

# Bridging Tradition and Innovation: Pathways to Natural and Sustainable Agriculture: A Case Study of Solan District, H.P.

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Chapter

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## ABSTRACT

*After green revolution agriculture sector witnessed several technological advancements and transformed our country from food-scarce to food surpluses. At present, the agriculture sector is facing the dual challenges of feeding a rapidly growing population while minimising its adverse environmental impacts. India is expected to be the most populous country in the world by 2030. So to adopt any natural/ sustainable farming techniques at very large scale required strengthening organic inputs chain to ensuring food and nutritional security to all. This paper examines the socio - economic, ecological and infrastructural challenges hindering the large scale adoption of natural/ sustainable agriculture in the Solan district of Himachal Pradesh. The study also analyses critical constraints including yield drop, labour scarcity, economic viability, cattle crises and inadequate organic material supply as per people opinion. Paper also discuss the role of Natural/ sustainable agriculture to promote ecological balance, and social equity in the region. The findings suggest that the integration of traditional ecological knowledge with modern advanced technological innovation can offers the most viable and reliable pathway toward long-term quality food security and climate resilience in present scenario.*

**Keywords:** *sustainable, environmental, ecological, organic, climate resilience.*

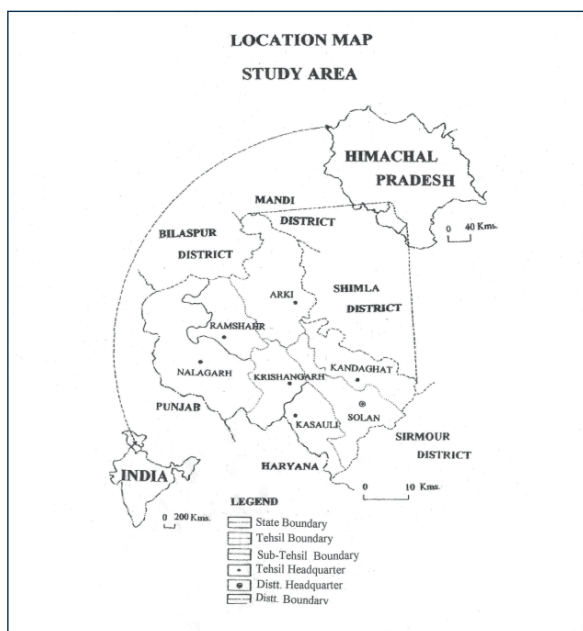
## INTRODUCTION

While natural agriculture and sustainable agriculture are often used interchangeably, they present two distinct philosophies with the same ultimate goal producing food without destroying the ecosystem the easiest way to differentiate them is that natural farming is a specific minimal intervention method to achieve harmony with nature. It is a chemical free approach whereas sustainable practices of agriculture is a broad goals that meet peoples' present needs without compromising the ability of future generations to meet their own needs. Use of organic certified commercial inputs or highly targeted minimal synthetic chemical may be use if crop is failing. In this agriculture it is very much

concerned about environmental and human health, social equity and economic viability. It is said that 80% of the world population live in countries where agriculture and land are the primary source of earning and livelihood (Singh, 2004). Agriculture is the Primary economic activity which is heavily influenced by physical, social and economic and political factors. These factors affect the intensity of land use choice of cropping farming methods, relationship between cropping and livestock raising etc. Agriculture is the backbone of Himachal Pradesh economy providing direct employment to over 60% of the state's population and contributing significantly to its gross state domestic product (GSDP). The post independence agricultural landscape of India was heavily shaped by the green revolution of the 1960s which successfully addressed acute food shortages using high yielding varieties of seeds, intensive irrigation and synthetic agro-chemicals. However, the long-term ecological consequences of these intensive modern agricultural, rising production cost etc. has leads to soil degradation, lowering of water tables, high carbon emissions have adversely threatened the sustainability of hilly farming and the livelihoods of small and marginal farmers. Land has a limited carrying capacity beyond which there will be degradation and loss in productivity due to excessive or over use (Singh, 2002). In response to these compounding ecological and economic crises a paradigm shift toward sustainable agriculture has gained momentum and the state has emerged as a pioneer in this transition and actively promoting alternative farming systems such as organic farming and subhash palekar Natural Farming (SPNF) locally operationalised under the Prakritik Kheti Khushhal Kisan Yojana. Unlike conventional chemical farming these low input, eco friendly methodologies protects the local biodiversity, natural microbial formulations and traditional knowledge to restore soil health, reduce dependency on external market inputs and mitigate the impact of climate change. Transitioning an entire agricultural landscape requires balancing ecological restoration with food security and economic viability. Challenges such as initial yield drops during the conversion period, inadequate organic input supply chains, labour intensity and lack of indigenous seeds continue to hinder wide spread adoption. The hilly state like Himachal Pradesh where approximately 89.9% of the population resides in rural areas and depend heavily on agriculture for their livelihood. Himachal Pradesh has been a pioneer in promoting chemical free agriculture in India and also providing subsidy and support on various infrastructure developments including indigenous cow, cattle shed paving etc. to promote natural farming. Himachal Pradesh is the first state in India to fix minimum Support price (MSP) for product grown under natural farming rupees 40 per kg for maize, rupees 60 per kg for wheat, rupees 90 per kg for raw turmeric and rupees 60 per kg for barley (Department of Agriculture Govt. of Himachal Pradesh). However, the geographical area of the district Solan is not conducive for agriculture crops nevertheless the agriculture is the main stay of rural economy of the district. More than half of the working population of the district is engaged in agriculture. The district may be divided into three distinct agricultural regions namely valley area of Nalagarh, Saproon and Kunihar (ii) Mid hill (iii) Higher hill of Solan Kasauli and Kandaghat tehsil. Due to the modern input in the agriculture sector, food grain production and the production and area

under vegetables and cash crops have also shown increasing trends (Annual Season and Crop Report, 2000-01).. Tomato has given an immense rise in the income of the unemployed educated youths and the economy of the study region. The record production of 27824 metric tons of this popular crop has been achieved during 2001. The commercialisation of agriculture has helped the farmers to produce more by way of intensive cultivation and built a strong base for economic development of the region in one hand, while on the other it has increased negative impacts, including soil degradation (fertility loss), water depletion, loss of biodiversity and widened economic inequality. Therefore, the shift towards natural and sustainable agriculture is no longer an environmental preference but it has become an absolute ecological and health necessity.

## STUDY AREA



The district of Solan constitutes the study area of present research work. It is situated between  $30^{\circ}45'$  to  $31^{\circ}21'10''$  north latitude and  $76^{\circ}36'$  to  $77^{\circ}15'20''$  east longitude, covering an area of 1936 square km. (Census of India, 1991). The terrain of the district varies from hilly to mountainous, except three valleys Saproon Valley in Solan tehsil, Doon Valley in Nalagarh tehsil and Kunihar Valley in Arki tehsil. The elevation varies from 300 to 3000 meters above mean sea level. The area of the district has been divided into 4 sub-divisions with headquarters at Solan, Kandaghat, Nalagarh and Arki, five tehsils and two sub tehsils (See Fig.-1). The soils of the region are young and thin which vary from light to sandy heavy and in the valley areas, it is sandy and sandy loam. Due to significant variations in the altitudes of the district, the temperature also varies considerably. Minimum temperature goes down below  $0^{\circ}\text{C}$  in higher reaches during the winter season, while the maximum temperature exceeds even  $40^{\circ}\text{C}$  in lower reaches during the summer season in the district.

## OBJECTIVES OF THE STUDY

- To evaluate the present status of prevailing agricultural practices and chemical dependency.
- To examine the impacts of natural/ sustainable farming on soil health and biodiversity.
- To analyse the crop yield dynamics and economic viability in the region.
- To present the peoples' perception to identify the socio- economic barriers in the adoption of natural and sustainable agriculture in the study region.

## DATA SOURCE

The present study is based both on primary as well as secondary data. The primary data has been collected through personal observation, interview method and questionnaires. The random sampling method has been used for this purpose. The secondary data has been obtained from various published and unpublished records of department of Land Record, Department of agriculture Himachal Pradesh, publications of Department of Economics and Statistics, District Statistical Department, District Gazetteer and Census Handbooks of various Censuses.

## METHODS AND APPROACHES

The present research study follows the following methodology in order to reach meaningful results. Library consultation has been done for the review of literature. The maps/diagrams have been prepared for visual interpretation. The present study incorporates quantitative and qualitative methods. Quantitative methods are used to analyse economic viability yield drops, input availability and demographic profiles while qualitative methods are applied to obtain people opinion regarding social equity and complex challenges i.e. the wild animal menace, cattle shortage, ecological balance and labour scarcity. A regional, ecological and behavioural approach has also been used in the analysis and presentation of this study.

## AGRICULTURAL PRACTICES AND CHEMICAL DEPENDENCY

Agriculture is the major occupation of the people of the district. Owing to spatial diversities of relief, rainfall, temperature, soil, irrigation and socio-economic structure, an agricultural heterogeneity and complex cropping pattern has been observed in the study area. All principal crops like maize, wheat, pulses, rice, barley, edible oilseeds, vegetable crops, groundnut, and mustard are the principal crops grown in the district. Although the percentage share of all these crops to the total cropped area varies from one area to another, which brings changes in crop association in the region.

**Table- 1.1 Cropping pattern (Major Food Crops of Study Region)  
1971-72 to 2000-01**

(Area in hectare)

| Y<br>E<br>A<br>R | Crop    | Rice        | Maize        | Wheat        | Barley      | Pulses      | Total |
|------------------|---------|-------------|--------------|--------------|-------------|-------------|-------|
|                  | 1971-72 | 6098(10.50) | 22197(38.40) | 18826(32.50) | 1414 (2.40) | 9311(16.20) | 57846 |
|                  | 2000-01 | 3552(6.30)  | 24421(43.60) | 23237(41.50) | 1569 (2.80) | 3225((5.80) | 56004 |

Source: *The Office of Commissioner (Revenue) H.P., Shimla*

The total area under major food crops in 1971-72 was 57846 hectares. The leading crop was maize, that has occupied 38.4 per cent of the total area under major food crops. It was followed by wheat with 32.5 per cent and pulses 16.2 percent. Rice was only fourth in order to importance, having occupied just 10.50 per cent of the total area under major food crops. Apart from these, barley was also grown on about 2.5 per cent of the area. In 2000-01, the area under major food crops reached its lowest position of 56004 hectares, out of which 43.6 per cent of the area was devoted to maize. Wheat has been the second most important crop, occupying an area of 23237 hectares (41.50 per cent). The area under barley has declined both in proportion and absolute terms. The area under pulses has declined all through right from 1971-72. In 2000-01 the area under pulses declined to just 3225 hectares, which comes to only 5.8 per cent of the total area.

Due to the modern inputs in the agriculture sector, food grain production increased from 63283 metric tons in 1987-88 to 66570 metric tons in 2000-01 (Anonymous, 2000-01). The production under vegetable and cash crops has also shown an increasing trend. The cash crop such as sugarcane is also grown in Nalagarh tehsil. Potato is a commercial crop in Kandaghat tehsil mainly. The district produced 1457 tons of potato during 2001-02. Apart from this, the other vegetable cultivation has also taken a boost. Tomato has given an immense rise in the income of unemployed educated youths and the economy of the study region. The record production of 27824 metric tons of these popular crops has been achieved during 2001. Thus, in the beginning, agriculture in the study region was not only subsistence and rudimentary in nature but also was low productive. But at present, the use of modern technology and improved agricultural seeds and other innovations in this sector has considerably increased agricultural production and market surpluses, which is contributing to the state's economy. In 2001, the income of 6747.71 lakh rupees was received from the agriculture sector of the economy in the district (Statistical Abstract of Solan District, 2001).

### **Impacts of natural and sustainable farming on soil health and biodiversity**

#### **Transitioning from intensive chemical farming**

Field study of the study region reveals that natural and sustainable agriculture practices in the study region serve as a critical framework in restoring the mountain biodiversity and fragile ecosystem functions which have been heavily degraded by conventional and modern intensive farming. Historically, Solan's position across the sub-tropical low hills and sub-temperate mid-hills made it

an ideal hub for off-season vegetable production such as high-value tomatoes, capsicum, peas and cauliflower. These crops of modern intensive farming—characterised by heavy reliance on hybrid seeds, intensive synthetic fertilisers, and harsh chemical pesticides—highly degraded the region's steep terraced soils. Moving away from these high-cost synthetic inputs and transitioning toward natural ecological processes, actively promoted through state initiatives like the *Prakritik Kheti Khushhal Kisan Yojana* this transition is significantly enhancing the soil health of the region.

### **Core ecological practices and soil enrichment**

The use of pesticides in the study region has increased more than four times from 6.566 metric tonnes in 1977 to 28.65 metric tonnes in 1990-91. Similarly, the consumption of fertilisers reached 2396 metric tonnes in 2001, which was only 707 metric tonnes in 1976-77 (Statistical Abstract of Solan District 1971-72, 2000-01). The chemical fertilisers also deteriorate the quality of our ecology and environment by polluting soils, water and plant in one hand and the health of human beings and other living organisms on the other that directly or indirectly consume them. But by adopting and integrating natural and sustainable agriculture practices like crop rotation, crop diversification, traditional patterns of cover cropping and an increase in organic inputs, we not only protect our ecology, environment and human health but also foster a strong soil microbiome by improving soil organic matter. Soil conservation with biodiversity preservation through these agricultural practices not only produces good quality food grains but also fortifies the agricultural landscape of the region against climate change.

### **Crop area and yield dynamics and economic viability in the region**

The crop yield of major cash crops like tomatoes, capsicum, peas, potato, ginger, sugarcane, garlic and cauliflower increased manifold due to commercialisation of agriculture, in which capital is used for the purchase of machinery, fertilisers, insecticides, pesticides, herbicides, improved plants, and many other technological innovations (Anderson, 1970). In other words, changing the traditional subsistence economy into a market-oriented economy. With the adoption of new innovative farming techniques and high-yielding varieties of seeds, the study region has moved rapidly towards vegetable and cash crops; the area under potato, sugarcane and ginger has increased from 694 hectares in 1973-74 to 867 hectares during the year 2000-01. But in the recent past, tomatoes have been taken up in a big way throughout the district; the area under this crop increased rapidly in recent past, it was 1877 hectares in 1997-98 but recorded 2542 hectares in 2001, while the production has increased to the level of 27824 metric tonnes during the year 2001. It was due to these cash crops that the irrigated area of the district, which was 94612 hectares in 1972-73 which increased to 123656 hectares by the year 200-01. In the study region, food grain production, which was about 56500 metric tonnes in 1981-82, reached 63283 metric tonnes in 1987-88 and further increased to 67146 metric tonnes by the year 2000-01 (Statistical Abstract of Solan District, 1981 and 2001).

To eradicate chemicals from the agriculture sector, the sustainable shift under initiatives like the state's *Prakritik Kheti Khushhal Kisan Yojana*, farmers are swapping chemical inputs for locally sourced, low-cost alternatives like

Jeevamrit (cow dung/urine formulations). It has been evidenced by the farmers of the study region that vegetable-based natural farming cropping systems, e.g. intercropping of tomato, Bean, and cucumber, yield up to 15 -20 per cent higher net returns, as these natural products get a high price in the market and the cost of production drops drastically.

**Socio- economic barriers in the adoption of natural and sustainable agriculture**

Adopting natural and sustainable agriculture requires overcoming deep-rooted socio-economic barriers that heavily influence a farmer’s capacity to transition. People’s perception regarding the socio-economic barriers reveals that people of the study region are facing various hurdles while adopting the natural and sustainable agricultural practices. The major barriers identified by them are chemical dependency habit, Transition Risk, labour crisis, and Lack of indigenous seeds. Table 1.2 represents the people’s (farmers’) perception of these socio- economic barriers of the study region

**Table-1.2 Socio-Economic Barriers in the adoption of Natural and sustainable agriculture: A Peoples’ (Farmers) View Points**

| Sr. No. | Opinion Regarding Socio-Economic Barriers | Total No. of Respondents | Per cent of Respondents |            |
|---------|-------------------------------------------|--------------------------|-------------------------|------------|
|         |                                           |                          | Agreed                  | Not Agreed |
| 1       | Chemical Dependency Habits                | 340                      | 90.7                    | 9.3        |
| 2       | Transition Risk                           | 340                      | 70.4                    | 29.6       |
| 3       | Labour Crises                             | 340                      | 80.9                    | 19.1       |
| 4       | Cattle Crises                             | 340                      | 87.3                    | 12.7       |
| 5       | Lack of indigenous seeds                  | 340                      | 83.6                    | 16.4       |

Source: Based on Field Survey, 2025-26

The table reveals that the chemical dependency habit has the highest agreement rate at 90.70 per cent of farmers. This strongly highlights that the habit of using chemical fertilisers is perceived as a massive hurdle to adopting natural agriculture. However, about 9.30 per cent of respondents do not agree with this opinion. Cattle crises have been reported by more than 87 per cent of respondents, as natural and sustainable agriculture heavily relies on livestock for manure, organic compost and bio-formulations. The shortage of rearing directly affects a farmer’s ability to switch systems. Solan has experienced rapid urbanisation and industrial growth, which has drawn youth away from agriculture. Because most of the farming households are nuclear, they rely on hired migrant labour. The cash saved by not buying chemical fertilisers is frequently wiped out by the increased cost of hiring manual labour to manage natural fields, it is evidenced by 80.90 percent respondent. A lack of indigenous seeds is widely recognised as a prominent socio- economic barrier by more than 80.00 per cent of the respondents. Whereas the challenges faced during the conversion period from chemical to organic farming have the lowest agreement of 70.4 per cent relative to the other while nearly 30 per cent of the respondents did not view it as a barrier.

## Findings of the study

- **Massive surge in Chemical Dependency in Conventional agriculture and environmental degradation:** The use of pesticides increase four time, jumping from 6.566 metric tonnes in 1977 to 28.65 metric tonnes by 1990-91. Fertiliser consumption similarly increased, reaching 2396 metric tonnes compared to just 707 metric tonnes in 1976-77. This heavy reliance has actively degraded soil health, polluted water and air and severely compromised local biodiversity and environment.
- **A significant shift toward commercial cash crops:** The region has progressively transitioned away from traditional subsistence grains toward high-value commercial crops like tomatoes, capsicum, peas, ginger, beans, cucumber, garlic, etc.
- **Decline in traditional food grains area:** While the cash crop grew, the land allocation for primarily food grain shrank or concentrated significantly during the study period. Pulses saw a sharp drop in area from 16.20 per cent of total area down to just 5.80 per cent. Conversely, maize and wheat remained highly dominant, together locking down over 85.00 per cent of major food crop area during the study period.
- **Severe Socio- economic barriers to sustainable farming adoption:** Through a field survey, the study quantified the exact friction points, i.e. chemical habits, cattle crises, lack of indigenous seeds, labour shortage and transition risk are major hurdles preventing farmers from shifting to sustainable natural farming practices like Prakritik Kheti Khushhal Kisan Yojana.
- **Eco- friendly practices effectively lowering the input costs at a localised level:** To eradicate chemicals from the agriculture sector, the sustainable shift under initiatives like the state's Prakritik Kheti Khushhal Kisan Yojana, farmers are swapping chemical inputs for locally sourced, low-cost alternatives like Jeevamrit (cow dung/urine formulations). It has been evidenced by the farmers of the study region that vegetable-based natural farming cropping systems, e.g. intercropping of tomato, beans, and cucumber, yield up to 15 -20 per cent higher net returns as these natural products get high prices in the market and the cost of production drops drastically.

## LIMITATIONS OF THE STUDY

- The study is geographically confined to selected areas of Solan district, Himachal Pradesh; therefore, the findings may not be fully generalisable to other districts or agro-climatic regions.
- The analysis is primarily based on cross-sectional field survey data and secondary sources, which may not fully capture long-term changes in farmers' behaviour and the sustainability outcomes of natural farming.
- The study focuses mainly on the transition from conventional to natural farming and does not include a detailed comparative economic analysis of all major cropping systems over multiple years.

- Responses collected from farmers are based on personal experiences and perceptions, which may be subject to recall bias or respondent bias.
- Environmental indicators such as soil fertility, biodiversity, water quality, and carbon sequestration were assessed using secondary information rather than direct scientific measurements.
- The study does not examine the long-term market performance, consumer demand, certification processes, or export potential of naturally produced agricultural commodities.
- Institutional aspects such as policy implementation efficiency, extension services, and supply-chain infrastructure were analysed only from the farmers' perspective and not from government or market stakeholders.
- Time and resource constraints limited the sample size and the inclusion of a broader range of stakeholders, such as input suppliers, traders, consumers, and agricultural extension officials.

## CONCLUSIONS

The transition from conventional chemical-intensive farming to natural and sustainable agricultural practices represents a vital evolutionary step for ensuring long-term food security, ecological balance, and climate resilience in the Solan district of Himachal Pradesh. Historically, the region capitalised on green revolution technologies. This shift triggered a commercial boom, particularly through off-season vegetable cultivation, where crop yields like tomatoes, capsicum, peas and cucumber expanded exponentially. However, this intensive paradigm came at a steep environmental cost. The heavy reliance on synthetic inputs caused critical degradation of soil health, compromised regional biodiversity and poisoned local micro-biomes, ultimately threatening the core ecosystem functions that sustain agrarian productivity. To counter these ecological hazards, state-led initiatives like the Prakritik Kheti Khushhal Kisan Yojana have effectively demonstrated that integrating traditional ecological knowledge with low-cost, locally sourced natural alternatives, such as Jeevamrit, can rejuvenate degraded soil health and solidify crops against climate anomalies. Furthermore, advanced traditional practices such as multi-cropping and intercropping have proven successful in optimising land use and maximising net returns during the transitional phase. Nevertheless, widespread institutional adoption faces deeply rooted socio-economic, structural and infrastructural barriers. Chief among these hurdles is a profound chemical dependency habit, transition risk, labour and cattle crises linked to the shortage of livestock needed to generate organic materials. Ultimately, the study demonstrates that natural agriculture cannot succeed in a vacuum or through fragmented area-wise implementation alone. To bridge the gap between ecological necessity and economic viability, the state must implement targeted interventions. Mitigating these systematic vulnerabilities requires strong infrastructural support- including subsidised labour-saving technologies, a streamlined organic material supply chain, indigenous seeds and a minimum support price for all-natural produce. Balancing Solan's commercial edge with traditional ecological safeguards offers the most reliable pathway toward long-term, equitable and climate-resilient food security.

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