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Organic farming in conserving bio diversity in India-A review

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ABSTRACT

The intensification and extension of modern agriculture is amongst the greatest threats to worldwide biodiversity and thereby food security. Promotion of genetic uniformity in the name of agricultural development cannot lead to sustainable agriculture and it has devastating effect on food security of next generation. Monoculture and replacement of traditional varieties by improved or exotic varieties has led to the decline of many traditional varieties in crops such as paddy, wheat, pulses, oil seeds and cotton in India. Thousands of varieties of rice, cotton, minor millets, pulses, and other crops are no longer in use. Besides, to sustain the yield under monocropping system, heavy pesticide applications were given to crops. This in turn affects the soil microbial population and insect diversity and questions the stability and sustainability of Indian agriculture. Sustainable farming systems such as organic farming act as a possible solution to this continued loss of biodiversity. This paper assesses the impacts of organic farming, relative to conventional agriculture on biodiversity, through a review of comparative studies of the two systems.

Key words: Agriculture commercialization, Food security, Green revolution, Monoculture, Sustainable farming.

Agricultural biodiversity is a broad term which includes all the components of biological diversity relevant to food and agriculture, and all the components of biological diversity that constitute the agro-ecosystem. It denotes the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem, its structure and processes. It is a precondition for sustainable agriculture and food security (FAO, 1999).

Over the years, Indian farmers have continuously modified the rich genetic material available to them from nature. The diversity was spread over both time and space, and both within and between species. For example, the traditional paddy field provided not only rice but also fish and other elements of biodiversity which were an important part of the diet of several communities, especially tribal's (Kothari,1994). In organic system, by using a system of crop rotation, harmful pests and diseases can be reduced and biodiversity increased. Farmers of Tumkur and Chitradurga areas of Karnataka are going back to grow traditional saline tolerant paddy in very less fertile and very hard soil (Anitha Reddy,2010).

The diverse traditional crop varieties are precious genetic resources that provide ecological balance and their conservation is crucial for future food security. To sustain crop production and thereby live of billions of organism in this world, the agro-bio-diversity should be carefully maintained at least to the current level. The study was aimed for assessing the impacts of organic farming, relative to conventional agriculture on biodiversity, through a review of comparative studies of the two systems.

To study about the loss of local or traditional varieties due to the impact of modern techniques on agriculture, many researches have been carried out throughout the world. Some of the studies have been presented below.

Green revolution and loss of bio diversity: Genetic uniformity promoted by the green revolution is the primary cause for most of the crop diseases and pests. The genetic base of plants has been narrowed down significantly due to the practice of selecting and breeding a handful of only successful varieties and hybrids. Currently, the world's food supply depends on about 150 plant species and among them just only 12 crops provides three-quarters of the world's food. More than half of the world's food energy comes from a limited number of varieties of three "mega-crops": rice, wheat, and maize (FAO,1999).

As per IUCN (2000) report, *Red List* of threatened species, habitat loss acts as the main threat to bio-diversity, with agricultural activities affecting 70 per cent of all threatened bird species and 49 per cent of all plant species (Hilton-Taylor,2000). Food and Agriculture Organization (FAO,1999) warned that the diversity of cultivated crops declined by 75% during the 20th Century and a third of

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today's diversity could disappear by 2050. In the United States, more than 7000 apple varieties were grown in the last century but over 85 percent of those varieties – i.e. more than 6000 varieties are extinct and just only two apple varieties account for more than 50% of the entire US crop (Shand,1997). In the Philippines, small farmers once cultivated thousands of traditional rice varieties, after Green Revolution just two varieties occupied 98% of the entire rice growing area in the mid-1980s.

It is reported that over 80% of varieties are lost in different species such as apple, maize, tomato, wheat and cabbage in worldwide (World Conservation Monitoring Centre,2003).

To list a few, bio diversity loss in various countries has been estimated as: lost 90% of fruit and vegetable varieties since 1900 in USA,400 melon varieties in 1970and only 12 are available today in Spain, all apples grown now originate from only 6 varieties in Germany, lost 90% of rice varieties since 1950 in China, and lost 80% of corn varieties since 1900 in Mexico.

In India, after Green Revolution, increase of yield has been given importance and crops which respond well to external inputs like fertilizers has been chosen. In the 1960s, an urban Indian consumed 32.9 kg of millets per annum per capita, whereas the value is only 4.2 kg in 2010 eight times lower after five decades. So-called "inferior" millets have lost share, to "superior" wheat and rice, mainly due to growing income and urbanization (National Council of Applied Economic Research, 2014). As a result, since 1956, the area under millets shrunk by 23% for pearl millet, 49% for finger millet, 64% for sorghum and 85% for minor millets. Introduction of new high yielding varieties has led to loss of indigenous varieties and diversity of indigenous agricultural system which in turn contributes to ecological instability due to shift from multiple cropping pattern to monoculture (Kaur,2014).

Genetic diversity among agricultural crops has also declined rapidly due to the introduction of new commercial varieties. These introduced new wheat and rice varieties came from a very narrow genetic base. India had nearly 1,10,000 varieties of rice till 1970 and this diversity has been lost to posterity as a result of the green revolution with its emphasis on mono culture and hybrid crops. Now, only 6,000 species or varieties of rice survive (Deb,2012).

In the Godavari district of the Indian state of Andhra Pradesh, an estimated 95% of the rice varieties have been lost. In northeast India, several varieties of sugarcane were replaced by a single hybrid variety. Bhonsle *et al*. (2011) have documented 45 traditionally-cultivated and 22 high yielding varieties from farmers across Goa but, all the traditional varieties are not available and most likely the germplasm has disappeared. Cultivation of some of the varieties such as Kalo Novan, Kalo Damgo, and Bello are becoming rare, due to the introduction of high yielding rice varieties, hence local germplasm and their genetic diversity are being eroded. About 400 traditional varieties have been slowly replaced by HYVs, reducing the number to hundreds. This has led to the loss of the genetic pool of many landraces that can adapt to the ongoing climate change in Tamil Nadu. Thousands of varieties of rice, cotton, minor millets, pulses, and other crops are no longer in use (Gillespie,2011).

Introducing exotics plant species can come at the expense of native species that may be rare, threatened or much localized in their distribution, leading to a loss in overall biodiversity (Pagiola *et al*.,1997). For example to satisfy the need of pulpwood for Indian paper- pulp industry and fuel wood for local timber use, planting of exotic plants like eucalyptus and wattle gained momentum after Indian independence. Several internationally sponsored social forestry programmes and central forest conversion schemes in the 1970s supported the planting of these tree species in India. The National Commission on Agriculture in 1976 recommended some species of eucalyptus as the most suitable for this purpose. In Karnataka, 90 per cent of the seedlings planted as a part of the Karnataka State Social Forestry Project of 1983, were eucalyptus species. A similar shift in agro forestry has also happened in Jeypore (Odisha), where eucalyptus is occupying traditional agricultural landscapes. Scientists have recently found that eucalyptus loses more water. In a day, a single tree can lost between 20-40 litres of water (Divya, 2014). Thereby, it competes for water with the local tree species of the Western Ghats.

Commercialization of agriculture in the recent years questioned the sustainability of resources. In the hilly regions of southern India, the native agro-bio-diversity is being replaced by the cultivation of cash crops for generating farm income. In Kolli hills (Tamil Nadu), over the last three decades, cassava has replaced native millets. It constitutes 70 % of crop production in the region. Over 7,000 hectares of farmland is devoted to H 165, a non edible variety, preferred by industry for its superior starch quality. Mono-cropping of a single variety over a large area displaced local crop diversity, negatively impacting on food security and make farmers more vulnerable to climate risks (King *et al*., 2014).

The erosion of agricultural bio-diversity questioned the sustainability of Indian agriculture by means of eroding the genetic base on which scientists depend for improvement of crops. HYVs, and more particularly hybrids, lose their viability and become susceptible to pest and disease attacks, after few years of its introduction. This necessitates the

infusion of fresh genetic material, which is again obtained from existing traditional varieties. Thus the introduction of these HYV's is a major cause of the removal of traditional crop diversity (Kothari,1994).

Livestock diversity has also faced a serious threat. In India, just 3 decades after the introduction of "modern" livestock breeds, an estimated 10 (50%) of the goat breeds, five (almost 20%) of the cattle breeds, and 12 (30%) of the sheep breeds are today threatened. The Ongole breed of cattle has already been lost in India. The Kadaknath breed of hen, the Bonpalo and Nilgiri breeds of sheep has almost been pushed to extinction (Balain *et al.*,1991).

The reason behind the loss of domestic animal diversity is the intentional cross-breeding with exotics, carried out by the government to increase the yields of milk or animal products. Semen banks have generally stored the semen of exotics. In case of poultry, exotics now make up 80% of the total population, with disastrous effects on indigenous poultry breeds. (Kothari,1994).

A large number of organisms like earthworm, millipedes, wasps, ladybirds and spiders, occurring in the rice agro-ecosystem, are beneficial to the rice crop, and there are no ways of calculating biodiversity lost after the application of chemical fertilizers and pesticides.

Benefits of organic agriculture over conventional in maintaining bio diversity: The rate of ecological and bio-diversity destruction has now been recognized and the need for conservation is acknowledged at the level of farmers. Research has demonstrated that organic agriculture significantly increases the density and species of soil's life. Soil forming and conditioning and nutrient cycling are encouraged by organic practices such as minimum tillage, crop rotations, strip-cropping, green manuring, organic fertilization, and avoidance of pesticides and herbicides use. Addition of manures in organic farms provides organic carbon to the soil and thereby increasing microbial populations particularly bacteria (Bossio *et al*., 1998; Fraser *et al*., 1988).

Reduced reliance on agro chemicals helps the plants in better adoption to local climatic conditions thus helps in expansion of better varieties. Undisturbed ecosystem forms an optimal condition for preservation and evolution of many locally evolved species (Simhachalam,2017).

Organic management allows the development of rich weed-flora as compared to conventional systems. In organic grassland, the average number of herb species was found to be 25 % more than in conventional grassland. Weeds influence the diversity and abundance of arthropods and flowering weeds are particularly beneficial to pollinators and parasitoids (FiBL, 2000). The presence of versatile flora attracts beneficial herbivores and other above-ground organisms. Their presence improves the nourishment of predatory arthropods.

Millets grown under organic practices constitute a farming system and millet fields are inherently biodiverse. There is a tradition of millet farming in India, where six to 20 crops are planted in the same area at the same time. The famous Baranaja cropping systems in the Himalayas are the evidence to this. In this millet-led system, 12 different crop varieties are grown in the same field at the same time. Saat Dhan in Rajasthan also is a host to a large variety of millets. The Pannendu Pantalu system of the South grows millets in combination with pulses and oilseeds, thus making it a holistic farming system (Satheesh, 2010).

Organic farms contain a greater wealth and diversity of arthropods than conventionally managed fields (Letourneau and Goldstein, 2001).Organic management increases the species richness of beneficial arthropods like predators and improves crop growth. In organic system the density and abundance of arthropods, as compared to conventional system, has up to 100% more carabids, 60-70% more staphylinids and 70-120% more spiders (FiBL,2000). The distribution of carabids was linked to changes in vegetation structure, and number of studies indicated a positive correlation between weed species richness and beetle species richness (Pfiffner and Niggli, 1996). In case of dung beetles, the reduced use of veterinary drugs and retention of herbaceous field boundaries in organic farming are likely to have positive impacts on their bio-diversity (Hutton and Giller, 2003).

The biomass of earthworms in organic systems was 30-40% higher than in conventional systems. The reasons for higher arthropod diversity are mainly related to organic plant protection management, low input organic fertilization and more diversified crop rotations (Stolton *et al*., 2000). Many studies reported (Brown, 1999; Liebig and Doran 1999) more earthworm population and species diversity, both in-field and within grass margins, in organic farms than conventional fields. Feber *et al*. (1997) indicated higher abundance of butterflies on organic than conventional farms. Species richness, abundance of food plants in field boundaries and lack of chemical spray drift were the important beneficial factors in organic field. Wickramasinghe *et al*. (2003) found out that total bat activity and foraging activity were significantly higher on organic farms (by 61% and 84% respectively) than on conventional farms. This result suggested that bats were actively selecting organically managed habitats. Some studies also identified more bird abundance on organic than conventional farms. Beecher *et al*. (2002) conducted a study in North America and indicated avian species richness and overall abundance on organic than conventional fields.

CONCLUSION

In the ecological cycle, human being's existence is very much dependent on a variety of other living creatures. So, preserving this variety is crucial for our existence. Homogenisation of crops through HYV monocultures would entail that a single disease or pest outbreak will devastate all crops in the field. Crop diversity is the best insurance against uncertainty in the market due to glut in production of any one variety of crops and agricultural bio- diversity gives farmers some options to mange climate risks and there by maintaining food security of the nation. Loss of bio-diversity is today's major ecological threat recognized even by the United Nations, which declared this decade as the UN decade on biodiversity and organic farming is the way forward in fulfilling this declaration.

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