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CASE STUDY

Economic Analysis of the Vegetable Crops Grown under Natural Farming: A Case Study in *Mandi* District of Himachal Pradesh

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ABSTRACT

The present study, entitled "Comparative Analysis of the Vegetable Crops Grown Under Natural Farming: A Case Study in Mandi of Himachal Pradesh," explores the practice of Subhash Palekar Natural Farming (SPNF/ZBNF) among 120 farmers in Sundernagar, Karsog, and Balh blocks in Himachal Pradesh. The study reveals that the literacy rate among the farmers is high, with 96.15% of the males and 81.58% of the females being literate. The average number of workers is 3.71, and the average landholding is 0.83 ha, out of which 0.30 ha is under natural farming and 0.15 ha is under conventional farming. The cropping intensity under natural farming is high at 204%, and the agriculture income share in total household income is 58.11%. The study also highlights the presence of livestock among the farmers, with cows, bullocks, and improved buffalo being the most common. Four major crops, including tomatoes, French beans, peas, and cauliflower, were grown under natural farming, with estimated yields per hectare ranging from 60 to 101 q/ha. The yield from SPNF crops was found to be less than that of conventional crops, but with the intercropping system, it becomes similar to conventional farming and has more diversity under SPNF. The estimated net returns per hectare for the major crops ranged from ₹ 75509 to ₹ 117433/ha, while the estimated costs per hectare ranged from ₹ 61620 to ₹ 86532/ha. The study suggests the need for a specialized and organized market for SPNF produce to increase the income of farmers and promote the practice of natural farming. Overall, the study provides valuable insights into the practice of SPNF among farmers in Himachal Pradesh and highlights the need for market interventions to support the practice and increase the income of farmers.

HIGHLIGHTS

- SPNF improves rural livelihoods by reducing costs and increasing resilience.
- SPNF promotes sustainability by cutting inputs, boosting biodiversity, and resilience
- Grassroots research and farmer-scientist collaboration refine and expand SPNF.
- Organized markets, policies, and research-sharing drive SPNF adoption.
- SPNF offers a sustainable alternative requiring institutional support.
- Economic viability of SPNF depends on market access and government backing.

Keywords: Natural Farming, Conventional Farming, Sustainable Agriculture, Cost of Cultivation, Socioeconomics, Vegetables, Specialized Market

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The agricultural sector has long been the backbone of the Indian economy, supporting around half of the country's population and contributing approximately 16.5 percent of the gross value added to the national economy (Anonymous, 2020a). However, the prevailing practices of chemical-intensive agriculture have created significant challenges for various stakeholders, including farmers, consumers, and the environment. The excessive use of biochemical inputs such as fertilizers and pesticides has resulted in a soil health deficit and the loss of valuable soil microflora, contributing to the depletion of biodiversity on agricultural land and polluting groundwater. Moreover, conventional agricultural practices have caused several environmental issues, such as climate change, soil depletion, deforestation, pollution, irrigation problems, and waste.

The Green Revolution, with its liberal use of inorganic fertilizers and pesticides, has undoubtedly played a vital role in increasing food grain production in India from 115.6 million tons in 1960-61 (Praduman *et al.* 2016) to over 281.37 million tons in 2018-19 (Anonymous, 2019). Likewise, annual N, P, and K fertilizer usage increased from 0.07 million tons in 1951-52 to over 25.95 million tons in 2016-17 (Bagal *et al.* 2018). According to the Ministry of Agriculture and Farmers' Welfare's Annual Report 2017-18, a 50 percent rise in food grain output can be attributed to increased fertilizer use. After all, with its heavy use of fertilizers creating a soil health deficit (Patra, 2016), the Green Revolution brought about the loss of valuable soil microflora. However, it has come at a high cost to the environment and human health. In recent years, there has been a growing recognition that Indian agriculture needs to reduce its dependency on chemical fertilizers and adopt sustainable farming practices that take into account the full costs and impacts of existing production practices.

Sustainable agriculture aims to help the environment by reducing agricultural runoff, conserving water, maintaining soil fertility naturally, and reducing contamination of lakes and rivers through the recycling of nutrients on the farm. One such approach is natural farming, also known as "Zero Budget Natural Farming" (ZNBF), which promotes farming with nature and without chemicals. This self-developing, self-nourishing, and self-sufficient farming approach aims to eliminate the use of chemical fertilizers and instead relies on different formulations made out of dung and urine of indigenous cows. Natural farming is expected to bring about changes in the crop pattern from monoculture to multi-cropping (Galab, 2018) and contribute to food security while reducing the environmental impact of agriculture. To encourage farmers to adopt natural farming practices, the government of Himachal Pradesh has introduced the Prakartik Kheti-Khushal Kisan Yojana scheme, which provides subsidies and training to farmers. Under this scheme, farmers can earn a 75% subsidy on drums for natural farming inputs, and up to Rs 50,000 has been given for the establishment of natural resource stores in each village for the supply of natural farming inputs (Anonymous, 2018). The present research study, titled "Production and marketing of vegetable crops grown under natural farming: A case study of Mandi district in Himachal Pradesh," explores the production and marketing aspects of vegetable crops grown under natural farming practices.

METHODS

Sampling Method

1. Description of the study area

The Mandi district can be found between latitudes 31°13'50" and 32°04'30" north and longitudes 76°37'20" and 77'23'15" east. On the northwest, it is bordered by Kangra, and on the west, by Hamirpur and Bilaspur. The district covers 3,950 square kilometers, or 7.09 percent, of the state's overall geographic area. The district has a total population of 9,99,518 people, or 253 people per square kilometer, according to the 2011 Census of India. 14.58 percent of the state's population resides in the district. The majority of the population in the Mandi district is dependent on agriculture for their livelihood. Anonymous (2018), Mandi district ranks third for the underproduction of vegetables (226725/ton) and second for the area under vegetables (11109/ha).

2. Selection of the study area

Most districts in Himachal Pradesh engage in the practice of natural farming. Himachal Pradesh's

Mandi district was specifically chosen for this study.

3. Sampling design and sample size

The farmers who practice natural farming were ultimately chosen using a simple random sampling design. From the Project Director of ATMA, Mandi, a list of farmers engaged in Subhash Palekar Natural Farming (SPNF) was initially obtained. Following that, 40 farmers were chosen at random from each of the three blocks of Sundernagar, Karsog, and Balh, based on their natural farming experience and progress. 120 farmers were therefore chosen as a sample for the study.

Distribution of natural farmers by size of their landholding among the sampled farmers

In order to analyze the data, all respondents were divided into three groups based on the size of their landholdings: marginal (less than 1 ha), small (between 1 and 2 ha), and medium (between 2 and 4 ha). Table 1 shows how the sample households were distributed based on their holding size.

Examining socio-economic status, resource structure, income and expenditure patterns, price spread, and growers' perceptions of natural farming practices were all done using simple tabular analysis. Averages and percentages were used as simple statistical tools to compare, contrast, and interpret the findings. Using the following formulas, the sex ratio, literacy rate, and index were determined:

$$\text{Literacy rate} = \frac{\text{Total no.of literate person}}{\text{Total population}} \times 100$$

$$\text{Literacy Index} = \frac{\sum W_i X_i}{\sum X_i}$$

where

W_i = weights (0, 1, 2, 3, 4, and 5) for illiterate, primary, middle, metric, secondary, and graduate and above, respectively.

X_i = number of persons in the respective category.

Commission for Agricultural Costs and Prices Cost Concepts (CACP) is applied for Cost and return analysis

1. **Cost A_1 includes**
   (a) Seed/Seedling cost
   (b) Value of manure, fertilizers, and plant protection chemicals
   (c) Hired human labor
   (d) Bullock labor
   (e) Owned and hired machinery
   (f) Irrigation charges
   (g) Depreciation on implements, farm buildings, and irrigation structures
   (h) Interest on working capital
   (i) Land revenue
2. **Cost A_1:** Cost A_1 + rent paid for leased land
3. **Cost B_1:** Cost A_1 + interest on the fixed capital assets excluding land
4. **Cost B_2:** Cost B_1 + rental value of owned land + rent paid for leased land
5. **Cost C_1:** Cost B_1 + imputed value of family labor
6. **Cost C_2:** Cost B_2 + imputed value of family labor
7. **Cost C_3:** Cost C_2 + 10 percent of cost C_2 on account of the managerial function performed by the farmer.

RESULTS AND DISCUSSION

Vegetable production is influenced by factors like the workforce, family size, and literacy, which affect the family's socioeconomic well-being. In the study region, joint families accounted for 15% of households. The average family size ranged from 4.43 members in marginal farms to 10.00 members in medium farms, with an overall average of 4.91 people per household. The average landholding size was 0.83 hectares, with different percentages allocated to various farming areas. Vegetable crops contributed 36.27% of total agricultural household income, while dairy accounted for about 22%.

Season-wise major crop combinations are:

In agriculture, multiple cropping is the practice of sequentially growing two or more crops on the same piece of land during one growing season instead of just one crop. It is a form of polyculture. In SPNF, multiple cropping systems are used in which one major crop is grown with another legume crop to fix nitrogen because in SPNF, chemical fertilizers and plant protection chemicals are not used and only

Table 1: Season-wise major crop combinations adopted under SPNF on sample households

Crop Combinations	*Kharif*	*Rabi*
Cereals, pulse & vegetables	Maize + Mash + French Bean Maize + Mash + French Bean Maize + Horsegram + French Bean	Wheat + Chickpea + Pea
Cereals & vegetables	Maize + French Bean + pea Maize + French Bean + Cucumber Maize + Soybean Maize + French Bean + Tomato Maize + Ginger	Wheat + Pea Wheat + Cauliflower + Potato Wheat + Mustard + Pea Wheat + French Bean + Pea Wheat + Garlic + Bitter gourd Wheat + Mustard Wheat + Sorghum + Mustard
Vegetable	Pea + French Bean Tomato + Cauliflower Bitter gourd + Cucumber + Brinjal	Pea + Spinach Coriander + Potato

natural fertilizers are used in crops. Season-wise major crop combinations adopted under SPNF in sample households are presented in Table 1.

Cost of Cultivation of Vegetables

Frenchbean cultivation under natural farming had an overall cost of ₹ 81,164.61. Seed accounted for 11.11% of the cost, followed by hired labor, natural fertilizer, and plant protection. The total cost of cultivation was ₹ 64,188.31, with natural fertilizer contributing 6.45%, hired labor 1.86%, and seed 1.51%. Plant protection constituted less than 1% of the overall cost. For tomato cultivation under natural farming, the overall cost was ₹ 86,532.87. Seed accounted for 21.77% of the cost, followed by natural fertilizer at 5.97%. Plant protection and hired labor each contributed less than 3% of the cultivation costs, indicating higher family labor participation and reduced labor expenses. Cauliflower cultivation under natural farming had an overall cost of ₹ 61,620.77, which was relatively high compared to other crops. Natural fertilizer contributed 7.13% of the cost, hired labor 4.47%, and seed 3.42%. Plant protection constituted less than 2% of the overall cost due to the use of natural plant protection materials instead of chemical fertilizers.

Frenchbean production costs: ₹ 1343.06/quintal. Peas: ₹ 1082.64/quintal. Tomatoes: ₹ 859.59/quintal. Cauliflower: ₹ 717.27/quintal. Tomato yield highest at 101.06 qtl/ha, followed by cauliflower (86.92 qtl/ha), frenchbean (60.50 qtl/ha), and pea (59.04 qtl/ha) due to improved management. High labor costs impacted Frenchbean revenue. Tomatoes had low labor costs, reducing production costs. Table 2 shows the details.

The objective of vegetable growing programs is to increase land productivity, meet rural population needs, create job opportunities, and promote socio-economic development. Assessing profitability and its impact on revenue and employment requires careful study. Different methods were used to measure the economic benefits, such as farm business income, farm labor income, net farm income, farm investment income, and output-input ratios. Frenchbean had the highest gross return, followed by Pea, Tomato, and Cauliflower. However, net returns indicated that Pea had higher returns due to lower production costs compared to Frenchbean. Pea also had the highest income from family labor. Farm income varied among different vegetables. The output-input ratio ranged from 1.91 for Tomato to 2.63 for Pea, indicating higher earnings in Pea cultivation compared to Frenchbean and other vegetables.

Comparison Between Natural Farming and Conventional Farming

In terms of cost, conventional farming had higher expenses for tomato (₹ 153,265.73/ha), Frenchbean (₹ 139,784.85/ha), cauliflower (₹ 135,529.75/ha), and peas (₹ 86,532.87/ha) compared to natural farming, which had higher costs for tomato (₹ 86,532.87/ha), Frenchbean (₹ 8,164.61/ha), peas (₹ 64,188.31/ha), and cauliflower (₹ 61,620.77/ha). Conventional

Table 2: Cost of Cultivation of Vegetables Grown Under SPNF (₹/ha)

Item of cost	French bean	Pea	Tomato	Cauliflower
Cost A1	26514.11 (32.63)	17851.72 (27.23)	36178.99 (41.17)	13680.88 (22.20)
Interest on fixed capital @ 5%	2547.59 (3.12)	3455.04 (5.22)	1907.92 (2.13)	956.19 (1.55)
Cost B1 = (Cost A1 + Interest on fixed capital)	29061.69 (35.75)	21306.76 (32.45)	38086.91 (43.30)	14637.07 (23.75)
Rental value of owned land	28906.25 (35.63)	28906.25 (45.63)	28906.25 (33.90)	28906.25 (46.92)
Cost B2 = (Cost B1 + Rental value of owned land)	57967.94 (71.39)	50213.01 (78.08)	66993.16 (77.20)	43543.32 (70.67)
Imputed value of family labour	15818.07 (19.52)	8139.99 (12.83)	11673.08 (13.71)	12475.56 (20.24)
Cost C1 = (B1 + Imputed value of family labour)	44879.76 (55.28)	29446.76 (45.28)	49759.99 (57.01)	27112.63 (43.99)
Cost C2 = (B2 + Imputed value of family labour)	73786.01 (90.91)	58353.01 (90.91)	78666.24 (90.91)	56018.88 (90.91)
Value of management input(10 % of cost C2)	7378.60 (9.09)	5835.30 (9.09)	7866.62 (9.09)	5601.89 (9.09)
Cost C3 = (C2 + Value of management input(10 % of cost C2))	81164.61 (100.00)	64188.31 (100.00)	86532.87 (100.00)	61620.77 (100.00)

Table 3: Cost and Returns in Vegetables

Particular	Frenchbean	Pea	Tomato	Cauliflower
Total Cost of cultivation (₹/ha)	81164.61	64188.31	86532.87	61620.77
Yield (Qtls/ha)	60.50	59.04	101.06	86.92
Gross Returns (₹/ha)	170687.40	168506.30	165295.23	137130.26
Net Returns (₹/ha)	89522.79	104318.00	78762.37	75509.49
Cost of production (₹/Qtls)	1343.06	1083.64	859.59	709.12

Table 4: Comparison between Natural Farming and Conventional Farming Based on Cost and Returns

Sl. No.	Particulars	NF	CF	NF	CF	NF	CF	NF	CF
		Freanchbean		Pea		Tomato		Cauliflower	
1	Total cost (₹/ha)	81164.61	139784.85	64188.31	100701.08	86532.87	153265.73	61620.77	135529.75
2	Yield (Qtls/ha)	60.50	78.99	59.04	64.85	101.06	128.81	86.92	116.94
3	Gross Return (₹/ha)	170687.40	224410.63	168506.30	182387.97	165295.23	260460.54	137130.26	204540.48
4	Farm Business Income (₹/ha)	144173.30	142393.69	150654.58	138512.97	129116.25	167702.74	123449.38	128276.72
5	Family Labour Income (₹/ha)	112719.46	111549.46	118293.29	106434.68	98302.08	137293.21	93586.94	98312.14
6	Net Farm Income (₹/ha)	89522.79	846625.78	104318.00	81686.89	78762.37	107194.82	75509.49	69010.73
7	Farm Investment Income (₹/ha)	128355.23	128177.72	142514.59	122919.83	117443.17	151537.59	110973.82	111296.19
8	Output input ratio	2.10	1.61	2.63	1.81	1.91	1.70	2.23	1.51

farming also yielded more produce for tomato (128.81 quintals/ha), cauliflower (116.94 quintals/ha), Frenchbean (78.99 quintals/ha), and peas (64.85 quintals/ha) compared to natural farming with tomato (101.06 quintals/ha), cauliflower (86.92 quintals/ha), Frenchbean (60.50 quintals/ha), and peas (59.04 quintals/ha). In Karnataka, similar results were observed with lower cultivation costs for paddy, guli ragi, ragi, and black gram in natural farming compared to conventional farming (Khadse

et al. 2019). Additionally, a study in the Purulia district of West Bengal showed that adopting ZBNF led to a 180 kg/ha reduction in crop yield, from 2800 kg/ha to 2700 kg/ha (Koner, 2020).

In natural farming, the output-input ratio for French beans was 2.63, while in conventional farming, it was 1.81. Similarly, for peas, the ratio was 2.63 in natural farming and 1.81 in conventional farming. For tomatoes, the ratio was 1.91 in natural farming and 1.70 in conventional farming. Lastly, for cauliflower, the ratio was 2.23 in natural farming and 1.51 in conventional farming. The study concluded that the cost of cultivation was lower in natural farming compared to conventional farming. This was attributed to the intercropping system and lower overall costs. The study also found a higher overall net income from natural farming. Similar results were observed in the study on jeevameutha as an alternative to chemical fertilizers in rice production, where the benefit-cost ratio was better with the jeevamrutha method compared to conventional farming. Specifically, the ratio was 3.39 in the Masura variety and 3.0 in the Hamsa variety, compared to 1.09 and 0.6, respectively, in conventional rice production (Amareswari, 2014).

CONCLUSION

Based on the study, it is evident that natural farming has emerged as a viable alternative to conventional farming, particularly in the context of farming distress and the need for sustainable livelihoods. The lower cost of cultivation under natural farming, coupled with the benefits of multiple cropping systems, indicates that there is potential for income generation through the adoption of these methods. However, there are certain challenges that need to be addressed to increase the adoption of natural farming in rural areas.

One of the key recommendations is the establishment of a liberal policy to guide the adoption of natural farming technologies. There is a need to create an organized marketing structure for natural farming produce to ensure that farmers receive fair prices for their products and reduce the role of middlemen.

Various government measures are also required to support the transition to natural farming, including linking farmers practicing SPNF with the market, implementing a True cost accounting mechanism, and providing subsidies and technical assistance for the operation and certification procedures for natural farming. It is important to note that initiatives that use local resources, reduce costs, address climatic risks and vulnerabilities, and ensure healthy food are relevant under rainfed conditions, resilient to climate change, and ensure healthy food.

Overall, the study highlights the potential of natural farming as an alternative farming model and the need for supportive policies and initiatives to increase its adoption in rural areas.

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