Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(1): 1560-1563
Received: 22-11-2019
Accepted: 28-12-2019

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Organic and inorganic wheat production for sustainable farming in Western Maharashtra

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DOI: https://doi.org/10.22271/phyto.2020.v9.i1z.14807

Abstract
The resource intensive ways of Indian agriculture has raised serious sustainability issues. Organic farming is one of the way found to meet the objectives of sustainable agriculture. India is the world's second-largest producer of wheat, accounting for almost 10% of global production. The present investigation was intended to depict the picture of sustainability in Pune district and it was aimed to examine sources yield gap and sustainability of wheat production. The study was based on the primary data for the year 2020-21 collected from the randomly selected 60 wheat growers spread over six villages from purposively selected. The tabular analysis techniques of averages, percentages, ratios, were used for interpretation of data and sustainability index were used for arriving meaningful findings.
The analysis of sustainability for organic wheat production indicated that the standard yield level for organic wheat production was 24.57 quintals/ha. The sustainability indices of organic wheat cultivation vary from 79 percent to 103 percent. Among the 30 farmers, 11 farmers showed the desired yield to be significantly higher than the standard yield value thus the overall sustainability index of the organic wheat cultivation was set to be 36.6 percent.
Therefore, study suggested that the effort must be concentrate on promoting the adoption of all recommended practices by all the organic wheat growers in order to achieve the integrated and complete benefits of organic production technology and to obtain maximum profit there is need to adopt organic farming for wheat cultivation by a greater number of farmers in areas, where wheat is predominately cultivated. The efforts shall be made to disseminate and make popular by the extension machinery and line departments.

Keywords: Organic farming, wheat, cost and returns and sustainable farming

1. Introduction
Sustainable development has been the subject of discussion and activity worldwide for more than a decade. Sustainable agriculture is necessary to attain the goal of sustainable development. Sustainable agriculture is defined by the Food and Agriculture Organization (FAO), as the efficient use of agricultural resources to satisfy evolving human needs while maintaining or increasing the quality of the environment and safeguarding natural resources. All definitions of sustainable agriculture place a strong emphasis on maintaining an agricultural growth rate that can satisfy the need for food among all living things without diminishing the fundamental resources. Since the 20th century, at least in the industrialized nations, the way that agriculture is done has changed substantially. Food productivity increased dramatically as a result of a significant advance in agricultural methods supported by modern plant breeding, enhanced agronomy, the use of conventional fertilizers, and the development of contemporary pesticides (IFPRI, 2002).
Organic agriculture is a production method that maintains the health of soils, ecosystems, and people, according to the International Federation of Organic Agriculture Movements (IFOAM). It realizes that organic farming integrates science, creativity, and tradition to benefit the environment as a whole, establish just relationships, and improve everyone's quality of life. The IFOAM's four guiding principles for organic farming are the principles of health, ecology, equity, and caring.
One of the many methods used to achieve the goals of sustainable agriculture is organic agriculture. Numerous methods employed in organic farming, such as intercropping, mulching, and combining crops and livestock, are not new to other agricultural systems, including the traditional agriculture used in ancient nations like India. However, organic farming is based on a number of laws and certification programmes that forbid the use of almost all synthetic inputs. The method is also recognized as having as its primary focus the health of the soil.

2. Wheat production in India and Maharashtra

Wheat (*Triticum aestivum*) grows on around 230 million acres worldwide and produces 731 million tonnes annually. With 33.29 million ha under cultivation, India is the world's second-largest producer of wheat, accounting for almost 10percent of global production. In the winter, Punjab, Haryana, Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, and Maharashtra cultivate wheat (Source: Ministry of Agriculture 2021). The production of food grains as a whole rise in 2021-2022, although wheat production falls. A total of 106 million tonnes of wheat will be produced in 2021-22.

3. Materials and Methods

The methodology deals with the characteristics of the methods adopted in selecting the sample, the nature and sources of the data and the various tools and methods used in analysing the data.

3.1 Sampling Design

A multistage random sampling design was used to conduct the present study. The sampling design consists of 4 stages. Where in selected design, tehsils were primary unit of sample, village are secondary unit and the sample respondents were tertiary unit of sampling. The same are graphically shown as below:

3.2 Selection of the Study Area

Organic farming is one of the instruments for improvement of sustainability of agriculture. So, it is getting popularized in the Maharashtra state and wheat production is concentrated in the pocket of Western Maharashtra. Hence Western Maharashtra region was selected purposively for the study.

3.2.1 Selection of the District

Out of 10 districts of Western Maharashtra, farmers nearly all districts practice organic method of cultivation. Pune is one of the leading district in numbers of organic growers, was selected purposively.

3.2.2 Selection of Tehsils and Villages

On the basis of information of area of organic wheat concentration and number of organic farmers, three tehsils *viz* Baramati, Junnar, and Purandar tehsils were selected purposively. Similarly, the villages were also selected on the basis of number of organic farmers.

3.2.3 Selection of the Cultivators

A list of all wheat growers from selected villages was prepared and 30 organic certified wheat cultivators was selected randomly. Besides 30 inorganic wheat cultivators having identical socio-economic conditions were randomly selected.

3.4 Analytical Tools for Data Analysis

3.4.1 Estimation of Sustainability:

For the analysis of the fourth objective, that is, the sustainability index was estimated by the method suggested by Kiresur *et al.* (1996). The method explains that sustainability of organic can be estimated by its proportional response to the existing Inorganic method of wheat cultivation which in turn could be quantified by means of site-specific index or site index. The various steps involved in estimation of sustainability index are stated below:

$E_i = (X_i - X_m)$

Where,

E_i = Site index,

X_i = Yield level of inorganic wheat for the i^{th} farm

X_m = Mean yield level of inorganic wheat for the crop growing situation.

$Y_i = a + bE_i$Where,

Y_i = Yield level of organic wheat for the i^{th} field

a = Regression constant (intercept)

b = Regression coefficient.

$$S = \frac{E_{max} + E_{min}}{2}$$

S = Symmetry of site indices,

E_{max}= Maximum value of Ei

E_{min}= minimum value of Ei.

$D_i = Y_i + bS$Where,

D_i= Desirable yield level of organic wheat for the ith field

$D_S = Y_m + S$Where,

D_S= Standard yield level of organic wheat for the centre /crop growing situation

Y_m= Mean yield level of organic wheat for the centre /crop growing situation.

$$\text{Sustainability Index} = \frac{D_i}{D_s} \times 100$$

D_i= Desirable yield level of organic wheat for the ith field

D_S= Standard yield level of organic wheat for the centre /crop

4. Results and Discussion

4.1 Estimation of Sources Yield (₹ / Ha) Gap

The total change in production is important dimension of agricultural growth. The output decomposition model is used to investigate the contribution of various sources to the productivity value difference between organic and inorganic wheat production methods. The total change in production value for any two production functions could be brought out by changes in production parameters that defined the production function itself, along with changes in input use levels. As result, the production function was considered as efficient and easy econometric method for decomposing output difference between two methods of production. Thus, Output decomposition model used for estimation of sources yield gap.

Table 1: Sources difference in yield (Rs / ha) in organic and inorganic wheat

Sr. No	Sources of difference	Difference (percent)
1	Total Output Difference	79.74
2	Technology Component	56.25
a	Neutral Component	58.73
b	Non neutral Component	-2.48
3	Input use difference	23.49
a	Human labour (Rs. /ha)	2.28
b	Irrigation (Rs. /ha)	28.27
c	Machine labour (Rs. /ha)	-26.31
d	Organic fertilizers/fertilizers	2.92
e	Seed (Rs. /ha)	1.27
f	Plant protection charges	8.44
g	Expenditure on FYM	6.62

The total estimated sources output difference exist between organic and inorganic wheat was 79.74 percent. The technology was major contributor to yield (Rs. /ha) difference with 56.25 percent. Among the input sources, human labour 2.28 percent, irrigation 28.27 percent, organic fertilizers 2.92

percent, seed 1.27 percent, Plant protection 8.44 percent and FYM 6.62 percent contribute positively to the output difference. The positive contribution of inputs to yield difference indicated that quantity of that inputs should be increase to obtain higher income on inorganic wheat farms. Whereas, the negative contribution of inputs indicated that the farmers can obtain higher production value by less spending on those inputs. Thus, without spending further money on inputs, only by using suggested organic technology and practices, the yield can be raised in wheat by 56.25 percent. The proper usage of inputs can reduce the production gap by 23.49 percent. Therefore, the involvement of technology in how various cultural practices are carried out was more crucial to reduce the production gap in case of organic and inorganic wheat.

Vinod R. Naik estimated that the total sources yield difference between the organic and inorganic chili production was 27.07 percent. With a share of 33.91 percent, technology which were the major contributor to output gap.

4.2 Sustainability Index of Organic Wheat

The sustainability index for condition of Pune district was calculated by using yield of organic and inorganic wheat. According to the method, the sustainability of organic wheat can be estimated by comparing to the existing method of inorganic wheat cultivation which can be measured by using of site index.

Desired yield and standard yield were calculated as discussed in methodology. These estimated values of desired yield and standard yield were used to calculate the sustainability index, the estimated results of sustainability index for farmer's adapted organic method of wheat cultivation along with desired yield (Di) and standard yield (Ds) values were presented in the Table 2.

The estimated values for regression coefficient (b) and the symmetry of site index (S) were (0.15) and (2.22 quintals), respectively. The calculated desired yield levels for respective farm were higher than the actual yield of that organic wheat farm. The estimated standard yield level for organic wheat production was 24.57quintals/ha. Sustainability index of organic wheat cultivation vary from 79 percent to 103 percent.

Out of 30 farmers, 11 farmers showed the desired yield to be significantly higher than the standard yield value. The overall sustainability index for farm level yields of organic wheat estimated to be 36.66 percent. Thus, the organic wheat yield was found to be non-sustainable with overall sustainability index 36.66 percent. The current lower value of sustainability index indicated that here may be gaps in the execution of package of practices with management aspects and an increase in some limits in application of key principles of organic wheat cultivation.

Table 2: Actual yield and sustainability index for organic method wheat cultivation

Sr. No.	Organic Yield (N=30)	Inorganic Yield (N=30)	Desired Yield (N=30)	Sustainability Index
1	20.00	35.00	20.33	83
2	22.72	38.00	23.05	94
3	22.75	38.00	23.08	94
4	21.00	37.00	21.33	87
5	24.25	39.00	24.58	100
6	19.00	36.50	19.33	79
7	20.00	35.00	20.33	83
8	24.50	39.00	24.83	101
9	24.50	33.00	24.83	101
10	20.00	35.00	20.33	83
11	22.50	34.00	22.83	93
12	24.50	39.00	24.83	101
13	20.00	35.00	20.33	83
14	22.00	34.00	22.33	91
15	23.50	33.00	23.83	97
16	24.50	39.00	24.83	101
17	24.50	39.00	24.83	101
18	20.00	35.00	20.33	83
19	19.50	36.50	19.83	81
20	21.00	35.00	21.33	87
21	24.50	33.00	24.83	101
22	20.00	35.00	20.33	83
23	25.00	32.50	25.33	103
24	21.00	35.00	21.33	87
25	24.50	39.00	24.83	101
26	19.00	35.25	19.33	79
27	24.50	39.00	24.83	101
28	22.75	34.50	23.08	94
29	23.50	34.00	23.83	97
30	25.00	32.00	25.33	103

D_i = Desired yield level of organic wheat of i^{th} field

D_S = Standard yield level (Mean yield of organic growers + Symmetry of site index)

S.I.= Sustainability Index $((D_i/D_S) \times 100)$

The above findings revealed that the organic wheat yield was non-sustainable with overall sustainability index 36.66 percent. Therefore, the null hypothesis has been accepted i.e. organic wheat yield is non-sustainable. These findings are similar with the outcomes of Rama Rao (2011) [6], he found that SRI method was not sustainable in North coastal zone of Andhra Pradesh with the sustainability index 46.7 percent.

5. Conclusions

1. The total sources yield (Rs. /ha) difference exist between organic and inorganic wheat production was (79.74%). The technology was major contributor to yield difference with 56.25 percent contribution. The proper usage of inputs can reduce the production gap by (23.49%). The inputs, which are positively contribute to yield difference should be increase to obtain higher income on inorganic wheat farms. The inputs, which are positively contributes to yield difference should be increase to obtain higher income on inorganic wheat farms.
2. The analysis of sustainability for organic wheat production indicated that the standard yield level for organic wheat production was 24.57qtls/ha. The sustainability indices of organic wheat yield vary from 79 percent to 103 percent. Among the 30 farmers, 11 farmers showed the desired yield to be significantly higher than the standard yield value thus the overall sustainability index of the organic wheat yield was set to be 36.6 percent.

6. Suggestion

The analysis of sustainability suggested that the effort must be concentrated on promoting the adoption of all recommended practices by all the organic wheat growers to achieve the integrated and complete benefits of organic production technology. Hence, it is advised to wheat growers to shift from inorganic wheat production to organic wheat production which is profitable and environmentally friendly.

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