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Impact of Sustainable Organic Farming on Biodiversity and Environment

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Abstract

This study was designed to access the impact of sustainable organic farming on biodiversity and environmental parameters from farmer's perspective in four villages of Kotputli Tehsil in Jaipur district of Rajasthan. The study sample comprises of 80 farmers who are practicing organic farming in Kiratpura, Kansli, Karwas and Sundarpura villages of Kotputli Tehsil in Jaipur district. The present study was based on both primary and secondary data. Primary data was collected with the help of stratified random sampling and personal interview survey conducted through structured questionnaire. For analyzing primary data frequency and percentage method were used. The results revealed that all the sampled certified organic farmers observed the effects of organic farming and they viewed that practice of crop diversification in organic farming suitable for maximum biodiversity and also attract new species in organic farms, as well as organic agriculture leads to increase in population of microbes, earthworms in organic farms and Bio pesticides prepared from plant and animal waste eg. Leaves of Neem (Azadirachta indica) tree, animal dung etc. is environmental friendly. Around 90 percent farmers observed that population of birds, bees and beetles have increased and natural pest reduced in their organic farms, but around 70 organic farmers did not observed the predatory insects and micro organisms in organic farms. Around 92 percent respondents observed that organic farming improves water retention capacity of soil due to use of organic manure and crop production increased due to improvement in soil fertility.

Key Words: Organic Farming, Sustainable Agriculture, Chemical Fertilizers, Vermicompost, Biodiversity, Environmental degradation.

1.Introduction

Agriculture is the largest ecosystem created by humankind on the Earth[20]. Around 4000 years ago agriculture began in India as per mentioned in 'Arthashastra'[17]. In ancient times farmers adhered to law of nature[1]. But later on during green revolution they started practicing intensive modern agriculture that utilize excessive quantity of agro chemical fertilizers, pesticides, insecticides, HYV seeds, excessive tillage and growth regulating agents to boost up the crop production to meet the needs of rapidly increasing population it results into degradation of natural ecosystem and decrease biodiversity and environmental pollution[13].

The continuous extensive application of agro chemicals resulted in soil and human health hazards, contamination of surface and ground water through runoff and environmental deterioration. Thus conventional farming became unsustainable method of agriculture[19]. In modern agriculture practice leaching of nitrogen and phosphorus causes eutrophication of water bodies like village ponds, wells and underground water pollution. Inorganic food contains toxic remains of synthetic chemicals that are harmful for human health and also leads to deterioration of habitats of various plant and animal species, ultimately decline in biodiversity[10].

In order to conserve environment, biodiversity and improve human health declined by chemical farming some farmers have adopted biointensive, ecology-based approach of agriculture known as organic farming[3]. Organic agriculture is native to India[19]. Organic farming prohibits the use of chemically synthesized fertilizers, pesticides, insecticides and mineral nitrogen fertilizers[7]. The concept of organic farming is "*Give back to nature*" where the philosophy is to feed the soil to maintain the soil health rather than the crop to grow faster[5]. Organic agro- ecosystem is consists of biological and environmental components including soil, air, and water, Organic matter, earthworms, microorganism producers, consumers, decomposers, sunlight and other climatic factors[10]. It is self-regulating and keeps ecosystem in equilibrium for longer period. Thus organic farming as a sustainable form of agriculture uses organic inputs, biological cycle, vermicompost, decomposed organic fertilizers, green manure, animal waste, crop residue and stubble back into farms for regulating natural ecosystem[7].

FAO suggested that "Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs"[16]. The basic motives of organic farming are development of agriculture in a sustainable direction and to protect environment and minimize ill effects of agriculture on environment[10].

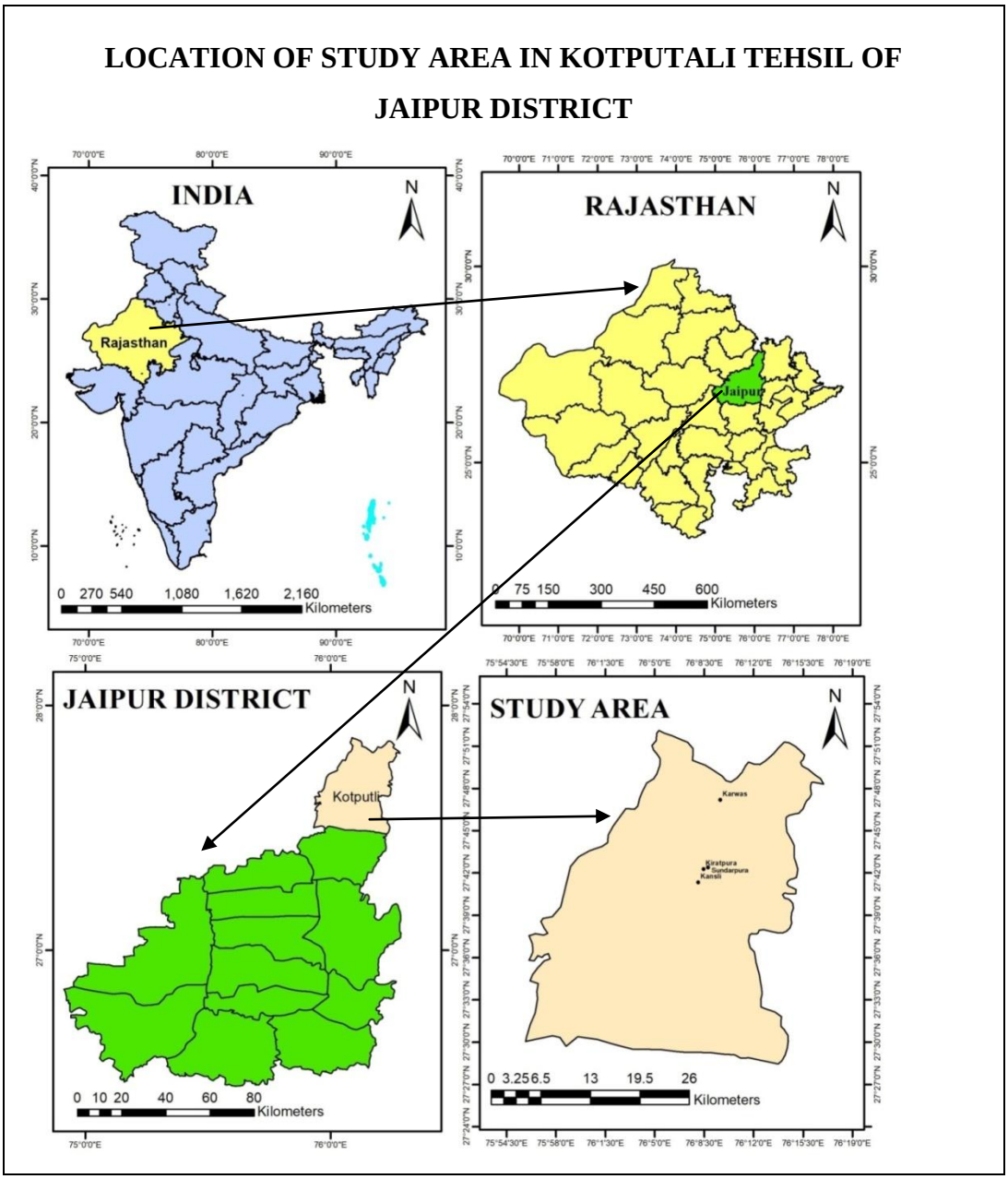
The motto of organic farming is to "*serve healthy food to people for good health*". Organic farming based on "*Nature can provides for everyone's need but not for greed*"…said by Mahatma Gandhi[16].The basic principles of organic farming are environmental and socio-economic sustainability[18]. Scholars found that organic matter increases water retention capacity

of soil and enhance strong growth of roots, results in high productivity[14].Organic inputs are environment friendly and application of bio fertilizers control the leaching of nitrate in soil, ground water pollution and reduce the growth of algal blooms in surface water bodies including ponds. Algal bloom adversely affect people's health and marine animals and organisms. Minimum tillage practice in organic farming which play vital role in soil erosion control and organic manure improves the water retention capacity of soil thus reduce need of irrigation so organic farming also can be practiced in low rainfall area. Organic farming can also play a significant role in reducing carbon dioxide level in air and aid in slowing down climate change and mitigating greenhouse effect and global warming. Various techniques of organic farming like minimum tillage, returning crop residue into soil, crop rotation, cover crops and integration of nitrogen fixing legumes increases the return of carbon into soil and decreases carbon dioxide in atmosphere[15.]

Organic agriculture creates a mosaic environment through intercropping method of agriculture[6]. The key to protect soil fertility, nitrogen self-sufficiency and fostering biological activity of soil for longer time is to maintain level of organic matter in farms by using legumes, biological nitrogen fixation, efficient recycling of crop residues, livestock waste and weeds. In organic farming pest, weeds, insect and disease control mainly depends on natural predators, green organic manure, inter cropping and crop rotation[2].

Plantation in buffer zones and border areas of farms develop a natural ecosystem for wide range of species and organic farms are rich in biodiversity including wild flora and fauna e.g. birds, honey bees, pollinators, ladybugs, beetles, butterflies and pest predators and also attract new species in farms and improve biological pest management, So crops, plants, micro organisms, insects, birds, pollinators and animals survive and naturally thrive in their natural environment thus organic farming maintain ecological balance[10]. Bio-pesticides supported the stability and sustainability of organic agro-ecosystem because these are not adversely affecting human health, soil fertility and environment in comparison to synthetic agro-chemicals[11]. Organic fertilizer does not kill micro organisms, earthworms and these increase soil fertility[12].

Biodynamic farms utilize bio-pesticides like green leaf manure of neem, organic manure, vermicompost that are non-toxic and environment friendly and also increases crop defense system[9]. The organic agriculture is capable of sustaining soil fertility and conserves environmental resource i.e. water, flora, fauna and rich biodiversity for longer time thus organic farming is sustainable and a less polluting as well as environment friendly agriculture system. Sustainable organic agriculture produces abundant food and other crops without deteriorating natural resources and polluting environment and also ensuring future generations the capacity to feed themselves with an adequate supply of healthy food[19].



2. Materials and Methods

2.1Data Collection

This study was based on both primary and secondary data. Primary data were collected through structured questionnaire. On the basis of stratified random sampling approach the farmers of these four villages were grouped into two strata i.e. certified organic farmers and inorganic

farmers. Out of certified organic farmers 20 respondents from each of four villages were randomly selected for the study.

2.1.1 Sites of the Study

This study was carried out in four villages i.e. Kiratpura, Kansli, Karwas and Sundarpura villages of Jaipur district which were purposively selected because maximum number of certified organic farmers in Jaipur district are from these villages according to the Rajasthan State Organic Certification Agency data. Villages were selected in such a way as to draw a sample of total 80 respondents. Thus 20 certified organic farmers were randomly selected through stratified random sampling method from each of four villages include: Kiratpura (N=20), Kasli (N=20), Karwas (N=20) and Sundarpura (N=20) and thus making the total sample size of 80 respondents.

Fig. 1

Fig. 2

Fig. 1 & 2 - Organic farms of Kirathpura Village

Fig. 3

Fig.4

Fig. 3 & 4 - organic farms of Sundarpura Village

2.1.2 Data Process and Analysis

Data collected from direct interviews was calculated and analyzed using descriptive tools: frequency and percentage method.

3. Results and Discussion

3.1 Effects of organic farming on biodiversity

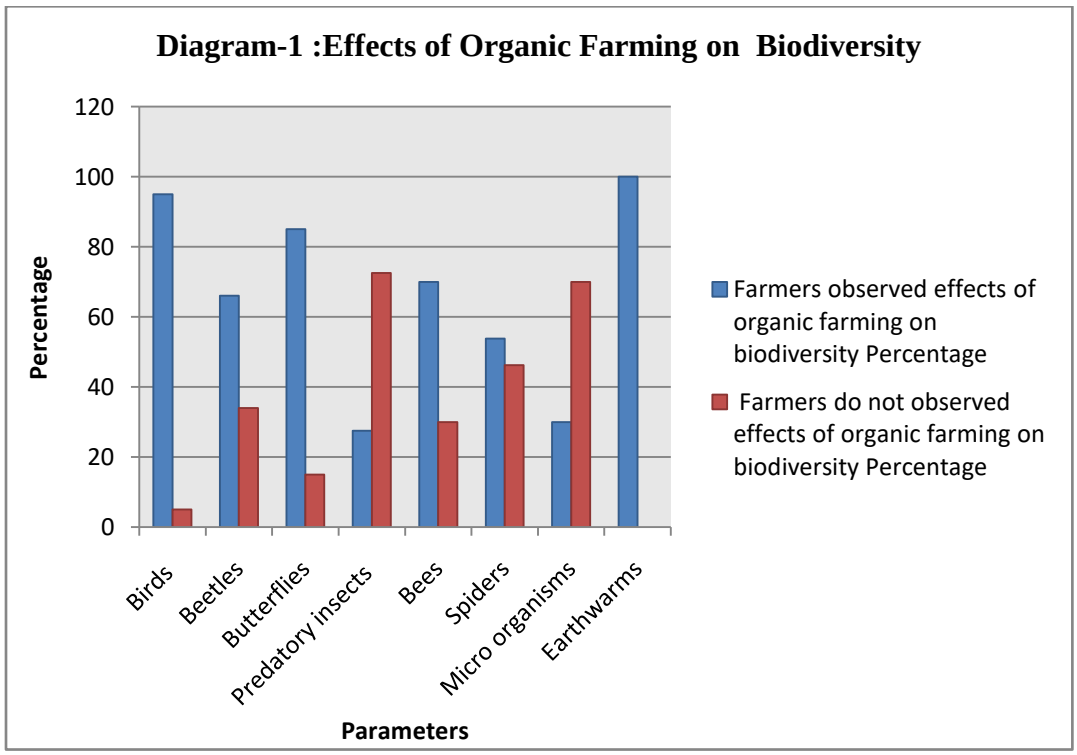
The results of the study indicated that all the sampled certified organic farmers observed the effects of organic farming and they viewed that practice of crop diversification in organic farming suitable for maximum biodiversity and also attract new species in organic farms, as well as organic agriculture leads to increase in population density of Earthworms in organic farms and Bio pesticides prepared from plant and animal waste eg. Leaves of neem tree, animal dung etc. is environmental friendly. Around 90 percent farmers observed that population of birds have increased and natural pest reduced in their organic farms, but around 70 organic farmers did not observed the predatory insects and micro organisms in organic farms. These results are also shown through bar diagram 1.

Table 1: Effects of organic farming on biodiversity

Parameters	Number of farmers who observed effects of organic farming on biodiversity		Number of farmers who do not observed effects of organic farming on biodiversity	
	Frequency	Percentage (%)	Frequency	Percentage (%)
1.Organic farms are rich in plants & animal species				
a. Birds (Aves)	76	95	4	5
b. Beetles & Ladybugs	52	66	28	34
c. Butterflies (Rhopalocera)	68	85	12	15
d. Predatory insects	22	27.5	58	72.5
e. Bees (Anthophila)	56	70	24	30

f. Spiders (Araneae)	43	53.75	37	46.25
g. Microbes-fungi, bacteria, protozoa	24	30	56	70
h. Higher density of earthworms	80	100	0	0
2.Natural pest reduction in soil	73	91.25	7	8.75
3.Crop diversification and inter-cropping is encourages biodiversity	80	100	0	0
4.Bio pesticides are environmental friendly	80	100	0	0

Source: Data based on field survey 2021



3.2 Effects of organic farming on environmental parameters such as soil, water and air

Table 2. Effects of organic farming on environmental parameters i.e. soil, water

Environmental Parameters	Number of farmers who observed effects of organic farming on environmental parameters		Number of farmers who do not observed effects of organic farming on environment	
	Frequency	Percentage (%)	Frequency	Percentage (%)
A. Soil				
1. Organic farming improve soil structure	80	100	0	0
2. Organic farming stabilize soil pH	24	30	56	70
3. Organic farming preserve and increase soil fauna				
a. Earthworms	80	100	0	0
b. Micro organisms- Fungi, Bacteria etc.	24	30	56	70
4. Organic farming improve soil fertility				
a. Soil fertility check through soil test	50	62.5	30	37.5
b. Yield improvement	76	95	4	5
c. Visual observation	80	100	0	0
5. Natural decomposition of animal dung in organic farms	80	100	0	0
6. Organic farming improves water retention capacity of soil due to use of organic manure	74	92.5	6	7.5
7. Organic farming minimize tillage as well as crop rotation and cover crops techniques used which control soil erosion	67	83.75	13	16.25
B. Water				
1. Organic farming reduces the risk of	12	15	68	85

ground water contamination				
2. Organic farming contribute in keeping surface water bodies like pond clean by avoiding polluted runoff from farms	59	73.75	21	26.25
3. Organic farming helps in reducing algal bloom in water bodies	17	21.25	63	78.75
4. Organic farming conserve water due to less need of irrigation	80	100	0	0

Source: data based on field survey 2021

The results of the study revealed that all the sampled organic farmers have observed that Organic farming improve soil structure, preserve and increase population of earthworms in soil, visually observed the improvement in soil fertility, natural decomposition of animal dung in organic farms and organic farming also conserve water due to less need of irrigation. About 60 percent sampled farmers have checked improvement in soil fertility through soil testing. Around 92 percent respondents observed that organic farming improves water retention capacity of soil due to use of organic manure and crop production increased due to improvement in soil fertility. And about 75 percent farmers viewed that organic farming contribute in keeping surface water bodies like pond clean and reduces concentration of nitrate in water bodies by avoiding polluted runoff from farms. Around 84 percent organic farmers observed that organic farming minimize tillage as well as crop rotation and cover crops techniques used which control soil erosion. But about 70 percent organic farmers did not observed that organic farming stabilize soil pH and increase in population of Micro organisms- Fungi, Bacteria and Protozoa in soil.

Conclusion

From the above analysis we can conclude that organic farmers observed the impact of organic farming and viewed that organic farming technique not only mitigate the problem of soil infertility and erosion, environmental degradation and ecosystem imbalance and decline of biodiversity but also encourage biological population, conserve water resources and maintain environmental stability. And also provide non-toxic, nutritious food products and fulfill human needs without harming environment, soil and human health. Thus it works in harmony with nature as a sustainable method of agriculture[8]. Therefore farmers should adopt organic farming that is natural, recyclable and sustainable, effective and cost efficient way to achieve sustainable development in agriculture sector[4]. The government of Rajasthan is taking initiatives and

proving subsidies to encourage organic farming and increase the area of organic farming in Rajasthan under Paramparagat Krishi Vikas Yojana (PKVY).

Declaration of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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