmers need to understand the scientific principles of agro-ecology for sustainable agricultural practices. Agro-ecology is increasingly recognized as the way forward for sustainable agriculture, as it can increase productivity without depleting the

environment and disempowering communities. It has consistently shown the potential to increase total output on diversified farms and is particularly valuable during uncertain economic and climatic conditions.

A. Natural resources degradation

- Complete disregard for natural resources.
- Inefficient use of natural resources such as water.

Rainfall:

- Washing away of sediments due to excessive runoff.
- Deforestation leads to decreased rainfall.
- Late onset of monsoons
- A water-loving crop, namely, raw sugarcane.
- Uneven distribution of precipitation.
- Untimely precipitation
- Unpredictability of precipitation
- Low efficiency of sediment use.
- Low water use efficiency
- Lack of reservoirs.
- Low level of water sharing and cooperation.
- Lack of protective irrigation
- Condition of watercourses
- Decreased rainfall in winter (affects rabi crop)

Dry spells:

- Consecutive days without rain
- Little/zero rainfall
- Temperature changes
- Heat waves cause dehydration

Ground water and borewells:

- Excessive lifting of ground water resulting in depletion of ground water resources.
- Early withdrawal of water
- Over pumping of borewells to irrigate water loving/water exhaustive crop
- Seasonal variation in rainfall lack of cultivation of irrigated dry crops
- Lack of storage facilities for recharging water into borewells
- Lack of rain water in deeper confined aquifer

Soil moisture:

- Low relative humidity
- More evapotranspiration due to luxurious growth of weed
- Lack of water harvesting facilities
- Lack of slow recharging of water run-off
- Lack of application of tank silt
- Due to loss in vegetation heavy runoff take place leads to less soil moisture conservation
- Growing water inefficient crops (cash crop)

Ecological Balance:

- Imbalance in harmful and beneficial insect ratio
- Enormous use of bio-pesticide

- Imbalance in weed and allopathic crop like sunflower

Soil fertility loss:

- No. of executive crop without application of manure and organic matter
- Soil erosion cause loss in mineral matter from soil
- Loss of soil moisture create disturbance in nutrient uptake
- Leaching
- Drainage
- Heavy runoff
- Volatilization
- Application of contaminated water in soil
- Application of toxic chemical/pesticide

B. Agronomic bad practice

Monocropping

- Monocropping excessively resulting in irreparable damage of agro-ecosystem and ecological balance of nature.
- Growing same crop year by year
- Lack of biological diversity
- Availability of local seed variety
- Growing traditional crop in particular region liked by local people or by specific locality

Mixed cropping:

- Completely stopping the practices of mixed cropping
- Lack of practicing intercropping
- Lack of contingency crop planning

Non judicious use of fertilizer:

- Excessive use of fertilizers/chemical
- Deuteriation of soil fertility
- Toxicity in soil affect nutrient uptake
- Increase in soil bulk density affect water retention capacity
- Enhance vegetative growth but destroy reproductive growth

Mulching:

- Emphasis on individual achievements
- lack of using destroyed weed as soil mulch
- lack of using pruned biomass as soil mulch
- lack of using antitranspirants
- traditional cultivation practices of crop
- ploughing along the slope
- broadcasting seeds
- sowing seed behind the country plough leading to poor as well as uneven plant
- pre-monsoon sowing
- limited choice of crop based on rainfall
- application of FYM in limited quantity
- lack of suitable variety in the region
- resource poor lack of accessing and recurring crop failure

C. Other causes

- Completely leaving away traditional agricultural practices.
- Cutting away the trees on farm and nearby forests
- Depletion of forest in the districts
- Leaving the check dams and other soil and water conservation structures.
- Loss of genetic diversity
- Lack of local crop varieties
- Unavailability of animal races (animal diversity)
- Decline in on-farm crop
- Loss of landscape diversity
- Habitat fragmentation
- Loss of soil quality due to heavy runoff of water leads to change in soil structure
- Capacity to resist from pest/disease, drought, storms, and other related problem
- Decline in interaction and bio resources flow between farm components
- Lack of practicing recycling crop residue and manures
- Lack of effective use of biomass
- Lack of complementarities between plants
- Low level of natural pest control
- Heavy dependence on external inputs
- Lack of lifesaving irrigation
- Erratic distribution of rainfall
- Very heavy rainfall
- Occurrence of dryspells in midseason
- Late arrival of rainy season
- Early termination of rainy season
- High summer temperature
- High speed of hot winds during crop season
- Pest and disease risk
- Fluctuating prices for harvested produce

In addition to the innovations of many public research institutions, various innovations have also been developed by some non-governmental organizations that manage and sustain agricultural ecosystems by optimizing and modeling agricultural skills and indigenous knowledge. These are innovations in daily practice. That's why they are called contemporary innovations. Although these are indigenous, they were tested and developed in informal settings by explorers and small farmers. Modern changes are changes that have existed or are taking place in current life. They occur simultaneously with government support and approval of new technologies. Current innovations or practices are widely recognized and accepted by farmers. The importance of today's innovations is important for farmers who survive with unique farming methods, face many challenges and innovate locally. These innovations are culturally compatible, environmentally friendly and in harmony with nature. A better understanding/understanding of the agroecological underpinnings of modern innovations is needed to support farmers. The agroecological basis of modern innovations is the research or scientific explanation behind the agroecological

products of modern innovations. The language of agroecology relates to all permaculture practices for farmers and the reasons behind the science and concepts of agroecology. It is very important for permaculture.

Conclusion

Today, agriculture is going through a difficult period. Among the many problems faced by farmers in India today, the most important are the increase in cultivation costs due to foreign dependence, the large change in market prices, the variability of monsoon rains and the loss of public support for agriculture.

The crisis in agriculture has increased in the last twenty years and has been caused by excessive chemical/water use, loss of biodiversity, etc. For various reasons, it led to a crisis in large areas of the region. In response to the agricultural crisis, a number of technological and institutional innovations have occurred in the country and good results have been achieved. Some are driven by religious beliefs (cattle breeding, Homeric therapy), while others are driven by scientific solutions (organic farming, permaculture, natural farming, etc.). These innovations resulting from informal activities are not yet considered as research subjects by innovation process researchers.

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