Journal of Biodiversity and Conservation Research

ISSN: xxxx-xxxx Vol. 1 (1), pp. 037-043, December, 2013. © Global Science Research Journals

Full Length Research Paper

Studies on floristic diversity of an organic farm of Himachal Pradesh, India: Transformation of a barren land to a productive niche

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Accepted 11 August, 2013

The ecological aspects pertaining to floral diversity, cropping systems and crop diversification of an organic farm CSKHPKV, Palampur were studied. The data for two years, that is, 2006-07 and 2007-08 was analyzed. The initial recorded data pertaining to various activities in the organic farm before 2006-07 showed low fertility soil status, very low productivity and least biodiversity in a so called barren land before the initiation of organic farming. The results over the period of two years showed how a barren land was converted to a lush green, fertile and productive land with increased biodiversity of flora through organic management practices. There was rich plant diversity on cultivated as well as uncultivated land. As many as 45 species of native plants and 50 species of introduced plants were found. However, 358 trees were found on the organic farm, out of which most were fodder trees and for green manuring. Ample crop diversification of introduced plants, cropland weeds and non-cropland weeds as well as trees was found on the organic farm. Crop diversification increased as soil status improved through organic management practices.

Key words: Organic farming, ecological, green manuring, diversification index.

INTRODUCTION

Organic agriculture is one of the broad spectrum of production methods that are supportive of healthy environment in this earth. More specifically, organic agriculture is a holistic food production system, which promotes and enhance agro ecosystem health, including biodiversity, biological cycles and sustaining the production system. Organic agriculture emphasizes the use of management practices in preferences to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. Organic farming increases the diversity of plants and animals. According to the analysis of various studies, it showed that on average, the number of species increased to about 30% in organic systems and the number of individual plants and animals was 50% greater on organic farms. Birds, butterflies, soil microbes, beetles, earthworms, spiders, vegetation and mammals are particularly affected. Many weed species attract beneficial insects that improve soil qualities and forage on weed pests (Hole et al., 2005). The present study deals with evaluation of ecological efficiency of an organic farm in terms of floristic diversity, crop pattern and crop diversification.

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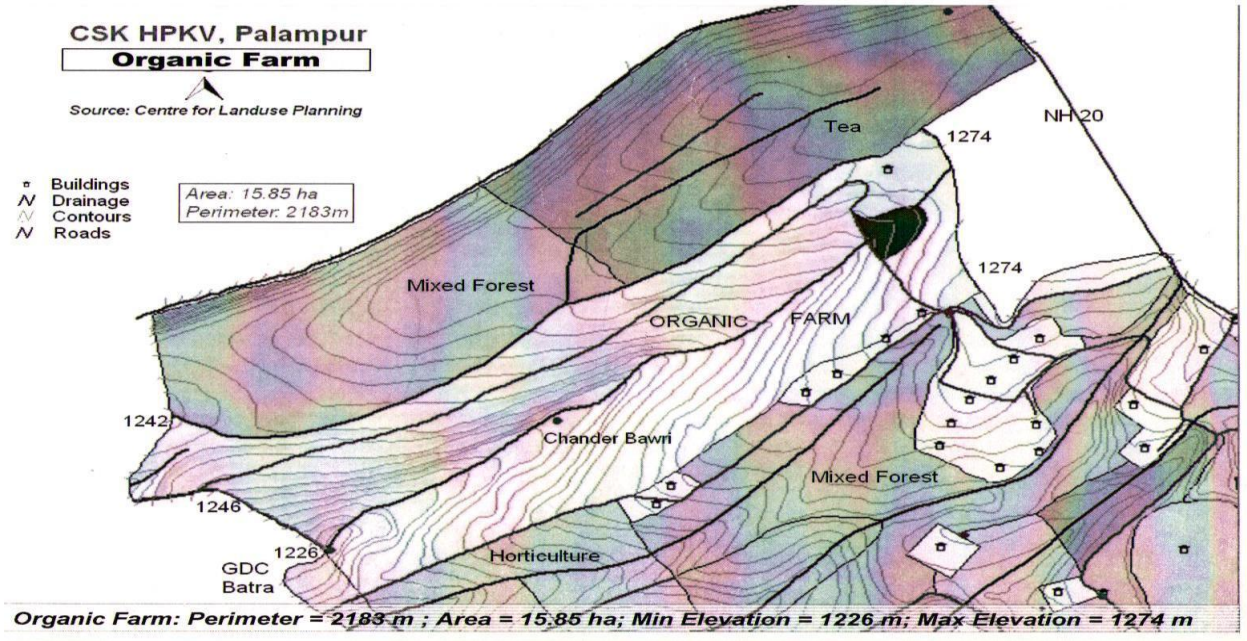

Figure 1. Map of model organic farm.

Brief history of organic farm

The farm took its shape on 15th April, 2006 .The organic farm was strengthened appreciably with the assistance of about Rs 1 crore from Indian Council of Agricultural Research (ICAR) under the project, "Niche Area of Excellence in Organic Farming". With this financial assistance from ICAR, the development activities on the farm increased. This was a neglected area in the outskirts of university area and was called Bengali Ahata. The barren land was turned into well laid out fields categorized into experimental block and demonstration block. Farm buildings, stores and cattle sheds were constructed. Bore well was dug out and sprinkler irrigation system was installed (Figure 1). In this way, a barren land infested with thorny bushes turned into a lush green land, a model organic farm which is an attractive destination of knowledge, charm, solitude and solace for visitors and farmers. The humble resonance of "Mantras" in the dawn and dusk further adds to ecological spiritualism of "Homa Farming". The available data before 2006 shows very low fertility status of soil due to which major proportion of land area was kept barren.

MATERIALS AND METHODS

Selection of the study area

The present study has been undertaken on the organic research farm of CSK HPKV, Palampur, Himachal, Pradesh. This farm was established in 2006 under the scheme "Niche Area of Excellence" funded by ICAR, New Delhi. The farm is located at 32°6'N latitude and 76°3'E longitude at an elevation of 1224 m above mean sea level in North Western Himalayas. It has a land area of about 15 hectares with a perimeter of 2183 m. Over the last 2-3 years, good infrastructural facilities have been developed and the systematic research work on the organic farming has been initiated.

Needless to say, there is scanty research work on organic farming and this farm offers opportunity to carry out research on organic farming in the country. Over the last two to three years, plethora of experimental trials have been laid down on different organic practices and thus, sufficient scientific information / data have been generated. Therefore, this farm has been selected purposively to study biodiversity of organic farming.

Data collection

The primary data was generated through sampling and the data was analyzed by the use of indices, ratios, percentages, etc. and the results were interpreted. The secondary data over two years maintained in the organic farm records was compared for 2006-07 and 2007-08.

Farm bio-diversity

Practicing agriculture means selecting a few species of plants or animals that are useful or edible, and modifying their environment to provide them nutrients/food, water and air, so that they grow in the best conditions. As a result, many farming systems consist of artificial ecosystems with very low biodiversity. This sometimes leads to catastrophic imbalances in the system, threatening natural resources as well as agricultural productivity and thereby endangering human beings. Organic farming is supposed to increase biodiversity. Thereby plant diversity of the organic farm was evaluated using quadrat method. It included mainly:

1. Introduced plant diversity of the farm
2. Weed diversity of the farm
3. Tree diversity of the farm

Table 1. Introduced plant diversity of the organic farm.

Food crops	Wheat Mash	Rice Soybean	Maize Barley	Kulthi Arhar	Gram Cowpea	Green gram Linseed	Lentil
Vegetables	Carrot Capsicum	Potato Cauli-flower	Radish Brocolli	Turnip Peas	Tomato Brinjal	Palak Cucumber	Cabbage
Fodder crops	Barseem Pennisetum	Fodder maize Sorghum	Jatorpha Dhaincha	Sesbania Breckaria	Napier bajra Lucern		
Medicinal plants	Aloe-vera Gerenium	Neem Lemon grass	Ocimum Stevia	Kapoor-tulsi Brahmi	Tagetus Mint	Turmeric	
Fruit trees	Kiwi	Strawberry	Banana	Papaya	Guava		

The tree diversity was evaluated using list-count method. Both quantitative as well qualitative work was done.

Quadrat method

Sampling unit was taken in an area of definite size and was a square. Besides listing the species, the numerical count of each species present per quadrat was also determined in order to identify the dominant species in a given area. Three steps were involved:

i Determination of the minimum size of quadrat by Species-Area-Curve method.
ii Determination of minimum number of quadrats to be laid down, and
iii Record of species- listing, counting of each species.

RESULTS

The available data before 2006 showed very low fertility status of soil due to which major proportion of land area was kept barren and infested by thorny bushes. The results obtained over the period of two years, 2006-07 and 2007-08 showed a tremendous transformation with multi level cropping and higher floral diversity.

Biodiversity

Ecological or organic farming is committed to the biodi-versity conservation in order to maintain greater stability and productive capacity within agro-ecosystem. Biodiver-sity is composed of all living organisms in a particular system but to know the complexity of agro-ecosystem, the plant diversity needs to be studied. Therefore, the plant diversity of the organic farm is described as follows:

Introduced plant diversity

One of the basic requirements in organic farming is a diversification of the agro-ecosystem. Thus, various food crops, vegetables, fodder crops, medicinal plants and fruit trees have been introduced to the farm (Table 1) so that system may consist of variety of crops and plant di-versity in order to provide better crises resistant structures.

Weed diversity of organic farm

The weed diversity on the organic farm is expected to be more than that of the conventional farming because of the healthier farming practices that promote the growth of all organisms in an eco-friendly way. The ecological or organic farm under investigation also supports large variety of weeds. Furthermore, an analysis depicted that among the narrow leaved weeds, the *Echinochloa colonum* was dominating species followed by *Phalaris minor* and *Avena fatua* (Table 2). Whereas, among the broad leaved weeds of cultivated area *Ageratum conyzoides* was the most dominant species followed by *Stellaria media*. How-ever, in the non-cultivated area among narrow leaved weeds, the *Cynodon dactylon* was recorded dominating whereas *Lantana camara* dominated among the broad leaved weed species.

Tree-diversity of the farm

The qualitative analysis of the tree population revealed that there were 16 different tree species on the farm with a number of about 358 trees (Table 3). Whereas quanti-tative estimation of tree diversity showed that Pajja (*Prunus paddam*) was dominating tree species on the farm followed by Oyi (*Albizia chinensis*) and Khirk (*Celtis australis*).

Cropping systems, cropping pattern and crop diversification

This section deals with the farm production systems on the organic farm. The components of farming systems along with their economics for the period of two years,

Table 2. Plant diversity of organic farm weeds.

Cropland weed		Non-cropland weed	
Narrow leafed weed	**Broad leafed weed**	**Narrow leafed weed**	**Broad leafed weed**
**Echinochloa colonum*	**Ageratum conyzoides*	*Imperata cylindrica*	**Lantana camara*
Digitaria sanguinalis	*Commelina benghalensis*	*Setaria glauca*	***Ageratum houstonianum*
Panicum dichotomiflorum	*Commelina forskalli*	*Panicum spp.*	*Bidens pilosa*
Setaria glauca	*Polygonum alatum*	**Cynodon dactylon*	*Solanum xanthocerpum*
Bracharia ramosa	*Aeschynomene indica*	*Paspalum distichium*	*Achyranthus aspera*
Echinochloa crusgalli	*Bidens pilosa*	*Bromus* spp.	*Chromalena adanophorum*
***Phalaris minor*	***Stellaria media*		*Erigeron canadensis*
Avena fatua	*Panunculus arvensis*		*Verbena* spp.
Lolium temulentum	*Anagallis arvensis*		*Trifolium repens*
Poa annua	*Vicia sativa*		*Chinopodium* spp.
Alopecurus myosurides	*Chenopodium album*		*Plantago lanceoleta*
Polypogon monsplensis	*Fumaria parviflora*		*Chenopodium album*
	Coronopus didymus		*Centella asiatica*

Table 3. Quantitative list of trees in the organic farm.

Common name	Scientific name	No. of trees
*Pajja	*Prunus paddam*	115
**Oyi	*Albizia chinensis*	61
Khirak	*Celtis australis*	50
Vaas	*Bamboosi* spp.	40
Chir	*Pinus roxburgii*	19
Poona	*Ehretia laevis*	17
Tooni	*Toona citrata*	11
Beul	*Grewia optiva*	9
Dhora	*Ficus palmata*	8
Toot	*Morus alba*	6
Kainth	*Pyrum pabhia*	6
Karal	*Bahunia variegata*	6
Guan	*Litrea nonopatla*	2
Dodan	*Sapindus mukorsii*	2
Triambal	*Ficus roxburgii*	2
Simbal	*Bombax ceiba*	4

*Dominant; **co-dominant.

2006-07 and 2007-08 have been contemplated in the ensuring section:

Cropping systems

Major cropping systems followed on the organic farm and the proportion of operational area under these systems has been shown in Figure 2. It was observed that number of cropping systems annual, biennial or perennial were practiced on the farm. About 11.78% of the area is allotted to annual, 71.28% to biennial and 9.12% to perennial cropping systems and 7.82% comprising other cropping systems (Table 4).

Cropping pattern

Cropping patterns shows the spatial distribution of cropped area under different crops in an agricultural year. Figure 3 shows the cropping pattern patronized on the organic farm during the last two years, 2006-07 and 2007-08. For the year 2006-07, cereals covered 36.28% area followed by green manures (21.59%) and pulses (9.67%). In the year 2007-08, cereals covered an area of 32.68% followed by pulses (15.15%) and vegetables (13.30%).

Extent of crop diversification

Table 5 shows the diversification index of the organic farm. It can be concluded that in the year 2007-08 (0.18) increased diversification was seen as compared to the initial year, 2006-07 (0.21). Thereby, confirming the increasing trend of diversification in organic farming with

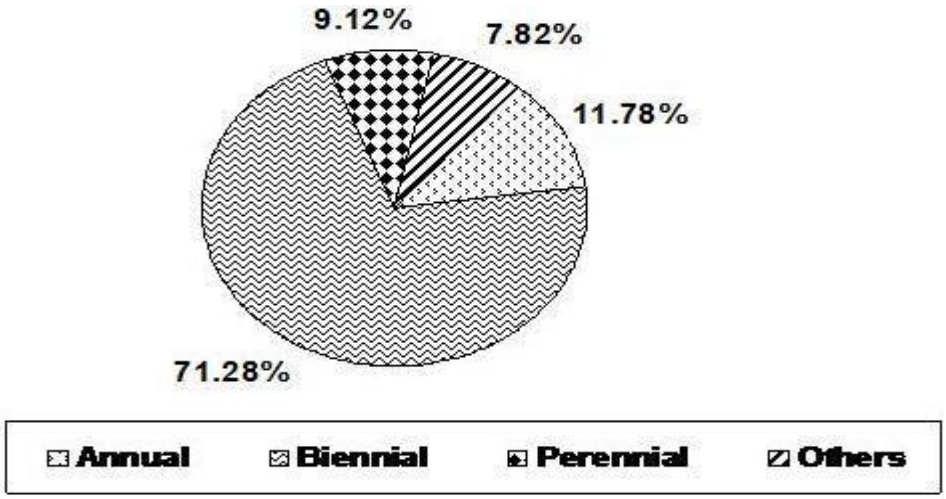

Figure 2. Cropping system followed in the organic farm.

Table 4. Cropping systems percentages.

Cropping systems	Area(m2)	Area(ha)	Percent
Fallow-redclover-makka-redclover	120	0.012	0.49
Jowar-lucern-makka-lucern	210	0.021	0.86
Maize-lucern-makka-lucern	190	0.019	0.78
Dhaincha-dhaincha-vegetables-gobi sarson	1000	0.100	4.10
Sub-Total	17394	1.7394	71.28
Perennial			
Setaria	724	0.072	2.97
Aloevera	823	0.082	3.37
Lemon-grass	679	0.068	2.78
Sub-Total	2226	0.223	9.12
***Others**	1908	0.191	7.82
Total net sown area	24403	2.4403	100.00

*Including maize + corn-palak-kapoortulsi + brahmi, pea-tagetus, pea-tagetus.

the passage of time.

DISCUSSION

Biodiversity

Introduced plant diversity

Organic farming is a diversification of the agro-ecosystem. Thus, various food crops, vegetables, fodder crops, medicinal plants and fruit trees have been introduced to the farm so that system may consist of variety of crops and plant diversity in order to provide better crises resistant structures. Gabriel et al. (2006) also showed the effects of farming system (organic vs. conventional) and position in the field (edge vs. center) on plant species richness in wheat fields at three spatial scales. It was found that diversity was higher in organic than conventional fields and higher at the field edge than in the field center at all spatial scales.

Weed diversity of organic farm

The weed diversity on the organic farm is expected to be more than that of the conventional farming because of the healthier farming practices that promote the growth of all organisms in an eco-friendly way. The ecological or organic farm under investigation also supports large va-riety of weeds. Importance of plant diversity has also been mentioned by Purtauf et al. (2005) not only in orga-nic systems but also conventional farming systems. According to Maeder et al. (2002) healthy ecosystems are

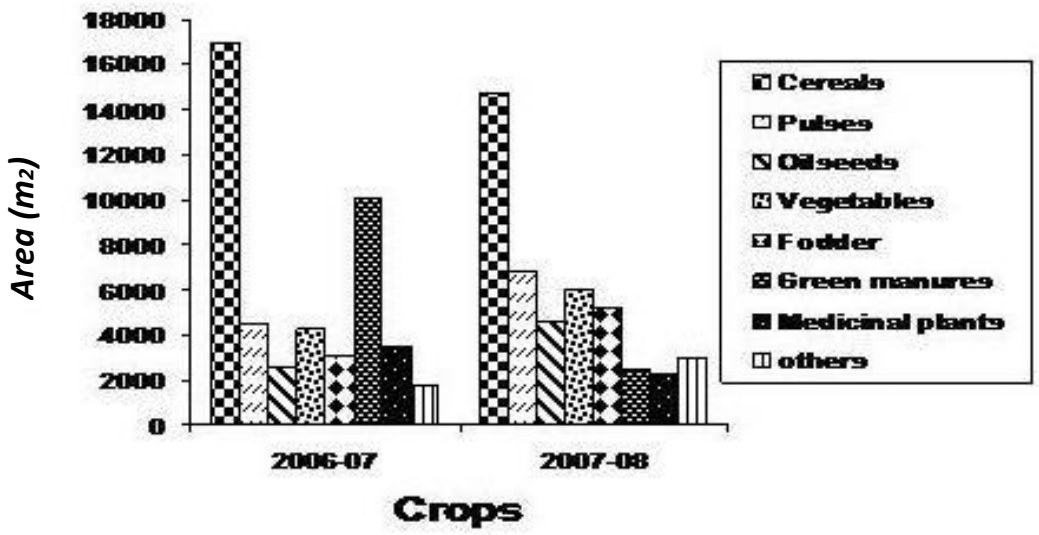

Figure 3. Cropping pattern in the organic farm.

Table 5. Diversification index of the organic farm.

	2006-07			2007-08		
	Area (m^2)	pi	pi^2	Area (m^2)	pi	pi^2
Cereals	1.6927	0.36	0.13	1.473	0.33	0.11
Pulses	0.451	0.10	0.01	0.6828	0.15	0.02
Oilseeds	0.2594	0.06	0.00	0.4614	0.10	0.01
Vegetables	0.4244	0.09	0.01	0.5994	0.13	0.02
Fodder	0.3108	0.07	0.00	0.5215	0.12	0.01
Green manures	1.007	0.22	0.05	0.2457	0.05	0.00
Medicinal plants	0.3484	0.07	0.01	0.2268	0.05	0.00
Fruits	0.0644	0.01	0.00	0.1288	0.03	0.00
Others	0.1074	0.02	0.00	0.168	0.04	0.00
Total	4.6655	1.00	0.21	4.5074	1.00	0.18

characterized by high species diversity. The DOK trial shows that organic farming allows the development of a relatively diverse weed flora. Nine to eleven weed species were found in organically managed wheat plots and one species in conventional plots. Between 28 and 34 carabid species were found in the BIODYN system, 26 to 29 species in the BIORG system and 22 to 26 species in the CONFYM system (18). Some specialized and endangered species were present only in the two organic systems.

Tree-diversity of the farm

The qualitative analysis of the tree population revealed that there were 16 different tree species composed of 358 trees on the farm. The quantitative estimation of tree diversity showed that Pajja (*P. paddam*) was dominating tree species on the farm followed by Oyi (*A. chinensis*) and Khirk (*C. australis*).

Cropping systems, cropping pattern, crop diversification

Cropping systems

It was observed that number of cropping systems annual, biennial or perennial were practiced on the farm. About 11.78% of the area is allotted to annual, 71.28% to biennial and 9.12% to perennial cropping systems and 7.82% comprising of other cropping systems. Among annual cropping systems charry-oats was the major system of the total cultivated farm area. Among biennial cropping systems, dhaincha-linseed-soybean-linseed, mash-wheat + lentil-arhar + soybean-wheat followed by maize-dhaincha-vegetables-gobisarson were the predominant cropping systems. There were 3 or 4 perennial cropping systems. Among these, Aloe-vera and Setaria were the main crops. Sampath et al. (1987) has also defined the importance of cropping system as principles

and practices of cropping in the areas where resources were limited, the method to give higher production. Cropping systems attached properly with animal husbandry, social forestry and other farm enterprises could produce good results.

Cropping pattern

Besides cropping systems, cropping patterns shows the spatial distribution of cropped area under different crops in an agricultural year. The cropping pattern was patronized on the organic farm during the last two years, 2006-07 and 2007-08. For the year 2006-07 cereals followed by green manures and pulses covered the highest percentage of area. In the year 2007-08, cereals followed by pulses and vegetables dominated.

Extent of crop diversification

The diversification index of the organic farm in the year 2007-08 (0.18) increased as compared to the initial year, 2006-07 (0.21). Thereby, confirming the increasing trend of diversification in organic farming with the passage of time. This is also supported by Franzen and Mulder 2007) who studied the ecological, economic and social perspectives on cocoa production worldwide. They suggested that diversification was the most effective way of optimizing ecological, economic and social outcomes.

Conclusion

There is rich plant diversity on cultivated as well as uncultivated land. As many as 45 species of native plants and 50 species of introduced plants were found. There is need to explore the possibility of using native (weed) plants for production of organic manures and bio agents. However, 358 trees were found on the organic farm, out of which most were fodder trees or used for green manuring. Many other species of fast growing trees can be introduced. There is ample crop diversification on organic farm. The diversification of introduced plants, cropland weeds and non-cropland weeds as well trees was found to be quite high.

ACKNOWLEDGEMENTS

The first author is thankful to her parents for their blessings and constant encouragement throughout the research period and also thanks Professor, Dr. R. C. Chauhan, her guide in research work for his help and support and boosting her when at times she got discouraged. She is thankful to all who have contributed even bit for making this work a success.

REFERENCES

Hole DG, Perkins AJ, Wilson JD, Allexander IH, Grio PV, Evans AD (2005). Does organic farming benefit biodiversity. Biolog. Conserv. 122:113-130.

Franzen M, Mulder MB (2007). Ecological, economic and social perspectives on cocoa production worldwide. Biodivers. Conserv. 16:3835–3849.

Gabriel D, Roschewitz I, Tscharntke T, Thies C (2006). Beta diversity at different spatial scales: Plant communities in organic and conventional Agriculture. Ecological Applications. 16(5):2011-2021.

Maeder P, Flieβbach A, Dubois D, Gunst L, Fried P, Niggli U (2002). Soil Fertility and biodiversity in organic farming. Science, 296:1694–1697.

Purtauf T, Roschewitz I, Dauber J, Thies C, Tscharntke T, Walters V (2005). Landscape content of organic and conventional farms: Influences on carabid beetle diversity. Agriculture, Ecosys. Environ. 108(2):165-174.

Sampath T V, Mahendra P, Ahlawat I PS (1987). New approaches to cropping systems. Indian Farming 37(2):16-19.