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Survey and prospects of yield stability of organic produce in Navsari District

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Abstract
Survey of Navsari district comprises major horticultural crops of mango and sapota. In the present study 30 farmers were surveyed each from organic and conventional farming system. Nearly 65.9% and 73.1% land of organic and conventional farming system were covered by horticultural crops, respectively. Area of mix farming under organic and conventional farming was 97% and 70%, respectively. Less number of farmers adopted mono cropping in organic farming as compared to conventional farming. The yield of paddy, sugarcane, green gram, banana, brinjal, okra and bottle gourd under organic farming were lower than conventional farming. However, yield of mango (9545 kg ha^{-1}) and sapota (15131 kg ha^{-1}) were higher under organic farming. Yield stability index of organic farming was lower (0.30) than conventional farming (0.56).

Keywords: Yield, stability, organic produce, survey, organic farming, conventional farming

Introduction
Organic farming is in an emerging stage in India. Considering the several drawbacks in the growth of organic farming in India which include lack of awareness, lack of good marketing policies, shortage of biomass, inadequate farming infrastructure, high input cost of farming, inappropriate marketing of organic input, inefficient agricultural policies, lack of financial support, incapability of meeting export demand, lack of quality manure and low yield (Bhardwaj and Dhiman, 2019) [2].

A few states have taken the lead in improving organic farming coverage as a major part of this area is concentrated only in a handful of states. Madhya Pradesh tops the list with 0.76 million ha of area under organic cultivation, that is over 27 per cent of India's total organic cultivation area. Sikkim is the only Indian state to have become fully organic so far. A majority of the states have only a small part of their net sown area under organic farming. Even the top three states that account for the largest area under organic cultivation Madhya Pradesh, Rajasthan, Maharashtra and Gujarat have only around 4.9, 2.0, 1.6 and 1 per cent of their net sown area under organic farming respectively (Kumar, 2020) [4].

Organic farming perceptions are quite divergent. But there is a strong consensus on its eco-friendly nature and inherent ability to protect human health. Also, many studies have revealed that organic agriculture is productive and sustainable. However, organic food production costs are higher as compared to conventional counterparts due to higher input cost and labor intensive in nature. Efforts have been made by the government of India on an overall basis to encourage organic farming. Even different organizations have been set up for the marketing of the produce of organic farming. The increasing demand for the organic food products in the developed countries as well as the policies adopted by the government of India to encourage. The exports of the organic Agri-products are the driving factors responsible for the uprising of the Indian organic food industries which have the potential to strengthen the Indian economy as well as the health standards of the Indian masses (Roy Chowdhury *et al.*, 2013) [10]. The most important prerequisite to make organic farming sustainable and profitable is to identify crops and their varieties suitable under organic farming particularly under nutrient stress condition. Hence the present work has been conducted to determine the yield stability and organic produce in the district.

Methodology
The Navsari district is located between 20°.07-21°.00 North longitudes and 72°.43-73°.00, East latitudes. It is a coastal district open to the Arabian Sea from West and is bounded by Valsad district on the North. On the East, it is contiguous to Dang district in Gujarat.

Navsari district comprise six talukas *viz.*, Navsari, Jalalpore, Gandevi, Chikhli, Khergam and Vansda. All talukas was considered for survey purpose. The data were collected from Navsari district farmers through a questionnaire survey. The survey was conducted in the year 2017-18. Altogether, 30 farmers were selected from organic farming and conventional farming system, respectively. Rasul and Thapa (2003) [9] sustainable indicators were used to test the sustainability in field condition. Farming details information was cumulated and converted in to percentage and reported separately for farmers who adopted organic and conventional farming. The yield calculated per hectare yield by using the following formula and reported in t ha^{-1}.

$$Yield(t/ha) = \sum_{i=1}^{n} Xi$$

Where,
Xi = Yield of respective crops in different surveyed farm
N = Area of respective crops in different surveyed farm

Yield stability index: It was examined by calculated an index based on farmers' subjective responses to a question related to yield trend. The index was calculated based on the following formula given by Rasul and Thapa, 2003 [9].

$$\text{Yield stability index} = \frac{(f_i * 1) + (f_d * -1) + (f_c * 0)}{N}$$

Where,
f_i = frequency of responses indicating increasing yield
F_d = Frequency of responses indicating decreasing yield
F_c = Frequency of responses indicating constant yield
N = Total number of responses

Result and Discussion

Farming details

1. Detail of farmers who adopting organic farming system

30 farmers who adopting organic farming were surveyed and the details are given in Table 1. Among the selected farmers, 10 farmers having certified organic farm and 15 farmers adopted organic farming system for more than 3 years.

2. Crops and farming systems

Surveyed area comprises of (Table 2). Nearly 65.9% and 73.1% land of organic and conventional farming system were covered by horticultural crops, respectively. The major horticultural crops of the study area were mango and sapota. The remaining area was majorly covered by paddy and sugarcane. Area of organic and conventional farming under vegetables and green gram were 3.6 and 4.4% and 0.5 and 0.4 %, respectively. Mix cropping systems were adopted by farmers of study area particularly in mango and sapota. Area of organic and conventional farming under mix cropping was 17.5 and 6.8%, respectively.

Less number of farmers adopted mono cropping (3%) in organic farming as compared to conventional farming (3%). In organic farming, 13, 17, 7 and 60% farmers adopted Crops + Orchard, Crops + Livestock, Orchard + Livestock and Crops + Orchard + Livestock, respectively. In conventional farming, the respective percentages were 20, 13, 0 and 37% (Table 3).

Adoption of mix farming is the central principle of organic farming. Cropping systems, including crop diversification, crop rotation and intercropping, and related agronomic practices used in agriculture have significant effect on soil health. It is well accepted that optimized crop diversification has various benefits, not only to growers but also to the environment and society, as increasing crop diversity can enhance heterogeneity of soil chemical nutrients, soil physical structures, and functional microorganisms at different spatial scales, leading to improved soil health, crop yields and also satisfy multiple needs of society (Rasul and Thapa, 2003 [9], Bardgett and Van der Putten, 2014 [1], Maron *et al.*, 2011 [6]).

Yield

Productivity

Survey result regarding yield of paddy, sugarcane, pulses, mango, sapota, banana and vegetables presented in Table 4 indicated that majority of farmers get lower yield of paddy, sugarcane, pulses, banana and vegetables, more or less similar yield of sapota and higher yield of mango as compared to conventional farming. Surveyed farmers who adopted organic farming get 23.2%, 9.7%, 3%, 7.9%, 13.8%, 13.2 and 18.2% lower yield of paddy, sugarcane, pulses, banana, brinjal, okra and bottle guard, respectively as compared to conventional farming. However, mango and sapota yielded higher under organic farm as compared to conventional farm (Table 4). This indicates that horticultural crops are more suitable in organic farming system. Tree crops like mango and sapota are long duration deep rooted and extract the nutrient from larger area as compared to seasonal field crops therefore, these crops taken the nutrient from soil slowly throughout the year. This may be probable reason that yield reduction was not observed in these crops. On the other hand crops like paddy, sugarcane, banana and vegetables required higher nutrient in shorter period and the nutrient requirement of these crops are higher as compare to tree crops. Organic sources used in organic farming are released the nutrients slowly as progress of decomposition. Therefore the nutrient released from the organic sources and nutrient required by the crops could not be matched, this may be probable reason for yield reduction in field crops under organic farming. Pulses required N at low rate at initial stage as a starter dose, this crops fix atmospheric N and enrich the soil with organic C. Therefore, pulses are most suited under organic farming. However, evaluation of pulse crops against pest and disease tolerant is required before growing of these crops under organic farming. This finding is in concurrence with the findings of Sau *et al.*, (2017) [11], Harimohan *et al.*, (2018) [3] and Patel *et al.* (2010) [8], Mohammad *et al.*, (2021) [7] and Lamba *et al.*, (2018) [5].

Stability of the yield

Stable yield obtained for a longer duration without degrading soil properties is the major requirement of sustainability. Higher numbers of farmers adopting organic farming was responded that the yield of crops obtained under organic farming was lower than the yield of crops obtained under conventional farming. This fact also reflected in the yield stability index (Table 5), stability index of organic farming was lower (0.30) than the stability index of conventional farming (0.56).

Conclusion

On the basis of results obtained from the survey studies revealed that more diversity in terms of accommodation of no. of crops as well more farming enterprises prevails in organic

farming with respect to conventional farming. However, yield (except mango and sapota) and yield stability were lower in organic farming in comparison to conventional farming. Overall sustainability of any enterprise is a complex phenomenon and enterprise such as organic farming is more complex as the sustainability of organic farming is based on so many factors *viz*. ecological, economic and social acceptability. Although many factors contributed in determination of the sustainability of organic farming, but on the basis of present study the economic stability and crop suitability are the key factors for the successful and sustainable organic farming.

Table 1: Detail of farmers adopted organic farming system

Total number of Farmers	Certified organic farm	Non-certified organic farm	Period of organic farming				
			1-2 year	2-3 year	3-4 year	4-5 year	> 5 year
30	10	20	5	10	4	3	8

Table 2: Major crops of survey area

Crops	% Area	
	Organic farming System	Conventional farming system
Paddy	10.6	6.3
Sugarcane	19.4	15.8
Green gram	0.5	0.4
Vegetables	3.6	4.4
Mango	37.5	42.5
Sapota	25.8	27.5
Banana	2.6	3.1
Mix crop	17.5	6.8

Table 3: Major farming system of study area

Farming systems	Farmers (%)	
	Organic	Conventional
Crops	-	3
Orchards	3	27
Crops+ Orchard	13	20
Crops+ Livestock	17	13
Orchard+ Livestock	7	-
Crops+ Orchard+ Livestock	60	37

Table 4: Average yield (kg ha^{-1}) of crops in study area

Crop name	Organic farming System	Conventional farming system	Relative (Conventional = 100)
Paddy	3262	4245	76.8
Sugarcane	80000	88571	90.3
Green gram	517	533	97.0
Mango	9545	7925	120.4
Sapota	15131	14967	101.1
Banana	76333	82857	92.1
Brinjal	17500	20307	86.2
Okra	7333	8444	86.8
Bottle guard	7833	9600	81.6

Table 5: Yield stability index

Index	Organic	Conventional
Yield stability index	0.30	0.56

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