**Original Research Article**

**Natural farming impact on farmers' income: Evidence reported from Mandi district of Himachal Pradesh India**

**ABSTRACT**

Agriculture is major source of income for farmers in the mountainous state of Himachal Pradesh, which is located in the North Western Himalayas. A sample of 60 farmers was chosen for the current study, which was carried out in the Mandi district of Himachal Pradesh, India, to examine the effect of Natural Farming on farmers' income. In contrast to Conventional Farming, where wheat, peas, maize, and tomatoes are produced, the study found that farmers in Natural Farming practiced mixed cropping, growing cereal-pulses, cereal-vegetables, vegetable pulses, and cereal-vegetable-pulses. In contrast to Conventional Farming, where cultivation costs ranged from Rs. 52,686 to 79,008/ha, Natural Farming had lower cultivation costs, ranging from Rs. 41,857 to 52,966/ha. Cereal-vegetable and cereal-vegetable-pulses combinations during the Kharif (36.5q/ha) and Rabi (34.56q/ha) seasons produced the highest yield in Natural Farming. With a high output-input ratio and a high relative economic efficiency ranging from 2.57 to 22.73, natural farming also provides large net returns. Thus, natural farming becomes a practical and profitable practice for farmers to maximize their yields without much investment in mid hills of Mandi area.

*Keywords:**Conventional farming, Cropping pattern, Mixed cropping, Natural farming, Traditional farming*

1. **INTRODUCTION**

With about 148 million workers in the fiscal year 2023, agriculture is one of the major economic sectors in India (Rathore, 2023). India is the world's largest producer of pulses and the second-largest producer of cereals, fruits, and vegetables because to its varied agroclimatic zone (Anonymous, 2021). To increase crop yield, the majority of Indian farmers have adopted conventional farming methods using high-yielding varieties of cereals and vegetables, and other chemical inputs which were started during the era of the green revolution to alleviate the situation of poverty and hunger in the country by (Nelson et al., 2019). The naturally spatial heterogeneity of soil and crop conditions within fields is ignored by conventional farming, which uniformly handles resource inputs (such as fertilizer, irrigation water, additives, and pesticides) (Corwin & Scudiero, 2019). Long-term farmers' dependency on these chemical inputs and high-yielding varieties with the motive of more yields not only deteriorates the fertility of the soil but also drives up the cost of production (Liu et al., 2015; Mahmud et al., 2021). Further, overuse of pesticides and fertilizers depletes natural resources and also results in negative effects on the ecosystem, including reduced soil productivity, loss of organic matter in the soil, climate change, water scarcity, stress on aquatic life, insurgence of pests, development of resistance, and occurrence of residual toxicity (Samal & Rout, 2018; Raza et al., 2019; Bisht & Chauhan, 2021; Rad et al., 2022). Moreover, food crops grown under this system are less nutritious and less safe due to the presence of high residue of the chemicals, causing disease (Grewal et al., 2017;Rani et al. 2023). However, India has gained an outstanding position in food production, but it is also facing a poor ranking in the hunger index (Singh et al., 2021).

To combat the harmful effects of chemical-based farming, there is a need for an alternative farming technique that works in harmony with nature, reduces the dependency on synthetic inputs and increases the productivity in long run. Natural farming is considered the best approach which is a traditional farming approach introduced by Masanobu Fukuoka (1913-2008), a Japanese farmer and philosopher in his book “The One-Straw Revolution” (Brown, 2020). In India, a similar concept is implemented known as Zero Budget Natural Farming (ZBNF) which was promoted by Padma Shri Subhash Palekar as a way of sustainable agriculture. He believes that nature provides all of the basic nutrients required for plant growth, and there is no need to purchase other inputs. The FAO has urged all countries to move towards the adoption of Agroecology to meet the twin goal of global food security and conservation of the environment (Chandel et al., 2021). There is growing evidence that food security and adequate nutrition for the global population can be achieved using climate-smart (Wakweya, 2023), and sustainable agricultural practices, while reducing negative environmental impacts of agriculture, including GHG emissions (Wijerathna-Yapa & Pathirana, 2022). The main four pillars of ZBNF are Beejamrit, Jeevamrit, Acchadan and Waaphas (FAO, 2016). Jeevamrit is a fermented solution made from cow dung, urine, black jaggery, pulse powder, and live soil, which is added to 200 L of water and kept in the shade for 2-7 days (Sharma et al., 2020). Beejamrit, or microbial seed coating, employs formulations based on cow dung and urine (Shyamsunder & Menon, 2021). Waaphasa, or soil aeration through a favorable microclimate in the soil, and Acchadan, or covering the soil surface with a layer of organic material to stop water evaporation and promote the production of soil humus (FAO, 2016). In addition to these, Palekar also suggests some homemade formulations i.e., Khatti Lassi (Sour buttermilk), Sonthastra, Agniastra, Brahmastra and Neemastra made from locally available Neem, Chilli, Garlic, Tobacco for disease and pest management.

Himachal Pradesh adopted traditional natural farming in the year 2016-17. The state government has promoted the traditional natural farming approach under the “Prakritik Kheti Khushhal Kisan” Yojna launched in the year 2018 with a budget allocation of Rs. 25 crores to encourage farmers towards its wider adoption. The objective of this scheme is to reduce the cost of cultivation, increase farmers' income and long-term benefits to the farming community. The peasants will be supported with training, and the required machinery, to achieve the objective of sustainable farming, doubling farmers’ incomes, improving soil fertility and low input costs (Vashishat et al., 2021). At present, 2,170 hectares of land are being cultivated under Subhash Palekar Natural Farming (SPNF) system (Anonymous, 2021b). The current study examined the economics of the natural and conventional farming systems in the Mandi district of Himachal Pradesh, India, taking into account the available information.

**2. MATERIAL AND METHODS**

**Study area**

Himachal Pradesh is an agriculture-dominated state which provides livelihood to about 69 per cent of its population. Due to the high financial burden of market inputs and concerns about health issues, the farmers of the states are shifting to the natural farming system. The government also acknowledges the importance of the natural farming system and provides extension facilities, and technical guidance to support this advocacy. The study was conducted in the Mandi district of Himachal Pradesh where 2 major developmental blocks (Balh, and Gopalpur) were selected for the study.

**Sample size and data collection**

Sixty farmers were chosen using a straight forward random selection process, which practiced both conventional and natural farming on their fields, and were in the transitional period of switching from a conventional to a natural farming system. A personal interview with the selected farmers was conducted in order to gather data. There were two parts to the survey tool. During the 2020–2021 cropping year, the first segment collected data on household characteristics and other demographics, while the second section collected data on the costs and returns of conventional and natural farming.

**Statistical data analysis**

Descriptive statistics: For the analysis of demographic characteristics of farmers.

**Analytical techniques**

**CACP cost concepts**

**Cost A1 includes**

* + 1. Cost of planting material
    2. Cost of manures, fertilizers and plant protections
    3. Cost of hired human labour
    4. Cost of owned and hired machinery
    5. Irrigation charges
    6. Depreciation of farm implements
    7. Land revenue
    8. Interest on working capital
* **Cost B1:** Cost A1 + interest on the fixed capital assets excluding land
* **Cost B2:** Cost B1 + rental value of owned land
* **Cost C1:** Cost B1 + imputed value of family labour
* **Cost C2:** Cost B2 + imputed value of family labour
* **Cost C3:** Cost C2 + 10 per cent of cost C2 on account of managerial function performed by the farmer.

**Total cost** = Total variable cost (TVC) + Total fixed cost (TFC)

**Total revenue** = Total output (Q) - Selling price (P)

**Profit/Gross margin** = TR – TC

**Crop Equivalent Yield (CEY)**

Numerous crop varieties were grown in multiple or mixed cropping in the natural farming system. Comparing the yield of several crops with that of a single crop was therefore extremely challenging. Crop equivalent yield (CEY), as defined by Francis (1986), is the total of the yields of the intercrops and the equivalent principal. Depending on the commodity price, the varying intercrop output was converted to the equivalent yield of any crop. The economic returns and crop equivalent yields (CEY) of various cropping sequences were thus compared. Mathematically, the CEY is represented as:

Where,

Cy = Yield of the main crop

Pc = Price of the main crop

(C1y, C2y, ….Cny) = Yield of intercrops, which are to be converted to the equivalent of the main crop yield

(PC1y, PC2y,PCny) = Price of the respective intercrops.

**Relative Economic Efficiency (REE)**

Technical efficiency, pricing or allocative efficiency, and economic efficiency (a combination of the first two) are the three categories distinguished by Farrell, 1957. Despite being the result of both technical and allocative efficiencies, economic efficiency is different from the other two. A comparative indicator of economic advantages, relative economic efficiency, can be computed by:

**Income measures**

For working out the profitability of natural farming in the study area following income measures were worked out.

**i) Family Labour Income (FLI)**

It is the return to family labour

FLI = Gross income – Cost B2

**ii) Net Income (NI)**

It is the net profit after deducting all cost items

NI = Gross income – Total cost (Cost C3)

**iii) Farm Business Income (FBI)**

It is the disposal income out of the enterprise.

FBI = Gross income – Cost A1

**iv) Farm Investment Income (FII)**

FII = Farm business income – Family labour wages

**3. RESULTS AND DISCUSSION**

**Demographic characteristics of sampled households**

The demographic profile provides insights into the composition, needs, and capabilities of the households engaged in farming activities. Understanding the demographic profile of households involved in farming is important for influencing crop production. These factors determine the socio-economic status of the family and play a major role in production, farm business and other marketing-related activities. The demographic profile of the sampled farmers is presented in Table 1. The sampled farmers were categorized into marginal (<1 ha), small (1-2 ha) and medium (2-4 ha) farm categories based on their land holding. The average family size of marginal, small and medium farm categories was 5.42, 5.45 and 4.00, respectively. At an overall level, 38.33 per cent of families were nuclear while 61.67 per cent were joint families in the study area. Agriculture was the main occupation of the sampled households i.e., 51.67 per cent of the workforce was involved in agriculture. The percentage of workers involved in service and business at the overall level was 26.97 and 21.36, respectively.

**Table 1. Demographic profile of the sampled farmers of Mandi District**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Family structure** | **Farm category** | | | |
| **Marginal** | **Small** | **Medium** | **Overall** |
| Joint family (%) | 62.50 | 66.67 | 33.33 | 61.67 |
| Nuclear Family (%) | 37.50 | 33.33 | 66.67 | 38.33 |
| The average size of family | 5.42 | 5.45 | 4.00 | 5.35 |
| ≤3 (No.) | 5.00 | 0.00 | 1.00 | 6.00 |
| 4-5 (No.) | 24.00 | 5.00 | 2.00 | 31.00 |
| ≥ 6 (No.) | 19.00 | 4.00 | 0.00 | 23.00 |
| Male (%) | 35.79 | 32.66 | 33.25 | 35.14 |
| Female (%) | 35.79 | 38.71 | 41.75 | 36.45 |
| Children (%) | 28.42 | 28.63 | 25.00 | 28.41 |
| Occupational Distribution |  |  |  |  |
| Agriculture | 2.37  (51.64) | 2.44  (50.00) | 2.00  (57.14) | 2.36  (51.67) |
| Service | 1.04  (27.05) | 1.11  (30.77) | 0.33  (14.29) | 1.02  (26.97) |
| Business | 0.73  (21.31) | 0.66  (19.23) | 0.67  (28.57) | 0.72  (21.36) |

\*Value in parentheses is the percentage to total

**Mixed cropping concept of natural farming**

Climate, altitude, soil condition, resource availability, and management considerations all influence cropping pattern in any given location. Natural farming is a mixed cropping method in which leguminous crops are planted as an intercrop with the primary crop to ensure that the crops complement each other. These leguminous crops influence the growth and yield parameters of the main crop synergistically through nitrogen fixation. It also diversifies the cropping pattern and reduces the dependency on sole crops.However, modern agriculture farming i.e., conventional farming replaced the mixed cropping concept with a sole cropping system. The advantages of mixed cropping include complementary use of growth factors like soil nutrients, light and water, decreased pest and disease incidence, efficient utilization of the resources, decreased soil erosion, increased total biomass production, increased yield stability, and increased household food security. Therefore, Palekar in his view also suggested the use of a mixed cropping concept with leguminous crops under a natural farming system. The primary crops grown in the study area were wheat, pea, maize and tomato presented in Table 2. Under the natural farming system, leguminous and non-leguminous crop combinations were most frequently used, however, in the conventional farming system, farmers choose to sow a single crop. Chickpeas, peas, soybeans, and French beans were the widely chosen leguminous plants by farmers in the study area under the natural farming system.

**Table 2. Various crops are grown under natural farming systems (NFs) mixed cropping systems and conventional farming systems (CFs)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Rabi season** | | **Kharif season** | |
| **Crops combinations under NFs** | **Crops grown under CFs** | **Crops combinations under NFs** | **Crops grown under CFs** |
| **Cereal- Pulses**  Wheat+ Chickpea  Wheat+ Chickpea+ Lentils | Wheat | **Cereal- Pulses**  Maize+ Soyabean  Maize+ Soyabean+ Black Gram | Maize |
| **Cereal- Vegetables**  Wheat + Pea + Potato  Wheat +Pea  Wheat +Pea+ Cauliflower  Wheat +Mustard | Wheat | **Cereal- Vegetables**  Maize +Tomato +Cucurbits  Maize +Cucurbits  Maize +Okra+ French Bean | Maize |
| **Vegetables- Pulses**  Pea +Radish+ Cauliflower +  Chickpea  Pea +Garlic +Chickpea  Pea +Lentils | Pea | **Vegetables- Pulses**  Tomato +Okra +Cucurbits+  Soyabean  Tomato +Okra +Soyabean  Tomato +Cucumber + Soyabean | Tomato |
| **Cereal- Vegetables-Pulses**  Wheat +Pea+ Chickpea  Wheat +Pea + Chickpea+ Lentils  Wheat +Mustard+ Chickpea | Wheat | **Cereal-Vegetables-Pulses**  Maize+ French-bean + Soyabean  Maize+ Okra +Kidney Bean  Maize + Cucumber + French-bean +Black Gram | Maize |

**Profitability analysis of the Existing farming system**

The cost of cultivation is an important component that includes total expenses incurred by farmers from land preparation to harvesting of the crop. It is a crucial factor for the analysis to assess the economic viability of their agricultural activities.

**Natural Farming**

In natural farming, locally available inputs viz; jeevamrit, ghanjivamrit, beejamrit, neemastra and bhramastra were used and their cost was calculated based on the price fixed by the government at Sansadhan Bhandar, Department of Agriculture, Himachal Pradesh, India. The input cost incurred under natural farming for the environment-friendly biodegradable inputs is presented in Table 3. From 3 it was found that, in Rabi season, the material cost accounted for different crop combinations i.e., Cereal-Pulses, Cereal-Vegetables, Vegetables –Pulses and Cereal-Vegetables-Pulses crop combinations were Rs. 5741.19/ha, Rs. 8779.56/ha, Rs. 9554.41/ha and Rs. 7153.51/ha, respectively. In the Kharif season, the highest material cost was found in the Vegetables–Pulses crop combination Rs 9,263/ha followed by Cereal–Vegetables-Pulses (Rs 8,799/ha) Cereal–Vegetables (Rs 8,395/ha) and Cereal–Pulses (Rs 4,409/ha). The seed was the major component in material cost in all crop combinations, followed by Ghanjivamrit and Agniastra accounting maximum share in total material costs. Besides this, the total labour contributed the maximum share in variable cost indicating its roots in traditional labour-intensive farming.

Cost assumptions for various crop combinations under natural farming are also shown in Table 3. During the Rabi season, the average total cost for Cereal-Pulses was 42,617/ha, for Cereal-Vegetables it was 48,958/ha, for Vegetables-Pulses it was 50,318/ha, and for Cereal-Vegetables-Pulses it was 45,607/ha. For Cereal-Pulses, Cereal-Vegetables, and Vegetables-Pulses, the variable cost (CostA1) was responsible for Rs. 13,271/ha, Rs. 16,921/ha, Rs. 16,323/ha, and Rs. 14,503/ha, respectively. Cereal-Pulses cost Rs 41,857/ha, Cereal-Vegetables cost Rs 51,001/ha, Vegetables-Pulses cost Rs 48,343/ha, and Cereal-Vegetables-Pulses cost Rs 52,966/ha during the Kharif Season. The variable cost (CostA1) was highest for Cereal- Vegetables-Pulses i.e., Rs. 18,406/ha followed by Vegetables-Pulses (16.595/ha), Cereal-vegetables (Cereal-vegetables) and Cereal-Pulses, respectively. This minimal input cost from farm-made formulations showed that these crop combinations of natural farming could be cultivated with ease and without a substantial financial outlay. Cereal-pulses combination of the kharif season were found to be the least expensive crop combination at an overall level indicating that cereal and pulse crops can respond well to natural farming due to minimum external input requirements. It presents a feasible agricultural choice for farmers with limited capital.

Crop Equivalent Yields (CEY) were used to calculate the yield of intercrops for the main crop which makes it easier to compare mixed crops grown naturally with a single crop grown conventionally. This converts the yields of various intercrops into equivalent yields of the main crop based on the price of the produce. In natural farming, Crop Equivalent Yields (CEY) for Cereal-Pulses, Cereal-Vegetables, Vegetables-Pulses and Cereal-Vegetables-Pulses were 26.97 q/ha, 34.56 q/ha, 37.03 q/ha and 32.31 q/ha, respectively in Rabi season and 29.91q/ha, 35.33q/ha, 39.16q/ha and 36.51q/ha, respectively in Kharif season. Total revenue and net returns were calculated and found that net returns under natural farming ranged from 9,291 to 42,259/ha in the rabi season and 11,973 to 33, 985/ha. The highest were found in Vegetable Pulses crop combinations in both seasons. Further, relative economic efficiency was also calculated to evaluate the percentage increase and decrease of net returns in natural farming systems over conventional farming. The Relative Economic Efficiency (REE) ranged from 15.87 to 22.73 per cent for different crop combinations, showing that natural farming utilises the resources more efficiently than conventional farming. Further, income measures were calculated to evaluate the profitability of natural farming for wider adoption. The Vegetable-pulses crop combination was found to have the greatest farm business income during both Rabi and Kharif seasons. Similarly, this combination of vegetables and pulses produced the highest family labour income, net farm revenue, and farm investment income.

**Table 3. Input cost under natural farming system of sampled households in the Rabi season and Kharif season**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Items of cost** | **Cost of cultivation (Rs/ha)** | | | | | | | |
| **Rabi season** | | | | **Kharif season** | | | |
| **Cereal- Pulses** | **Cereal-Vegetables** | **Vegetables -Pulses** | **Cereal-Vegetables-Pulses** | **Cereal- Pulses** | **Cereal-Vegetables** | **Vegetables –Pulses** | **Cereal-Vegetables-Pulses** |
| **Average area** | 0.03 | 0.14 | 0.01 | 0.13 | 0.09 | 0.09 | 0.03 | 0.08 |
| **Material cost** | 5,741 | 8,779 | 9,554 | 7,153 | 4,409 | 8,395 | 9,263 | 8,799 |
| Ghanjivamrit | 1,896 | 1,561 | 1,593 | 1,211 | 1,093 | 1,490 | 1,475 | 2,028 |
| Bijamrit | 123 | 204 | 109 | 109 | 32 | 30 | 26 | 36 |
| Jivamrit | 308 | 658 | 379 | 577 | 343 | 358 | 368 | 367 |
| Agniastra | 272 | 1,330 | 1,484 | 1,028 | 1,108 | 1,629 | 1,404 | 1,638 |
| Neemastra | 90 | 187 | 304 | 3.00 | 216 | 324 | 201 | 231 |
| Seed | 3,050 | 4,837 | 5,682 | 4,223 | 1,615 | 4,562 | 5,787 | 4,496 |
| **Tractor** | 2,464 | 3,090 | 2,134 | 2,906 | 2,738 | 3,077 | 2,481 | 4,696 |
| **Total labour** | 9,182 | 11,028 | 9,947 | 10,806 | 10,260 | 13,244 | 11,294 | 12,609 |
| Owned labour | 7,913 | 8,525 | 8,570 | 8,858 | 9,126 | 11,348 | 9,104 | 10,662 |
| Hired labour | 1,269 | 2,502 | 1,376 | 1,948 | 1,134 | 1895 | 2,190 | 1,946 |
| **Cost A1** | 13,271 | 16,921 | 16,323 | 14,503 | 10,807 | 15,968 | 16,595 | 18,406 |
| **Cost B1** | 14,453 | 18,152 | 17,727 | 15,718 | 12,023 | 17,198 | 17,821 | 19,640 |
| **Cost B2** | 30,828 | 35,981 | 37,173 | 32,602 | 28,925 | 35,015 | 34,844 | 37,488 |
| **Cost C1** | 22,367 | 26,678 | 26,298 | 24,576 | 21,150 | 28,547 | 26,925 | 30,303 |
| **Cost C2** | 38,742 | 44,507 | 45,743 | 41,461 | 38,052 | 46,364 | 43,948 | 48,151 |
| **Cost C3** | 42,617 | 48,958 | 50,318 | 45,607 | 41,857 | 51,001 | 48,343 | 52,966 |
| CEY | 26.97 | 34.56 | 37.03 | 32.31 | 29.91 | 35.33 | 39.16 | 36.51 |
| Total Revenue | 51,908 | 66,531 | 92,577 | 62,197 | 53,831 | 63,589 | 82,329 | 65,722 |
| Net returns | 9,291 | 17,573 | 42,259 | 16,590 | 11,973 | 12,588 | 33,985 | 12,756 |
| REE (%) | -35.10 | 22.73 | 16.95 | 15.87 | 5.42 | 10.84 | 2.57 | 12.31 |
| FBI | 38,637 | 49,609 | 76,253 | 47,693 | 43,023 | 47,621 | 65,733 | 47,315 |
| FLI | 21,080 | 30,549 | 55,404 | 29,594 | 24,905 | 28,574 | 47,484 | 28,233 |
| NFI | 9,291 | 17,573 | 42,259 | 16,590 | 11,973 | 12,588 | 33,985 | 12,756 |
| FII | 30,723 | 41,083 | 67,683 | 38,835 | 33,897 | 36,272 | 56,629 | 36,652 |
| Output-Input ratio | 1.22 | 1.37 | 1.84 | 1.36 | 1.29 | 1.25 | 1.70 | 1.24 |

**Conventional farming**

In conventional farmers grow only solo crop as major crops as presented in the Table 4. The average cultivated area under Wheat, Pea, Maize and tomato was 0.17, 0.03, 0.12, 0.07 ha. The total material cost was found maximum for Pea (Rs 33, 054/ha) followed by Pea, Wheat and Maize. In material cost, seed has a major share followed by plant protection. The total cost involved in plant protection ranged from Rs. 4,072.03/ha to Rs. 19,919.99/ha and was highest in the case of pea followed by tomatoes. The highest labour cost was found in tomatoes i.e., Rs.11741.01/ha due to its intercultural operations.The total cost of cultivation was Rs. 79,008/ha in pea, Rs. 53,499/ha in Wheat, Rs. 52,686/ha in Maize and Rs. 74,543/ha in Tomato out of which the variable cost i.e., Cost A1 was Rs. 41,394 /ha in Pea, Rs. 20,225/ha in Wheat, Rs. 24,078/ha in Maize and Rs. 35,735/ha in Tomato. The yield under conventional farming for Wheat, Pea, Maize and Tomato was 35.23 q/ha, 41.05q/ha, 35.58q/ha and 43.07 q/ha, with net returns ranging from Rs 14,317, Rs36,136, Rs 11,357 and Rs 33,131/ha, respectively. In the conventional farming system, the profitable returns were found in pea (Rs. 72,611/ha), similarly, Pea yielded the highest household labour income, net farm revenue, and farm investment income, at Rs. 71,133/ha, Rs. 36,135/ha, and Rs. 64,127/ha, respectively. The highest output-input ratio was observed in the Vegetables-Pulses crop combination in both seasons i.e., 1.84 and 1.70 indicating that on investing Rs. 1 farmer was getting returns of Rs. 1.84 and Rs. 1.70 in the rabi and kharif season, respectively under the natural farming system.

By comparing Tables 3 and 4 it was found that natural farming had a low cost of cultivation as compared to a conventional farming system which provides better returns to natural farmers. Labour was the major component in natural farming showing its labour-intensive nature. On comparing the output-input ratio, it was found that natural farming provides more output with less consumption of inputs or farmers are better utilizing resources in the natural farming system. These results were supported by similar studies conducted in various regions of India (Kumar, 2018; Mishra, 2018; Sulok et al., 2018, Galab et al., 2019; Pal et al., 2019; Koner & Laha 2020).

**Table 4. Input crops grown conventionally during the seasons of Rabi and Kharif**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Items of cost** | **Cost of cultivation (Rs/ha)** | | | |
| **Wheat** | **Pea** | **Maize** | **Tomato** |
| Average area | 0.17 | 0.03 | 0.12 | 0.07 |
| Material cost | 15,100 | 33,054 | 14,384 | 27,008 |
| Seed | 5,440 | 8,647 | 1,572 | 4,596 |
| FYM | 3,049 | 3,098 | 2,521 | 3,875 |
| Fertilizer | 2,538 | 1,388 | 1,442 | 2,066 |
| Plant Protection | 4,072 | 19,919 | 8,846 | 16,470 |
| Tractor | 3,009 | 3,098 | 1,767 | 3,229 |
| Total labour | 7988 | 9771 | 6086 | 11741 |
| Hired labour | 1,524 | 1,286 | 917 | 1,646 |
| Owned labour | 6,463 | 8,484 | 5,168 | 10,094 |
| **Cost A1** | 41,394 | 20,225 | 24,078 | 35,725 |
| **Cost B1** | 42,872 | 21,703 | 25,329 | 37,203 |
| **Cost B2** | 63,341 | 42,172 | 42,728 | 57,672 |
| **Cost C1** | 51,356 | 28,167 | 30,498 | 47,297 |
| **Cost C2** | 71,825 | 48,636 | 47,896 | 67,766 |
| **Cost C3** | 79,008 | 53,499 | 52,686 | 74,543 |
| Yield | 35.23 | 41.05 | 35.58 | 43.07 |
| Total revenue | 67,817 | 1,02,625 | 64,044 | 1,07,675 |
| Net returns | 14,317 | 36,136 | 11,357 | 33,131 |
| FBI | 47,592 | 72,611 | 39,965 | 71,949 |
| FLI | 25,645 | 71,133 | 21,315 | 50,002 |
| NFI | 14,317 | 36,135 | 11,357 | 33,131 |
| FII | 41,128 | 64,127 | 34,797 | 61,855 |
| Output-input ratio | 1.27 | 1.54 | 1.22 | 1.44 |

**4. CONCLUSIONS**

Natural farming is an economically viable approach to meet the growing food population's demand while considering environmental concerns. It is a mixed cropping concept that eliminates synthetic inputs and emphasizes locally available farm inputs, reducing cultivation costs and making it more accessible to resource-constrained farmers. Natural farming also reduces negative externalities in the environment by controlling soil erosion, groundwater deterioration, and water stress due to excessive irrigation. It is designed for high-grade, nutritious food, forming the basis for preventive health management and societal well-being. The transition towards natural farming has increased due to awareness of healthy lifestyles and changing climate change patterns. Natural farming systems generate higher farm business income, family labour income, net farm income, and investment income than conventional farming systems, supporting living standards without financial investment. Government organizations should encourage farmers by educating them, providing technical guidance and training, and organizing interactions with institutions and scientists working on natural farming practices.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

**REFERENCES**

1. Anonymous. (2021). Ministry of Agriculture and Farmers Welfare. Retrieved from <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1739601>
2. Anonymous. (2021b). Need for more land under natural farming. Retrieved from <http://www.tribuneindia.com/news/himachal/need-for-more-land-under-natural-farming-47329>
3. Bisht, N., & Singh Chauhan, P. (2021). Excessive and disproportionate use of chemicals cause soil contamination and nutritional stress. IntechOpen. <https://doi.org/10.5772/intechopen.94593>
4. Brown, T. (2020). The philosophy of Masanobu Fukuoka. Permaculture Research Institute. Retrieved from <https://www.permaculturenews.org/2020/07/25/the-philosophy-of-masanobu-fukuoka>
5. Chandel, R. S., Gupta, M., Sharma, S., Sharma, P. L., Verma, S., et al. (2021). Impact of Palekar's natural farming on farmers' economy in Himachal Pradesh. Indian Journal of Ecology, 48(3), 873-878.
6. Corwin, D. L., & Scudiero, E. (2019). Review of soil salinity assessment for agriculture across multiple scales using proximal and/or remote sensors. Advances in Agronomy, 158, 1-130. <https://doi.org/10.1016/bs.agron.2019.07.001>
7. FAO. (2016). Zero-budget natural farming in India. FAO, Rome, p. 4.
8. Farrell, M. J. (1957). The measurement of productivity efficiency. Journal of the Royal Statistical Society, Series A (General), 120, 153–290. <https://doi.org/10.2307/2343100>
9. Francis, C. A. (1986). Distribution and importance of multiple cropping. Agricultural Systems, 25, 238–240. <https://doi.org/10.1016/0308-521X(87)90024-2>
10. Galab, S., Reddy, P. P., Raju, S. R., Ravi, C., & Rajani, A. (2019). Impact assessment of Zero Budget Natural Farming in Andhra Pradesh – Kharif 2018-19. Centre for Economic and Social Studies, Nizamiah Observatory Campus, Begumpet, Telangana, p. 60.
11. Grewal, A. S., Singla, A., Kamboj, P., & Dua, J. S. (2017). Pesticide residues in food grains, vegetables and fruits: A hazard to human health. Journal of Medicinal Chemistry and Toxicology, 2(1), 1-7.
12. Koner, N., & Laha, A. (2020). Economics of Zero Budget Natural Farming in Purulia district of West Bengal: Is it economically viable? Studies in Agricultural Economics, 122, 22-28.
13. Kumar, S., Kale, P., & Thombare, P. (2019). Zero Budget Natural Farming (ZBNF): Securing smallholder farming from distress. Agriallis Science for Agriculture and Allied Sector, 1, 1-4.
14. Liu, Y., Pan, X., & Li, J. (2015). A 1961–2010 record of fertilizer use, pesticide application and cereal yields: A review. Agronomy for Sustainable Development, 35(1), 83-93. <https://doi.org/10.1007/s13593-014-0259-9>
15. Mahmud, A. A., Upadhyay, S. K., Srivastava, A. K., & Bhojiya, A. A. (2021). Biofertilizers: A nexus between soil fertility and crop productivity under abiotic stress. Current Research in Environmental Sustainability, 3, 100063. <https://doi.org/10.1016/j.crsust.2021.100063>
16. Mishra, S. (2018). Zero Budget Natural Farming: Are this and similar practices the answers? Nabakrushna Choudhury Centre for Development Studies. (n.d.). 23p.
17. Nelson, A. R. L. E., Ravichandran, K., & Antony, U. (2019). The impact of the Green Revolution on indigenous crops of India. Journal of Ethnic Foods, 6(8). <https://doi.org/10.1186/s42779-019-0011-9>
18. Pal, D., Singh, B., Kumar, M., Singh, H., & Kaur, S. (2019). Zero Budget Natural Farming in India – A review. International Journal of Current Microbiology and Applied Sciences, 8, 869-873.
19. Rad, S. M., Ray, A. K., & Barghi, S. (2022). Water pollution and agriculture pesticide. Clean Technology, 4, 1088-1102. <https://doi.org/10.3390/cleantechnol4040066>
20. Rani, M., Kaushik, P., Bhayana, S., & Kapoor, S. (2023). Impact of organic farming on soil health and nutritional quality of crops. Journal of the Saudi Society of Agricultural Sciences, 22(8), 560-569. <https://doi.org/10.1016/j.jssas.2023.07.002>
21. Rathore, M. (2023). Number of employees in agriculture industry India FY 2017-2023. Retrieved from <https://www.statista.com/statistics/1284035/india-employment-in-agriculture-sector/#statisticContainer>
22. Raza, A., Razzaq, A., Mehmood, S. S., Zou, X., Zhang, X., et al. (2019). Impact of climate change on crops adaptation and strategies to tackle its outcome: A review. Plants, 8(2), 34.
23. Samal, K. C., & Rout, G. R. (2018). Genetic improvement of vegetables using transgenic technology. In Genetic Engineering of Horticultural Crops (pp. 193-224).
24. Sharma, S. K., Jain, D., Choudharya, R., Jat, G., Jain, P., et al. (2021). Microbiological and enzymatic properties of diverse Jaivik Krishi inputs used in organic farming. Indian Journal of Traditional Knowledge, 20(1), 1-7.
25. Shyamsunder, B., & Menon, S. (2021). Study of traditional organic preparation Beejamrita for seed treatment. International Journal of Modern Agriculture, 10(2).
26. Singh, P., Kurpad, A. V., Verma, D., Nigam, A. K., Sachdev, H. S., et al. (2021). Global Hunger Index does not really measure hunger – An Indian perspective. Indian Journal of Medical Research, 154(3), 455–460. Retrieved from <https://pubmed.ncbi.nlm.nih.gov/?term=Singh%20P%5BAuthor%5D>
27. Sulok, K. M. T., Ahmed, O. H., Khew, C. Y., & Zehnder, J. A. M. (2018). Introducing natural farming in black pepper (Piper nigrum L.) cultivation, Sarawak, Malaysia. International Journal of Agronomy, 18, 1-6.
28. Vashishat, R. V., Laishram, C., & Sharma, S. (2021). Problems and factors affecting adoption of natural farming in Sirmaur district of Himachal Pradesh. Indian Journal of Ecology, 48(3), 944-949.
29. Wakweya, R. B. (2023). Challenges and prospects of adopting climate-smart agricultural practices and technologies: Implications for food security. Journal of Agriculture and Food Research, 14, 100698. <https://doi.org/10.1016/j.jafr.2023.100698>
30. Wijerathna-Yapa, A., & Pathirana, R. (2022). Sustainable agro-food systems for addressing climate change and food security. Agriculture, 12, 1554. <https://doi.org/10.3390/agriculture12101554>