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Concept Paper

Eco-farming: relevance and rewards

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ABSTRACT

Eco-farming tries to cut down costly inputs and minimize negative environmental impacts by making intelligent use of existing ecological factors. It is developed as an alternative to the increasingly intensive use of irrigation and fertilizers and tries to free farmers from constraining factors in the local natural environment. The element of eco-farming is a part of traditional farming system that can be promoted among the poor farmers living in rainfed conditions. An important key element for promoting theses of agricultural practices is to reduce poverty in India. These can only be possible by catalytic development of people's association that ensures people's participation. Ecological farming can provide large scale carbon sinks and offer many other options for mitigating climate change. In addition farming with biodiversity is the most effective strategy to adapt agriculture to future climatic conditions. A mix of different crops and varieties in one field is a proven and highly reliable farming method to increase resilience to erratic weather changes. This farming is better than conventional agriculture because it protects nature by taking advantage of natural goods and services such as biodiversity, nutrient cycling, soil regeneration and natural enemies of pests and integrating these natural goods into agro-ecological systems that ensure food for all today and tomorrow.

Keywords: Ecological farming; INM; biofertilizers; sustainability; soil health

INTRODUCTION

The major problems encountering agricultural production are the pervasive erosion of natural resources such as land, water and biodiversity, fast declining soil fertility and use efficiency of inputs such as water, fertilizers and energy. Demographic pressures accelerate the erosion of natural resources whereas agronomic deficiencies bring down the use efficiency of inputs (Hendrix et al 1990).

By incorporating the major components of ecological farming namely soil healthcare and nutrient management the potential of 150 MT of food grains per annum can be untapped (Mader et al 2002). The main objective of eco-farming is to grow crops based on the soil and climate of the region and to help the ecology and farming to gather more gains from economy with the efficiency of inputs (Altieri 2002, Finckh et al 2000, van Bruggen 1995). This technology may be grouped into four categories:

i) Those that reduce the environmental burden of greenhouse gases (CO_2 and methane), global warming and ozone depletion. This can be achieved by promoting renewable sources of energy (draught animal power), electrical energy from garbage disposal and biogas from organic wastes.

ii) Those that reduce the demand on land, water and biodiversitywithout adverse effects on agricultural production and nutritive value of food. It is achieved by nursing the soil back to health by changing cropping patterns to maximize ecological productive efficiency and by improving water use efficiency through conjunctive use of rain, tank, underground well and river waters, reduce conveyance losses and finally phasing out subsidies.

iii) Those that continue to improve crop productivity under shrinking land resources (genetic and agronomic) are achieved by hybrid vigour, gene pyramiding, multiple cropping patterns and integrated nutrient and pest management.

iv) Those that reduce hunger and poverty by adopting cost-effective farming to bring equity to food prices and wages and to encourage job promoted growth right in the villages to arrest migration as ecological refugees.

Integrated nutrient management

As early as 1974 the need for integrated nutrient management (INM) was elucidated. The INM philosophy combines economic and efficient traditional and frontier technologies to gain from the symbiosis and synergy of crop soil environment bio-interactions (Anon 2005). The approach is flexible and minimizes the use of chemicals but maximizes the use efficiency and farmer profit. The concept is for optimization of the effects of all available sources of plant nutrients to improve soil fertility availing nature's gifts. To formulate, fertilizer use levels are based on three principles viz basic soil fertility and climate, nature of crop as a part of the cropping system and at least 50 per cent of the total nutrient level NPK in organic form.

The soil is treated as a living system for promoting all the functions viz supportive, buffering and store-house of nutrients and water supply (Fliessbach and Mader 2000). The excellence of performance is closely related to nature and levels of organic matter maintained with appropriate tillage and cultural practices. Soil fertility is not static but dynamic determined by many soil quality indicators (physical, chemical and biological). Productivity is a function of fertility in interaction with the environment and farmer skills of management (Swift and Anderson 1993). The system approach of fertilization of crops proposed as early as 1980 failed to take root either in the field or in the minds of the industry since the complex product

patterns of the fertilizer manufactured in India are a total misfit to the concept of INM. The soil health foundation was founded in the US in 1947 by JI Rodale with the sole objective of consistent promotion and encouragement of agricultural practices to protect and improve the soil. There is compelling relevance and imperative need to monitor soil health in terms of physical, chemical and biological properties. These properties can be measured. The soil is no longer considered as an inert matter for anchoral support of the plant studied for its chemistry and nutrient content but an ecologically dynamic living system (Seufert et al 2012, Wolfe and Cormack 2000).

As per the earth charter which is an ethical framework for building a just sustainable and peaceful global society by 21st century- a testament (1995) with its declaration of ten clauses in its preamble lends unusual support to the cause of soil health promotion. Clause 4 underlines the life of the soil to safeguard the dynamic processes of the earth and all that is within, embracing inanimate matter and all forms of life is the essence of the organic approach to soil fertility management on a sustainable basis. Clause 9 says joint stewardship of the living and non-living elements of the earth's ecosystem permits advancement towards sustainability for the future and thus allows development with equity. Healthy soil, food and people interrelationship becomes profitable with the inclusion of animals in the food chain when farming system becomes sustainable (http://earthcharter. org/discover/what-is-the-earth-charter/).

A combination of dairy and fresh produce arising from home gardens is based on five principles being the most promising for India. These are i) crop rotation, (ii) providing a habitat, (iii) continuing soil enrichment with compost, green manure and mulch, (iv) crop diversity and (v) plant selection.

As these principles are under abuse in major farming systems in India hence unsustainable crop yields surfaced to the agony of those working towards food security (Chakravarty and Dand 2005).

Organic farming and biofertilizers

Traditional agricultural practices with special reference to legume in cereal rotation, use of green manures and rural agricultural waste as compost and tank silt application will help build the soil organic matter base as a reliable index of fertility. This is a long term endeavor but once attained all parameters whether physical, chemical or biological work at optimum levels (Dahama 2010, Vandermeer et al 1998). Bacterial fertilizers such as *Rhizobium* and *Azospirillum* become redundant. The indigenous flora will be functional at peak efficiency. Each farmer can prepare his vermicompost on his farm and apply it. The earthworms will thus work

as the soil is hospitable. Earthworms naturally occurring in the soil are a recognized indicator of the agro-ecosystem's health for stable aggregation of clay organic matter complexes and efficient nutrient recycling (Altieri and Nicholls 1999).

Current status of biofertilizers

The benefit of inoculation with specific biofertilizer in crops is a composite effect of the entire nitrogen fixing system of the soil with the inoculant under study as one of the components. To encourage the activity of one component of the system at the expense of others beyond narrow limits in the soil is more than formidable (Francis and Clegg 1990). Using biofertilizers to replace and economise on a part of non-renewable energy-based fertilizers is worth the effort. The extensive research programme on beneficial bacteria and fungi has resulted in the development of a wide range of biofertilizers which satisfied the nutrient requirements of crops and increased the crop yield as well. It is necessary to condition the soil to be more hospitable for the inoculant (Ayala 2001, Tamm 2000). Use of green manure *Sesbania rostrata* holds high promise in this direcrtion. For each tonne of fertilizer manufactured nature's gift is three tonnes. Agricultural practices should in no way retard and denigrate the size of nature's gift to farming. Long term conservation of the soil's health is the key benefit of bio-fertilizers.

Ecological agriculture that efficiently combines use efficiency of inputs and economic yield maximization will begin to prevent the abuse of natural resources. On its progress depends the achievement of food security and sustainability of farming systems. Ecological agriculture will reactivate the fatigued green revolution to move forward through promotion of soil health, package of agronomic practices with each component a blend of tradition and modernity and a policy to value each input based on its intrinsic worth free from subsidies. There is the need to recapture local knowledge about farming systems. A synthesis of traditional wisdom and ecological prudence of tropical agriculture with modern advances in technology will help higher use efficiency of inputs and sustainable crop yield maximization (Scialabba and Lindenlauf 2010, Pretty 2006). This is symbolic to low input sustainable agriculture and sustainable agricultural research and education programme widely promoted in the US. In fact this has been the agronomic package of practices adopted in national demonstrations of ICAR on farmers' fields since 1965. Research on agro-ecological foundations crucial to sustainable agriculture is totally unattractive to industrial funding. A private endeavor all over the world (India is no exception) is restricted to research projects that command expanding markets and bulging profits. Investment in biotechnological research for agriculture is small (about a fifth of the total) with the lion's

share going to the human genome and health in the fierce battle against cancer and AIDS. Even miracle seeds can respond in a healthy soil. Nearly all agricultural production of the future must come from productivity of the soil which is now mostly sick and substandard. Crop yields swing between technological thrusts and eco-climatic threats with the best bet on ecological farming where the relevance is acceptable, the rationale sound and the rewards impressive.

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