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Agricultural Sustainability and Organic Farming

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ABSTRACT

In the 20th century, great increases in productivity of Indian agriculture has encouraged higher and higher use of heavy farm equipment, fossil fuel, intensive tillage, high-yielding crop varieties, irrigation, extraneous inputs, and capital. In the process we incurred a great loss in the eco-system by indiscriminate use of fertilizers and other chemicals. Now, what we need is to save our natural resources – water, biodiversity and land. It may not be wondering if we assume that organic farming system may generate such situation to address both the challenges mentioned above. The present paper devoted an exploring effort to find out what performance is brought about by organic farming to address the problem of sustainability of crop productivity of different vegetable crops grown in West Bengal across the seasons. The sustainability measures viz. Sustainable Yield and Sustainable Value Indices (SYI and SVI) have been used for the purpose. The results showed that despite lower production in organic farms than inorganic farms, the sustainability of productivity occurred in organic farms were satisfactory. On the other hand, net return (value of products) from organic farms exhibited moderate sustainability. This was due to unorganized market for price premium of organic productions. Another reason of unattractive receipt from organic farms was higher cost of organic nutrients. The analysis concluded that availability of market and price premium with easy accessibility in sufficient quantity of organic manure may influence more sustainability in receipts towards vegetables cultivation in organic farms.

Keywords: Organic farming, sustainability, yield index, value index

Perhaps this is the time to recognize the fact that the green revolution has all but run out the working power of agricultural community and there is the deep crisis in agriculture. Although 2/3rd of the Indian population is dependent on agriculture for their livelihood, it generates only about 17% (2007) of the country's gross domestic product. The growth rate of agriculture has been stagnating at 4-5% for several years and inclines downwards even further when the monsoon fails because almost 60% of cultivation is still under rainfed condition. Again, 56 million hectares of irrigated land are producing 56% of food grains, while the remaining 44% is produced from 85 million hectares of rainfed land. This dependence of agriculture coupled with stagnating public investment in agriculture for years, has begun to stagnate and even decline the overall agricultural productivity as well as production. The Economic Survey pointed out that the yield of cereals dipped from 2174 kg/ha in 2007-08 to 2107 kg/ha in 2008-09. Pulses, oilseeds and fibres have also shown similar slides. Overall trend in agricultural productivity in West Bengal is not different from the national scenario. High population growth in the state demands more production but, our damaged ecosystems are not responding to the chemical methods (Table 1). All crops, except maize and oilseeds, exhibited slump in total production in 2008-09 as compared to 2001-02.

In this circumstances, there required to evolve new sustainable methods in agriculture for ensuring the stability of production systems. The effects of unsustainability are more acutely affecting the farm economics in Africa and Asia due to increased population pressure.

Considering the potential environmental benefits of organic production and its compatibility

Table 1: Production of some important crops in West Bengal from 2001-02 to 2008-09

(in lakh tonnes)

Crops	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Rice	152.60	143.89	146.62	148.85	145.11	147.46	147.20	(-) 150.3
Wheat	9.60	8.87	9.86	8.41	7.74	8.00	9.17	(-) 7.65
Maize		0.55	1.26	1.91	2.07	2.54	2.44	(+) 3.43
Potato	78.20	69.02	76.22	70.77	74.62	50.52	99.00	(!) 41.21
Pulses	1.70	1.68	2.12	1.67	1.75	1.54	1.58	(-) 1.30
Oilseeds	4.90	4.71	6.49	5.55	6.23	6.45	7.01	(+) 5.77

Source: Statistical Abstracts

with integrated agricultural approaches to rural development, organic agriculture may be considered as a development vehicle for developing countries like India, in particular. It is to be kept in mind that yield sustainability is essentially depending upon sustainable soil fertility and agro-eco-system. The role of organic farming is not restricted to merely supply of nutrients (as in case of fertilizers). Its primary role extends to improve soil fertility – measured in terms of physical and biological characters. The sources of organic farming are able to naturally fit themselves into an agro-eco-system than chemicals and therefore, are able to mould the soil system to long term sustainability. The biological bases of sustainable crop yield lie in sustainable fertility and sustainable agro-eco-system. Increase in productivity or maintenance of productivity of crops can be achieved if fertility and eco-systems are able to be maintained at their best natural forms.

Such possibility exists only with the practice of organic farming rather than chemical/inorganic farming. Therefore, organic farming may be considered first as an alternative, as organic farming stresses more on supplying plant nutrients by all possible decomposable natural resources and release the nutrients slowly without allowing the soil environment to be flooded with a particular nutrient suddenly. This not only inhibits their loss due to leaching and volatilization but also is in tune with the capacity of plant roots to absorb and adsorb the ions. Having considered all these facts, the study has been conducted with the following specific objectives.

Objectives

The specific objectives of the study are:

- to assess the sustainable yield index (SYI) of organic farming,
- to assess the assess the sustainable value index (SVI) of organic farming, and
- policy implication for improving sustainability of crop productivity.

Database

Only primary data have been used in this study programme. The primary data have been collected by personal interview method with the aid of pre-tested survey schedule specially prepared for this purpose. Different aspects of farm operation have been obtained for organic farming systems. These aspects are (i) input and output record of organic farms, (ii) price received on sale of products, and (iii) the income received from sale of products in market. For estimating the extent of sustainability three consecutive years data were collected from primary source during the period of 2007-08 to 2009-10.

METHODOLOGY

The data for the analysis consisted of the productivity and net return of different crops grown in selected organic farms. To analyze sustainability of different crops in different districts of West Bengal the most recognized formula for calculating cost of cultivation, cost of production, net income and indices of sustainability measures were used.

Selection of areas

For the study, two districts, viz. Jalpaiguri and North 24 Parganas were selected purposively since both Government and Non-Government organization (NGO) were working there in the field

of promotional activities of organic agriculture. In the second stage, 4 blocks (2 from each district) were selected purposively. In the third stage, 4 villages (1 from each block) were selected. Two villages of NGO activity area were selected randomly. On the other hand, as there was only one village under Government management system for organic farming in each district, so both the villages were selected purposively.

Selection of farmers

In the first stage, all the listed farmers practicing organic farming have been subdivided into five categories based on size of land holdings viz., (i) sub-marginal (below 0.50 ha), (ii) marginal (0.51 ha to 1.00 ha), (iii) small (1.01 ha to 2.00 ha), (iv) medium (2.01 ha to 4.00 ha) and (v) big (4.01ha and above). In the next stage, 60 sample households (30 organic households from Government activity area + 30 organic households from NGO activity area) were selected from each district using stratified random sampling (SRS) with probability proportionate to size class (PPS) method. Thus, total 120 respondents from the two districts had been selected for in-depth study.

Analytical framework for assessment of sustainability

In order to address the objectives, descriptive analysis and statistical analysis were employed in this study.

Descriptive statistics

Descriptive statistics involved the calculation of total, average, percentages, etc.

Statistical analysis

To analyze sustainability at the level of productivity of different crops in different districts of West Bengal following most common indices of sustainability measures were used:

Among the four types of sustainability, viz. i) yield sustainability, ii) economic sustainability, iii) soil fertility sustainability, and iv) eco-system sustainability, the assessment of first two sustainability are independent except an important linkage that level of yield and quality of produce respectively alter the gross returns and price offered. The rest two are complicated to assess due to lack of comprehensive empirical expression. However, two predictive models that are developed to explain yield sustainability and economic sustainability as stated below are followed here. Again, to assess the yield sustainability and the economic sustainability, Sustainable Yield Index (SYI) and Sustainable Value Index (SVI) are to be calculated, respectively. The formula for determining these two indices are as follows:

Sustainable Yield Index (SYI)[1]

The yield sustainability may be measured by using the following formula, developed by CRIDA scientists Singh *et al*. (1990).

$$\text{SYI} = \frac{\dot{Y} - \sigma}{Y_{\max}}$$

Where,

SYI = Sustainable yield index

Ý = Mean yield over years

σ = Standard deviation (measure to risk)

Y_{max} = Maximum observed yield

Higher values of SYI (up to 1.0) indicate better sustainability of yield, because they indicate lower standard deviation. SYI is useful model to study yield sustainability. But maximum observed yield can vary from situation to situation and therefore comparison of yield sustainability of same crop (same variety) over wider location may lead to disparity. Further, SYI is dependent on varying criteria to fix up maximum observed yield, such as breeders criteria, farmers perception, experimental maximum yield, etc.

Sustainable Value Index (SVI)[2]

Singh *et al.* (1999) from Hissar have developed a model to assess the economic sustainability in terms of sustainable value index, as follows:

$$\text{SVI} = \frac{ANI - 1.96 \times \sigma}{MNI}$$

Where,

SVI = Sustainable value index

ANI = Average net income

σ = Standard deviation

MNI = Maximum net income

Developed SVI (value, up to 1.0) calculates the index of value realized by an enterprise or entire farming system, based on the use of SYI. Deciding MNI (Maximum net income) can be arbitrary over locations and the model could be further strengthened to include varying criteria to decide MNI.

The net income from the individual organic farm produce has been worked out following the standard cost concepts, which are as follows:

Cost A_1: (Hired human labour wage + Bullock labour wage + Hired machinery charges + Cost of seeds/seedlings + Cost of manures + Cost of biopesticides + Irrigation charges + Interest on working capital (@ 4% p.a., e.g. KCC) + Land revenue and taxes + Depreciation on farm implements and machinery + Miscellaneous expenses).

Cost A_2: (*Cost A_1* + Rent for leased in land)

Cost B_1: (*Cost A_2* + Interest on fixed capital: It has been calculated as per duration of a specific crop, on the basis of an assumption of @ ₹ 0.20 per day, i.e., ₹ 6.00 per month (30 days).

Cost B_2: (Cost B_1 + Rent for own land: It has been calculated on the basis of rent for leased in land prevailing at the area during the study period.

Cost C: (*Cost B_2* + Imputed value of family labour).

The calculated Cost C is considered as Total Cost of Cultivation

The computation of cost of cultivation as well as cost of production and net farm income for each organic farm in respect of the crops grown have been worked out on the basis of input prices of organic farm production systems prevailing in the study area following the applied cost concepts. The prevailed output prices and cost of cultivation of the crops have been used in computation of net farm income during the study period. The formulae followed for these computations were as follows:

$$\text{Cost of Cultivation (₹/ha)} = \frac{\text{Cost C}}{\text{Operated area in hectare}}$$

$$\text{Cost of Production (₹/quintal)} = \frac{\text{Cost C + Marketing cost}}{\text{Total production in quintal}}$$

$$\text{Net Farm Income (₹/ ha)} = \text{Gross Revenue (₹/ ha)} - \text{Cost C}$$

Finally, tabular presentation for understanding the sustainability of organic farm has been done.

RESULTS AND DISCUSSIONS

The major findings of the study are discussed in the following sections. The first section deals with the *assessment of the sustainable yield index (SYI) of organic farming* while the second section describes the *assessment of the sustainable value index (SVI) of organic farming* in the study area. Finally, attempt has been taken to suggest some *policy measure* to achieve sustainability in agriculture as a whole.

Stainable Yield Index (SYI) of organic farming

The following Table 2 reveals the result of SYI of vegetable crops grown in Bio-village area. It has been observed from the table that tomato, cauliflower and potato have the lowest index value by 0.87, whereas the highest index value by 0.95 has been showed for lady's finger cultivation. Other 6 crops have the index value within the range from 0.90 to 0.95. However, all the values are almost equal/close to 1, and thus indicate better sustainability of yield in organic farms (Table 2).

Table 2: Sustainable Yield Index (Bio-village area)

Sl. No.	Crop	Mean Yield	S.D	Max. Yield	SYI
1	Brinjal	377.69	18.49	401.12	0.90
2	L.finger	109.43	1.32	111.46	0.95
3	Tomato	215.88	8.11	228.32	0.87
4	C.flower	187.80	9.43	205.46	0.87
5	Cabbage	239.93	9.97	251.78	0.93
6	Cowpea	42.84	1.56	44.55	0.91
7	Bean	122.22	3.24	125.98	0.91
8	P.gourd	239.60	9.97	255.67	0.91
9	Potato	166.11	7.34	177.59	0.87
10	Chilli	53.61	1.56	56.33	0.92

Source: Field Survey by the author

The figures in Table 3 pointed out that the SYI for all the 10 crops of organic farms in NGO area attained a reasonable higher value, ranging from 0.87 to 0.97, which almost equal / close to 1. This is the indication of higher sustainability of yield in organic farms (Table 3).

Table 3: Sustainable Yield Index (NGO area)

Sl. No.	Crop	Mean Yield	S.D	Max. Yield	SYI
1	Brinjal	374.91	14.32	401.12	0.90
2	L.finger	111.44	2.23	114.41	0.97
3	Tomato	220.87	10.69	240.25	0.97
4	C.flower	186.22	8.01	205.46	0.87
5	Cabbage	240.89	7.52	251.78	0.91
6	Cowpea	44.30	1.86	46.39	0.93
7	Bean	126.47	5.38	132.62	0.94
8	P.gourd	238.56	7.09	255.67	0.90
9	Potato	175.79	11.01	189.79	0.89
10	Chilli	53.30	1.23	56.33	0.92

Source: Field Survey by the author

The interesting point may be noted here that 3 crops in Bio-village area (viz. tomato, cauliflower and potato) and 2 crops in NGO area (viz. cauliflower and potato) attained the index value of below 0.90 and the remaining other crops have index value either equal to or higher than 0.90 in the study area. Perhaps varietal requirement as well as demand for nutrients is responsible for comparatively lower sustainability of productivity/yield of these crops.

Another point is to be underlined that the index values are slightly lower in Bio-village area than the index values of NGO area in general. The Bio-village programme has been initiated in this area since 2005-06 by the Department of Agriculture, Government of West Bengal and the NGOs are working for promoting organic farming in the study area since the nineties of the last century. So, as per result, it may infer that sustainability in production increases in course of time in organic farming system.

Sustainable Value Index (SVI) of organic farming

The Table 4 depicts that SVI of the crops under consideration was even negative, viz. -0.12 for lady's finger and – 0.54 for cowpea in Bio-village area. The SVI for all the other crops was around 0.50 (i.e. ½ of 1), except potato, that attained the value of SVI by 0.90, showing a better economic sustainability, despite moderate and negative economic sustainability from the other crops in the Bio-village area (Table 4).

Table 4: Sustainable Value Index (Bio-village area)

Sl. No.	Crop	Ave. Net Income	S.D	Max. Net Income	SVI
1	Brinjal	203,779.46	32,783.11	252,054.39	0.55
2	L.finger	23,615.78	14,297.04	36,869.47	-0.12
3	Tomato	115,227.76	18,884.07	139,454.10	0.56
4	C.flower	69,035.42	13,485.42	89,795.79	0.47
5	Cabbage	63,055.04	12,627.34	78,799.79	0.49
6	Cowpea	5,468.21	6,169.12	12,310.65	-0.54
7	Bean	139,390.70	30,423.46	178,739.38	0.45
8	P.gourd	103,835.15	24,470.39	130,808.04	0.43
9	Potato	73,943.78	2,144.07	77,262.46	0.90
10	Chilli	72,737.54	12,438.82	87,853.76	0.55

Source: Field Survey by the author

Perhaps, the buyers were not so attractive to lady's finger and cowpea, produced in organic process. So, these crops did not able to attain premium price. But as potato is an essential vegetable of daily food-chart, buyers showed their willingness to pay a reasonable premium price. Thus, potato attained almost sustainability (SVI = 0.90) in respect of its value, i.e. price.

The figures in Table 5 reveal that the SVI for cowpea is negative only in the NGO area. All the 9 remaining crops have a positive value of SVI. Not only that, except lady's finger, remaining 8 crops exhibited the value over 0.50 for SVI. Moreover, the crops like brinjal, tomato, bean, pointed gourd and potato attained SVI value of around 0.80. This is the indication of almost sustainable price of these crops. Among these 5 crops, bean is demanded in winter like cauliflower, cabbage, etc. But the demand for brinjal, tomato, pointed gourd and potato existed throughout the year. Perhaps, buyers are willing to pay premium price for the commodities of their demand for all the year round. They are not so interested to pay premium price for seasonal agricultural products, produced in organic process, except bean (Table 5).

Table 5: Sustainable Value Index (NGO area)

Sl. No.	Crop	Ave. Net Income	S.D	Max. Net Income	SVI
1	Brinjal	173,851.88	11,365.22	193,900.31	0.78
2	L.finger	6,050.24	1,737.72	8,621.98	0.31
3	Tomato	97,583.96	5,427.00	105,632.64	0.82
4	C.flower	59,020.99	9,438.66	76,741.62	0.53
5	Cabbage	52,337.61	6,953.74	60,475.95	0.64
6	Cowpea	-507.33	609.50	418.51	-4.09
7	Bean	110,516.95	4,095.50	118,070.59	0.87
8	P.gourd	79,097.17	4,789.21	88,839.80	0.78
9	Potato	73,225.13	2,669.20	77,262.46	0.88
10	Chilli	60,659.47	6,711.20	80,119.54	0.59

Source: Field Survey by the author

It may be psychological consideration that consumption of poisonous inorganic food for a short time will not be so harmful for their health. Therefore, seasonal products have to sale comparatively lower premium price in NGO area. However, the overall picture of SVI indicates that the value (price) for products of NGO area is more sustainable than the value (price) for products of Bio-village area under organic process of cultivation. Perhaps the reason behind this is the organised market structure for sale of organic as well as bio-farm production in NGO area. Moreover, time to time interaction between producers (farmers) and consumers in this area help for getting higher premium price. This interaction also helps in selection of crops for cultivation and to decide a reasonable premium price for bio-farm production. This system was absent in Bio-village area. Thus bio-farm products of Bio-village area were suffering from comparatively lower sustainability in respect of its price as well as value.

CONCLUSION

The fundamentals of organic farming – "the ideals of land stewardship in order to keep the land productive for generations" - are not new. However, organic farming as we know it now came about as a reaction to the wide adaptation of input intensive farming around the time of WW-II, as a result of technological advances made earlier in the century and food shortages experienced during the war. From the facts and figures, discussed above, it may be concluded that the sustainable agriculture in West Bengal may become viable only, if organic farming is followed with due attention by using on-farm resources, although it is a very difficult task. Besides sustainability, increasing consciousness about conservation of environment as well as health hazards associated with agrochemicals and consumers' preference to safe and hazard-free food are the major factors that lead to the growing interest in alternate forms of agriculture in the world. The demand for organic food is steadily increasing both in the developed and developing countries with an annual average growth rate of 20–25%. Organic agriculture, without doubt, is one of the fastest growing sectors of agricultural production.

It is now widely believed that to prevent farming from becoming non-remunerative, development of appropriate integrated livestock-cum-crop husbandry based farming systems is urgently necessary that should be ecologically sustainable and would cause revival of soil fertility, bring down pollution and improve the living surroundings resulting in general welfare of the producers as well as the consumers. Overall self reliance in all issues concerning food and agriculture is not a mere slogan but possibly the only way to survival for a densely populated country like India in general and West Bengal in particular.

Policy implication for improving sustainability of crop productivity

- The universities, in the field of agriculture, animal husbandry and fisheries sciences, in the state should jointly made an effort in formulating a comprehensive schedule of sustainable integrated farming system in collaboration with the subject-matter experts in the Government as well as experienced farmers practicing organic farming that would go a long way in solving the implementation-related problems of small and marginal farmers in the state.
- Appropriate doses, as far as possible, of organic manures should be formulated for different agro-ecological region.
- Suitable crop planning should be prepared on the basis of regional agro-climatic condition.
- Marketing infrastructure for price premium should be given top priority.

ENDNOTES

1 Singh, *et al.* (1990), CRIDA Scientists, Hissar

2 Singh, *et al.* (1999), CRIDA Scientists, Hissar

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