Emergence of Zero Budget Natural Farming in Himachal Pradesh: Prospects and Challenges

Suresh Kumar[1*]; Tilak Raj[2]

[*1]Research Scholar, Department of Economics, Panjab University, Chandigarh
[2]Associate Professor (Economics), University Business School, Panjab University, Chandigarh
*Corresponding Author

Received:- 01 June 2025/ Revised:- 09 June 2025/ Accepted:- 17 June 2025/ Published: 30-06-2025

Abstract— *Zero Budget Natural Farming (ZBNF) is an agricultural method that does not require external inputs. This study, based on secondary data, analyses the number of farmers practicing natural farming and the land area under cultivation, as well as the prospects and challenges of ZBNF in Himachal Pradesh. The study reveals that Kangra district had the highest farmer adoption rate (22.33 per cent) under ZBNF, while Lahaul-Spiti had the lowest (0.46 per cent). Mandi had the largest area under ZBNF (24.61 per cent), and Lahaul-Spiti the smallest (0.71 per cent) from 2018-19 to 2022-23. The percentage growth rate of area under ZBNF was observed to be 156.20 per cent, and for the number of farmers, it was 1069.58 per cent from 2018-19 to 2022-23, indicating overall increases in both farmers' adoption and area expansion for ZBNF practices. A high positive correlation of 0.9681 has been found between the number of farmers and the area under ZBNF. The study underscores the need to target more farmers and expand the cultivation area under ZBNF, as it is crucial for protecting soil fertility, providing healthy and chemical-free food. Therefore, the government and stakeholders should promote ZBNF and offer technical knowledge on best practices.*

Keywords— Natural Farming, ZBNF, Sustainable Agriculture, Pillars of ZBNF, Pest Management in ZBNF.

JEL classifications: Q01, Q10, Q15, Q16, Q24.

I. INTRODUCTION

In India, Himachal Pradesh is the only state where 89.96 per cent of the population residing in rural areas where agriculture and horticulture directly employ approximately 70 per cent of the state's total workforce (GoHP, 2021). In the context of food insecurity, global warming, climate change, natural resource depletion, migration, and farmer suicides, Zero Budget Natural Farming (ZBNF) may be the world's most successful agrarian movement in terms of reach (Biswas, 2020).

Most farmers depend heavily on inorganic chemical inputs like fertilizers and pesticides, which contribute to groundwater pollution and harm water-dependent ecosystem. This practice also causes a gradual decline in soil fertility and poses significant health risks to farmers across India due to the continuous use of chemicals and pesticides. In line with the central government's target to double the farmers' income by 2022, natural farming method promoted by Padma Shri awardee Shri Subhash Palekar, are seen as essential strategies for achieving this objective (Mahajan and Dev, 2022).

Zero Budget Natural Farming is an agricultural approach that involves no initial financial outlay or spending on external inputs. If cost is incurred by chance, it is offset by profitable production. ZBNF is gaining momentum for its ability to enhance soil health over the long term, fostering diversified crops, encouraging microbial activities, and facilitating nutrient recycling, and promoting beneficial biological interactions. Particularly in rain-fed areas where the impact of the green revolution is less important, ZBNF emerges as a promising alternative in the face of unpredictable weather conditions. It represents an extreme form of low external input sustainable agriculture (LEISA), wherein all inputs are locally sourced (on the farm), and the output of one farming system serves as the primary input for another farming system (Biswas, 2020).

The government of Himachal Pradesh introduced the '*Prakritik-Kheti-Khushhal-Kisan-Yojna'* (PK3Y) through adoption of 'Subhash Palekar Natural Farming' to boost ZBNF across various cereal crops such as paddy, wheat and wheat. Efforts have also been made to produce vegetables and fruits in the state (GoHP, 2020, 2023). In the financial year 2023-24, a budget

provision of ₹13.00 crore has been made to the *Prakritik-Kheti-Khushhal-Kisan-Yojna* under ZBNF (GoHP, 2024). Several factors, including soil protection techniques, mulching, natural pesticides and fertilizers, less number of inputs, chemical-free produce, organic manures, limited irrigation needs, and cost-effectiveness, plays a crucial role in influencing the adoption of natural farming. In the era of modernization, information dissemination through mass media channels such as the internet, newspapers, and word of mouth from friends and family has become the primary source of information (Gamoh et al., 2022; Kumar and Kumari, 2020).

Under '*Prakartik-Kheti-Khushhal-Kisan-Yojna'*, workshops and trainings are being organized to inform farmers about natural farming. ZBNF promises to drastically cut production costs. It eliminates the need for loans for farming activities by relying entirely on internal inputs. Therefore, the government and concerned stakeholders should prioritize providing effective technical knowledge on best natural farming practices (Kumar and Kumari, 2020; Biswas, 2020; Mahajan and Dev, 2022).

With the deepening of the theoretical exploration of Zero Budget Natural farming in academia, scholars have begun to pay attention to the area and farmers' adoption level of this farming. For example, the study analysed by Choudhary et al (2012) assessed that the development, dissemination, and adoption of low-cost integrated farming system models would greatly encourage hill farmers to diversify their farming to increase productivity and profitability. Choudhary (2013) has suggested, the improved farming technology offers significant potential to boost pulse productivity, profitability, and water use efficiency through a frontline demonstration program in Himachal Pradesh. Choudhary and Suri (2014) showed that the demonstrated farm technology has great potential to increase oilseed productivity, profitability, and water-use efficiency, allowing resource-limited hill farmers in Himachal Pradesh to earn better livings. Yadav et al (2015) found that there is a need to educate and aware farmers about better technology through trainings and demonstrations, as well as ensure the availability of critical inputs on time, in order to close production gaps in maize in Himachal Pradesh.

Further, Bishnoi and Bhati (2017); Kumar et al (2019); Korav et al (2020); Ranjan and Sow (2021) defined the meaning as well as four pillars (Jivamrita, Bijamrita, Acchadana and Whapasa) and principle method of ZBNF which incorporates crop rotation, green manures and compost, biological pest control, and mechanical cultivation. Bharucha et al (2020) found that the statistically significant differences in yield and farmers' income between ZBNF and Non-ZBNF practices across various locations and crops. As per the available literature, natural farming is a new technology or practice that has been adopted by farmers in recent years and known as the '*Prakartik-Kheti-Khushhal-Kisan-Yojna'* in the state. The studies mentioned above pertain to different time periods and employ various methodologies. Most of the studies focus on theoretical aspects, while very few are based on analysing the trends of natural farming in Himachal Pradesh.

The present study focuses and attempt to analyse the trends of area and farmers under ZBNF from 2018-19 to 2022-23 in Himachal Pradesh. The specific objectives are: to analyse the trends and percentage growth rate in area and number of farmers under ZBNF in HP; to identify the correlation between area and number of farmers under ZBNF in HP.

II. DATA SOURCES AND METHODOLOGY

The present study is based on secondary data which is compiled from '*Prakritik-Kheti-Khushhal-Kisan-Yojna'* under ZBNF, Directorate of Agriculture, Government of Himachal Pradesh, Shimla. This scheme was started in 2018 in the state. Data related to the area under natural farming and farmers practicing under natural farming are recorded for the period 2018-19 to 2022-23 only, due to the limitation of time period. The data have been analysed through percentage growth rate, and correlation between area and the numbers of farmers under ZBNF.

The percentage growth rate has been calculated for the years from 2018-19 to 2022-23 for the area and the number of farmers under natural farming. This analysis was carried out for the entire state. To compute percentage growth rate, the following formula has been used.

$$Percentage\ Growth\ Rate = \frac{PV-IV}{IV} \times 100 \quad (1)$$

The given formula represents that, PV is the present value and IV is the initial value.

III. RESULTS AND DISCUSSIONS

3.1 Emergence of Zero Budget Natural Farming in Himachal Pradesh:

This section analyses the percentage of farmers and area practicing under natural farming during the period 2018-19 to 2022-23. After that, the performance of natural farming in Himachal Pradesh has been analysed through percentage growth rate and correlation between the number of farmers and area under natural farming.

Table 1 depicts that the farmers and area under natural farming have been recorded about 1.77 per cent and 7.43 per cent, respectively, in the adoption year 2018-19. This indicates that a small number of farmers are working over a relatively small area. Similarly, there is a significant increase in both the number of farmers (25.02 per cent) and the area (25.48 per cent) during 2019-20.

Likewise, the number of farmers increased slightly by 27.36 per cent, while the area increased by 26.87 per cent during 2020-21. This could indicate a substantial expansion in farming activities or more farmers participating in agriculture. This indicates a major change, potentially due to factors like the expansion of land under cultivation.

TABLE 1
AREA AND FARMERS UNDER ZBNF: 2018-19 TO 2022-23

(in %)

Years	Farmers	Area
2018-19	1.77	7.43
2019-20	25.02	25.48
2020-21	27.36	26.87
2021-22	25.21	21.19
2022-23	20.65	19.04

Source: Computed from ZBNF data, Department of Agriculture, Government of Himachal Pradesh, Shimla.

Furthermore, there is a decline in both the number of farmers (25.21 per cent) and the area (21.19 per cent) during 2021-22. This could indicate a contraction in farming activities, possibly due to adverse conditions such as poor weather, economic challenges, or shifts in policy. Moreover, the number of farmers and area decreased to 20.65 per cent and 19.04 per cent during 2022-23.

The lower numbers of farmers and area could reflect the initial phase where limited awareness and resources, participation, and area coverage were still growing. During the COVID-19 pandemic peak period 2020-21, the agricultural sector saw a significant increase in both the number of farmers and the area under cultivation. This was largely due to economic disruptions that caused many urban workers to return to rural areas and engage in farming as a means of livelihood and food security, as it ensured low costs, health benefits and long-term sustainability. The reverse migration to rural areas further contributed to the temporary surge in agricultural activity.

Table 2 depicts that the Kangra and Mandi districts have the highest percentages of both farmers and agricultural area with 22.33 per cent of the farmers and 20.66 per cent of the area in Kangra, indicating this district is a significant agricultural hub, and in Mandi district 21.61 per cent of the farmers and 24.61 per cent of the area, similar to Kangra, representing a substantial role in the region's agriculture.

TABLE 2
DISTRICT WISE FARMERS AND AREA UNDER ZBNF: 2018-19 TO 2022-2023

(in %)

Name of District	Farmers	Area
Bilaspur	3.11	3.31
Chamba	8.55	5.82
Hamirpur	8.56	8.69
Kangra	22.33	20.66
Kinnaur	1.41	2.09
Kullu	6.86	5.17
L & S	0.46	0.71
Mandi	21.61	24.61
Shimla	9.47	9.16
Sirmaur	5.24	5.65
Solan	5.63	6.70
Una	6.79	7.43

Source: Computed from ZBNF data, Department of Agriculture, Government of Himachal Pradesh, Shimla.

Similarly, Lahaul & Spiti (L & S) and Kinnaur have the lowest percentages, with 0.46 per cent of the farmers and 0.71 per cent of the area in Lahaul & Spiti, and 1.41 per cent of the farmers and 2.09 per cent of the area in Kinnaur, due to harsh climate, high-altitude terrain, limited arable land, and scarce water resources, which make large-scale farming practices challenging. This indicates that these are the least agriculturally intensive districts relative to others. Additionally, the remoteness and lower population density of Lahaul & Spiti further limit the adoption and expansion of natural farming in the district. Moreover, the high area under natural farming in Mandi and Kangra districts can be attributed to their favorable climate, fertile soil, larger farming population, and better accessibility and infrastructure, which support extensive agricultural activities.

3.2 Pillars of Zero Budget Natural Farming:

The four pillars of ZBNF are essential for promoting sustainable agriculture, reducing farmers' dependence on costly external inputs, creating a self-sustaining, cost-effective, and eco-friendly farming system. These four pillars are;

3.2.1 Jivamrita/Jeevamrutha:

Jeevamrutha also known as jivamrita, is a natural bio-fertilizer composed of 200 liters of water, 10 kg of desi cow dung, 5 to 10 liters of desi cow urine, 2 kg of jaggery, 2 kg of pulse flour, and a handful of soil. It enhances soil microbial activity, improving nutrient availability for crops and boosting soil fertility. This promotes healthy plant growth and reduces the dependence on chemical fertilizers, fostering sustainable farming practices (Ranjan and Sow, 2021; Kuamr, 2021; Korav et al., 2020; Kumar and Kumari, 2020; GoHP, 2023).

3.2.2 Bijamrita/Beejamrutha:

Beejamrutha is also called Bijamrita, specifically used for seed treatment and focuses on protecting seeds from diseases. The ingredients typically include desi cow urine, cow dung, lime, water, and a small amount of soil. Its primary function is to coat the seeds with beneficial microbes, protecting them from soil-borne diseases and promoting healthy germination (Kumar, 2021; Ranjan and Sow, 2021; Korav et al., 2020; Kumar and Kumari, 2020; GoHP, 2023).

3.2.3 Acchadana/Mulching:

Covering the soil with dust or plant materials (Acchadana/Mulching) offers several benefits. As Palekar suggests there are three types of mulching they are a) soil mulching b) straw mulching (Kumar and Kumari, 2020) c) live mulching. Soil mulching involves protecting the topsoil during cultivation to improve aeration and water retention, while straw mulching uses decomposing organic material from plants or animals to cover the soil. According to Palekar, live mulching is important and involves growing diverse cropping patterns of monocotyledons and dicotyledons to enhance soil health (Kumar, 2021; Ranjan and Sow, 2021; Korav et al., 2020; GoHP, 2023).

3.2.4 Whapasa/Moisture:

According to Palekar, roots mostly demand water vapour. Whapasa is distinguished by the presence of both water and air molecules (Kumar, 2021). ZBNF includes practices for water conservation and efficient water use based on the specific needs of crops. Whapasa improves water efficiency by reducing irrigation frequency and applying water in small amounts at noon in alternate furrows, which helps retain both air and moisture in the soil (Ranjan and Sow, 2021; Kumar and Kumari, 2020; GoHP, 2023).

3.3 Pest Management in Zero Budget Natural Farming:

Crops can suffer significant damage from pests and diseases, with weeds producing the greatest yield loss, followed by pests and diseases. Addressing these problems is a key challenge in natural farming. Plant extracts are used to develop effective treatments for insect control, with protection methods including blends of buttermilk, cow milk, pepper powder, neem seeds, and green chilies (Korav et al., 2020). Some research papers have identified and described various naturally extracted, chemical-free compounds. They are:

3.3.1 Agniastra:

The mixture contains 20 litres of desi cow urine, 500 grammes of tobacco, 500 grammes of green chilli, 500 grammes of local garlic, and 5 kilogrammes of neem leaves pulp mashed in cow urine. It should be kept cool place after preparation. To spray one acre, combine 6-8 litres of Agniastra (left over from boiling) with 200 litres of water. This treatment is particularly successful in controlling pests such as leaf roller, stem borer, pod borer, and fruit borer (Korav et al., 2020; Kumar and Kumari, 2020).

3.3.2 Brahmastra:

An alternative method to manage pest populations in natural farming involves the gathering of various plant leaves, such as neem, castor (eranda), custard apple leaves, lantern camellia, pomegranate, guava, papaya, and white datura leaves. These leaves are crushed and boiled in desi cow urine, and the resulting mixture is then filtered. Once filtered, the extract can be stored for extended periods of time. This method proves highly efficient against various pests, including sucking pests, pod borers, fruit borers, and others. For 1acre 2.5-3 litres solution mix in 200 litres water and used as spray (Korav et al., 2020; Kumar and Kumari, 2020).

3.3.3 Neemastra:

Comprising 5 liters of local cow urine, 5 kilograms of cow dung, 5 kilograms of neem leaves, and 100 liters of water, this solution is created by mixing all the ingredients. It is ready for use after 48-72 hours and is applied on 1 acre of land. Its primary efficacy lies in controlling sucking pests and Mealy Bugs (Kumar and Kumari, 2020; Korav et al., 2020).

3.3.4 Dashparni ark:

Consisting of 200 liters of water, 20 liters of local cow urine, 2 kg of cow dung, 500 grams of turmeric powder, 500 grams of ginger paste, 200 grams of asafoetida (heeng) powder, 1 kg of tobacco powder, 1 kg of green chilli paste, 1 kg of garlic paste, and 2-2 kg leaves from 10 different plants including castor (eranda), custard apple, neem karang, bael, datura, aak, mango, guava, marigold, and turmeric. Subsequently, these materials are mixed, and the solution is ready for application on 1 acre of land after 28 days (Kumar and Kumari, 2020).

Table 3 represents that the number of farmers are extremely high positive growth rate (1316.71 per cent) from 2018-19 to 2019-20, indicates a very substantial increase in the number of farmers participating in ZBNF. Similarly, the area under ZBNF also saw a significant increase (242.91 per cent) during the same period. This represents that not only more farmers are adopting ZBNF, but they are also applying it over much larger areas. This could be due to several reasons, such as a new policy initiative, government incentives, increased awareness, or a shift in agricultural practices toward sustainable farming.

Likewise, the growth rate for farmers slowed down significantly to 9.34 per cent during 2019-20 to 2020-21, indicating a much smaller increase in the number of farmers participating in ZBNF. Although still positive, the area under ZBNF also saw a reduced growth rate compared to the previous year, but it remained substantial at 5.48 per cent. This represents a continued expansion in ZBNF coverage, albeit at a slower pace. This could mean that after the initial surge in participation, growth stabilized, or that most of the farmers who were likely to switch to ZBNF had already done so

TABLE 3
PERCENTAGE GROWTH RATE OF FARMERS AND AREA UNDER ZBNF: 2018-19 TO 2022-23

Years	Farmers	Area
2018-19 to 2019-20	1316.71	242.91
2019-20 to 2020-21	9.34	5.48
2020-21 to 2021-22	-7.85	-21.17
2021-22 to 2022-23	-18.07	-10.15
2018-19 to 2022-23	1069.58	156.20

Source: Computed from ZBNF data, Department of Agriculture, Government of Himachal Pradesh, Shimla.

Similarly, the growth rate became negative, indicating a decline in the number of farmers participating in ZBNF by 7.85 per cent, whereas the area under ZBNF saw a sharp decline of 21.17 per cent. Moreover, the number of farmers and area under ZBNF continued to decline with 18.07 per cent and 10.15 per cent during the period 2021-22 to 2022-23. Likewise, the growth rate for farmers observed to be 1069.58 per cent, and for area, it was 156.20 per cent, which shows a substantial increment in growth rates from 2018-19 to 2022-23.

The correlation value given in Table 4 indicates a high and positive relationship between the two variables. A value of 0.9681 represents that as the number of farmers increases, the area under consideration also tends to increase, and vice versa.

TABLE 4
CORRELATION MATRIX OF FARMERS AND AREA UNDER ZBNF: 2018-19 TO 2022-23

	Area	Farmers
Area	1.0000	0.9681
Farmers	0.9681	1.0000

3.4 Prospects of Zero Budget Natural Farming:

The cost of production under ZBNF is considered zero because farmers do not need to purchase inputs from the market. It aims to eliminate dependence on credit and costly external inputs, enabling farmers to avoid debt and practice sustainable, low risk farming, thereby reducing the engagement of hired manual labour. It also requires less effort and time (Das et al., 2022). It uses only 10 per cent of the water that typical crop cultivation methods do. In one month, one cow may produce 10-12 kg of fresh dung, which is sufficient for 30 acres of land. Significantly, higher yields were discovered under ZBNF in many cash and food crops, such as fruits, vegetables and spices. ZBNF farms are resilient to prolonged droughts and flooding. Growing various crops and border plants on the same plot helps improve soil fertility and nutrient levels (Das et al., 2022; Ranjan and Sow, 2021; Korav et al., 2020). Overall, ZBNF practices lead to reduced water and electricity usage, better farmer health, and the preservation of local ecosystems and biodiversity. This also eliminates toxic residues in the environment and enhances soil quality, biodiversity, livelihoods, water management, better environmental health, reduced greenhouse gas emissions, increased farmer income, climate resilience, women's empowerment, and nutrition (Korav et al., 2020; Biswas and Pakhira, 2023).

Among the various natural farming methods used worldwide, ZBNF has gained significant popularity in India. Andhra Pradesh, Himachal Pradesh, and Gujarat are the leading states promoting this model, with others like Uttar Pradesh, Madhya Pradesh, Odisha, Chhattisgarh, and Uttrakhand also adopting it. India's diverse agro-climatic conditions and the rich traditional knowledge of its farmers present numerous opportunities to expand natural farming practices (Biswas and Pakhira, 2023).

The Green Revolution, with its focus on high-yielding varieties, chemical fertilizers, and pesticides, has led to reduced soil health by depleting essential nutrients, harming beneficial microbes, accumulating toxins, and contaminating groundwater. These practices also contribute to environmental and health issues, with burning crop residues further decreasing soil organic matter and increasing air pollution. As globalization heightens the need for environmental sustainability, natural farming offers a viable solution to these problems (Korav et al., 2020). Overall, natural farming is a vital strategy for protecting the planet and ensuring the well-being of future generations (Biswas and Pakhira, 2023).

IV. CHALLENGES OF ZERO BUDGET NATURAL FARMING

ZBNF is nature-friendly and sustainable, as it boosts beneficial microbes, provides chemical-free nutrients, and ensures toxin-free food for humans and animals. However, its broader adoption faces several hurdles; it demands more labor and animal manure, which is unsustainable with India's current cattle population. It also requires significant investment and advanced technology but avoids heavy machinery to prevent soil compaction. Additionally, natural products often have limited market value and are priced similarly to chemically produced goods due to underdeveloped agricultural market infrastructure. Natural farming can produce yields comparable to or greater than chemical farming, but profitability may be low due to limited market access and a lack of premium prices. With the growing global population and food scarcity concerns, meeting production goals without chemical inputs or hybrid crops remains a challenge.

Managing crop-specific weeds, diseases, and pests using natural methods can be ineffective for farmers. The limited availability of indigenous cows, crucial for manure in ZBNF, further complicates its practice. Despite being introduced by Mr. Subhash Palekar, ZBNF has not widely accepted in his home state of Maharashtra. Additionally, there is a need for specialized practices suited to various crops, which requires development of guidelines by state colleges, government institutions, and extension workers (Korav et al., 2020).

V. CONCLUSION AND POLICY IMPLICATION

Zero Budget Natural Farming is an agricultural method that requires no initial investment and eliminates the need for purchased inputs. It enhances sustainability by reducing water and electricity usage, protecting farmer health, preserving local ecosystems, and preventing toxic residues. There is a positive and high correlation (0.9681) between the area under cultivation and the number of farmers. This represents the number of farmers, and the area under consideration also tends to increase.

In the face of challenges such as food insecurity, climate change, resource depletion, migration, and farmer suicides, ZBNF has emerged as a highly effective global agricultural movement. So that the government and other stakeholders should prioritize the promotion of the ZBNF in the state.

To promote ZBNF, it is essential to allocate a larger share of the union budget (10-15 per cent) should go towards agriculture. To realize the potential of natural farming, farmers, government organizations, academic institutions, and consumers must work together. Investments in infrastructural developments, capacity building, and research and development may help natural farming practices spread across the nation.

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