NABARD RESEARCH STUDY - 48

NABARD

Documenting Cases of Successful Farmers Adopting Indigenous, Climate Resilient and Sustainable Farming Practices in India

Xavier Institute of Management, XIM University, Bhubaneshwar

आर्थिक विश्लेषण एवं अनुसंधान विभाग
Department of Economic Analysis & Research

राष्ट्रीय कृषि और ग्रामीण विकास बैंक, मुंबई
National Bank for Agriculture and Rural Development, Mumbai

2024

Documenting cases of successful farmers adopting indigenous, climate resilient and farming practices in India

Research and Development Project funded by NABARD

Submitted by

Prof. Amar KJR Nayak
Xavier Institute of Management,
XIM University, Bhubaneshwar

Documenting cases of successful farmers adopting indigenous, climate resilient and farming practices in India

About NABARD Research Study Series

The NABARD Research Study Series has been started to enable wider dissemination of research conducted/sponsored by NABARD on the thrust areas of Agriculture and Rural Development among researchers and stakeholders. The study titled 'Documenting Cases of Successful Farmers adopting indigenous, climate resilient and farming practices in India' completed by XIM University, Bhubaneshwar is the forty-eighth in the series.

In recent years, the effect of climate change has become increasingly apparent, posing significant challenges to agricultural practices worldwide. In India, where agriculture remains a cornerstone of the economy and livelihood for millions, integrating traditional knowledge with modern techniques presents an opportunity of learning from the past to build a more resilient and sustainable future for agriculture in India and beyond.

This study explores the experience of 25 farmers across 15 states of India who have successfully adopted indigenous and climate- resilient techniques to not only sustain but enhance their productivity in the face of changing climatic conditions. In presenting these cases, the study attempts to understand the sustainability features of traditional indigenous farming systems in the context of farmers, farming systems, and ecosystems regarding their financial viability, technical relevance, and climate resilience.

Hope this report would make a good reading and help in generating debate on issues of policy relevance. Let us know your feedback.

Kuldeep Singh
Chief General Manager
Department of Economic Analysis and Research

DISCLAIMER

This study has been supported by the National Bank for Agriculture and Rural Development (NABARD) under its Research and Development (R&D) Fund.

Content

List of Figures

List of Tables

Acknowledgments

I want to thank the Department of Economic Analysis and Research (DEAR), NABARD Mumbai, Xavier Institute of Management, XIM University Bhubaneswar, for kindly facilitating this vital research.

First, we would especially like to highlight the regular support and feedback provided by Shri Kuldeep Singh, Chief General Manager, NABARD and his colleagues including Dr. Ashutosh Kumar, General Manager, Dr. Sohan Premi, Deputy General Manager and Ms. Anshumala, Assistant Manager. I thank Shri P V S Suryakumar, former Managing Director at NABARD, for exploring whether ecological farming can be financially viable and technically regenerative for farmers in India. Second, I thank Dr. K.C. Badatya, Chief General Manager, DEAR NABARD, and Dr. KJ Satyasai, former Chief General Manager, DEAR, for their kind support for this research. Third, I also thank the Chief General Managers of different states and their support teams for kindly facilitating the field visits whenever requested.

I also thank the Vice Chancellor, Prof. Dr. Antony R. Uvari, SJ, for his kind approval to undertake this study. I also thank Fr. S Antony Raj, SJ, Registrar and Chief Finance Officer, Prof. Dr. Arokiyadass, SJ, and his Team at XIM University for supporting this study.

I want to thank all the farmers who spared their valuable time working diligently to provide the details on their respective farms' various expenditures and incomes. Given the stickiness of complex farm production, post-harvest activities, storage, and marketing activities in each crop, it is challenging for a farmer to combine all costs and income. In the above context, I express my most profound appreciation to the farmers who spared their time, trusted in me, and shared details of their farming practices' expenditure, income, and technicalities.

I also thank the reviewers for their systematic review of this report. The review process improved the overall quality and presentation of the report.

Amar KJR Nayak
Principal Investigator

15th September 2024

Executive Summary

The study indicates that ecological (indigenous+) farming practices improve ecosystem services by balancing the five critical factors of agricultural production, i.e., Jal (water), Jamin (land - soil health), jungle (forest - ecology), + farm diversity and indigenous seeds (genetically stable genetic materials). As a farm gets closer to balancing these five ecological factors of production, the regenerative production cycles are initiated, and farm ecosystem services improve. In turn, they have led to higher yield, more significant total production of the farm, regularity in farm production from diverse produce, including seasonal field crops, and all-through-the-year farm produce (vegetables, fruits, different outputs from on-farm livestock including milk and egg).

The study shows that farmers adopting ecological (indigenous+) farming practices show good financial performance. For all the 25 sample farmers operating in better to worse ecologically balanced agroecological systems, the average net income per hectare per month is Rs. 28,970. This figure for net income is nearly three times that of the national average net income of farmers in India.

Variations in their net income have been observed depending on how the five ecological (indigenous +) factors have been adopted and the ecological balance achieved by the sample farmers. For the first set of 15 farmers who have greater ecological balance on their respective farms, the estimated average net monthly income per hectare is INR 39,147, whereas it is only INR 13,704 for the second set of 10 farmers whose farms are still in different stages of ecological balance. From the sample cases, the farmer with the highest net monthly income per hectare is INR 79,274. Most importantly, the study on ecological (indigenous+) farming practices provides a potential clue at a smallholder farm level to resolving the impending climate crises that India and the World face today.

The purpose of the all-India case study of farmers adopting indigenous climate resilient and sustainable farming practices was to understand and document the (a) financial viability of such farmers in short and medium terms, (b) how balancing critical factors of production of this indigenous system increase farm productivity in the long term, and (c) contribution of this indigenous system towards ecosystem services and climate resilience at the farmer field level.

The study provided a perfect triangulation of findings on the science and performance of this farming system, along with previous DEAR-NABARD-supported studies and action research on the subject. From the field observations, it can be inferred that the financial performance of farmers depended on the degree of balancing the critical agricultural production factors by a farmer. Balancing the critical factors improved the ecosystem services in a farm, which reduced the farm's cost and performance in terms of quality, yield, and total harvest. The study provides insight into future agriculture policy, programme execution methods, and agriculture research to empower farmers, make agriculture resilient to increasing climate changes, and help reduce the demand for growing government subsidies.

Objectives of the Study

- To understand the sustainability features of traditional indigenous farming systems in the context of farmers, farming systems, and ecosystems regarding their financial viability, technical relevance, and climate resilience.

- To scientifically document the cases of farmers adopting the traditional indigenous methods with specific reference to their financial viability in terms of increase in net incomes (short term), increase in farm productivity through better farming techniques (long term), and climate resilience through better ecosystem services (sustainability or inter-generational terms).

Design of Study & Methodology

The proposed study followed the Case Research methodology. A detailed contextual analysis of selected farmers was undertaken as part of this methodology. The data collection methods included detailed interviews with farmers, their family members, and other neighboring, physical visits to respective farms, soil sample collection in some cases, and systematic documentation of their expenditure at different stages of farming and income from different produce from the respective farms. Finally, the net income per hectare per month was estimated for each of the selected 25 farmers of the study.

A comparison of these sampled farmers was undertaken to understand the effect of the degree of adoption of the five design variables of the ecological (indigenous +) farming system on the net income of farmers. A comparative analysis of the net incomes of these sampled farmers with those of farmers adopting mainstream farming using fertilizers and pesticides in respective states was undertaken to understand the differences. Recommendations on policy, execution, and research were based on these findings.

Critical Factors of Production & Proposition of the Study:

Factors of Production: The Indigenous farming systems are known for three key factors: jal (water), jungle (forest-farm ecology), and Jamin (land-soil). The above three factors and two additional factors, i.e., farm diversity and indigenous seed, were incorporated in this study based on our previous action research on sustainable agriculture. Accordingly, the critical production factors of the study included moisture/water source, soil health, genetic stability of seed & livestock, farm diversity, and farm forestry/ecology.

More specifically, the critical variables of investigation in this study included (a) whether soil moisture is retained through in-situ water harvesting or obtained from an external source, (b) whether the soil system is developed through organic matter and on-farm diverse biomass that enables microbial activity in the soil, (c) whether seeds and livestock are indigenous, and (d) whether sample farmers adopted diversified farming including a large number of fruit trees, a variety season-based field crops well integrated with livestock on the farm, and (e) whether deep farm forestry with perennial forest and fruits trees around the farm was being maintained. By incorporating two

additional factors and specifying the nature of five factors through the clear variables above, this indigenous farming system may be termed an ecological (indigenous +) climate-resilient farming system.

The proposition of the Study: The dynamic interactions of the critical factors of production manifest in making agriculture sustainable or unsustainable. The study proposed that regenerative cycles will be initiated as a farmer picks up the ecological (indigenous +) climate-resilient farming system variables and the ecosystem services improve on the farm. With improved ecosystem services, the farm has a higher yield and more production, making the farmer financially better off. In addition, the diversity of farm production helps farmers deal better with market risk, especially on prices. It also ensures regularity in income for a farmer every month.

Sampling

Cases of farmers were sampled across the different states of India. The sampling ensured the representation of different economic, social, environmental, geographic, and institutional contexts in India. Some of these farmers were selected from the verified list of farmers from the previous case study of natural farming undertaken by DEAR-NABARD, a few were obtained through the reference of the NABARD regional offices in respective states, a few from Andhra Pradesh (SERP-Zero Budget Natural Farming, now renamed as CMNF - Community Managed Natural Farming) from the list provided by the state department and a few were through the network of organic farmers in respective regions.

Based on the review and suggestions, farmers selected were from the nineteen (19) Indian states, i.e., Gujarat, Andhra Pradesh, Odisha, Punjab, Maharashtra, Karnataka, Madhya Pradesh, Kerala, Nagaland, Bihar, Uttar Pradesh, Tamil Nadu, Pondicherry, Rajasthan, Jammu & Kashmir, Chhattisgarh, Haryana, Jharkhand, & West Bengal. Finally, based on field visits and verifications, twenty-five cases from fifteen (15) states nationwide were systematically selected. The list of farmers (sample) is provided in this section below.

Major Findings & Observations

The significant findings and observations are provided in three critical and interrelated aspects, i.e., (a) Improvement in ecosystem services of a farm while adopting an ecological (indigenous+) farming system, (b) Reduction in Climate risk and Market risk – With improvements in organic carbon, on-farm water conservation & its harvest, on-farm manure, and biomass production, the ecosystem services improves in the farm. With increased diversity on a farm, pest attacks are reduced, reducing the cost of pest management. With better balancing of the five factors of production, ecosystem services improve, enhancing the ability of farmers to minimize climate risk and market risk, and (c) Increase in financial performance and regularity in the income of farmers with greater immersion in this system of ecological (indigenous+) farming system.

Improvement in Ecosystem Services

It was observed that the sample of farmers from different geographies across India had different levels of ecological (indigenous+) farming systems. Farmers who incorporated most of the five

factors had better ecological balance and ecosystem services. Farms with systematic soil improvement efforts improved soil organic carbon. In turn, it increases moisture retention capacity or water holding capacity. Such farmers had a water supply throughout the year. Additionally, some farmers had regular water supply from external sources.

Farms with many trees (ecology) on and outside the farm had lower temperatures and could stabilize the micro-climate within the farm, providing a safe environment for honeybees, butterflies, and other flies that improved the pollination rates. On trees outside the farm area, most ecological farmers systematically planted trees around their farms. A few others had the natural endowment of the region, like farmers like Farmer Case Study 12 of Nagaland and Farmer Case Study 19 of Odisha. However, some farmers, such as Farmer Case Study 25 of Odisha and Farmer Case Study 18 of Bihar, have neither natural endowments nor knowledge or community support for maintaining tree cover in their respective areas.

Farms with greater farm diversity enhanced biomass production on the farm. It helped protect the micro life below and above the soil on the farm and produced more biomass for the livestock on the farm. This also helped farmers to produce crops throughout the year and get regular income from the farm. Depending on how each farmer had balanced all the five factors of production, the degree of ecosystem service was available to the farmers. In each case, the ecosystem service situation is mentioned. All farmers with high monthly incomes per hectare exhibit better balancing of the factors of production and have facilitated better ecosystem services. Farmers such as Farmer Case Study 1 from Maharashtra, Farmer Case Study 2 from Rajasthan, Farmer Case Study 3 from UP, Farmer Case Study 13 from Gujarat, Farmer Case Study 6 from Karnataka, Farmer Case Study 14 from Madhya Pradesh illustrate this well. The last five farmers in this list with lower net incomes, viz., Farmer Case 21, Farmer Case 22, Farmer Case 23, Farmer Case 24, and Farmer Case 25, their farms are a little far from the balance required.

However, it is to be noted that balancing the production variables simultaneously requires understanding and time. Maintaining this balance is dynamic and requires deep engagement, expertise, and skills. Farm expenses per hectare can rise early in this balancing act. However, as these variables reach near balance, the expenses decrease, the yield increases, and the farmer's net income per hectare per month increases.

Reduction in Climate risk and Market risk

From the individual case studies, it was observed that farmers with a better ecological balance on most of the factors of production had better ecosystem services, which reduced their climate risk. As mentioned above, farmers such as Farmer Case 1, Farmer Case 2, Farmer Case 3, Farmer Case 13, Farmer Case 6, and Farmer Case 14 are a few whose farms illustrate this.

While diversity in farm production contributes significantly to ecosystem services and climate resilience, it is the most critical aspect that protects farmers from climate and market risks. Diversity in farm production plans, including fruits, vegetables, cereals, pulses, spices, tubers, and a variety of livestock, facilitates the interconnectedness and interdependence in a natural circular production system. Diversity also helps the soil systems to be alive and healthy, improves in-situ water harvesting, and reduces pest problems on farms, leading to a gradual improvement in ecological balance within the farm. All these farming methods can balance the variations in rainfall, rise in

temperature, hot and dry winds (loo) flows in summer months, and balance the microclimate at the farm level. Further, even if one or two crops fail due to climate change, the diversity of the production basket of a farmer limits the risk to the farmer.

The diversity of farm production baskets is better aligned to meet the smaller quantities of supplies in the local market throughout the year. The farm produce stays fresh, nutritious, and unique to local taste. This product diversity strategy or 'economies of scope' in production keeps farm produce from commodification and risk of market price reduction due to oversupply as in the mono-cropping (strategy of economies of scale) farming system. While all the 25 farmers in this study exhibited diversity in their farming practices, the first 15 farmers exhibited a greater balance of the critical factors of production than the last 10 farmers.

Financial Performance of Farmers

The financial performance of farmers adopting ecological (indigenous+) climate-resilient farming systems seems robust. It can better handle climate risks and reduce production and market risks through a diversified farming system.

It was observed that farm performance in terms of its yield, production, and net income depended on various factors, i.e., the farmer's local context, exposure, awareness, understanding, and commitment to ecological farming. Overall, it was observed that balancing the critical factors improved the ecosystem services in a farm, which reduced the farm's cost and performance in terms of quality, yield, and total harvest. With better ecosystem services, production costs are reduced, and net income accordingly increases.

For all the 25 farmers operating in better to worse ecologically balanced agroecological systems, the average net income per hectare per month is Rs. 28,970. However, for the first set of 15 farmers who have greater ecological balance on their respective farms, the estimated average net monthly income per hectare is INR 39,147, whereas it is only INR 13,704 for the second set of 10 farmers whose farms are still in different stages of ecological balance. From the sample cases of farmers, the farmer with a higher net monthly income per hectare is INR 79,274.

The table below on the Estimated Net Income of a Farmer summarizes the diversity of produce from a farmer's field, including crops, vegetables, fruits, and livestock. The table also provides data on farm size, total net income per year, total net income per month, and estimated net income per month per hectare of land of all 25 sampled farmers.

Estimated Net Incomes of Farmers

Sl. No.	Name of the State	Name of Farmers	Production Diversity of the Farmer	Farm Size (In Hectare)	Year of Farm Data	Total Net Income per Year (In INR)	Net Income per month (in INR)	Net Income per month per Hectare (in INR)
1	Maharashtra	Case Study 1	Toor, Methi, Coriander, Haldi (Turmeric), Pumpkin, Palak, Fruits, Vegetables, Wheat, Livestock, Milk, etc.,	5.12	2021-22	4870600	405883	79,274
2	Rajasthan	Case Study 2	Milk, Fruits, Vegetables, Ducks, Field crops, Value addition on Farm, etc.	18.21	2021-22	11667896	972325	53,395
3	Uttar Pradesh	Case Study 3	Paddy, Spices, Sugar Cane, Turmeric, Mango, Fruits, Livestock of cows, Processing units	3.00	2021-22	1613155	134430	44,810
4	Gujarat	Case Study 4	Mango, Lemon, Coconut, Amla, Jamun, Water Apple, Custard Apple, Drumstick, Ram Phal, 5 Star Fruit, Banana	0.70	2020-21	368524	30710	43,872
5	Andhra Pradesh	Case Study 5	Drumstick, Field Bean, Chrysanthemum & Crossandra	0.80	2021-22	410000	34167	42,708
6	Karnataka	Case Study 6	Vegetable Seed production, Sapling Production of Fruit Plants & Ornamental Plants, Vegetables, Tubers, Fruits, livestock, Milk, etc	2.36	2022-23	1112500	92708	40,554
7	West Bengal	Case Study 7	Paddy, vegetables, pulses, oilseeds, fruits, livestock, Fishery	0.80	2021-22	362200	30183	37,729
8	Kerala	Case Study 8	Paddy, Vegetables, Horticulture, Livestock of cows and Chicken	0.80	2021-22	344810	28734	35,918
9	Gujarat	Case Study 9	Bottle guard, Parval, Sugarcane, Halid, Guava, apple bel, Mango, Milk, etc	4.72	2021-22	1876000	156333	33,121
10	Karnataka	Case Study 10	Coconut, Ragi, fruits, spices, Timber, livestock of cows and Goats	1.60	2021-22	614933	51244	32,028
11	Punjab	Case Study 11	Wheat, Alsi, Mustard, Maize, Ragi, Haldi, Vegetables, Mango, Grapefruit, Guava, Amla, Kinu, Milk, etc	2.20	2022-23	815900	67992	30,905

12	Nagaland	Case Study 12	Paddy, potato, onion, tomato, chili, soybean, dal, cabbage, pea, beans, garlic, fruits, Livestock of cows	1.60	2022-23	565808	47151	29,469
13	Gujarat	Case Study 13	Paddy, Chickpeas, Mustard, Vegetables, Curry leaves, Coconuts, Banana, Sapota, Milk, Coconut saplings	6.07	2021-22	2059600	171633	28,276
14	Madhya Pradesh	Case Study 14	Vegetables, Fruits, Wheat, Pulses, Turmeric, Milk, etc.	2.36	2021-22	783940	65328	27,681
15	West Bengal	Case Study 15	Paddy, vegetables, pulses, oilseeds, fruits, livestock, Fishery	1.21	2021-22	398750	33229	27,462
16	Punjab	Case Study 16	Cereals, Pulses, Vegetables, Horticulture, & Livestock (cow & buffalo)	1.57	2020-21	423800	35317	22,495
17	Kerala	Case Study 17	Paddy, banana, rambhuttan fruit, arecanut, nearly 65 varieties & honey	0.78	2021-22	194675	16223	20,799
18	Bihar	Case Study 18	Paddy, Maka (Maize), Chana, Wheat, Livestock of cows, buffaloes, and Goats	1.60	2022-23	390340	32528	20,330
19	Odisha	Case Study 19	Cereals, Pulses, Vegetables, Livestock, Horticulture	2.07	2020-21	4,39,450	36621	17,691
20	Pondicherry	Case Study 20	Paddy, Ragi, vegetables, Fruits, nearly 96 varieties	4.00	2022-23	561913	46826	11,707
21	Odisha	Case Study 21	Paddy, Green Gram, Mango, Lemon	1.80	2021-22	212350	17696	9,831
22	Tamil Nadu	Case Study 22	Turmeric, banana, coconut, vegetables, Livestock of cows	3.00	2021-22	338704	28225	9,408
23	Andhra Pradesh	Case Study 23	Chili, Cotton, Leafy Vegetables	1.21	2020-21	129650	10804	8,929
24	Odisha	Case Study 24	Cereals, Pulses, Vegetables, Livestock, & Horticulture	3.93	2020-21	376300	31358	7,979
25	Odisha	Case Study 25	Cereals, Pulses, Vegetables, Spices, Livestock, Horticulture	4.72	2020-21	446001	37167	7,874

Source: Table 5.4 of this Report

Recommendations

Based on the close observations of farmers in different contexts in terms of their awareness, knowledge, and competence of ecological (indigenous farming) and their local social-ecological-institutional-organization contexts, the recommendations are suggested on (a) *Policy Formulation, (b) Policy Execution and (c) Research Support for Ecological Climate Resilient Agriculture.*

Policy Formulation

- Given the manifestations of climate change in terms of rise in temperatures, abnormal rainfall patterns, subsequent loss of biodiversity, and very high risks to agriculture and food production, both the National Government and the State Governments need to provide a clear and firm policy direction for ecological, regenerative climate resilient agriculture.
- The ecological regenerative agriculture, i.e., an improved version of our indigenous system of farming with the following features, viz., (a) moisture in farmland is retained through in-situ water harvesting method, (b) soil system is developed through organic matter and on-farm diverse biomass that enables microbial activity in the soil, (c) genetically stable seeds and livestock (indigenous or improved varieties), and (d) diversified farming including a large number of fruit trees, a variety season-based field crops well integrated with livestock on a farm, and (e) deep farm forestry with perennial forest and fruits trees around each optimally sized farm need to adopted.
- In addition to the technical challenges, Agricultural Policy also needs to address several other inter-related challenges (social, institutional, organizational): (a) poor grass cover of soil leading to poor soil health which is due to lack of moisture during summer season, (b) poor tree cover of land leading to disruption of micro-life (butterflies, different flies, honey bees, birds) above ground that impact pollination and crop yield, (c) free grazing of different livestock during January to July in many localities in India, (d) lack of genetically stable (indigenous) pool of seeds, planting materials and livestock, (e) land fragmentation and litigation with farmers having access to less than 1 hectare of land for farming, and (f) lack of coordination for production planning and marketing by individual farmers at the village and GP level.
- Formulate a Policy to promote and strengthen FPOs at the GP level such that it can facilitate in converging the various schemes of the state department and the national government for the smallholder farmers and that it can facilitate the active participation of smallholder producers with other local institutions of a GP including SHGs, FIGs, Pani Panchayats, Vana Surakhya Samitis, and Gram Panchayat Development Plan.

Program Execution

- The State Agriculture Department, RKVY, and Extension Centers need to set up a 1-hectare Ecological Farming System in each Gram Panchayat to motivate and encourage smallholder farmers to showcase its benefits & develop their confidence to adopt the techniques of Ecological Agriculture.
- Provide systematic training to farmers on the methods of Ecological - Regenerative Agricultural Systems.
- Invest in physical infrastructure for water harvesting and in-situ water conservation in every village and farmers' fields.

- Invest in fodder cultivation and cattle sheds at the farmer/village level.
- Promote natural resource management and common cattle grazing at the GP/Ward level.
- Invest in developing seed banks in every GP to promote indigenous seeds for various crops and vegetables.
- Make provisions for carbon credits for farmers adopting the ecological regenerative agricultural system for carbon sequestration in their respective ecologically regenerative climate-resilient farms.
- Promote Family Farming among small and marginal farmers to facilitate Diversity in agricultural production and timely care.
- To deal with land fragmentation and capacity to invest in ecological & climate resilient farming, promote a small farmer group of 3-5 smallholder farmers with land adjacent to each other to undertake ecological farming jointly in their 1-2 hectares of land.
- Facilitate and fund the establishment of GP-level multi-product, multi-service FPO as an institution for farmers to support farmers in adopting ecological farming and diversifying its production.

Agricultural Research

- Agricultural Universities and Research Institutions should undertake research on Ecological Agriculture that is regenerative in nature and climate resilient.
- Students, doctoral scholars, and scientists in agricultural science need to know systems science and systems dynamics in nature and agroecological systems.
- Research in System Dynamics related to key production factors of Ecological Agriculture, i.e., moisture, soil, genetic matter, diversity, and ecology, needs to be studied through field experiments and action research.
- Research on whether ecological agriculture can reduce the cost of farming in different contexts and reduce the growing burden of subsidies on the state exchequer needs to be studied.

1.0 Introduction

This Final Report provides an Executive Summary, significant findings, and recommendations based on the overall analysis and synthesis. Although the study required to compile cases of twenty (20) farmers from across India, we compiled twenty-five (25) farmers with different landholdings from as many as fifteen (15) different states within the approved budget. While each of these 25 farmers performed well in their respective localities, they provided more significant variations in the level of ecological balance in their respective farms. The variations among them helped in observing the nuances and effects of different factors of production of the ecological (indigenous+) farming system.

The individual case studies of select farmers from different regions covered three critical aspects viz., (a) technical aspects of the farming system, (b) ecosystem services of the farming system, and (c) commercial aspects of the farming system. The technical aspects of farming included land size and farmer's practice of the critical factors of the indigenous climate-resilient farming system. The ecosystem services included the complementary effect of different production factors and the balancing effect arising from dynamic interactions. The commercial aspects included the total cost of farming at different stages, revenues from different crops in different seasons or months, and the farmer's net income earned per hectare per month.

Background & Rationale

Endowed with enormous natural resources and diverse climatic conditions, India has been one of the significant sources of diverse food-producing regions in the world. With the onset of the Industrial Revolution, British colonization of India, and India's independence, agriculture in India has evolved through multiple paradigms. From indigenous diverse farming systems, Indian agriculture was led into specialized agriculture and mono-cropping during the British Raj in India. India encountered an acute food shortage in the middle of the twentieth century. However, with the application of modern science to agriculture, India successfully emerged from the food production crisis of the 1960s. Today, India is a significant producer of food items in the world. It is the largest producer of milk, pulses, and jute and ranks second largest producer of rice, wheat, sugarcane, groundnut, vegetables, fruit, and cotton. It is also one of the leading producers of spices, fish, poultry, livestock, and plantation crops (FAO, September 2022).

Despite the above praiseworthy achievements, distress among smallholder farmers and the un-viability of agriculture in the Indian context have been reported more often in the present times than before. Systematic research studies have also established this point of view (Swaminathan, 2006; Radhakrishnan R, 2007; NABARD, 2015; Satyasai KJ, 2015; Nayak AKJR *et al.*, 2015). Over the last 75 years, modern technology-based agriculture has enhanced the production of food crops, vegetables, and fruits in India. However, farmers' real net income per unit of land has gradually declined over the years. The per unit cost of farming has steadily risen, and the price of their produce has not increased commensurately. As a result, small and marginal farmers, who form over 90% of farmers in India, are indeed in a critical state. It puts Indian agriculture in a challenging situation. This phenomenon is reflected in various literature and reports from the Government of India, NSSO Reports, NABARD studies, and other studies in India. Reduction in productivity due to climate change has been experienced in recent years, which has further burdened the net income of farmers.

In the above changing and challenging context, some research suggests that the sustainability of agriculture can be achieved through systematic and scientific management of soil, seed, moisture, agricultural diversity, and local ecology. More than the external industrial inputs of fertilizers, chemicals, and pesticides, healthy soil management is the key to high yield and sustainable production (Howard 1943, 2013). Soil health is linked to the overall management of other dimensions of moisture management, seed, cropping pattern, and integration of agriculture with livestock and forestry. All these improve the micro-ecosystem, enhancing the conditions for better plant protection and agriculture (Collette & Kenmore et al., FAO 2011, Rupela 2011). Similarly, the scientific experiments in recent years in India prove the above points (Gopalakrishnan & Rupela et al. 2012, Pannerselvam 2013). Many research studies across India also conclude that agriculture's productivity and efficiency lie in sustainable agricultural practices (Shiva 1993, 2010a, 2010b, Alvares 2009, Nayak 2012, CRIDA 2012, and Nayak 2014, 2015a, 2016).

International research and studies across the world by different agencies are also building up the argument that agriculture must adopt sustainable methods by following the basic principles of bringing back life to the soil through integrated agro-ecological agricultural practices (IAASTD 2009, Third World Network 2012, and UNCTAD 2013). Several research reports from across the world argue for small-scale, diversified, and integrated methods of agriculture. These studies suggest that it would be logically flawed if 'economies of scale' were applied in agricultural ecosystems, unlike the logic of scale in industrial production systems (Nayak, 2018).

Empirically, there are several farmers (both small & large) across India who seem to have been successful and sustainable by adopting indigenous farming methods within the history of the rich, diverse farming practices in India. Interestingly, there are various types of traditional farming practices in India. Alvares (2009) captures these as different forms of organic farming. However, given their genesis in specific micro-climatic conditions, these practices have specific nuances. Accordingly, the different nomenclature of these indigenous farming systems includes Natural Farming, Natueco Farming, Bio-dynamic Farming, Permaculture, Zero Budget Farming, Spiritual Farming, Indigenous Micro Organism based farming, Organic Farming, external sustainable Agriculture, Integrated Agriculture, and Sustainable Agriculture (Nayak, 2014).

With different experiences of modern industrial agriculture and ecological (indigenous+) agriculture, many policy executives are in a dilemma on how to ensure higher yield in agriculture, ensure sufficient food production for the country, and make the smallholder farmers profitable. In the above background and policy dilemma, this case study of farmers across the country is to verify the financial viability of farmers adopting indigenous, climate-resilient, sustainable farming in terms of cost, net income, and regularity in earning by a farmer per unit hectare land.

Regularity in earnings means average net income per month. The technical on-farm practices and processes to assess the performance-viability of indigenous+ farming system include farm practices in terms of farm diversity, conditions of soil health, in-situ water availability, nature of farm inputs (in terms of seed types, source of soil nutrients, cost, and complexity of farm machinery), and status of farm ecology that enhance pollination and pest control. The study shall also include assessing the

overall systems dynamics of ecosystem services on the farm and the regenerative capacity of the farm, the farmer, and the local ecosystem.

2.0 Objectives of the Study

- To understand the sustainability features of traditional indigenous farming systems in the context of farmers, farming systems, and ecosystems regarding their financial viability, technical relevance, and climate resilience.

- To scientifically document the cases of farmers adopting the traditional indigenous methods with specific reference to their financial viability in terms of increase in net incomes (short term), increase in farm productivity through better farming techniques (long term), and climate resilience through better ecosystem services (sustainability or inter-generational terms).

3.0 Design of Study & Methodology

The proposed study followed the case research methodology. A detailed contextual analysis of selected farmers was undertaken as part of this methodology. The data collection methods included detailed interviews with farmers, their family members, and other neighboring, physical visits to respective farms, soil sample collection in some cases, and systematic documentation of their expenditure at different stages of farming and income from different produce from the respective farms.

The farmers provided their expenditure and income data in different ways. While some farmers could provide monthly income & expenditure, others could provide annual income & expenditure of their respective farming activities. Depending on their respective farm diversity, farmers had farm production only on a daily, weekly, monthly, or seasonal basis. Some daily farm produce includes milk & egg; monthly farm produce includes banana and papaya; some seasonal produce includes a variety of vegetables and fruits such as mango and chiku; and some annual produce includes field crops including different types of cereals and pulses. According to the above farm production, a farmer earns daily, monthly, seasonal, or yearly. Finally, the net income per hectare per month was estimated for each of the selected 25 farmers of the study.

A comparison of these sampled farmers was undertaken to understand the effect of the degree of adoption of the five design variables of the ecological (indigenous +) farming system on the net income of farmers. A comparative analysis of the net incomes of these sampled farmers with those of farmers adopting mainstream farming using fertilizers and pesticides in respective states was undertaken to understand the differences. Recommendations on policy, execution, and research were based on these findings.

3.1 Key Factors of Production & Proposition of the Study

Factors of Production: The Indigenous farming systems are known for three key factors: Jal (water), Jungle (forest-farm ecology), and Jamin (land-soil). The above three factors and two additional factors, i.e., Farm diversity and indigenous Seed, were incorporated in this study based on our previous action

research on sustainable agriculture. In short, the five critical factors of production included Water, Soil, Seed, Farm Diversity, and Farm Ecology, as shown in Figure 3.1

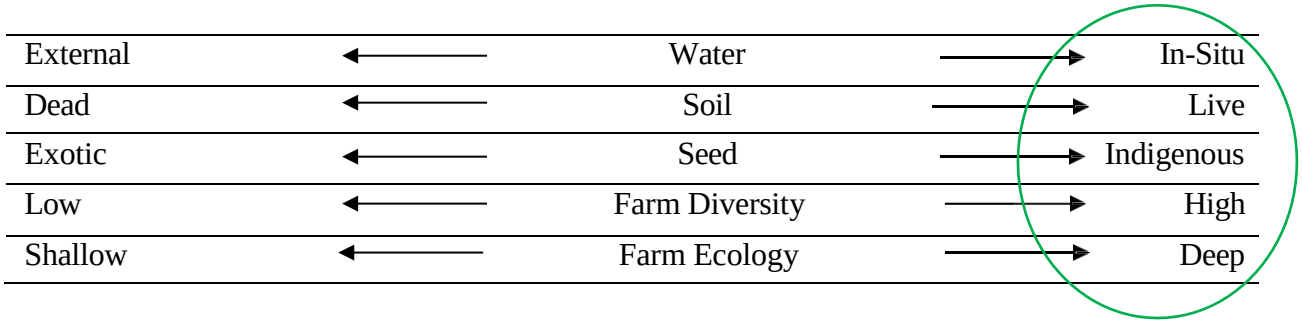


Figure 3.1: Factors of Agricultural Production

From each of the above five factors of production, a farmer may choose a specific variable of each factor, as indicated in Figure 3.1. For instance, regarding water, a farmer may choose to source water externally or create provisions for in-situ water harvesting. Similarly, on soil, a farmer may choose to use inorganic synthetic fertilizers to provide nutrition to the plant. This action makes the soil dead of the existing soil micro-organisms. On the other hand, the farmer may choose to use farmyard organic manure that improves the soil's microbial population, making the soil livelier. Similarly, the farmer could choose production variables for the other three factors from either end of the spectrum for each factor of production.

More specifically, the critical variables of investigation in this study included (a) whether soil moisture is retained through in-situ water harvesting or obtained from an external source, (b) whether the soil system is developed through organic matter and on-farm diverse biomass that enables microbial activity in the soil, (c) whether seeds and livestock are indigenous, and (d) whether sample farmers adopted diversified farming including a large number of fruit trees, a variety season-based field crops well integrated with livestock on the farm, and (e) whether deep farm forestry with perennial forest and fruits trees around the farm was being maintained. By incorporating two additional factors and specifying the nature of five factors through the clear variables above, this indigenous farming system may be termed an ecological (indigenous +) climate-resilient farming system.

The proposition of the Study: The dynamic interactions of the critical factors of production manifest in making agriculture sustainable or unsustainable. The study proposed that regenerative cycles will be initiated as a farmer picks up the ecological (indigenous +) climate-resilient farming system variables and the ecosystem services improve on the farm. With improved ecosystem services, the farm has a higher yield and more production, making the farmer financially better off. In addition, the diversity of farm production helps farmers deal better with market risk, especially on prices. It also ensures regularity in income for a farmer every month.

3.2 Sampling of Cases for Study

Cases of farmers were sampled across the different states of India. The sampling ensured the representation of different economic, social, environmental, geographic, and institutional contexts in India. Some of these farmers were selected from the verified list of farmers from the previous case study on natural farming undertaken by DEAR-NABARD, a few were obtained through the reference

of the NABARD regional offices in respective states, a few from Andhra Pradesh (SERP-Zero Budget Natural Farming, now renamed as CMNF - Community Managed Natural Farming) from the list provided by the state department and a few were through the network of organic farmers in respective regions.

Based on the review and suggestions, twenty-five cases of farmers from fifteen **(15)** states nationwide were systematically selected. The list of farmers (sample) with their respective states is provided in this section below.

Table 3.2.1 Sample Farmers for the Study

Sl. No.	Name of Farmers	Production Diversity of the Farmer	Farm Size (In Hectare)	State
1	Case Study 1	Toor, Methi, Coriander, Haldi (Turmeric), Pumpkin, Palak, Fruits, Vegetables, Wheat, Livestock, Milk, etc	5.12	Maharashtra
2	Case Study 2	Milk, Fruits, Vegetables, Ducks, Field crops, Value addition on Farm, etc.	18.21	Rajasthan
3	Case Study 3	Paddy, Spices, Sugar Cane, Turmeric, Mango, Fruits, Livestock of cows, Processing units	3.00	Uttar Pradesh
4	Case Study 4	Mango, Lemon, Coconut, Amla, Jamun, Water Apple, Custard Apple, Drumstick, Ram Phal, 5 Star Fruit, Banana	0.70	Gujarat
5	Case Study 5	Drumstick, Field Bean, Chrysanthemum & Crossandra	0.80	Andhra Pradesh
6	Case Study 6	Vegetable Seed production, Sapling Production of Fruit Plants & Ornamental Plants, Vegetables, Tubers, Fruits, livestock, Milk, etc	2.36	Karnataka
7	Case Study 7	Paddy, vegetables, pulses, oilseeds, fruits, livestock, Fishery	0.80	West Bengal
8	Case Study 8	Paddy, Vegetables, Horticulture, Livestock of cows and Chicken	0.80	Kerala
9	Case Study 9	Bottle guard, Parval, Sugarcane, Halid, Guava, apple bel, Mango, Milk, etc	4.72	Gujarat
10	Case Study 10	Coconut, Ragi, fruits, spices, Timber, livestock of cows and Goats	1.60	Karnataka
11	Case Study 11	Wheat, Alsi, Mustard, Maize, Ragi, Haldi, Vegetables, Mango, Grapefruit, Guava, Amla, Kinu, Milk, etc	2.20	Punjab

12	Case Study 12	Paddy, potato, onion, tomato, chili, soybean, dal, cabbage, pea, beans, garlic, fruits, Livestock of cows	1.60	Nagaland
13	Case Study 13	Paddy, Chickpeas, Mustard, Vegetables, Curry leaves, Coconuts, Banana, Sapota, Milk, Coconut saplings	6.07	Gujarat
14	Case Study 14	Vegetables, Fruits, Wheat, Pulses, Turmeric, Milk, etc.	2.36	Madhya Pradesh
15	Case Study 15	Paddy, vegetables, pulses, oilseeds, fruits, livestock, Fishery	1.21	West Bengal
16	Case Study 16	Cereals, Pulses, Vegetables, Horticulture, & Livestock (cow & buffalo)	1.57	Punjab
17	Case Study 17	Paddy, banana, rambhuttan fruit, arecanut, nearly 65 varieties & honey	0.78	Kerala
18	Case Study 18	Paddy, Maka (Maize), Chana, Wheat, Livestock of cows, buffaloes, and Goats	1.60	Bihar
19	Case Study 19	Cereals, Pulses, Vegetables, Livestock, Horticulture	2.07	Odisha
20	Case Study 20	Paddy, Ragi, vegetables, Fruits, nearly 96 varieties	4.00	Pondicherry
21	Case Study 21	Paddy, Green Gram, Mango, Lemon	1.80	Odisha
22	Case Study 22	Turmeric, banana, coconut, vegetables, Livestock of cows	4.00	Tamil Nadu
23	Case Study 23	Chili, Cotton, Leafy Vegetables	1.21	Andhra Pradesh
24	Case Study 24	Cereals, Pulses, Vegetables, Livestock, & Horticulture	3.93	Odisha
25	Case Study 25	Cereals, Pulses, Vegetables, Spices, Livestock, Horticulture	4.85	Odisha

The following section presents case studies of each of the selected sample farmers from across the country in order of their financial performance per unit of land per month.

4.0 Case Studies of Farmers

Case Study 1

Case Abstract

Farmer Case 1 transformative shift to natural farming in Maharashtra showcases a successful transition from conventional methods to sustainable agriculture over a 16-acre farm. His journey began with the realization that natural farming techniques significantly enhanced soil health and profitability. Farmer Case 1 reduced farming expenses and increased net income by adopting organic manure, efficient water conservation techniques, and indigenous seed varieties. His farm demonstrates high biodiversity, integrating agriculture, forestry, and livestock, contributing to a balanced ecosystem. This approach has made his farm a model of sustainability, earning recognition through awards for innovative practices. His dedication extends beyond cultivation, as he educates others through training programs on his farm, emphasizing the significance of sustainable farming practices for future generations.

District & State

Yavatmal district, situated in the southwestern part of the Wardha Painganga-Wainganga plain in Maharashtra, shares borders with Amravati and Wardha districts to the north, Chandrapur district to the east, Telangana State and Nanded district to the south, Washim and Hingoli districts to the west. In north-central Peninsular India, Maharashtra connects the northern plains with the southern peninsula. Its climate varies from continental to maritime, with the coastal Konkan districts experiencing heavy rains but mild winters and generally humid weather throughout the year. The maximum summer temperatures range between 36°C and 41°C, while winter temperatures vary from 10°C to 16°C. Rainfall begins in the first week of June, peaking in July, and varies significantly across different state regions.

Background of the Farmer & Farm

Farmer Case 1 has been in farming since 1975. As a young and inexperienced farmer, he initially practiced the traditional inorganic method of agriculture by using chemical fertilizers, pesticides, and hybrid seeds in 1978. In the beginning, chemical farming was profitable, but gradually, the cost of production rose, and farms made losses. This situation continued till 1994, when he considered nature his teacher and started natural farming. He did experiments on his land by using four bags of fertilizer in one part of the land and one bag of the same fertilizer in another. He got the exact yield from both the land. Again, he continued his experiment by using one bag of fertilizer in one part of the land and no fertilizer in another part. He also used insecticide and realized the decline in yield where insecticide was used. In the year 2000, he got a much higher yield from the field where chemical pesticides and fertilizers were not used than that of the field where these things were used. The cost of production of naturally grown fields was also significantly less. Again, Farmer Case 1 realized pesticide use caused the unnatural death of many species, like ants whose dead bodies were good for soil health when they die naturally.

Finally, in 2000, he converted his whole farming process into natural farming and named it "Sharma Naisargik Kheti Paribar." Behind his success, Farmer Case 1 points to the four critical areas: timely irrigation of farms, labor management, choice of seasonal crops, and quality of seeds. Mr. Sharma believes soil, water, and seeds are a farmer's strength. In the initial years, he planned crops based on different time frames of 60-65 days, 100 – 110 days, and 180 – 200 days to enrich soil. In this process, the residual biomass of the first crop was used as a cover crop, which decomposed into organic manure and kept the topsoil moist.

He has designed and developed a tool for contour mapping his land for adequate irrigation. The total cost of making this tool is only Rs. 400/-. This tool is made of two wooden blocks of 6 inches * 6 inches with a thickness of 2 inches each. A 6-foot-long wooden pole is fixed vertically into the center of each block, and the joint is prepared using iron strips and nails. A measuring tape is fixed on one side of each pole, starting from one foot away from the top. One 50-foot 'slab level pipe' joins the two poles. This tool helped Farmer Case 1 measure the accuracy level of his farmland.

Principle/belief: "Hard work, knowledge, and planning" are Farmer Case 1's foundations of success, and according to him, these are essential to his practice of natural-ecological farming, which significantly enhances net income multiple times.

Land use: The total land of "Farmer Case 1 Naisargik Kheti Paribar" is 16 acres. He grows crops on 13 acres; on the remaining 3 acres, he has his own house, cattle shed, and training infrastructure. Subhash Sharma has planted trees in the name of his family members, pet animals, and farm workers. He has gradually planted around a thousand tall and short trees to conserve soil and the environment and engages in growing a large variety of crops. The detailed costing and income sheets list various crops he grows. On 13 acres of land, his total cropped area in a year is about 23 acres. In any given year, he grows nearly two crops on the same patch of land.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Soil: Farmer Case 1 follows the soil treatment processes to make the soil of his farm more viable for farming activities. He applies on-farm organic manure to improve soil fertility, which has reduced his input cost. To complement his farmyard manure, he procures some cow dung from outside. He applies different quantities of organic manure per acre for various crops. He is practicing contour farming principles for an equal water flow for a given crop.

Water: He uses water from the open well on his farm to irrigate crops on his farm. He has undertaken indigenous methods like trenching around the farm with micro-locks in the farmland to conserve rainwater during the rainy season. This process also stops the wastage of rainwater. This system helps increase the groundwater level of the farmland and charges water from the open well. Hence, he is not dependent upon external sources, viz. river/canal/reservoir, to irrigate his farmland.

Seed: Generally, he uses his on-farm seeds. His on-farm seeds have reduced his farming expenses and helped him to increase his net income. Sometimes, when he cannot obtain local seeds, he also procures seeds from the market. Before seed sowing, he goes for seed treatment for better germination.

Diversity: This farm is one of the most diversified farming systems based on the copping intensity and variety of crops grown. The detailed costing and income sheets show the list of crops grown. The farm is a combination of agriculture, forest, and livestock. The cattle shed provides necessary manure (inputs) to his farm. The diversity in cropping patterns and crop rotation keeps the field green throughout the year. Besides, his farm provides regular employment to 7 families (30-35 persons) annually.

Ecology: He has grown 700 tall trees and 300 short trees in and around his farmland, which strengthens the ecology of his farmland. All these long and short trees, along with several horticulture trees, have strengthened the biodiversity of his farmland.

Ecosystem Services & Climate Resilience

Balancing the above five factors of production, viz., ecology (trees on the farm), soil health improvements, and farm diversity in field crops, horticulture plants, indigenous local seeds or genetic material, and on-farm livestock, has increased ecological balance. This balance among the key factors has improved the ecosystem services regarding organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. The relatively higher yield of the farm, despite the slight rise in temperature and rainfall variations in recent years and the increase in total production, are some indicators to mark the climate resilience of the farm.

Diversity in Farm Production & Market Resilience:

The excellent demand for farm produce from the market indicates the quality of the farm produce. Given the quality of taste and nutrition, Farmer Case 1 receives orders from many consumers for various crops before the harvest period. Regular income from the farm and a very high net income per hectare indicate the high demand and market resilience and high short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production and output from the farm for most of the year makes the farmer market resilient. He can get better prices for his product as the customer base is significant, and many are direct consumers.

Benefit to Farmer & its Impact on Other Farmers

A farmer with a master's degree in agriculture who made losses until 1994 is now a highly profitable farmer adopting a natural farming system that uses indigenous farming with improvised techniques of tree plantation, soil, water, diversity, and indigenous seeds. He has been an inspiration to many farmers across the country. He has trained hundreds of farmers, youths, and professionals from other fields on his farm and in different sites. His annual income of about INR 300,000 (please see detailed information sheet below) from training others indicates this. The total net income of the farmer is summarized below.

Estimated Net Income[*] (2021-22)

- Net Income 1 (all through year activities based) = INR 5,05,200
- Net Income 2 (seasonal crop-wise) = INR 43,65,400

- Total Annual Net Income = INR 48,70,600
- Total Area: 13 acres = 5.12 hectares
- Net Income per hectare per year = INR 9,51,289
- Net Income per hectare per month = INR 79,274

*For more details, please see the detailed information sheet below.

Detailed Information

Land Information:

Total Cultivable Land (in acres): 16

Total land used for Natural Farming/Ecological (in acres): 13

Ecosystem Services related Information of the Farm:

- Soil Test Report (Tested by Farmer)
- Organic Carbon of Farm (Date): 0.4 in 2011 and 1.8 in 2018
- Water Source (if any open well / dug well / bore well): Open well – Diameter-25 ft. and Depth – 53 ft.
- Please indicate the depth (in feet) from ground to water level in May: 25 ft in February-May.
- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): Local
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety): Local
- Type & No. of Perennial Trees in and around Farm: 700 tall trees and 300 short trees

Table 4.1.1: Net Income 1 (all through year activities based) of Farmer Case Study 1 Farm (April 2021-March 2022)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Total (in INR)
Type of Expenditure													
1. Manure (INR 2200 x 36 loads)													79200
Total													79200
Sources of Income:													
1.Milk (for home)	19200	19200	19200	19200	19200	19200	19200	19200	19200	19200	19200	19200	230400
2.Fruits & Vegetables (for home)	4500	4500	4500	4500	4500	4500	4500	4500	4500	4500	4500	4500	54000
3.Annual Income from Training													300000
Total													584400
Regular Net Income	(584400-79200)												505200

* Cost of seeds of the said farmer has been included as part of the product-wise total expenditure.

Table 4.1.2: Net Income 2 (seasonal crop-wise) of Case Study 1 Farm (April 2021-March 2022)

Name of Product 1 (with area cultivated)	Per Acre Expenditure in farming this produce & value addition	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Toor+Maize (2.5 acre)	Land preparation	3000	Toor – 600 kg Maize	Toor – INR 255 per kg	Toor: 600 kg per acre x INR 255 x 2.5 acres = 382500 Maize: INR 54000 per acre x 2.5 acres = 135000 Total: 517500
	Sowing	1200			
	Intercultural Operations[1]	12600			
	Harvesting	4200			
	Threshing (for eight[2] quintals - raw)	3600			
	Transport	700			
	Total Expenses	25300			
	Total Net Income (517500-25300)				492200

Name of Product 2 (with area cultivated)	Per Acre Expenditure in farming this produce & value addition	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Corriander (Dhania) (1 acre)	Land preparation	3000	6000	20 (Greens)	120000
	Sowing	1500			
	Intercultural Operations	14000			
	1st Harvest	12000			
	Transport	4000			
	Commission (10%)	12000			
	Total Expenses	46500			
	2nd Harvest		400	200 (Seeds)	80000
	Harvesting	1500			
	Threshing	3000			
	Manual Cleaning	8000			
	Total Expenses	12500			

[1] Intercultural Operations includes Child weeding, Dowra 1, 2, & 3, Irrigation, Removing pods by hand etc.
[2] The total quantity of harvest is 8 quintals (800 kg) which is the total raw quantity before threshing. Upon threshing and removal of chaff, the total harvest of the seed is 6 quintal (600 kg) that is available for sale.

	Total expenses (1st +2nd Harvest)	59000	Total Income	200000
	Total Net Income (200000-59000)			141000 x 1 acre = 141000

Name of Product 3 (with area cultivated)	Per Acre Expenditure in farming this produce & value addition	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Haldi (Turmeric) (3 acre)	Land preparation	3000	3300	200 (Wholesale)	660000
	Sowing	2000			
	Intercultural Operations	18700			
	Harvesting (15000 kg) @Rs.2/-/kg	30000			
	Boiling @Rs.1/kg	15000			
	Polishing @ Rs.0.8/kg	12000			
	Powdering @ Rs.20/kg	66000			
	Transport	3300			
	Manpower	2000			
	Total Expenses	152000			
	Total Net Income (660000-152000)				508000 x 3 acres = 1524000

Name of Product 4 (with area cultivated)	Per Acre Expenditure in farming this produce & value addition	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Pumpkin (6 acre)	Land preparation	3000	11000	15	165000
	Sowing	300			
	Intercultural Operations	7800			
	Harvesting	11000			
	Transport	7000			
	Commission @10%	16500			
	Total Expenses	45600			
	Total Net Income (165000-45600)				119400 x 6 acres = 716400

Name of Product 5 (with area cultivated)	Per Acre Expenditure in farming this produce & value addition	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Palak (2 acre)	Land preparation	3000	4000	30	120000
	Sowing	1200			
	Intercultural Operations	4000			
	Harvesting @ Rs.2/- per kg of 4000 kg	8000			
	Transport	2000			
	Total Expenses	18200			
	Total Net Income (120000-18200)				101800 x 2 acres = 203600

Name of Product 6 (with area cultivated)	Per Acre Expenditure in farming this produce & value addition	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Chana (2 acre)	Land preparation	3000	1200	85	102000
	Sowing	1200			
	Intercultural Operations	10700			
	Harvesting	2000			
	Threshing	3000			
	Transport (Farm to House)	500			
	Total Expenses	20400			
	Total Net Income (102000-20400)				81600 x 2 acres) = 163200

Name of Product 7 (with area cultivated)	Per Acre Expenditure in farming this produce & value addition	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Methi (Fenugreek) in	Seed from market	2000	2000	25	50000

January (1 acre)	Sowing	1000			
	Intercultural Operations	2000			
	Harvesting cost	4000			
	Transport	1000			
	Commission (10%)	5000			
	Total Expenses	15000			
	Total Net Income (50000-15000)				35000 x 1 acre = 35000

Name of Product 8 (with area cultivated)	Per Acre Expenditure in farming this produce & value addition	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Tomato (1 acre)	Land preparation	3000	25000	20	500000
	Intercultural Operations	34700			
	Harvesting cost (@ Rs.2/kg)	50000			
	Transport cost (700/1500 kg)	9000			
	Commission (10%)	50000			
	Total Expenses	146700			
	Total Net Income (500000-146700)				353300 x 1 acre = 353300

Name of Product 9 (with area cultivated)	Per Acre Expenditure in farming this produce & value addition	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Methi (Fenugreek) (in October) (1 acre)	Land preparation	3000	4000 kg	40	160000
	Sowing[3]	3500			
	Intercultural Operations	2500			
	Harvesting (Rs.2/-per kg)	8000			
	Transport	2000			
	Commission (10%)	16000			

[3] The cost of the 20 kg Methi Seed (Rs. 2000/-) has been calculated in Sowing Head.

	Total Expenses	35000			
	Total Net Income (160000-35000)				125000 x 1 acre = 125000

Name of Product 10 (with area cultivated)	Per Acre Expenditure in farming this produce & value addition	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Wheat (1 acre)	Land preparation	3000	1500	60	90000
	Sowing	1500			
	Intercultural Operations	14500			
	Harvesting	3000			
	Threshing	4500			
	Transport	1000			
	(Fodder on farm – 5000) (income)	--			
	Total Expenses	27500			
	Total Net Income (90000-27500)				62500 x 1 acre = 62500

Name of Product 11 (with area cultivated)	Per Acre Expenditure in farming this produce & value addition	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Onion (1 acre)	Land preparation	3000	25000	20	500000
	Sowing	2000			
	Intercultural Operations	20000			
	Harvesting @Rs.2/- per Kg	50000			
	Transport	11200			
	Commission @10%	50000			
	Total Expenses	136200			
	Total Net Income (500000-136200)				363800 x 1 acre = 363800

Name of Product 12 (with area cultivated)	Per Acre Expenditure in farming this produce & value addition	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Cowpea (1.5 acre)	Land preparation	3000	3000	30	90000
	Sowing[4]	5000			
	Intercultural Operations	9200			
	Harvesting cost (Rs.2/kg)	9000			
	Transport	4200			
	Commission @ 10%	9000			
	Total expenses	39400			
	Total Net Income (90000-39400)				50600 x 1.5 acre = 75900

Name of Product 13 (with area cultivated)	Per Acre Expenditure in farming this produce & value addition	Amount (in INR)	Total Harvest (in Pieces)	Avg. Sale Price per Psc (in INR)	Total Income from the Sale of this Produce (in INR)
Raddish (0.5 acre)	Land preparation	3000	80000	4	320000
	Sowing	3000			
	Intercultural Operations	13000			
	Harvesting cost	32000			
	Transport	18000			
	Commission @ 10%	32000			
	Total Expenses	101000			
	Total Net Income (320000-101000)				219000 x 0.5 acre = 109500

[4] The cost of the 5 kg Cowpea Seed (Rs. 3000/-) has been accounted as part of sowing.

Farm Photos

Case Study 2

Case Abstract

Farmer Case 2's transition to natural farming in Rajasthan embodies a holistic approach towards agriculture and livestock management over his 45-acre farm. Having pursued professional and academic paths initially, Surendra ventured into farming in 2016, incorporating a variety of crops, fruits, and dairy units into his operations. His farm exemplifies diversity in agricultural production, integrating crops like guava, mango, and dates, along with dairy farming, showcasing efficient land use for varied produce. Surendra has expanded his agricultural activities to include value addition and marketing, establishing a farmer-producer company for collective efforts in processing and selling farm products. His plans include introducing eco-tourism and ayurvedic health treatments to create a multi-functional farm that supports community wellness and education through a proposed gurukul. This case study illustrates the integration of modern entrepreneurial spirit with traditional farming wisdom, emphasizing the importance of diversification, larger community involvement, and sustainable agriculture practices.

District & State

Bhairana is a small village in the Dudu Tehsil of Jaipur District, Rajasthan. It is bordered to the north by Haryana and Sikar Districts, to the south by the Tonk District, to the west by Ajmer and Nagaur districts, and to the east by Alwar and Dausa districts. Rajasthan, the largest state in India with a geographical area of 3.42 lakh square kilometers, is located in the country's northwest. It is surrounded by Punjab, Haryana, and Uttar Pradesh to the north and northeast, Madhya Pradesh to the southeast, and Gujarat to the southwest, with an international border with Pakistan. The climate in Rajasthan is generally arid or semi-arid, with hot temperatures year-round and extreme temperatures in both summer and winter. The hottest months are May and June, and the monsoon season, from July to September, brings moderate to low rainfall.

Background of the Farmer & Farm

Farmer Case 2, an inhabitant of Bhairana village of Bichoon in Rajasthan, is a natural farming practitioner. He is cultivating various crops and fruits on his 45 acres of land. His principal farm products are Guava, mango, Khajoor (dates), Chili, Brinjal, Milk, Mousami, Chikoo, Lemon, and Ber.

While Farmer Case 2 was always interested in farming, his father guided him to study in college and take up other professional activities. After completing his master’s studies, Surendra managed a school for children's education in Jaipur, the capital city of Rajasthan.

In 2016, Farmer Case 2 bought this patch of 30 acres of land and started farming, including the dairy unit. Gradually, he expanded his activities on the farm. It is highly diversified with field crops, vegetables, horticulture, and livestock. Currently, cows, ducks, camels, and horses are part of livestock. There are nearly 200 cows, and he plans to expand it to 400 cows.

In addition to farm diversity, he has also begun value addition and marketing activities for his farm produce. Additionally, a farmer producer company has also been registered with the cooperation of local farmers to undertake collective value addition and marketing. Further, he plans to start eco-tourism and ayurvedic health treatment on his farm and start a gurukul on his farm.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Soil: His farm's soil seems quite fertile, given the rich biodiversity on the farm. The soil is primarily covered with some crops, trees, or plants. He applies organic manure prepared from cow dung to improve soil fertility. Further, he applies microbial solutions to control pest attacks. All these measures have increased his farm's natural environment, which is conducive to natural farming.

Through his dairy unit, he can produce 750 tons of bio-fertilizers, 4000 liters of bio-pesticides, and 200 tons of vermicompost per year from his farm. This manure is used on the farm and sold outside for profit.

Water: Farmer Case 2 has dug four borewells on his farmland to irrigate his farm crops. The depth of borewells is 200 ft. each. In May, the water level is 5 ft below the ground level. Further, he has dug farm ponds and erected rainwater harvesting structures that help him harvest 3.5 crore liters of rainwater. His total water requirement on the 5-hectare land of active farming is 25 lakh liters of water, equivalent to a requirement of 5 lakh liters per hectare per year.

Seed: The seeds, planting materials, and livestock are primarily of local varieties and some improved varieties. The cows are a local Gir breed; horticultural plants are obtained from the local nurseries and horticulture department. The ducks are also of the local breed.

Diversity: He has diversified his farming practices by integrating horticulture activities and animal husbandry into field crop cultivation. His animal husbandry activities include local Gir Cow, Duck, and Fishery varieties. He proposes incorporating goats, sheep, poultry, cattle, and horses. All these measures have helped him to generate revenue throughout the year.

Ecology: His farm is surrounded by various perennial trees. He has planted about 90,000 trees over the last 12 years. These include horticultural trees, biomass-generating fodder plants, and forest trees. All these perennial trees have strengthened his farm ecology and controlled the environment of his farmland. He obtains about 10 tons of green biomass per annum from the trees.

Ecosystem Services & Climate Resilience

Despite the farm being in a desert area, Farmer Case 2 has consistently planted perennial trees. Nearly 90,000 perennial trees have been planted so far. He has gradually and systematically balanced the above five factors of production: ecology (trees on the farm), soil health improvements, increase in farm diversity in field crops, horticulture plants, indigenous local seeds or genetic material, and on-farm livestock. The ecological balance among the key factors is gradually improving the ecosystem services in terms of organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. The water availability in the farm ponds in mid-summer indicates soil health, soil porosity, and farm water holding capacity. The large quantities of organic manure from the dairy unit on the farm also

increase soil health and organic carbon. The farm yield is relatively higher (production increased by 25%) despite a slight rise in temperature and rainfall variations in recent years. This result is an indicator of the farm's climate resilience.

Diversity in Farm Production & Market Resilience

The excellent demand for farm produce from the market indicates the quality of the farm produce. Given the quality in terms of taste and nutrition, the farmer receives orders from many consumers for various crops. Regular income from the farm, its bio-fertilizer processing unit, dairy unit, and various fruits and vegetables indicate high demand and market resilience. It also indicates high short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production and output from the farm for most of the year makes the farmer market resilient. He gets better prices for his product due to its organic nature and higher quality in terms of taste and nutritional value.

Benefit to the Farmer & its Impact on Other Farmers

The farmer has gained mainly from this method of farming. Farmer Case 2, with a master's degree, though interested in agriculture, worked elsewhere out of his father's desire. However, during the last 12 years, he has engaged actively in natural farming based on an indigenous system of farming using the five critical factors of production. He adopts a natural farming system that uses indigenous farming with improvised techniques of tree plantation, soil, water, diversity, and indigenous seeds. He has won several awards for his farming practices, including the Brukhya Manab National Award in 2022, which has inspired other young farmers. He plans to offer holistic training to farmers and people on his farm. He is now a highly profitable farmer. His current total net income from his farm is summarized below.

Estimated Net Income*(2021-22)

- Net Income 1 (all through year activities based) = INR 22,62,396
- Net Income 2 (seasonal crop-wise) = INR 94,05,500
- Total Annual Net Income = INR 11,667,896
- Total Area: 45 acres = 18.21 hectares
- Net Income per hectare per year = INR 6,40,741
- Net Income per hectare per month = INR 53,395

*For more details, please see below the detailed Information Sheet.

Detailed Information

Land Information:

Total Cultivable Land (in acres): 45 acres (18.21 hectares)

Total land used for Organic/Natural Farming/Ecological (in acres): 45.

Other Information:

- Soil Test Report (please attach, if available): Not done
- Organic Carbon of Farm (Date): July 2015
- Water Source (if any open well / dug well / bore well): 4 nos, Farm Pond 3.5 Crore Liter (rainwater harvesting structure)
- Please indicate the depth (in feet) from ground to water level in May: depth 200 feet, water level 5 feet.
- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): Local, Indigenous variety Vs. Hybrid, GM variety
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety): Local bred Goat, Sheep, Indigenous variety Gir Cow, Horse, camel, poultry, fisheries, Duck.

Table 4.2.1: Type & No. of Perennial & Horticulture Trees in Case Study 2 Farm

S.No.	Type	No. of Plant
1	Neem	3000
2	Sisham	200
3	Leshwa	50
4	Sahejna	6000
5	Ardoo	200
6	Sahtut	200
7	Su Babul	3000
8	Jamun	100
9	Pilkan	350
10	Thar Shobha Khejri	500
11	Hejlursen	5000
12	Bel	100
13	Mango	3000
14	Guava	200
15	Sapodilla	50
16	Mousamee	1000
7	Lemon	300
18	Alu Bhukhara	50
19	Katahal	25
20	Ber	200
21	Anwla	500
22	Anjjeer	100
23	Anaar	300
24	Khajur	100
25	Apple	50

Table 4.2.2: Net Income 1 (all through year activities based) of Case Study 2 Farm (April 2021-March 2022)

	March	April	May	June	July	Aug	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	
Type of Expenditure													**Total (in INR)**
1. Salary to working families	350000	350000	350000	350000	350000	350000	350000	350000	350000	350000	350000	350000	4200000
2. Electricity	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	80000	960000
3. Water	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	120000
4. Cow feed	842000	842000	842000	842000	842000	842000	842000	842000	842000	842000	842000	842000	10104000
5. Other Exp.	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	1200000
Total													**16584000**
Source of Income:													
1. Milk (For Home)	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	24000	288000
2.Milak (For Sale	720000	720000	720000	720000	720000	720000	720000	720000	720000	720000	720000	720000	8640000
3. Fruits (For Home)	9200	9200	9200	9200	9200	9200	9200	9200	9200	9200	9200	9200	110400
4. Fruits (For sale)	600000	600000	600000	600000	600000	600000	600000	600000	600000	600000	600000	600000	7200000
5. Vegetable (For Home)	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	90000
6. Vegetable (For Sale)	167083	167083	167083	167083	167083	167083	167083	167083	167083	167083	167083	167083	2004996
7. Organic Fertilizer	22500	22500	22500	22500	22500	22500	22500	22500	22500	22500	22500	22500	270000
8. Duck (Sale)	0	0	0	105000	0	0	0	0	0	108000	0	0	213000
9. Fish (Sale)	0	0	0	30000	0	0	0	0	0	0	0	0	30000
Total													**18846396**
Regular Net Income													**2262396**

Table 4.2.3: Net Income 2 (seasonal crop-wise) of Surendra Case Study 2 (April 2021-March 2022)

Name of Product .1	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg (in INR)	Total Income from the Sale of this Produce (in INR
Guava 1.5 acres	Name of Expense1	-	19500	45	877500
	Name of Expense2	-			
	Name of Expense3	-			
	Total	00			
	Total Net Income: 877500-00				877500

Please note that all the expenses on seasonal crop cultivation and crop harvest, value addition, and marketing are covered under Table 4.2.2.

Name of Product .2	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg (in INR)	Total Income from the Sale of this Produce (in INR
Mango 2 acres	Name of Expense1	-	7000	50	350000
	Name of Expense2	-			
	Name of Expense3	-			
	Total	00			
	Total Net Income: 350000-00				350000

Name of Product .3	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg (in INR)	Total Income from the Sale of this Produce (in INR
Chiku 0.2 acres	Name of Expense1	Total	6500	40	260000
	Name of Expense2	-			
	Name of Expense3	-			
	Total	00			
	Total Net Income: 260000-00				260000

Name of Product 4	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg (in INR)	Total Income from the Sale of this Produce (in INR
Mousami 3.35 acres	Name of Expense1:	-	65000	45	2925000
	Name of Expense2	-			
	Name of Expense3	-			
	Total	00			
	Total Net Income: 2925000-00				2925000

Name of Product .5	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg(in INR)	Total Income from the Sale of this Produce (in INR
Lemon 1acre	Name of Expense1	-	6000	50	300000
	Name of Expense2	-			
	Name of Expense3	-			
	Total	00			
	Total Net Income: 300000-00				300000
Name of Product .6	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg (in INR)	Total Income from the Sale of this Produce (in INR
Ber 1 acre	Name of Expense1	-	20000	50	1000000
	Name of Expense2	-			
	Name of Expense3	-			
	Total	00			
	Total Net Income: 1000000-00				1000000

Name of Product .7	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg (in INR)	Total Income from the Sale of this Produce (in INR
Anwla	Name of Expense1	-	20000	25	500000
	Name of Expense2	-			

1 acre	Name of Expense3	-			
	Total	00			
	Total Net Income: 500000-00				500000

Name of Product .8	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg (in INR)	Total Income from the Sale of this Produce (in INR
Anar 0.5 acre	Name of Expense1	-	15000	55	825000
	Name of Expense2	-			
	Name of Expense3	-			
	Total	00			
	Total Net Income: 825000-00				825000

Name of Product .9	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg (in INR)	Total Income from the Sale of this Produce (in INR
Khajoor 0.3 acre	Name of Expense1	-	700	40	28000
	Name of Expense2	-			
	Name of Expense3	-			
	Total	00			
	Total Net Income: 28000-00				28000

Name of Product .10	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg(in INR)	Total Income from the Sale of this Produce (in INR
Apple	Name of Expense1	-	750	60	45000
	Name of Expense2	-			
	Name of Expense3	-			
	Total	00			
	Total Net Income: 45000-00				45000

Name of Product .11	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg (in INR)	Total Income from the Sale of this Produce (in INR
Alu Bukhara 0.5 acre	Name of Expense1	-	4000	50	200000
	Name of Expense2	-			
	Name of Expense3	-			
	Total	00			
	Total Net Income: 200000-00				200000

Name of Product .12	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg (in INR)	Total Income from the Sale of this Produce (in INR
Chilly 1.5 acre	Name of Expense1	-	15000	60	900000
	Name of Expense2	-			
	Name of Expense3	-			
	Total	00			
	Total Net Income: 900000-00				900000

Name of Product .13	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg (in INR)	Total Income from the Sale of this Produce (in INR
Brinjal 0.5 acre	Name of Expense1	-	7500	50	375000
	Name of Expense2	-			
	Name of Expense3	-			
	Total	00			
	Total Net Income: 375000-00				375000

Name of Product .14	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg (in INR)	Total Income from the Sale of this Produce (in INR
Tomato	Name of Expense1	-	14000	50	700000
	Name of Expense2	-			

	Name of Expense3	-			
	Total	00			
	Total Net Income: 700000-00				700000

Name of Product 15	Different Expenditures in farming this produce & value addition, if any		Total Harvest (in Kgs)	Avg. Sale Price per kg (in INR)	Total Income from the Sale of this Produce (in INR
Ladies-finger 0.5 acre	Name of Expense1	-	2000	60	120000
	Name of Expense2	-			
	Name of Expense3	-			
	Total	00			
	Total Net Income: 120000-00				120000

Farm Photos

Case Study 3

Case Abstract

Farmer Case 3 from Uttar Pradesh embodies a remarkable journey from green revolution practices to organic farming, initiated in 1997. With a B.Sc. degree from Delhi University, he transformed his farming approach on his father's advice. His venture into organic farming, spurred by the adverse effects of conventional practices, led to his recognition with the prestigious awards. Tyagi's farm is a family endeavor involving his wife in livestock care, one son in value-addition activities, and another in marketing. Emphasizing soil health through organic manure and microbial solutions, Tyagi has maintained a fertile land without inorganic chemicals. His commitment to organic farming is a testament to its viability, showcasing a successful balance of critical agricultural production factors, leading to a sustainable and productive farming system.

District & State

The Bulandshahr District, situated in the Meerut region of Uttar Pradesh between the Ganga and Yamuna rivers, is part of the national capital region near Delhi. It is a significant grain-producing agricultural district. Uttar Pradesh, a critical Indian state, boasts the fourth-largest economy in the country. Agriculture has been a primary revenue source for its residents since ancient times and remains so today. The climate of Uttar Pradesh varies, with a dominant humid subtropical climate and dry winters. Parts of Western Uttar Pradesh have semiarid climates. Summers are sweltering, winters are cold, and the monsoon season can be very wet or dry, often leading to floods due to heavy rain.

Background of the Farmer & Farm

Farmer Case 3 lives in Behta village of Bulandshahr district in Uttar Pradesh. He has done his B.Sc. Degree from Delhi University. However, his father insisted he take up farming practices. Hence, motivated by his father’s advice, he started farming in 1980. Initially, he applied the green revolution techniques in his farming practices, but when faced with adverse consequences, he started looking for alternative farming techniques.

He searched for better knowledge in general and farming in particular. Subsequently, he came across the idea of organic farming practices and started practicing organic farming in 1997. He never looked back again. His conviction in organic farming is so deep that he has tried to involve everyone in the family in farming activities. His wife cares for the livestock: cows, feeding, and milking. One of the sons and his wife are involved in farm value-addition activities through in-house tool development and processing innovations. The other son supports the marketing of farm produce. It was encouraging to see that Mr. Bharat's grandchild wishes to take forward his grandfather's organic farming methods.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Soil: The soil of his farmland is quite fertile. He uses organic manure that has increased the microbial population of his farmland. He believes that the existence of microbial populations in farmland should not be either disturbed or destroyed as they are the key to the success of organic farming. Against this backdrop, he never applies any inorganic chemical inputs to farming. He also applies microbial solutions in his farming to control pest attacks. Two soil samples of his farmland were tested at the Soil Lab of OUAT, Bhubaneswar. The test report reveals that the Organic Carbon of the two soil samples is high.

Water: Farmer Case 3 uses water from borewells to irrigate his farm crops. In May, the water level of the bore well is 40 feet below the ground level. He uses a 7.5 HP 3 KW solar water pump to pump water from his borewell for irrigation. He irrigates his farm crops at regular intervals. He believes that watering crops often is not necessary. He also applies mulching principles after irrigation to maintain and balance the moisture in the soil.

Seed: Farmer Case 3 uses indigenous varieties of seeds for farming purposes. To him, seed is an equally important activity. Generally, he collects his seeds during the harvesting period and preserves them for the next cycle. He follows the seed sowing calendar for better germination of seeds and better growth of farm crops. Before seed sowing, he generally takes stock of the seed quality, bed preparation, environment, and temperature.

Diversity: He has diversified his farming activities by integrating horticulture activities, medicinal plants, and livestock. He follows the intercropping practices to increase the biodiversity of farmland. He focuses on the spacing factor between horticulture plants. This diversification has helped him to increase his Net Income.

Ecology: Farmer Case 3 has grown perennial trees, including a variety of mangoes, such as Chosa, Dushari, Amarapali, Langara, Gulab Jammu, Mallika, Arunima, Ramkela, and Gotau in and around his farmland. Besides, he also grown Teak, Khirmi, Melia Dubia, Bambo, Mohagani, and Kadamba. All these have strengthened his farm ecology.

Ecosystem Services & Climate Resilience

The balancing of the above five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), indigenous local seeds or genetic material and on-farm livestock has increased ecological balance. This balance among the key factors has improved the ecosystem services regarding organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. The relatively higher yield of the farm, despite a slight rise in temperature and rainfall variations in recent years and an increase in total production, are some indicators to mark the climate resilience of the farm.

Diversity in Farm Production & Market Resilience

The high quality of the farm produce ensures good demand for the produce. The farm products are in good demand locally, nationally, and internationally. The farm is certified by well-recognized organic brands. Given the quality in terms of taste and nutrition, the farmer receives orders from many consumers for various crops before the harvest period. Regularity of income from the farm and a very high net income per hectare indicate the high demand and market resilience and high short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production and output from the farm for most of the year makes the farmer market resilient. He can get better prices for his product as the customer base is significant, and many are direct consumers. Further, the systematic value-addition activities on the farm help the farmer increase the shelf life of many farm produce. The farmer is not compelled to sell all his produce as a commodity at one go to any trader, adding to his resilience to the vagaries of the market.

Benefit to Farmer & its Impact on Other Farmers

A farmer with a BSC degree from Delhi University who made losses for the first 20 years of his farming when he followed industrial farming is now a highly profitable farmer by adopting the natural farming system. He uses indigenous farming with improvised techniques of tree plantation, soil, water, diversity, and indigenous seeds. He has been an inspiration to many farmers across the country. He has trained hundreds of farmers, youth, and professionals from other fields on his farm and in other sites. His contribution to policy-making in agriculture, particularly in UP, is significant.

The current total net income of the farmer is summarized below.

Estimated Net Income*(2021-22)

- Net Income 1 (all through year activities based) = INR -7,21,845
- Net Income 2 (seasonal crop-wise) = INR 23,35,000
- Total Net Income = INR 16,13,155
- Total Area: 7.5 acres = 3 hectares
- Net Income per hectare per year = INR 5,37,718
- Net Income per hectare per month = INR 44810

*For more details, please see the detailed information sheet below.

Detailed Information

Total Cultivable Land (in acres): 7.5 acres

Total land used for Natural Farming/Ecological (in acres): 7.5

Ecosystem Services related Information of the Farm:

- Soil Test Report (please attach, if available): attached in the report
- Organic Carbon of Farm (Date): Sample 1: 1.13, Sample 2: 0.88

- Water Source (if any open well / dug well / bore well): Bore well 7.5 HP, 3 KW Solar water pumps.
- Please indicate the depth (in feet) from ground to water level in May: 40 feet
- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): Indigenous varieties.
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety): Local cow breed (20 numbers)
- Type & No. of Perennial Trees in and around Farm: Perennial trees: Mango variety - Chosa, Dushari, Amrapali, Langara, Gulab Jammu, Mallika, Arunima, Ramkela, Gotau
- Timber Plants: Teak, Khirmi, Melia Dubia, Bambo, Mohagani, Kadamba,
- Others: Drumstick, Lemon, Guava, Lemongrass

Table 4.3.1: Net Income 1 (all through year activities based) of **Case Study 3 Farm (April 2021-March 2022)**

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Total
Type of Expenditure													
1.Salary to Working families													0
i.Nursery Man - 1no	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	120000
ii.Livestock Man - 1no	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	120000
iii.Farm Workers - 2 nos	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	300000
2. Ploughing	18000	18000	18000	18000	18000	18000	18000	18000	18000	18000	18000	18000	216000
3. Electric charges													80000
4.Cow Feed													40000
5. Diesel cost (240 ltr x 89.74)	2153.76	2153.76	2153.76	2153.76	2153.76	2153.76	2153.76	2153.76	2153.76	2153.76	2153.76	2153.76	25845
Total Regular Expenses													901845
Sources of Income:													
1.Milk (for home)	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000	180000
Total Income													180000
Total Net Income	(180000-901845)												-721845

Table 4.3.2: Net Income 2 (seasonal crop-wise) of **Case Study 3 Farm (April 2021-March 2022)**

Name of Product 1 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Sugar Cane 2.25 acre	Name of Expense	00	50000 kg Sugar cane 5500 kg jaggery	60/kg	330000
		00			
	Total Net Income: 330000-00				330000

Name of Product 2 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Yellow Mustard 2.25 acre	Name of Expense	00	1300 kg mustard seed – 500-liter oil 800 kg cake	280 30	140000 24000
	Total Expenses	00			
	Total Net Income: 164000-00				164000

Name of Product 3 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Paddy 3 varieties PB – 1 Kala Namak 1121	Name of Expense	00	8000 kg paddy 2200 kg Rice	120	264000
	Total Expenses	00			
	Total Net Income: 264000-00				264000

Name of Product 4 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Turmeric as a winter crop 4.5 acre	Name of Expense	00	8000 kg seed – 1600kg powder	250	400000
	Total Expenses	00			
	Total Net Income: 400000-00				400000

Name of Product 5 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Mango 2.5 acre	Name of Expense	00	9000 kg mango		
			7000 kg as fruit	65	455000
			2000 kg as pickles	200	400000
	Total Expenses	00			
	Total Net Income: 855000-00				855000

Name of Product 6 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Livestock Cows 20 nos	Name of Expense	00	60 kg as Ghee	2200	132000
	Total Expenses	00			
	Total Net Income: 132000-00				132000

Name of Product 7 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Horticulture & Medicinal Plants Nursery	Name of Expense	00	Mango – 500	80	40000
			Medicinal – 6000	15	90000
			Lemongrass – 10000	1	10000
	Total Expenses	00	Guava - 1000	50	50000
	Total Net Income: 190000-00				190000

Farm Photos

Case Study 4

Case Abstract

Farmer Case 4, a farmer from Surat, Gujarat, transitioned to natural farming on his 1.75-acre farm after experiencing significant losses in his Gerbera flower business due to high costs and reliance on chemical inputs. His journey to natural farming began in 2017, inspired by organic farming advocates. The farm, designed like an orchard, is a model of diversity with mango, lemon, coconut, amla, and various vegetable cultivations. It also serves as a training site for visitors interested in natural farming. Manohar's approach focuses on balancing critical production factors like soil health, water conservation, and seed quality, which underscores the potential of natural farming to sustain livelihoods while promoting ecological balance.

District and State

Surat, located in Gujarat in western India, is a vibrant city with rapid growth fuelled by immigration from various parts of Gujarat and other states. Gujarat is a state along India's western coast, with its longest coastline, primarily on the Kathiawar Peninsula. It is the fifth-largest Indian state by area, covering 196,024 km², and the ninth-most populous, with 60.4 million residents as of 2011. Gujarat's climate varies, with its plains experiencing hot, humid summers and cold, dry winters, while the hilly regions and coastal areas have milder summers. Winter daytime temperatures average around 29 °C (84 °F) and drop to about 12 °C (54 °F) at night. During summer, daytime temperatures can reach 49 °C (120 °F), with nights not falling below 30 °C (86 °F). The monsoon season runs from June to September, and most of Gujarat receives scant rainfall.

Background of the Farmer & Farm

Farmer Case 4 is a resident of Surat. He had owned a furniture business before getting into farming. Subsequently, he expanded his business to Gerbera Flower (G. Jamesonii). He and other farmers entered this business and started selling their flowers in Delhi and other Metros. The flowers were grown using the modern poly-house method using bank loans. The high cost of farming in this method using chemical fertilizers and pesticides and losses in this flower business increased his loan burden soon. He had incurred huge losses, and the loan outstanding in the bank amounted to INR 30 lakhs. Then, he sold his land for INR 45 lakhs to pay off the bank and wound up his flower business.

After this shocking experience, he attended the talk of organic farmers such as Late Deepak Suchde and Mr. Subhas Palekar. Being convinced of the problem of his past farming practice, he entered the field of natural farming and started practicing natural farming on his leftover 1.75 acres of land in 2017. He has grown several horticulture plants on his farm, like mango, lemon, coconut, amla, jamun, water apple, custard apple, drumstick, ram phal, 5-star fruit, and banana. Besides, he is also cultivating different types of vegetables, viz. brinjal, tomato, ladies' finger, pinwale etc. This natural farming has sustained his livelihood.

Overall Land use pattern: A total land of 1.75 acres has been designed like an orchard with several fruit trees. Bananas are the main fruit tree. Mango, Guava, and drumsticks are other fruit and vegetable-bearing trees in larger numbers. Since the farm is relatively young, sufficient empty spaces exist for growing vegetables. The farm is also designed as a training unit so visitors can get a proper field visit.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Moisture (in-situ water harvest conservation) **management**

Farmer Case 4 uses canal water for irrigation purposes. He has not developed any indigenous measures like open wells/bore wells to irrigate his farmland's farm crops. He uses a motor pump to lift water from the canal for irrigation purposes, for which he spends about Rs.3833/- annually on electric charges.

Farm forestry (ecology & biomass)

The farm has about 30 perennial trees viz: Karanja, Peepal, Neem etc., in and around this 1.75-acre farm. The horticulture trees and plants within the farm largely contribute to the ecology of this farm. The farmer has also not been trained on the need for good farm forestry around the farm for various ecosystem services for the farm and adjacent farms. Though the challenge for this piece of land is that the farm size is less than a hectare, there is less space for planting forest species around and inside the farm, so the farm's ecology can be strengthened.

Soil Health

The farmer applies compost on his farmland to make the soil fertile. During the monsoon, he applies much of a microbial-rich solution (Jeev Amrut) to 1000-1200 liters per month as this can get better incorporated in the soil than in summer due to insufficient water. Despite these limitations, the soil of this farm looked quite fertile. The farmer spends about INR 25,500 annually on land preparation and retaining soil health, which includes the cost of power tiller, fuel, and maintenance.

The soil of his farmland was collected and given at OUAT Bhubaneswar for laboratory testing, which revealed that the soil's pH level was 7.14 and the organic carbon was 0.58. The microbial activity in his farmland is adequate.

Seeds-sampling-livestock (genetic material composition)

The farmer prefers to use local seeds for farming purposes. He argues that local seeds can survive in local agroclimatic conditions. Further, the cost-effectiveness is much lower than hybrid/GM seeds. Last year, he spent only Rs. 2000/- on seeds. The farmer owns one local breed of cow. He does not want to have any other livestock and expressed his inability to do so because he belongs to the Jain community. He may, however, gradually grow more saplings for himself and other producers in the future.

Farm diversity (energy and production basket) **management**

Farmer Case 4 has diversified by growing various horticulture plants like Mango, Amla, Custard Apple, Ram Phala, Lemon, Coconut, Jamun etc. Further, he cultivates various vegetables and harvests brinjal, ladies-finger, pinwale (Pointed Gourd), and turmeric at different points of time each year. His regular source of income comes from selling pinwale (pointed gourd) and bananas. The annual income

of these two is estimated at Rs. 90000 and Rs.168000, respectively, per year. This diversification has established the biodiversity in his farmland.

The farm has a local variety of Mango, Moringa, Lemon, Banana, Custard Apple, Ram Phal, 5 Star fruit, Coconut, Amla, Jamun, Water apple, Brinjal, Ladies Finger, Tomato, Meth, etc.). There is also one local cow. Besides about 6 liters of milk per day, the farmer gets Urine: 8-10 liters per cow urine per day and 8-10 kg per day of cow dung. In addition to the earlier images, the images of farm diversity of the farm are given below.

Ecosystem Services & Climate Resilience

Within about five years, the farmer has done well to balance the above five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), indigenous local seeds or genetic material and on-farm livestock. All this seemed to have increased the ecological balance on his small farm. This balance among the key factors has improved the ecosystem services regarding organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. The relatively higher yield of the farm, despite a slight rise in temperature and rainfall variations in recent years and an increase in total production, are some indicators to mark the climate resilience of the farm.

Diversity in Farm Production & Market Resilience

The high quality of the farm produce ensures good demand for the produce. The farm products are in high local demand. Given the quality of taste and nutrition, the farmer receives regular orders for various crops from many consumers. He has about 120 customers and does not have to sell his produce as a commodity to traders. Regular income from the farm and a very high net income per hectare indicate high demand and market resilience. This also exhibits short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production and output from the farm for most of the year makes the farmer market resilient.

Benefit to Farmer & its Impact on Other Farmers

A businessman turned farmer who first made losses from the mono-cropping of Gerbera flowers is now highly profitable by adopting the natural farming system. He uses indigenous farming with improvised techniques of tree plantation, soil, water, diversity, and indigenous seeds. He has been an inspiration to many farmers and people who visit his farm. He has also been included as a trainer by the district agriculture unit ATMA) to train local district farmers. He has trained about 50 farmers so far. He has helped about 10 farmers replicate his farming in his locality. The current total expenditure and income to the farmer are summarized below.

Expenditure and Income Details:

The gross annual income of this 1.75-acre Farm was estimated to be INR 4,48,000. The total annual cost of operation was estimated to be INR 1,19,476. Accordingly, the net annual income of the farm was found to be INR 3,68,524. The table below gives the details:

Estimated Net Income*(2020-2021)

- Total Revenue = INR 4,88,000
- Total Expenses = INR 1,19,476
- Total Net Income = INR 3,68,524
- Total Area: 1.75 acres = 0.70 hectares
- Net Income per hectare per year = INR 5,26,463
- Net Income per hectare per month = INR 43,872[a]

[a] projected per 1 hectare

* The details of the expenditure and income of the Farm are given in the tables in the next two pages.

The net monthly income of this 1.75-acre farm has been estimated to be INR 30,710. Accordingly, the net monthly income of 1 hectare of land would amount to INR 43,872. This high income suggests the potential of this farm; with time, it can build up its other strengths and sources of income.

Table 4.4.1: Total Expenses of Case Study 4 Farm (April 2020 - March 2021) *

Particulars (please indicate all other components)	Pre-monsoon/Summer)			Kharif			Winter						
	APR	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	Total (INR)
Land Preparation Tiller+ Fuel+ Maintenance													25533
Input Cost													00
Labor Cost													36000
Seeds													2000
Any Other Cost 1. Cow													6000
2. Pump													3833
3. Fuel (Petrol)													12000
4. Electricity													3360
5. Motorcycle fuel													12000
6. Horticulture Plants													18750
Total													**119476**

***** Since the farmer has not maintained or could not recall well his monthly expense, the annual figures are reported in this case.

Table 4.4.2: Total Revenue of Case Study 4 Farm (April 2020 - March 2021) *

Particulars	Pre-monsoon /Summer			Monsoon			Rabi Window						
	APR	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	Total (INR)
Cereals: 1. Paddy													00
2. Wheat													00
3. Maize													00
Pulses													00
Vegetables 1. Banana													168000
2. Moringa													20000
3. Water apple													12000
4. Pinwale (for 6 months)													90000
5. Brinjal for 3 months (Dec-Feb)													12000
Livestock: Cow													00
Horticulture 1. Lemon (6 plants-Local, 5 plants – Seedless)													70000
2. Mango (Kesari & Lengda)													90000
3. Coconut													5000
4. Turmeric													10000
Any Other: 1. Income from Training													5000
2. Farmers' Field visits													6000
Total													**488000**

***** Since the farmer has not maintained or could not recall well his monthly income, the annual figures are reported in this case.

Farm Photos

Case Study 5

Case Abstract:

Farmer Case 5's adoption of natural farming in Andhra Pradesh represents a transformative journey from conventional to sustainable agriculture on his 2-acre farm. Venturing into natural farming in 2016 with guidance from agriculture officers and training facilities provided by the state's Department of Agriculture, Farmer Case 5 cultivated major crops such as Drumstick, Field Beans, Chrysanthemum, and Crossandra, alongside traditional drumsticks. His farm, characterized by intercropping and income-based crop selection, lacks a systematic farm forestry focus. The efforts in moisture management through a bore well, mulching, use of cow dung, microbial solutions, and pre-monsoon dry sowing contribute marginally to water conservation. This case underscores the importance of adapting indigenous practices and training to enhance productivity and sustainability, though it highlights gaps in holistic ecological planning and water conservation strategies.

District & State

Palnadu District is located in Andhra Pradesh and is bordered to the north by Telangana and Krishna Districts, to the west by Mahabub Nagar District, and to the south by Prakasam District. The district lies between 16°03' to 16°37' Northern Latitude and 79°22' to 80°21' Eastern Longitude, with a total geographical area of 730,123 hectares, 150,759 hectares of which are covered by forest. Andhra Pradesh, known as the "Rice Bowl of India," is located in southeastern India. The state is known for its primary crops, including rice, cotton, groundnut, pigeon pea, sunflower, black gram, and sorghum. Andhra Pradesh has a tropical climate with three main seasons: monsoon, summer, and winter, plus a brief spring. Its proximity to rivers, seas, and hills results in minimal weather variation across the state, with the plateau region experiencing a more moderate climate compared to the coastal belt and low valleys.

Background of Farmer & Farm

Farmer Case 5 is a resident of Kothapalem village of Palnadu District in Andhra Pradesh. He owns 2 acres of cultivable land on which he has been practicing Natural Farming since 2016. Before this, he followed fertilizer and chemical-based agriculture. It was tough to meet his family's needs from this type of farming.

In 2016, agriculture officers from the district reached out and introduced natural farming to the farmers in the village. With the help of the training facility provided by the district officials of the State Department of Agriculture of Andhra Pradesh, the farmer has picked up the methods of natural farming. He has used the traditional drumsticks of the village in his production system. As a young farmer focused on just 2 acres, he has been taking good care of his farm with good production and returns. The major crops grown on his farm now include Drumstick, Field Beans, Chrysanthemum, and Crossandra.

Overall Land use Pattern: The two-acre farm has fencing around it, a bore well on the farm, and is neatly segregated from significant crops. There is intercropping on the whole farm. Only income-based crops are usually planted on the farm. Farm forestry with the ecological focus of the farm has not been planned for. The agricultural department has not focused on this issue.

Balancing the Critical Factors of Production:

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Moisture (in-situ water harvest & and conservation) **management:**

The farmer dug a bore well on his farm for irrigation purposes. The depth of the borewell is 180 feet. A 5 HP motor has been fitted to pump the water from the bore well. Once a week, he irrigates one acre of land, and accordingly, the irrigation for the whole 2 acres of his farmland goes on a rotational basis. While there is no systematic effort to harvest and conserve rainwater, the practices of mulching with farm biomass, use of cow dung and microbial solution (Jeev Amrit), and pre-monsoon dry sowing (PMDS) help conservation of water to some extent. Pumping water from the bore well has become more accessible. The farmer observed that drawing water from the bore well has not been an issue since the beginning of this farming system.

Farm forestry (ecology & biomass)

This farm has little focus on developing farm forestry. This system of farm layout has not been part of the training from the agriculture department. The biomass requirement for covering the soil to protect microorganisms from direct sunlight is partially fulfilled by mulching the soil with various crop residues and through PMDS (pre-monsoon dry sowing). Dry sowing with various leguminous crops, pulses, dhanicha, millet, etc., every summer is carried out to keep the soil covered from direct sunlight and increase biomass on the farm.

Soil Health

The soil of this farmland looked fertile. The departmental soil test report, however, has been awaited. The farmer applies organic manure in his farmland to maintain soil fertility. He also applies organic microbial solutions to control pest attacks that maintain the nutritional quality of farm crops.

Seeds-sapling-livestock (genetic material composition)

Farmer Case 5 uses his local/indigenous seed. Generally, he selectively picks healthy fruits for seed collection from his farmland during crop harvest time. He also follows the seed preservation process to keep it safe for the next cycle. The village farmers have used drumstick seeds for several generations, and the fruit is of very high quality.

The livestock, especially cows, is an indigenous breed. Cow dung and cow urine of these local cattle are being used for incorporation into the farm. The local Shiva temple has several indigenous cows. Farmers practicing natural farming take cow dung and urine from the temple cowshed. In exchange, the farmers give the fodder to cows in the village temple.

Farm diversity (energy and production basket) management: The farmer has diversified the farm crops that provide him with constant income. This diversification has increased biodiversity in his farmland to some extent. However, livestock activities need to be integrated further with his farming activities, which will provide him with extra income. At the same time, he can use the cattle dung as organic manure to improve soil fertility and the microbial population of his farmland.

Ecosystem Services & Climate Resilience

Within about six years, the farmer has done well to balance the above five factors of production, viz., soil health improvements, increase in farm diversity with some ecology (trees on the farm), indigenous local seeds or genetic material, and on-farm livestock. All this seemed to have helped increase the ecological balance on his small farm. This balance among the key factors has improved the ecosystem services regarding organic carbon in soil and water absorption capacity on the farm. Maintaining the crop yield of the farm despite a slight rise in temperature and rainfall variations in recent years is an indicator of the farm's climate resilience.

Diversity in Farm Production & Market Resilience

The high quality of the farm produce ensures good demand for the produce. Given the quality, the farmer receives regular crop orders from many consumers. Regular income from the farm and a high net income per hectare indicate the demand and market resilience. This progress exhibits short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production and output from the farm for most of the year makes the farmer market resilient.

Benefit to Farmer & its Impact on Other Farmers

A young farmer who initially made losses in farming before 2016 is now highly profitable by adopting the natural farming system. He uses indigenous farming with improvised techniques of better soil and water management, diversified farming, and indigenous seeds. He has inspired many young farmers in the village and is often called *'Dhoni' after the former Indian Cricket Team Captain among young farmers*. The current total expenditure and income to the farmer are summarized below.

Expenditure and Income Details:

The gross annual income of this 4.0-acre (1.57 hectares) Farm was estimated to be INR 5,10,000. The total annual cost of operation was estimated to be INR 1,00,000. Accordingly, the net annual income of the farm was found to be INR 4,10,000. The table below gives the details:

Estimated Net Income[*] (2021-22)

- Total Revenue = INR 5,10,000
- Total Expenses = INR 1,00,000 (approx.)
- Total Net Income = INR 4,10,000
- Total Area: 2 acres = 0.80 hectares
- Net Income per hectare per year = INR 5,12,500
- Net Income per hectare per month = INR 42,708[b]

b Projected for 1 hectare

Monthly Income

The net monthly income of this 2.0-acre (0.80-hectare) farm has been estimated to be INR 34,167. Accordingly, the net monthly income of 1 hectare of land would amount to INR 42,708. This high income suggests the potential of this farm, and with time, it can build up its other strengths, especially in farm forestry, to reduce the cost of maintaining soil health and enhance income from horticulture and livestock.

Table 4.5.1: Total Expenses of Case Study 5 Farm (April 2021-March 2022)

Particulars	Pre-monsoon/Summer)			Kharif window									Total
	APR	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	
Ploughing	3000	1400	4000										8400
Inputs & Labors		5000	4000	4000	4000	4000	4000	4000	4000	4000			37000
PMDS Seed	1000												1000
Brinjal	3700												3700
Drumstick									2000				2000
Field bean										2400			2400
Transport							4000						4000
Harvesting							34600						34600
Total:	**7700**	**6400**	**8000**	**4000**	**4000**	**4000**	**42600**	**4000**	**6000**	**6400**	**0**	**0**	**93,100**

Table 4.5.2: Total Revenue of Case Study 5 Farm (April 2021 - March 2022)

Particulars	Premonsoon /Summer						Rabi Window						Total
	APR	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	
Brinjal		700x15= 10500	1000x18= 18000	1000x17= 17000	1000x20= 20000	800x15= 12000	700x15= 10500	800x15= 12000					100000
Drumstick													250000
Cluster bean													50000
Flowers													110,000
Total:		**10500**	**18000**	**17000**	**20000**	**12000**	**10500**	**12000**					**510,000**

Farm Photos

Case Study 6

Case Abstract

Farmer Case 6's journey into sustainable agriculture began with the rejuvenation of fallow land in Karnataka under the guidance of Lakshmi Prasad and Manjunath, culminating in an ecological farm emphasizing diversified, integrated farming systems. Having previously gained experience in organic practices and the marketing of organic produce, Farmer Case 6, with technical support from his wife, Mrs. Manju, transformed the farm into a model of ecological sustainability. Their approach integrates scientific advancements in horticulture and vegetable seed growth with organic farming knowledge acquired from visits to various farms across Karnataka. This case exemplifies a successful application of holistic and integrated farming practices, demonstrating the potential of combining traditional wisdom with modern scientific techniques to achieve sustainable agricultural outcomes.

District & State

Karnataka, the seventh largest state in India by area, consists of 30 districts and is bounded by the Arabian Sea and the Laccadive Sea to the west, Goa to the northwest, Maharashtra to the north, Telangana to the northeast, Andhra Pradesh to the east, Tamil Nadu to the southeast, and Kerala to the southwest. The state has dynamic weather, experiencing arid, semi-arid, and humid tropical climates influenced by altitude, topography, and distance from the sea. Karnataka receives an average annual rainfall of around 1355 millimeters, with the southwest monsoon bringing the most. Udupi district receives the highest average rainfall, while Chitradurga, Koppal, and Bijapur districts receive the least.

Background of the Farm & Farmer

The land was fallow (not under cultivation) for about 20 years before the work started here. In 2009, Lakshmi Prasad purchased this land and motivated Manjunath to carry out organic farming and provided financial support for land development, the creation of irrigation facilities, the construction of a farmhouse, and the purchase of cows. Manjunath worked as a contract laborer at Biocentre, Department of Horticulture, Government of Karnataka for a period of 3 years (2005 to 2007) and one year in Jaivik Krishik Society (2008) as a sales assistant cum driver before he moved to work full time in this farm in 2009.

At Biocentre, Bangalore Manjunath was exposed to organic nurseries, such as fruit and vegetable cultivation, preparation of vermicompost, Biodigester extract, panchagavya, fish meal, botanical extract, etc. At Jaivik Krishik Society (JKs), he acquired knowledge of packing, grading, organic methods of fruit ripening, and storage of organic produce. Later, officials from the Department of Horticulture and organic farmers guided him in adopting integrated and holistic farming practices on the land.

About 8 years ago, around 2014, Farmer Case 6, a former scientist from Biocentre, Bangalore, took charge of the farm and systematically developed it as a model ecological farm with diversified, integrated farming systems. He has also adopted the most scientific advancements in horticulture, nursery development of horticulture plants, and vegetable seed-growing.

Expertise: Self-knowledge on organic farming by visiting various organic farms around Bangalore, Mysore, Tumkur, and Shimoga districts in Karnataka. From the beginning, Farmer Case 6 and his

wife, Mrs. Manju, technically supported this farm.

Organic to the ecological farming system: The farm started by adopting a cow-based farming system by following mixed farming, crop rotation, production of inputs on the farm through recycling the bio waste, preparation of botanic extracts, panchagavya, and fish meal for control of pests and diseases. Today, it is a well-developed ecological farm.

Land use: The entire 7 acres of land has been used since 2009 for growing fruits like Banana, Papaya, Guava, Pomegranate, and 35 types of other indigenous and exotic fruits. Different types of vegetables, namely Tomato, Brinjal, Capsicum, Onion, and a variety of gourds and greens, are being cultivated depending on the season. He also grows cereals such as finger millet, paddy, and jowar during the rainy season. Napier grass and horse gram are grown as fodder crops for cattle. Pulses such as red gram, horse gram, green gram, cowpea, and oil seed crops like groundnut are grown as intercrops and cereals. Currently, the cultivation is being carried out on 6.0 acres. The rest is for a house and training facility.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five key factors of production?

Water (Moisture): The entire farm uses a drip irrigation system. The sources of water are tubewell, rainwater harvest, and canal water. There are structures for rainwater harvesting structures which recharge the underground water.

Soil health indicates soil productivity, fertility, and microbial activity. On the farm, soil macronutrients and crop availability have substantially improved. Soil microbial activity measured in earthworms, Trichoderma, pseudomonas, phosphate solubilizing bacteria, and several other valuable bacteria has increased. Compost, green manures, organic waste generated from the farm, cow manure, and urine are used to improve the soil microbial activity.

Seed: He collects seed and planting materials from the Biocentre, Department of Horticulture, Government of Karnataka, Indian Institute of Horticulture Research, University of Agricultural Sciences, organic farmers, and NGOs. Vegetable seeds of some crops are self-multiplied and stored in cloth bags and tin containers.

Diversified Integrated Agriculture: Field crops, horticulture crops, dairy, and fish farming are integrated. Good post-harvest practices, such as grading, packing, and ripening, are adopted on farms. Local cows are used as dry cattle for agriculture operations, and there is a local cross-breed cow for milking purposes. The manure and urine of the cattle are used to prepare compost, vermicompost, panchagavya, biodigester extract, etc.

Ecology: Various fruit and forest trees now make up for a magnificent ecologically balanced farm today. Neem trees are planted on the bunds of the farm, and fodder cum green manure trees such as milea dubia, vitex negunda, neem, adhatoda vasica, and casuarinas are on the border of the farm. These trees also act as windbreakers. Various fruit plantations and flower plants attract birds and

butterflies, which contribute to maintaining the ecological balance of the farm. Farm biowastes are recycled and used on the farm for proper waste management.

Ecosystem Services & Climate Resilience

Within about eight years, the horticulture scientist turned farmer has done very well to balance the above five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), indigenous local seeds or genetic material and on-farm livestock. All this seemed to have significantly increased the ecological balance on his farm. This balance among the key factors has improved the ecosystem services regarding organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. The relatively higher yield of the farm, despite the slight rise in temperature and rainfall variations in recent years and the increase in total production, are some indicators to mark the climate resilience of the farm.

Diversity in Farm Production & Market Resilience

The high quality of farm produce ensures good demand for the produce. The farm products are in high local demand. Given the quality of taste and nutrition, the farmer receives regular orders for various crops from many consumers. Regular income from the farm and a very high net income per hectare indicate the high demand and market resilience. This change exhibits short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production and output from the farm for most of the year makes the farmer market resilient. Further, training Manjunath, one of the support team members, in the processing, packing, and marketing of organic produce has greatly enhanced Dr. Ramakrishna's capacity to deal with market dynamics.

Benefit to Farmer & its Impact on Other Farmers

A horticulture scientist turned farmer who trained farmers on mono-cropping using external input-intensive and subsidy-driven farming has systematically changed the farming paradigm at a farmer field level. He has made his farm highly profitable by adopting the natural farming system. He uses indigenous farming with improvised techniques of tree plantation, soil, water, diversity, and indigenous seeds. He has been an inspiration to many farmers and people who visit his farm. The current total net income of the farmer is summarized below.

Estimated Net Income*(2022-23)

- Net Income 1 (all through year activities based) = INR 2,75,000
- Net Income 2 (seasonal crop-wise) = INR 8,73,500
- Total Annual Net Income = INR 11,48,500
- Total Area: 6.0 acres = 2.36 hectares
- Net Income per hectare per year = INR 4,86,653
- Net Income per hectare per month = INR 40,554

*For more details, please see the detailed information sheet below.

Detailed Information

Land Information:

- Total Cultivable Land (in acres): 6 acres
- Total land used for Organic/Natural Farming/Ecological (in acres): 6 acres.

Ecosystem Services related Information of the Farm:

- Soil Test Report: Soil samples collected and will be given for testing the Organic Carbon of the Farm (Date):
- Water Source (if any open well / dug well / bore well): Bore well.
- Please indicate the depth (in feet) from ground to water level in May: 200 ft.
- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): local & open pollinated varieties
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety): Indigenous & Local
- Type & No. of Perennial Trees in and around Farm: Forest, horticulture & fodder Trees (Total-200 nos.)

Table 4.6.1: Net Income 1 (all through year activities based) of Case Study 6 Farm (April 2022-March 2023)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Total (in INR)
Type of Expenditure													
1.Salary to Working families	40000	40000	50000	60000	60000	60000	50000	40000	40000	60000	60000	40000	600000
2.Electricity	1000	1000	1000	1000	2000	2000	2000	2000	2000	2000	2000	2000	20000
3.Inputs	0	0	20000	0	0	0	20000	0	0	0	20000	0	60000
4.Cow Feed	0	0		20000	0	0	0	0	0	0	20000	0	40000
5.Recurring Infrastructure	15000	15000	15000	20000	20000	20000	15000	15000	15000	15000	15000	15000	195000
6.Education/Training/Research/ Conservation	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	240000
Total													1155000
Sources of Income:													
1.Fruits (for home)	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	60000
2.Fruits (for sale)	30000	30000	30000	40000	40000	30000	30000	30000	30000	30000	30000	30000	380000
3.Vegetable (for home)	8000	8000	8000	8000	8000	8000	8000	8000	10000	10000	8000	8000	100000
4.Vegetables (for sale)	40000	40000	50000	60000	60000	50000	50000	40000	50000	50000	50000	50000	590000
5.Commercial crops (for home)	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	60000
6.Commercial crops (for sale)	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	240000
Total													1430000
Regular Net Income													**275000**

Table 4.6.2: Net Income 2 (seasonal crop-wise) of Case Study 6 Farm (April 2022-March 2023)

Name of Product 1 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Seed Production Tomato (0.25)	Nursery raising	3000	9 Note: own seeds costing Rs. 200/-	9000	81000
	Land preparation	6000			
	Inputs (Bio-inputs & Compost)	10000			
	Planting & crop management	12000			
	Plant care & protection	3000			
	Harvest & seed separation	8000			
	Drying, packing & Marketing	3000			
	Total Expenses	45000			
	Total Net Income (81000-45000)				36000

Name of Product 2 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Seed production Beans (0.25 cares)	Land preparation	6000	120	500	60000
	Inputs (Bio)	6000			
	Sowing, crop management	8000			
	Plant protection & crop care	3000			
	Harvesting & planting	4000			
	Seed separation, packing, & marketing	3000			
	Total Expenses	30000			
	Total Net Income (60000 – 30000)				30000

Name of Product 3 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)

Sapling production (fruit plants & ornamental pants) (0.5 acres)	Stock plant production (6000 nos) & maintenance	60000	5000 saplings	100	500000
	Mother plant maintenance	20000			
	Budding/grafting/cutting	60000			
	Nursery inputs (Bags, soil, bio-inputs & compost)	60000			
	Re-bagging & Maintenance for 10 months	40000			
	Marketing -	25000			
	Total Expenses	265000			
	Total Net Income (500000 – 265000)				235000

Name of Product 4 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Production of loofahs for Sponge & Vegetables (1.0 acres)	Nursery raising	4000	500 plants x 10 = 5000 fruits	20	100000
	Inputs (Bio inputs like neem cakes & compost))	6000			
	Land preparation, pitting, filling	10000			
	Planting, staking, threading	20000			
	Crop management, plant protection	5000			
	Harvesting, drying, storage	10000			
	Sponge cleaning an marketing	10000			
	Total Expenses	65000			
	Total Net Income (100000 – 65000)				35000

Name of Product 5 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Brinjal seed production (open field)	Nursery raising	2000	8	6000	
	Land preparation	6000			

(0.50 acres)	Bio inputs	4000			48000
	Planting & crop management	6000			
	Plant protection	3000			
	Harvesting, seed preparation	6000			
	Cleaning, packing, marketing	3000			
	Total Expenses	30000			
	Total Net Income (48000 – 30000)				18000

Name of Product 6 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Onion / Garlic (0.5 acres)	Nursery raising for Onion	5000	Onion – 5000	20	100000
	Cost of seeds/bulbs	1000			
	Land preparation	10000	Garlic - 1000	50	50000
	Inputs	10000			
	Planting saplings/bulbs & crop management	15000			
	Plant protection	5000			
	Harvesting & cleaning	5000			
	Drying, packing, marketing	5000			
	Total Expenses	56000			150000
	Total Net Income (150000 - 56000)				94000

Name of Product 7 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Vegetables: Tomato, cucumber, ridge gourd, bitter gourd	Nursery raising	2500	2000	30	60000
	Land preparation & opening pits	8000			
	Transplanting & crop management	5000			

(0.25 acres)	Training the wires	8000			
	Plant care & protection	5000			
	Harvesting & grading	5000			
	Packing & marketing	5000			
	Total Expenses	38500			
	Total Net Income (60000 – 38500)				21500

Name of Product 8 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Vegetables: Brinjal, chili (0.25 acres)	Nursery raising –	3000	3000	20	60000
	Land preparation & opening pits-	8000			
	Transplanting & crop management-	10000			
	Crop Care & Protection	5000			
	Harvesting & grading	5000			
	Packing & Marketing	3000			
	Total	34000			
	Total Net Income (60000 - 34000)				26000

Name of Product 9 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Tuber vegetables: sweet potato, potato, radish, carrot (0.25 acres)	Land & bed preparation	10000	3500	20	70000
	Inputs, seed, compost, bio inputs	8000			
	Sowing & crop management – 8000	8000			
	Crop care & protection	5000			
	Harvest & cleaning -	5000			
	Grading & marketing	5000			

	Total Expenses	41000			
	Total Net Income (70000 – 41000)				29000

Name of Product 10 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Bundles)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Greens: Palak, Bit, coriander, Amaranths (0.25 acres)	Land & bed preparation	8000	3000	15	45000
	Seeds, bio-inputs	5000			
	Sowing & caring	3000			
	Crop management	3000			
	Harvesting & bundling	3000			
	Marketing	3000			
	Total Expenses	25000			
	Total Net Income (45000 - 25000)				20000

Name of Product 11 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Turmeric (Production processing) (0.50 acres)	Land preparation	4000	200	400	80000
	Inputs (Neem Cake & Compost)	3000			
	Planting & covering	4000			
	Crop management (8 months)	5000			
	Harvesting & cleaning	10000			
	Processing, boiling, drying, cleaning, milling	15000			
	Packing & Marketing	5000			
	Total Expenses	46000			
	Total Net Income (80000 – 46000)				34000

Name of Product 12 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Banana (0.25 acres)	Land preparation, opening pits, filling with bio-inputs, compost –	5000	100 plants x 4 = 400 kg 100 suckers	40	Fruit – 16000 Suckers – 2000 Leaves – 2000 Total - 20000
	Planting & providing shade -	2000			
	Crop management, crop protection,	2000			
	providing staking	1000			
	Harvesting, ripening, & marketing	3000			
	Total Expenses:	13000			
	Total Net Income (20000-13000)				7000

Name of Product 13 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Papaya (0.50 acres)			2000	30	60000
	Total Expenses	20000			
	Total Net Income: 60000-20000				40000

Name of Product 14 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce/processed produce
Mango (1.0 acres)			3000	40	120000
	Total Expenses	30000			

	Total Net Income: 120000-30000				90000
Name of Product 15 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce/processed produce
Coconut (60 plants) (1.00 acres)			3500	20	70000
	Total Expenses	25000			
	Total Net Income: 70000-25000				45000
Name of Product 16 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any		Total Harvest	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Sapota, Guava, Butter fruit, Water apple, Rose apple (mixed cropping) (100 Plants) (1.00 acres)			1800	40	72000
	Total Expenses:	20000			
	Total Net Ncome:72000-20000				52000

Name of Product 17 (with area cultivated)	Different Expenditures in farming this produce & value addition if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Jack (Bund & Boarder planting) (50 nos. trees) (1.0 acres)			7500	10	75000
	Total	20000			
	Total Net Income: 75000-20000				55000

Name of Product 18 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any		Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Oyster Mushroom 10x20 sq. ft. house (tile structure) Cost: 100000				40 kg per cycle & 4 batch per month =160 kg/month	150	24000
	Total Expenses	18000				
	Total Net Income: 24000-18000					6000

Farm Photos

Case Study 7

Case Abstract

Farmer Case 7 showcases a transformative journey to regenerative agriculture in West Bengal, demonstrating substantial benefits in soil health, crop yield, and farm resilience. She transitioned from conventional to natural farming methods, diversified her crops, and integrated livestock and fishery, leveraging indigenous water conservation and soil rejuvenation techniques. This approach enriched the farm's biodiversity and ecological stability, illustrating the significant financial and environmental advantages of natural farming. Rani's success story exemplifies how integrating traditional knowledge with sustainable practices can lead to a more resilient and productive agricultural system, highlighting regenerative agriculture's impact on livelihoods and the ecosystem.

District & State

Purulia, the westernmost district of West Bengal, holds national significance due to its strategic tropical location, shape, and funnel-like function. It channels the tropical monsoon currents from the Bay of Bengal to the subtropical regions of north-west India while serving as a gateway between West Bengal's industrial regions and the hinterlands of Orissa, Jharkhand, Madhya Pradesh, and Uttar Pradesh. West Bengal, the twelfth largest state in India by area, stretches from the Himalayas in the north to the Bay of Bengal in the south. It is bordered by Sikkim and Bhutan to the north, the Bay of Bengal to the south, Assam and Bangladesh to the east, and Orissa, Bihar, and Nepal to the west. The state features four major geographical regions, with cooler climates in the northern mountains and temperatures ranging from below-freezing in the hills during winter to about 45°C in the southern parts during summer. The monsoon season, which lasts from June to September, brings heavy rainfall.

Background of the Farmer & Farm:

Farmer Case 7 is a resident of Lara village in the Purulia district of West Bengal. She is a natural farming practitioner, and her natural farming is facilitated by NABARD’s Watershed Program and as part of the climate change adaptation program guided by a local agency, viz., Development Research Communication & Services Centre (DRCSC). She is a tribal farmer, and her husband and married son work together in the natural farming system. Following her association and training with DRCSC since 2015, she has begun cultivating various crops in her 2 acres of farmland like paddy, oilseeds, pulses, and vegetables. She gradually diversified her natural farming, integrating livestock and fishery activities.

Before adopting natural diversified farming practices, Farmer Case 7, like any other farmer in the village, used synthetic industrial fertilizers and pesticides. Her primary advisor for agriculture was the local dealer who sold chemical fertilizers and pesticides. As part of a NABARD project, climate change adaptation, when members of DRCSC approached the farmers of Lara village to discuss natural farming, they resisted the change.

However, with some persuasion, DRCSC formed groups of women and men to discuss and deliberate on how to go about solving the water, food, and income problems. Even though farmers started making vermicompost for their use, they often applied both vermicompost and fertilizers to their farming in the early years of adopting natural farming. With the demonstration of the negating effect of this practice, the farmers learned to give up the use of synthetic fertilizers.

Gradually, in addition to diversifying field crops on farms from paddy to paddy, pulses, and mixed cropping, Farmer Case 7 diversified her livestock from cows to cows, goats, ducks, and hens. Subsequently, the small water tanks were used to cultivate fishery. Training was provided to grow plant biomass and azolla for the livestock. As Ms. Sulekha Laha, one of the members of DRCSC, mentioned, "Addition of livestock not only increased their nutritional security, but it also served as an 'any time money' (ATM), a source to sell livestock and get immediate cash when in emergency need of money."

Before 2016, farming in Lara village, including that of Farmer Case 7, was a loss-making activity. There was a shortage of water, farmer families had low levels of nutrition, and families had minimal assets. There was a food shortage in about 80% of farmers' families during March-April and September-October. The situation has dramatically changed for the better over the last seven years. Like many women, she says, "We now have sufficient food throughout the year." The asset base has gradually increased for individual farmers.

Among the many farmer families that adopted natural farming, Farmer Case 7 had a more significant advantage as her husband supported her wholeheartedly in the new farming method. Lately, her married son has also joined this natural farming system.

Balancing the Critical Factors of Production:

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Soil: Farmer Case 7 applies organic manure prepared from cow dung to improve soil fertility. Further, she prepares and applies microbial solutions to control pest attacks. All these measures have increased the growth of the microbial population in her farmland, helping her achieve good yields of different crops.

Water: Her farmland falls under the rainfed zone. To tackle the water problem, she has dug ditches to irrigate her farm crops. In addition to it, she uses rainwater for farming purposes. In May, the water level is 3 ft below the ground level. This is a remarkable improvement in water harvesting.

Seed: The seeds, planting materials, and livestock are primarily of local varieties and some improved varieties. The cows, goats, ducks, hens are local breeds. Horticultural plants are obtained from the local nurseries and horticulture department.

Diversity: She has diversified her farming practices by integrating horticulture activities and animal husbandry to field crop cultivation. Her animal husbandry activities include local cow, duck, goat, and fisheries varieties.

Ecology: With the support of DRCS, the people have developed about 33 acres of fallow land by planting about 23 varieties of trees. This has also improved the village's ecological base. It also provides some additional income for people in the area. Her farm is surrounded by perennial trees like Palmirah Palm, Date Palm, Neem, Arjun, Wooden Apple, and Jack Fruit. All these perennial trees have balanced

her farm ecology.

Ecosystem Services & Climate Resilience

Though this farmer has adopted natural farming in the recent about 6-7 years, the systematic interventions on the above five factors of production, viz., ecology (trees on the farm), soil health improvements, increase in farm diversity both in field crops, indigenous local seeds or genetic material and on-farm livestock has improved ecological balance. This balance among the key factors has improved the ecosystem services regarding organic carbon in soil and water absorption capacity. The tree plantation in fallow land in the area has increased green cover, adding to better water absorption. Despite a slight rise in temperature and rainfall variations in recent years and the increase in total production from a diverse production basket, the relatively higher yield of farms are some indicators to mark the climate resilience of the farming system.

Diversity in Farm Production & Market Resilience

Diversity in farm production and output from the farm for most of the year makes the market resilient. Farmers can get better product prices as their customer base is significant, and many are direct consumers. Regular income from the farm and a very high net income per hectare indicate the demand and market resilience and short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer.

Benefit to Farmer & its Impact on Other Farmers

A farmer's family that suffered from a food shortage for about four months until 2016 is now very confident of sufficient food and nutrition for her family. This progress is a sign of the success of adopting a natural farming system that uses indigenous farming with improvised techniques of tree plantation, soil, water, diversity, and indigenous seeds. She has been an inspiration to many farmers within the community. The local agency DRCSC has adopted her as the local champion of the natural farming system, says Ms. Sulekha Laha, the field supervisor from DRCSC. The farmer family has dramatically gained from this practice of agriculture. The current total net income of the farmer family is summarized below.

Estimated Net Income*(2021-22)

- Net Income 1 (all through year activities based) = INR 1,37,900
- Net Income 2 (seasonal crop-wise) = INR 2,24,300
- Total Annual Net Income = INR 3,62,200
- Total Area: 2 acres = 0.80 hectares
- Net Income per hectare per year = INR 4,42.750
- Net Income per hectare per month = INR 37,729[e]

e Projected for 1 hectare

*For more details, please see the detailed information sheet below.

Table: 4.7.1: Net Income 1 (all through year activities based) of Case Study 7 Farm (April 2021-March 2022)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Total (in INR)	Remarks
Type of Expenditure														
1.Salary to Working families/Hired Labors	-	-	-	-	-	1500	-	-	-	1500	1200	-	4200	Own labored & hired as well
2.Electricity/Fuel	500	400	-	-	-	-	-	500	-	-	-	-	1400	Fuel Cost for using Pump
3.Water														Own Ditch
4.Cow feed														Own
Total													5600	
Sources of Income:														
1.Milk (for home)	700	800	750	750	700	750	750	750	750	800	750	750	9000	Average
3.Fruits (for home)	400	400	400	100	100	100	100	-	-	-	-	-	1600	Average
5.Vegetables (for home)	1800	1800	1800	1800	1800	2000	2000	2000	3000	3000	3000	3000	27000	Average
6.Vegetables (for sale)	7500	7500	6000	1000	1000	2000	3500	4000	4000	6000	6000	6500	55000	Average
7. Paddy (for Sale)	-	-	-	-	-	-	-	-	-	-	-	40000	40000	Average
8. Pulses (for Home)	250	250	200	200	200	250	250	250	250	250	250	250	2850	Average
9.Fish	500	300	300	200	600	300	400	200	200	300	450	500	4250	Average
10. Meet/Egg	300	200	200	400	300	600	300	400	100	300	200	500	3800	Average
Total													143500	
Regular Net Income	(143500-5600)												137900	

Table 4.7.2: Net Income 2 (seasonal crop-wise) of Case Study 7 Farm (April 2021-March 2022)

Name of Product 1	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Paddy 2 acres	Seed Own	-	4200 kg	20	84,000
	Labor- Own & Hired	-			
	Water- Own Ditch	-			
	FYM-Own	-			
	Vermi Compost- Own	-			
	Organic Pesticides- Prepared by her own	-			
	Pheromone Trap Supported by DRCSC	-			
	Total	00			
	Total net Income: 84000-00				84000

Name of Product 2	Different Expenditures in farming this produce & value addition if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Vegetables 1.167 acres (in two seasons)	Seed Own	-	2150 Kg	30	64,500
	Labor- Own and Hired (Rs.500/ labor)	500			
	Water- Own Ditch & Rainwater				
	FYM Own				
	Vermicompost- Own				
	Organic Pesticides- Prepared by her own				
	Total	500			
	Total net Income: 64500-500				64000

Name of Product 3	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Mustard	Name of Expense 1: Seed- own	-	200 kg	60	12000
	Intercultural Operations	500			
	Water- Own Ditch & Rainwater	-			
	FYM Own	-			
	Vermicompost- Own	-			
	Organic Pesticides- Prepared by her own	-			

	Total	500			
	Total Net Income: 12000-500				11500

Name of Product 4	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Pulses 0.167 acres	Seed- own	-	50 kg	150	7500
	Labor- Own	-			
	Water- Own Ditch & Rainwater	-			
	FYM Own	-			
	Total	00			
	Total Net Income: 7500-00				7500

Name of Product 5	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Fishery 1 acre (shared with 5 persons)	Fingerling(50kg)-	10000	1000 Kg	150	150000
	Lime	500			
	Labor	1000			
	Net	2000			
	Total	13500			
	Total Net Income:	150000-13500			136500/5 persons = 27300

Name of Product 6	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Livestock	Food-own	-	Goat- 6 no Cow- 3 no Hen & Duck- 20 no	150 x 200 kg	30,000
	Labor-own	-			
	Total	00			
	Total Net Income: 30000-00				30000

Farm Photos

Case Study 8

Case Abstract

Farmer Case Study 8, from Kerala, exemplifies a dedicated shift to organic farming, significantly improving soil health and crop yield over his 10-acre farm. Farmer Case 8 has demonstrated sustainable farming practices' substantial ecological and economic benefits by integrating various crops like paddy, vegetables, and spices while maintaining livestock and fishery. His farm stands out for its comprehensive approach to agriculture, emphasizing the importance of biodiversity, natural pest control methods, and organic manure, which collectively contribute to increased productivity and sustainability. This approach supports environmental health and offers a scalable model for other farmers aiming to transition towards more sustainable and productive agricultural practices.

District & State

Malappuram district, headquartered in Malappuram, was established on June 16, 1969. It was formed by combining parts of the former Palakkad and Kozhikode districts, specifically from Ernad taluk, parts of Tirur taluk from Kozhikode district, and parts of Perinthalmanna and Ponnani taluks from Palakkad district. The district experiences a dry season from December to February, a hot season from March to May, and a heavy Southwest monsoon from October to November, which accounts for about 75% of the annual rainfall. The climate is generally hot and humid. Kerala, known for its relatively stable climate throughout the year, is exposed to the southwest monsoon from July to September and the northeast monsoon from October to November.

Background of Farmer & Farm

The farm is the farmer's homestead land. Farmer Case 8 was a teacher in a school and is hence known as the master of his farming community in Kerala. His family has been following mixed farming for the last 40 years. While he practiced organic farming on his farm as a full-time teacher, after his retirement, he has been fully immersed in a diversified natural farming system. His spouse/wife is still serving as the headmaster of a school but has been an active companion to the integrated natural farming on this farm for over three decades.

Farmer Case 8 has taken the adjacent land for annual paddy cultivation and some vegetable cultivation. He has constructed a water harvesting structure within his homestead farmyard, where he relaxes at the end of the day’s work. Children have grown up and settled down in different professions. Chandran Master has regularly trained other organic and natural farmers across Kerala.

Type of Climate Resilient Ecological Farming: Farmer Case 8 is doing mixed cropping and integrated farming on his farm and grows varieties of crops like paddy, areca-nut, mango, papaya, coconut, & vegetables. Chandran and his wife have integrated local breeds of cows and chickens on their farm.

Land use: He is practicing natural farming on 2 acres of land. He adopts a diverse farming system. His farming activities include paddy, areca-nut, mango, papaya, coconut, & vegetables. Besides, he has integrated livestock (cows and chickens) into his farming practices.

Balancing the Critical Factors of Production:

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five key factors of production?

Soil: He generally uses farmyard manure to enhance soil fertility. He has had no use for fertilizer or pesticides on his farm since the beginning. The soil is lively and healthy. The plants on his farm show no pest attack. Cow dung and cow urine are regularly applied on the farm. The organic carbon is high, and Ph is 6.5, near neutral (7.0).

Water: He has constructed a deep-water harvesting structure adjacent to his homestead. All rainwater from the house's premises is harvested here, sufficient for the farm's irrigation, bathing, and other requirements. Chandran also uses water from the canal, well, & and pond for irrigation purposes in his adjacent land. With a pH of 7.0, the water quality is good.

Seed: Farmer Case 8 uses indigenous seeds to cultivate various crops. The couple systematically collects local indigenous seeds and carefully preserves seeds from crops grown on the farm. They spend about Rs. 17500/- on paddy and vegetable seeds to add variety to their farm produce.

Diversity: Farmer Case 8 has diversified his agricultural farming practices. He has also integrated dairy into his farming activities, which enables him to prepare organic manure for his farming activities. As mentioned, the couple also rears free grazing chicken on their farm. They also have a provision to grow fish in ponds on their house premises. There is the production of something every day.

Ecology: The diversified farming with tall and short trees on the homestead farm is lush green, even at the peak of summer. His farm is also surrounded by various perennial and fruit trees, which help maintain a balanced and healthy farm ecology.

Ecosystem Services & Climate Resilience

Since the beginning, the farmer has done well to balance the above five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), indigenous local seeds or genetic material and on-farm livestock. Despite the limitations of working on small homestead land, he has systematically increased the ecological balance on his small farm. This balance among the key factors has improved the ecosystem services regarding organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. The relatively higher yield of the farm, despite the slight rise in temperature and rainfall variations in recent years and the increase in total production, are some indicators to mark the climate resilience of the farm.

Diversity in Farm Production & Market Resilience

The high quality of the farm produce ensures good demand for the produce. The farm products are in high local demand. Given the quality of taste and nutrition, the farmer receives regular orders for various crops from many consumers, especially the local hospital that prescribes organically grown vegetables for its patients. Regular income from the farm and a very high net income per hectare from

the farm indicate high demand and market resilience. This also exhibits short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production and output from the farm for most of the year makes the farmer market resilient.

Benefit to Farmer & its Impact on Other Farmers

As a good teacher who shows the right path, Farmer Case 8 has shown people how to balance life and live ecologically. His farming has been enjoyable and profitable because of the adoption of the natural farming system. He uses indigenous farming with improvised techniques of tree plantation, soil, water, diversity, and indigenous seeds. He has been an inspiration to many farmers in the state. He has been one of the lead trainers of organic farming in Kerala and has trained over 500 farmers in batches of 20 members. He has already prepared four book manuscripts on natural farming and is now ready for publication. The Biodiversity Board of Kerala has certified his farm and 24 other farms, which he has guided so far. He proudly says, "Due to my organic food production and consumption, I have maintained good health and not gone to any hospital during the last 40 **years"**. The current estimated income from the farm is summarized below.

Estimated Net Income[*] (2021-22)

- Net Income 1 (all through year activities based) = INR 2,25,060
- Net Income 2 (seasonal crop-wise) = INR 1,19,750
- Total Annual Net Income = INR 3,44,810
- Total Area: 2 acres = 0.80 hectares
- Net Income per hectare per year = INR 4,31,013
- Net Income per hectare per month = INR 35918[d]

d projected for 1 hectare

*For more details, please see the detailed information sheet below.

Detailed Information

Land Information:

- Total Cultivable Land (in acres): 2
- Total land used for Natural Farming/Ecological (in acres): 2

Ecosystem Services related Information of the Farm:

- Soil Test Report (please attach, if available)
- Organic Carbon of Farm (Date): 3% to 4%
- Water Source (if any open well / dug well / bore well): Rainwater, Canal, Well, Pond
- Please indicate the depth (in feet) from ground to water level in May:
- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): Indigenous variety
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety):
- Type & No. of Perennial Trees in and around Farm

Table 4.8.1: Net Income 1 (all through year activities based) of Case Study 8 Farm (April 2021-March 2022)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	**Total**
Type of Expenditure													
1.Salary to Working families													14500
2.Electricity													6000
3.Water													4000
4.Cow feed													36000
Total													60500
Sources of Income:													
1.Milk (for home)													18000
2.Milk (for sale)													40000
3.Fruits (for home)	900	900	900	900	900	900	900	900	900	900	900	900	10800
4.Fruits (for Sale)													15000
5.Vegetables (for home)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	18000
6.Vegetables (for sale)													50000
7.Rice (for home)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	12000
8.Plantain (for home)	750	750	750	750	750	750	750	750	750	750	750	750	9000
9.Coconut	2730	2730	2730	2730	2730	2730	2730	2730	2730	2730	2730	2730	32760
8. Areca-nut													30000
9.Training Fee													50000
Total													285560
Regular Net Income	(285560-60500)												**225060**

Table 4.8.2: Net Income 2 (seasonal crop-wise) of Case Study 8 Farm (April 2021-March 2022)

Name of Product 1 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Rice 1 acre	Seed	1500	1000		Paddy: 30,000 Hey: 9000
	Labor Charge	13500			
	Manure	5000			
	watering	1100			
	Pest control	550			
	Harvesting	3300			
	Transport cost	2000			
	Total Expenses	26950			39000
	Total Net Income: 39000-26950				12050

Name of Product 2 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Vegetables 1 acre	Seed	4000	1600	40	64000
	Labor Cost	22500			
	Manure	6000			
	Watering	2500			
	Pest control	1000			
	Harvesting	1000			
	Total Expenses	37000			64000
	Total Net Income: 64000-37000				27000
Name of Product 3 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Arca-nut 50 cents	Labor cost	7000			50000
	Manure	7500			
	Watering	2500			
	Harvesting	3000			
	Total Expenses	20000			50000
	Total Net Income: 50000-20000				30000

Name of Product 4 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Coconut 40 cents	Labor cost	3500			25000
	Manure	3000			
	Watering	1500			
	Harvesting	2000			
	Total Expenses	10000			25000
	Total Net Income: 25000-10000				15000

Name of Product 5 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Plantain	Labor cost	2000			15000
	Manure	1500			
	Watering	1500			
	Total Expenses	5000			15000
	Total Net Income: 15000-5000				10000

Name of Product 6 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Mango + Papaya	Labor cost	3000			7500
	Total Expenses	3000			7500
	Total Net Income: 7500-3000				4500

Name of Product 7 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Cashew nut	Labor cost	1800			5000
	Total Expenses	1800			
	Total Net Income: 5000-1800				3200

Name of Product 8 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Milk	Fodder cost	30000			58000
	Labor cost	10000			
	Total Expenses	40000			
	Total Net Income: 58000-40000				18000

Farm Photos

Case Study 9

Case Abstract

The farm of Farmer Case 9 in Gujarat showcases the adoption of natural farming practices over 4.72 acres. Transitioning from chemical-intensive methods, Patel has seen improvements in soil fertility and farm productivity. His diverse crop selection, including vegetables and fruits, integrated with dairy farming, underscores a holistic approach to agriculture. Patel's journey highlights the ecological and economic benefits of moving away from synthetic inputs towards sustainable farming practices, contributing to a healthier environment and increased farmer resilience.

Introduction on District & State:

Farmer Case 9 resides in Arphan village, Olpad Taluk, within the Surat District of Gujarat. Surat is a dynamic city in western India, witnessing rapid growth due to immigration from different parts of Gujarat and other Indian states. Gujarat, located along the western coast of India, features the country's longest coastline of about 1,600 km, primarily along the Kathiawar peninsula. The state is the fifth-largest by area, covering approximately 196,024 km², and the ninth-most populous, with a 2011 population of 60.4 million. Gujarat's climate varies, with hot, humid summers and cold, dry winters in the plains. The hilly and coastal regions experience milder summers. Winter daytime temperatures average around 29 °C (84 °F), dropping to 12 °C (54 °F) at night. In summer, daytime temperatures reach about 49 °C (120 °F), with nights not cooler than 30 °C (86 °F). The monsoon season brings scant rainfall to most of Gujarat, from June to September.

Background of the Farmers & Farm

Farmer Case 9, a natural farming practitioner, belongs to Gujarat. He and his family have been farming since 1952. He and his family practiced inorganic chemical-based farming for the first four years, 1952-1956. However, after encountering the farming practices of Mr. Bhaskar Save, a well-known farmer from Gujarat, he was encouraged to go for natural farming. Subsequently, he came across the practices and experiences of farmers such as the late Deepak Suchde, Subhas Palekar, and many others. He was inspired and gradually more and more convinced about natural farming.

He observes that “use of industrially produced fertilizers and pesticides is harmful to the soil and plant species; the soil becomes hard and poor in organic matter, the water consumption is more.” With organic and natural farming practices, he says, “soil becomes healthy, microbial population increases, water consumption is lower, pollination is better, and crop yields are higher.” He adds, “Local seeds give the best result in the changing climatic conditions.”

Farmer Case 9 owns 24 acres (in the local language, 40 Bigha). He is practicing natural-ecological farming on 12 acres (20 Bigha). The major crops grown on his farm are Bottle Guard, Parval, Sugarcane, Haldi (Turmeric), Guava, Apple Bel, and Mango. He has many horticultural and medicinal plants in and around his farm. He also maintains a good number of cows on his farm. He also produces organic fertilizers and microbially rich solutions from cow dung, cow urine and farm biomass for his use and to sell to other farmers in the local community and outside. He also has a processing unit for paddy, wheat, and turmeric. The women members of the family carry out food processing activities and are marketed along with other farm items.

All these diverse integrated farming activities keep all family members busy throughout the year, and there is a regular flow of income. Some items are earned daily, some are earned weekly, and others are earned monthly and seasonal. Farming has been profitable and has helped large families grow, educate children, care for older people in the family, and live well.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Soil: The soil of his farmland is rich and fertile. He applies organic manure in his farmland to maintain soil fertility. The soil of his farmland is tested at OUAT, which reveals that the microbial population is adequate and that more microbial activity is suitable for his farmland. The livestock on the farm provides the manure for his farm. In addition, he prepares a lot of microbially rich solutions (Amrit jal) that he applies on the farm, mainly during the rainy season.

Water: He has a borewell on the farm. There has been a gradual increase in groundwater on his farm. However, he also uses canal water since a canal irrigation facility is available near his farm. In short, sufficient water is available on the farm throughout the year.

Seed: Farmer Case 9 uses his indigenous seeds. He follows the seed collection and preservation techniques to preserve the seeds for the next cycle. Through his small network of farmer friends, he collects indigenous seeds from across the country, tries them out on his farm, and then saves those that adapt better and give better yields on his farm.

Diversity: He has diversified his farming activities by integrating cattle/livestock and horticulture activities into it. Livestock activities help him generate income by selling milk and cow dung chips used as fuel for cooking foods. The primary source of income also comes from selling horticultural items like mango, apple, lemon, banana, etc. All these horticulture plants are of local varieties.

Ecology: Although he has not systematically worked to develop the farm ecology, he has planted several guava plants and coconut plants on his farm. Other forests and fruit trees are also on his farm and around his house premises. All these serve to improve the farm ecology.

Ecosystem Services & Climate Resilience

For over sixty years now, the farmer and his family have done well to balance the above five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), indigenous local seeds or genetic material and on-farm livestock. Over these years, he has systematically increased the ecological balance on his farm.

This balance among the key factors has improved the ecosystem services regarding organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. The relatively higher yield

of the farm, despite the slight rise in temperature and rainfall variations in recent years and the increase in total production, are some indicators to mark the climate resilience of the farm.

Diversity in Farm Production & Market Resilience

The farm products are in high local demand and are reasonably priced even in the local market. Given the quality of taste and nutrition, the farmer receives regular orders for various crops from many consumers. Regularity of income (daily income from milk and weekly income from greens, fruits, and vegetables) from the farm and a very high net income per hectare indicate the high demand and market resilience**.** This also exhibits short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production, integration of farming with dairy, and value-addition activities ensure a regular flow of income, making the farmer self-reliant and market resilient.

Benefit to Farmer & its Impact on Other Farmers

Farm yield, total production, and net income have been good and sustained for over 60 years. Maintaining a large joint family, covering all needs of education of children, and other family expenses from the farm income demonstrates the success of the natural farming practice. From the profits, the farmer has also gradually built physical assets such as a large house, processing unit, tractor, family car, motorcycles, etc., which are indicators of the gains from this farming system.

He has been an inspiration to many farmers in the state. He has a regular trainer on natural and organic farming training organized by ATMA at the local level. Several farmers and youth visit his farm to learn. Many farmers have also replicated his practices on their farms. The current estimated income from the farm is summarized below.

Estimated Net Income*(2021-22)

- Net Income 1 (all through year activities based) = INR 67,200
- Net Income 2 (seasonal crop-wise) = INR 18,08,800
- Total Annual Net Income = INR 18,76,000
- Total Area: 12 acres = 4.72 hectares
- Net Income per hectare per year = INR 3,97,458
- Net Income per hectare per month = INR 33,121

*For more details, please see the detailed information sheet below.

Detailed Information

Land Information:

Total Cultivable Land (in acres): 40 Bigha (24 acres)

Total land used for Organic/Natural Farming/Ecological (in acres): 20 Bigha (12 acr

Ecosystem Services related Information of the Farm:

- Soil Test Report (attached):
- Organic Carbon of Farm (Date): 0.65 (High) dated. 30.08.2022
- Water Source (if any open well / dug well / bore well):
- Please indicate the depth (in feet) from ground to water level in May. No information
- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): local and indigenous variety
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety): local and indigenous variety
- Type & No. of Perennial Trees in and around Farm

Table 4.9.1: Net Income 1 (all through year activities based) of Case Study 9 Farm (April 2021-March 2022)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Total (in INR)
Type of Expenditure													
1.Water	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	18000
2.Cow feed	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	30000
Total													48000
Sources of Income:													
1.Milk (for home)	7350	7350	7350	7350	7350	7350	7350	7350	7350	7350	7350	7350	88200
2.Fruits-Guava & Hibiscus juice (for home)													8000
3.Vegetables (for home)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	18000
4.Cow dung Chips													1000
Total													115200
Regular Net Income	(115200-48000)												67200

Table 4.9.2: Net Income 2 (seasonal crop-wise) of Case Study 9 Farm (April 2021-March 2022)

Name of Product 1 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Apple bel	Expenses	0	50 Trees	200	10000
	Total Expenses	0			
	Total Net income:				10000

Name of Product 2 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Bottle gourd (1 acre)	Land Preparation	2500	24000	25	600000
	Sowing	400			
	Mandap	80000			
	Labor for mandap	12000			
	Diesel	1500			
	Rope	900			
	Stick	600			
	Transport	33600			
	Total Expenses	131500			
	Total Net Income (600000-131500)				468500

Name of Product 3 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Parval (0.6612 acre)	Seed	3600	12000	30	360000
	Mandap (150000/6)	25000			

	Labor	24000			
	Rope	900			
	Labor	2000			
	Stick	1800			
	Labor	3000			
	Labor (Manuring) & Other	2400			
	Harvesting cost	80000			
	Total Expenses	142700			
	Total Net Income (360000-142700)				217300

Name of Product 4 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Sugar (12 bigha)	Seed:	120000			792000
	Labor:	31200			
	Water:	18000			
	Cleaning:	6000			
	Rock Phase:	22800			
	Mulching:	6000			
	Ploughing:	14400			
	Total expenses	218400			
	Total Net Income (792000-218400				573600

Name of Product 5 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Guava (100 Plants)	Covering	9600	2000	50	100000
	Total Expenses	9600			

	Total Net Income (100000-9600)	90400

Name of Product 6 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (In Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Hibiscus					10000
	Total Net Income				10000

Name of Product 7 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (In Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Mango			300	30	9000
	Total Net Income				9000

Name of Product 8 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (In Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Haldi (Turmeric) (sale as Powder)	Cultivation, Labor, Procurement	320000			750000
	Total Expenses	320000			
	Total Net Income 750000-3200000				430000

Farm Photos

Case Study 10

Case Abstract

Farmer Case 10 manages the L. Narayan Reddy Farm in Karnataka, following in the footsteps of his late father who was a renowned organic farmer. The farm, spread over 4 acres, has been practicing natural farming for over 40 years, transitioning from synthetic chemical-based farming due to its detrimental effects on soil quality and profitability. Under Sairam's management, with his family's active participation, the farm maintains its legacy of quality and diversity in farming. It has become a symbol of sustainable agriculture, earning numerous awards for its innovative practices. The Reddy family's dedication to organic farming extends beyond cultivation to educating others through training facilities, emphasizing the significance of sustainable farming practices for future generations.

District & State

Bengaluru Rural District, one of Karnataka's 30 districts, was established in 1986 when Bengaluru was divided into Bangalore (Rural) and Bangalore (City). The district is currently divided into two divisions, consisting of four taluks, 35 hoblis, 1,713 habitats, 177 densely populated villages, and 105 gram panchayats. The region is known for cultivating various agricultural and horticultural crops like silk, rice, peanuts, sugarcane, castor, grapes, and mulberry. Karnataka, the seventh largest state in India, has a dynamic climate that varies due to differences in altitude, topography, and proximity to the sea. The state experiences arid, semi-arid, and humid tropical climates, with an average annual rainfall of around 1,355 millimeters. The southwest monsoon brings the most rainfall, with the Udupi district receiving the highest average rainfall, while districts like Chitradurga, Koppal, and Bijapur get the lowest.

Background of the Farm & Farmer

Farmer Case 10 manages his father’s farm, L. Narayana Reddy Farm, in Bangalore, Karnataka. He and his family are currently taking forward organic farming practices on 4 acres of farmland. For over 40 years, Sairam and his father have been following natural farming. Prior to that, his father followed synthetic chemical-based farming. The soil quality became poor, and farming became un-profitable; hence, his father shifted to natural farming.

Farmer Case 10 now lives with his wife, son, and his mother. Both Sairam and his wife work on the farm. The son is also involved in the supervision and working of the farm. Although the son did not seem very involved in the farm, he was close to his father’s detailed estimated figures when enquired about the farm's operations and earnings.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Soil: The soil fertility of his farmland is quite rich and very healthy. He applies organic manure to enrich soil conditions and soil fertility. Further, he also applies rich microbial solutions in his farming practices to control pest attacks. According to records, the organic carbon of the land is high in the range of 0.8

to 1.0. The recent report, however, showed a different result. The soil pH is 6.7, which is near neutral (7.0), and organic carbon is low despite the tremendous green cover of land. His farmland soil has been tested at the OUAT laboratory in Bhubaneswar.

Water: Farmer Case 10 uses water from two farm bore wells to irrigate his crops. In May, the water level of one bore well was 600 feet below ground level, and the other bore well was 200 feet below ground level. The location of one well is appropriately located, and the other is off the underground water line.

Seed: Farmer Case 10 uses local seeds for farming purposes. Sometimes, he collects local seeds from his farmer friends. Further, the plants and trees of his farmland are also local varieties, and he applies organic manure for better growth of these plants.

Diversity: He has diversified his farming activities by integrating horticulture, spices, and livestock. He rears ten cows and eight goats. In addition to this, he has also integrated poultry activities. All these have strengthened his Net Income. In the image beside this para are both Sairam and his wife milking a quietly standing cow. It shows the level of care that the cow perceives of the couple.

Ecology: He has grown 8-10 varieties of perennial trees and 20 varieties of 300 plants. All these perennial trees and plants balance their farm ecology, protecting farm crops from temperature and high wind speed.

Ecosystem Services & Climate Resilience

His farm is now full of horticultural trees. The farm's boundary has been covered with large forest trees and bamboo. The farm has been gradually and systematically balancing the above five factors of production, viz., ecology (trees on the farm), soil health improvements, increase in farm diversity both in field crops, horticulture plants, indigenous local seeds or genetic material and on-farm livestock. The ecological balance among the key factors has gradually improved the ecosystem services in terms of organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. There is sufficient groundwater on the farm. It also has a large water tank that stores water. It is constructed on the upper end of the farm, slightly above the ground. The farm gets irrigated using the force of gravity. There is a diversity of livestock, too. It has cows, goats, and hens. In addition to providing a steady source of income from milk and eggs, this livestock provides valuable organic manure for plants and vegetables on the farm. The diversity of plants ensures climate resilience to the farm.

Diversity in Farm Production & Market Resilience

The high quality and taste of fruits and vegetables on this farm keep direct customers and retail stores closely tied up with the farm. The quality of cows, goats, and eggs created high consumer demand. The organic farming network in Bangalore is always ready to procure fruits and vegetables from this farm. Diversity in production ensures market resilience as the farm is not dependent on one large buyer. High quality in terms of taste and freshness attracts customers, who pay a reasonable price for its produce. Diversity in farm production and output from the farm for most of the year makes the farmer market resilient and ensures regular income almost daily. This practice also indicates high short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer.

Benefit to the Farmer & its Impact on Other Farmers

Farmer Case 10's father has greatly inspired the farming community in Karnataka and the whole country among the organic farming community. The farming family has gained mainly from this farming method. The farm's profitability has kept the second generation to keep up the farm, and the third generation is also looking forward to further developing the farm and taking forward the training provisions already created on the farm. The current total net income from the farm is summarized below.

Estimated Net Income* (2021-22)

- Net Income 1 (all through year activities based) = INR 52,000
- Net Income 2 (seasonal crop-wise) = INR 5,62,933
- Total Annual Net Income = INR 6,14,933
- Total Area: 4 acres = 1.60 hectares
- Net Income per hectare per year = INR 3,84,333
- Net Income per hectare per month = INR 32,028

*For more details, please see the detailed information sheet below.

Detailed Information

Land Information:

- Total Cultivable Land (in acres): 4
- Total land used for Natural Farming/Ecological (in acres): 4

Ecosystem Services related Information of the Farm:

- Soil Test Report (please attach, if available): Not available
- Organic Carbon of Farm (Date): Not available
- Water Source (if any open well / dug well / bore well): 2 nos. of Borewell.
- Please indicate the depth (in feet) from ground to water level in May: 600 ft & 200 ft
- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): Local seeds/ (from friends)
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety): Goat-8 nos., Cows-10 no - HF – 3 nos. (Mix) Mallangdgheta – 5 nos.
- Type & No. of Perennial Trees in and around Farm: 8-10 varieties: 300 plants, 20 varieties

Table 4.10.1: Net Income 1 (all through year activities based) Case Study 10 Farm (April 2021-March 2022)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	**Total (in INR)**
Type of Expenditure													
1.Salary to Working families	21000	21000	21000	21000	21000	21000	21000	21000	21000	21000	21000	21000	252000
2.Electricity	500	500	500	500	500	500	500	500	500	500	500	500	6000
3.Cow feed	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	72000
4.Seeds													2000
5.Toos													10000
6.Petrol/Diesel													10000
7. Equipment Maintenance													190000
Total													542000
Sources of Income:													
1.Milk (for home-1 ltr. / day)	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	12600
2.Milk (for sale-10 ltr. / day)	10500	10500	10500	10500	10500	10500	10500	10500	10500	10500	10500	10500	126000
3.Fruits (for home-3 kg/day)	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	43200
4.Fruits (for sale-400kg/month)	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	14400
5.Vegetables (for home – 2 kg / day)	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	28800
7. Egg	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	27000
8.Goats (sale/year)													50000
9. Cows (sale/year)													10000
10.Spices (30kg@Rs.1000/- per kg))													30000
11.Coffee (60kg@200/- per kg)													12000
12.Biogas	500	500	500	500	500	500	500	500	500	500	500	500	6000
13.Noni (100 liters@300/year)													30000
12.Training	17000	17000	17000	17000	17000	17000	17000	17000	17000	17000	17000	17000	204000
Total													594000
Regular Net Income	(594000-542000)												**52000**

Table 4.10.2: Net Income 2 (seasonal crop-wise) of Case Study 10 Farm (April 2021-March 2022)

Name of Product 1 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Coconut 60 trees	Name of Expense 1:	00	6000 pieces	25	150000
	Total Expenses	00	Coconut Oil 60 liters	350	21000
	Total Net Income: 171000-00				171000

Name of Product 2 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Ragi	Name of Expense 1:	00	500	40	20000
	Total Expenses	00			
	Total Net Income: 20000-00				20000

Name of Product 3 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Sapota 40 trees	Name of Expense 1:	00	900	35	31500
	Total Expenses	00			
	Total Net Income: 31500-00				31500

Name of Product 4 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Mango 60 trees	Name of Expense 1:	00	As Fruits – 600	120	72000
	Total Expenses	00	As Pickles – 100	200	20000
	Total Net Income: 92000-00				92000

Name of Product 5 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Jack fruit 8 trees	Name of Expense 1:	00	300	30	9000
	Total Expenses	00			
	Total Net Income: 9000-00				9000

Name of Product 6 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Pomelo 6 trees	Name of Expense 1:	00	400	50	20000
	Total Expenses	00			
	Total Net Income: 20000-00				20000

Name of Product 7 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Timber 100 trees (15 years)	Name of Expense 1:	00	20000/15/Year		1333
	Total Expenses	00			
	Total Net Income: 1333-00				1333

Name of Product 8 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Litchi 1 acre	Name of Expense 1:	00	25	120	3000
	Total Expenses	00			
	Total Net Income: 3000-00				3000

Name of Product 9 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Amte Kai 2 trees	Name of Expense 1:	00	150	200	30000
	Total Expenses	00			
	Total Net Income: 30000-00				30000

Name of Product 10 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Amba 3 trees	Name of Expense 1:	00	15	100	1500
	Total Expenses	00			
	Total Net Income: 1500-00				1500

Name of Product 11 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Guava 30 trees	Name of Expense 1:	00	200	40	8000
	Total Expenses	00			
	Total Net Income: 8000-00				8000

Name of Product 12 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
All spices 2 trees	Name of Expense 1:	00			1000
	Total Expenses	00			
	Total Net Income: 1000-00				1000

Name of Product 13 (with area cultivated)	Different Expenditures in farming this produce & value addition if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Tejpata 3 trees	Name of Expense 1:	00			1000
	Total Expenses	00			
	Total Net Income: 1000-00				1000
Name of Product 14 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Drumstick	Name of Expense 1:	00	60 kg as vegetable	100	6000
	Total Expenses	00	Drumstick leaves		5000
	Total Net Income: 11000-00				11000

Name of Product 15 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Butter fruit 15 trees	Name of Expense 1:	00	200	150	30000
Citron 40 trees			200 pscs	10/psc	2000
Banana 30 plants			500kg	70	35000
Ram phal 5 plants			30 kg	120	3600
	Total Expenses	00			
	Total Net Income: 70600-00				70600

Name of Product 16 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Greens	Name of Expense 1:	00		10000/month	10000
Vegetables			400kg/month	40	16000
Toor dal				10000/year	10000
Roots (air potato, elephantia/diascesia)				2000/year	2000
	Total Expenses	00			
	Total Net Income: 38000-00				38000

Name of Product 17 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Soybeans	Name of Expense 1:	00	500	100	50000
	Total Expenses	00			
	Total Net Income: 50000-00				50000

Name of Product 18 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Chicken	Name of Expense 1:	00	10	350	3500
	Total Expenses	00			
	Total Net Income: 3500-00				3500

Name of Product 19 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Jaggery	Name of Expense 1:	00	5 kg/month	100	500
	Total Expenses	00			
	Total Net Income: 500-00				500

Farm Photos

Case Study 11

Case Abstract

Farmer Case 11's transition to natural farming in Punjab began in 2012, influenced by health concerns and environmental degradation linked to conventional farming. Initially adopting green revolution technologies, Singh shifted to natural farming with NGO support, experiencing immediate positive changes in his farm's ecosystem. His 5.5-acre farm now practices mixed cropping with diverse crops and integrated livestock, balancing critical production factors such as soil health and water conservation. Singh's journey reflects a commitment to a healthy and sustainable farming system, emphasizing natural farming practices' ecological and health benefits.

District & State

Barnala, a district in Punjab, India, was established in November 2006 after being separated from Sangrur district. Centrally located, it borders Ludhiana district to the north, Moga district to the northwest, Bathinda district to the west, Sangrur district to the east, and Mansa district to the south. Situated at 231.9 meters (760.9 feet) above sea level, Barnala experiences a humid subtropical climate with dry winters (Classification: Cwa). Punjab, known as the "land of five rivers," is one of India's most prosperous states and relies heavily on agriculture. The state is a key contributor to India's food security, producing nearly two-thirds of the country's food grains and a third of its milk, and it leads in wheat production. The people of Punjab have played a significant role in advancing the Green Revolution, a major agricultural initiative.

Background of the Farmers & Farm

After his graduation, Farmer Case 11 took to farming in 2004. From 2004 to 2011, he practiced farming using technologies of the green revolution, viz., inorganic fertilizers, pesticides, large amounts of water, and heavy machinery. All this was the common practice among farmers in Punjab. However, Farmer Case 11 said the experience was awful. It became more challenging to work with the soil, the cost of farming was high, crop yield reduced over time, and net income reduced with time. In 2009, his mother fell ill and was diagnosed with cancer. Then he realized that the number of cancer patients is increasing in Punjab. This situation made him think about the problems of ill health and polluted environment in Punjab. He understood the harmful effects of green revolution techniques on living beings and the environment. He says, “I promised to stop growing food using poison, fertilizers, and pesticides since this realization.”

In 2012, with the help of an NGO, “Kheti Virasat Mission,” he started natural farming. In the first year, he could experience positive changes in his farm crop yield and income from diversity. He exclaimed, “The number of birds and insects is increasing on my farm, and I am also able to cultivate some vegetables that I was not able to grow in this land.”

I, the principal investigator of this study, visited Farmer Case 11 in 2013 to conduct a study on organic farming. As part of this study, I revisited him in 2022. He has transformed his farm within the last 10 years. At the same time, he initially hesitated to share the cost and income from his production as he was not concerned about mere profitability but was interested in seeking a good and healthy farming

system. However, after some deliberations and sharing, he agreed to think of the costing and income details, which he subsequently shared. The results are pretty encouraging for both practice and policy.

Land use: Farmer Case 11 is doing mixed cropping on his farm and grows varieties of crops like Basmati, wheat, cereals, pulses, and vegetables (carrot, peas, onion, tomato, Potato). He has a total of 5.5 acres of land. He adopts a diverse farming system. He has more fruit trees and forest plants on the farm. His farming activities include Wheat, Alsi, Mustard, Maize, Ragi, Haldi (Turmeric), Vegetables, Mango, Grapefruit, Guava, Amla, and Kinu. Besides, he has integrated livestock into his farming practices.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five key factors of production?

Soil: He generally uses farmyard manure to enhance soil fertility. There is a compost pit on his farm where farm waste and other biodegradable materials are recycled to become compost, and the use of this compost enhances the population of soil microorganisms and earthworms. Farmer Case 11 also sprays Jeev Amrit (cow urine preparation) and Vermi-wash to build up topsoil. The soil has greatly improved with time. Today, the soil of his farmland is divided into two categories-(1) jungle land, not cultivated at all, and (2) land cultivated for 4 years.

Water: Farmer Case 11 uses water from Bore wells for irrigation purposes. The depth of the bore well is 400 feet. The water is 150 feet below the ground level in May. He uses a motor to pump out the water from the borewell for irrigation. The water table seems to be increasing with the passing year.

Seed: Farmer Case 11 uses local seeds to cultivate various crops. He has been collecting seeds from other farmers and trying to make his farm the seed source. He spends INR 22000 towards seed, including labor and plot preparation.

Diversity: Farmer Case 11 has diversified his agricultural farming practices. His farming activities demonstrate that he practices wheat, maize, and ragi in vegetables in winter and summer and mustard in Rabi. His major earnings come from wheat, maize, and mustard. He has also integrated dairy into his farming activities, which enables him to prepare organic manure for his farming activities. He says the method of natural farming itself controls pests and insect problems. In a mixed cropping system, one crop protects the other. In the early years, he used preparations from neem leaves to protect the crop from diseases.

Ecology: Various trees in and around Farmer Case 11's farm have strengthened his ecology. He has grown 800 different varieties of perennial trees. Further, he has also grown 40 varieties of fruit trees. His diversified farming has strengthened his net income and his farm's biodiversity.

Ecosystem Services & Climate Resilience

The farmer has done well to balance the above five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), indigenous local seeds or genetic material and on-farm livestock. Over the last ten years, he has systematically increased the ecological balance on his farm. This balance among the key factors has improved the ecosystem services regarding organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. The relatively higher yield of the farm, despite the slight rise in temperature and rainfall variations in recent years and the increase in total production, are some indicators to mark the climate resilience of the farm.

Diversity in Farm Production & Market Resilience

The high quality of the farm produce ensures good demand for his farm produce. The farm products have a high local demand and are sold all in premium and not as a commodity. Given the quality of taste and nutrition, the farmer receives regular orders for various crops from many consumers. Regularity of income (daily income from milk and weekly income from greens, fruits, and vegetables) from the farm and a very high net income per hectare indicate the high demand and market resilience. This also exhibits short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production and output from the farm for most of the year makes the farmer market resilient.

Benefit to Farmer & its Impact on Other Farmers

Since adopting natural farming, he says**, "**farming has been both enjoyable and profitable." Farm yield, total production, and net income have increased. He has been an inspiration to many farmers in the state. He does not go out to train, but many people visit his farm to learn, and he happily shares his techniques and experiences. The current estimated income from the farm is summarized below.

Estimated Net Income* (2022-23)

- Net Income 1 (all through year activities based) = INR 80,000
- Net Income 2 (seasonal crop-wise) = INR 7,35,900
- Total Annual Net Income = INR 8,15,900
- Total Area: 5.5 acres = 2.20 hectares
- Net Income per hectare per year = INR 3,70,864
- Net Income per hectare per month = INR 30,905

*For more details, please see the detailed information sheet below.

Detailed Information

Land Information:

- Total Cultivable Land (in acres): 5.5
- Total land used for Organic/Natural Farming/Ecological (in acres): 5.5

Ecosystem Services related Information of the Farm:

- Soil Test Report: Given for soil testing at OUAT.
- Organic Carbon of Farm (Date): High
- Water Source (if any open well / dug well / bore well): Bore well.
- Please indicate the depth (in feet) from ground to water level in May: 150 feet
- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): Hybrid vegetable (cabbage & Brinjal)
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety): local – Saibal
- Type & No. of Perennial Trees in and around Farm: Fruit – 40 varieties, Neem & Flower – 25 varieties, 800 perennial trees

Table 4.11.1: Net Income 1 (all through year activities based) of Case Study 11 Farm (April 2022-March 2023)

Expenditure & Income	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Total Amount (in INR)
Types of Expenditure													
1.Cow Feed	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	48000
Total													48000
Sources of Income:													
1.Milk (for home)	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	14400
2.Fruits (for home)	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	39600
3.Vegetables (for home)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	24000
4.Sale of Livestock													50000
Total													128000
Regular Net Income: (128000-48000)													80000

Table 4.11.2: Net Income 2 (seasonal crop-wise) of Case Study 11 Farm (April 2022-March 2023)

Product 1 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (INR)	Total Harvest (Kgs)	Avg. Sale Price per Kg (INR)	Total Income from the Sale of this Produce (in INR)
Wheat	Seed sowing	4000	3500	50	175000
	Harvesting	12000			
	Total Expenses	16000			
	Total Net Income: 175000-16000				159000

Name of Product 2 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Alsi (Flexi)	Seed sowing	2000	100	200	20000
	Harvesting	1000			
	Total Expenses	3000			
	Total Net Income (20000-3000)				17000
Name of Product 3 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Mustard	Seed sowing	2000	600	90	54000
	Harvesting	1000			
	Total Expenses	3000			
	Total Net Income (54000-3000)				51000

Name of Product 4 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Maize	Land Preparation	2500	2000	50	100000
	Harvesting	6000			

	Processing	4000			
	Total Expenses	12500			
	Total Net Income (100000-12500)				87500

Name of Product 5 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Ragi (Atta)	Land Preparation	2500	300	90	27000
	Harvesting	2500			
	Processing	600			
	Total Expenses	5600			
	Total Net Income (27000-5600)				21400

Name of Product 6 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Amla	-	-	2500	20	50000
	Total Net Income:				50000
Name of Product 7 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Kinu	Labor	1500			10000
	Total Expenses	1500			
	Total Net Income (10000-1500)				8500
Name of Product 8 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)

Grape+Mosami+ Amrud/Guava+ Mango, Dasy	-	-			18000
	Total Net Income:				18000

Name of Product 9 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Vegetables - Potato, Kadu, Bhindi	Plot preparation, Seed, Seed sowing, labor	22000			106000
	Labor Charges	27000			
	Total Expenses	49000			
	Total Net Income (106000-49000)				57000

Name of Product 10 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Banana					4000
	Total expenses	0			
	Total Net Income				4000

Name of Product 11 (with area cultivated)	Different Expenditure in farming this produce & value addition if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from Sale of this Produce (in INR)
Brinjal	Labor Charges	7000			35000+40000 = 75000
	Total Expenses	7000			
	Total Net Income (75000-7000)				68000

Name of Product 12 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Cabbage					80000
	Total Expenses	0			
	Total Net Income				80000

Name of Product 13 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in Rs.)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Haldi (Turmeric) (Powder)	Sowing	1500	250	500	125000
	Harvest	3000			
	Cleaning	1500			
	Cutting	1500			
	Grinding	3000			
	Total Expenses	10500			
	Total Net Income (125000-10500)				114500

Farm Photos

Case Study 12

Case Abstract

Farmer Case 12 from Nagaland practices farming on a 4-acre farm, focusing on traditional farming techniques and integrating local cattle breeds. His transition to organic farming, supported by the National Dairy Research Centre, has led to improved soil health and crop yields, emphasizing the integration of dairy into farming. Kiso's farm is a testament to the power of organic manure, cow urine, and local seed use in enhancing soil fertility and reducing erosion despite the challenges posed by the hilly terrain. His farm grows diverse crops, including paddy, potatoes, onions, tomatoes, and various vegetables, underlining the importance of balancing soil health, water conservation, seed quality, farm production diversity, and ecology for sustainable agricultural success.

District & State

Kohima, the capital city of Nagaland since December 1, 1963, is located in the south at an altitude of 1,444 meters above sea level. The city experiences a moderate version of a humid subtropical climate characterized by pleasant temperatures year-round. Winters, particularly in December and January, are the coldest months, occasionally experiencing frost and snow in higher altitudes. During peak summer, from July to August, temperatures range between 80 and 90 degrees Fahrenheit, with heavy rainfall typical in this season. Nagaland was inaugurated as the 16th state of India in 1963, and it has a humid subtropical climate with dry winters. The state's annual temperature is 25.05°C, slightly lower than India's national average, and it typically receives around 171.22 mm of rainfall with 207.55 rainy days per year.

Background of the Farmer & Farm

Farmer Case 12, an inhabitant of Kidima village of Kohima district in Nagaland, has been practicing farming in his 4 acres of farmland. Like other farmers, he, too, was not clear whether using chemical fertilizers and pesticides would increase his yield. He adopted traditional farming in the area with few seasonal crops. Though he had some cattle, his farming was not integrated with livestock.

Since 2016, the farmers of this village have been technically trained and supported by the National Dairy Research Centre based in Kohima promoting local cow breeds and facilitating organic farming. The scientists also observed that the crop yields of these farmers had fallen when they had not integrated dairy into household farming. However, crop yields gradually increased with the systematic integration of local cow breeds into household farming. Applying farmyard manure and cow urine in the farmlands enriched soil health and improved crop yield. The principal crops now include paddy, potato, onion, tomato, chili, soybean, dal, cabbage, pea, beans, garlic, and fruits.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Soil: Farmer Case 12 applies organic manure prepared from cow dung on his farmland. He himself prepares organic manure and applies it to increase soil fertility. Due to hilly terrain, the rate of soil erosion is fast, and continuous manuring is required. He pointed out that he stopped rearing Thutho Cattle from 2017 to 2020, adversely affecting his crop yield due to a lack of manure. Again, he took up rearing Thutho Cattle in 2021.

Water: Farmer Case 12 uses the water from the perennial spring to irrigate his farm crops. In addition to this, he is also dependent on rainwater to grow farm crops. He has not yet developed water conservation and harvesting in his farming area.

Seed: He uses local seeds for farming purposes. He collects seeds from his farm crop before harvesting them and preserves them for the next cycle. Further, he planted the local varieties of various fruit plants. He applies his organic manure to his farm crops and fruit plants for their growth.

Diversity: He has diversified his farming activities by integrating horticulture and livestock. He is rearing Thutho cattle, which are of local varieties. His net income from selling it as live weight and dried cow dung is INR 50000. His horticulture trees include plum, peach, pear, Guava, and bananas, which provides him with a Net Income of INR 69000.

Ecology: His farmland is surrounded by primarily deciduous types of trees. Both horticulture trees and deciduous trees in and around his farmland have strengthened his farm ecology. Another interesting point is that all uncultivated lands are reserved for tree plantation (timber and firewood) and grazing area purposes that help stop free grazing.

Ecosystem Services & Climate Resilience:

With training and experience, the farmer has gradually integrated most of the five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), indigenous local seeds or genetic material and on-farm livestock are very well balanced.

Endowed with rich flora and fauna, the farmer has the required ecological balance around the farm. This ecological farming provides cover from the rise in temperature. Agriculture land is in small patches in a hilly state like Nagaland, and the farmer gets ecological cover from the natural environment. The farmer has been trained on farm-yard organic manure and vermicompost and hence has been improving his soil health. Diversified farming on the farm has further increased biomass for the soil, which enhances soil health. With these, the water-moisture holding capacity of the farm increases.

The balance among the key factors has improved the ecosystem services regarding organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. The relatively higher yield of the farm, despite the slight rise in temperature and rainfall variations in recent years and the increase in total production, are some indicators to mark the climate resilience of the farm.

Diversity in Farm Production & Market Resilience:

Given their nutritional value and taste quality, farm products are in high local demand and sold at a premium, not as a commodity. The farmer receives regular orders for various crops from many consumers. Regularity of income (daily income from milk and weekly income from greens, fruits, and

vegetables) from the farm and a very high net income per hectare indicate market resilience. All this also exhibits short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer.

Benefit to Farmer & its Impact on Other Farmers

The farmer's crop yields have increased with the increase in ecological balance and soil health. With diversification, the regularity in income and total income have increased. The excellent quality of his farm produce gives a reasonable price to the farmer, and the total income has substantially increased. He has also become a model farmer in the area. With time, he could emerge as a lead trainer in natural farming. The current estimated income from the farm is summarized below.

Estimated Net Income* (2022-23)

- Net Income 1 (all through year activities based) = INR 3,23,788
- Net Income 2 (seasonal crop-wise) = INR 2,42,020
- Total Annual Net Income = INR 5,65,808
- Total Area: 4 acres = 1.60 hectares
- Net Income per hectare per year = INR 3,53,630
- Net Income per hectare per month = INR 29,469

* For more details, please see the detailed information sheet below.

Detailed Information

Land Information:

- Total Cultivable Land (in acres): 25 Acres (Approx.)
- Total land used for Natural Farming/Ecological (in acres): 4 to 4.5 acres.

Ecosystem Services related Information of the Farm:

- Soil Test Report (please attach, if available): No
- Organic Carbon of Farm (Date): No
- Water Source (if any open well / dug well / bore well): Perineal spring (approx. 1 Acre), rainwater dependent.
- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): Mostly Local/Indigenous varieties
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety): Indigenous cattle (Thutho)

Type & No. of Perennial Trees in and around Farm: Mostly deciduous type of trees, all uncultivated land are reserved for tree plantation and grazing area (for timber and firewood)

Table 4.12.1: Net Income 1 (all through year activities based) of Case Study 12 Farm (April 2022-March 2023)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	**Total**
Type of Expenditure													
1.Salary to Working families	900	900	900	900	900	900	900	900	900	900	900	900	10800
2.Electricity	450	450	450	450	450	450	450	450	450	450	450	450	5400
3.Cow feed	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	24000
Total													40200
Sources of Income:													
1.Rice/Paddy (for home)													48000
2.Maize													16000
3.Fruits (for sale)	5833	5833	5833	5833	5833	5833	5833	5833	5833	5833	5833	5833	69996
4.Vegetables (for sale)	16666	16666	16666	16666	16666	16666	16666	16666	16666	16666	16666	16666	199992
5. Sale dung	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	30000
Total													363988
Regular Net Income	(363988-40200)												323788

Table 4.12.2: Net Income 2 (seasonal crop-wise) of Case Study 12 Farm (April 2022-March 2023)

Name of Product 1 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Indigenous Onion (Allium Chinese) 0.75 acre	Land Preparation	3000	800 Sale: 560	100	= Rs. 56,000
	Total Expenses	3000			
	Total Net Income 56,000-3000				53000

Name of Product 2 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Potato 0.5 acre	Land Preparation	3000	600 Sale: 300	50	15000
	Seed	4000			
	Total Expenses	7000			
	Total Net Income: 15000-7000				8000

Name of Product 3 (with area cultivated)	Different Expenditures in farming this produce & value addition if any	Amount (in INR)	Total Harvest (in Kgs)			Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
			Name of Items	Total yielding	Total sale		
			Tomato	300	210	80	16800
			Chili	60	30	200	6000
			Soybean	80	24	120	2880
			Brinjal	60	24	80	1920
			Cow pea	40	8	120	960
			Dal	70	28	120	3360
			Pumpkins	120	60	40	2400

			Summer squash	250	50	40	2000
	Total Expenses	00					36320
	Total Net Income: (36320-00)						36320

Name of Product 4 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)			Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
			Name of Items	Total yielding	Total sale		
Winter crops 1 acre (crop rotation in summer cultivated land)	--	00	Cabbage	120	30	40	1200
			Mustard leaves	90	22.50	40	900
			Pea	80	40	200	8000
			Beans	80	40	150	6000
			Garlic	80	48	200	9600
	Total Expenses	00					25700
	Total Net Income: (25700-00)						25700

Name of Product 5 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)			Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
			Name of Items	Total yielding	Total sale		
Fruits (Usually planted on the periphery/ Boundaries of the cultivated Land)	--	00	12 Plum trees	30 kg-50kg per tree		50	10000
			8 Peach trees	20kg-30kg per tree		50	8000
			3 Pear trees	30 kg-50kg per tree		50	4000
			9 Guava trees	20kg-25kg per tree		80	9000

			23 patches of Banana tree	At least 3 fruit-bearing trees per patch per year		800 per tree (average)	38000
	Total Expenses	00					69000
	Total Net Income: (69000-00)						69000

Name of Product 6 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Thutho cattle	rearing of Thutho up to maturity (4 Years)	40000	Average Live weight of Thutho (4 Yrs) = 300 Kgs On average, a cow can produce 6 to 7 kgs per day	Live weight sale price=@ Rs 200 per Kgs Dried dung @ Rs.5 per Kg.	60000 30000
	Total Expenses	40000			90000
	Total Net Income: 90000-40000				50000

Farm Photos

Case Study 13

Case Abstract

Farmer Case 13 practices natural farming across 15 acres in Gujarat, demonstrating a remarkable model of sustainable agriculture. Save's farm is a rich tapestry of biodiversity, cultivating a wide range of crops, from paddy and chickpeas to an assortment of fruits and vegetables, alongside dairy farming. His farm emphasizes the critical balance of production factors - soil health, water conservation, indigenous seeds, farm diversity, and ecology - to create a thriving natural farming ecosystem. This holistic approach enhances crop yield and supports ecosystem services, showcasing the potential of natural farming to sustain both livelihoods and the environment.

District & State

Valsad district, formerly known as Bulsar, is one of the 33 districts in Gujarat, located on the western coast of India. Valsad is a horticulture hub renowned for producing mango, papaya, chikoo, banana, and sugarcane. The district is famously known as the mango capital of Gujarat, particularly for its Alphonso mango, also called Valsadi Haafus. Additionally, Valsadi chikoo is highly sought after both nationwide and globally. Gujarat, which boasts the longest coastline in India at 1,600 km, is bordered by Pakistan to the northwest and by Rajasthan, Madhya Pradesh, and Maharashtra to the north, east, and southeast, respectively. The state experiences three distinct seasons: summer (March to May), where temperatures can reach up to 45°C; monsoon (June to September) with heavy rains; and winter.

Background of the Farm & Farmer

Farmer Case 13 is practicing natural farming on 15 acres of land. This farm is located in Dehri village in Valsad District in Gujarat. Farming here includes paddy, chickpea, mustard, vegetables, turmeric, coconuts, coconut saplings, sapota, bananas, mangoes, curry leaves, etc. Besides, it has integrated livestock into the farming practices. The farm has been developed as an orchard and has been named Kalpavrukhsa.

Farmer Case 13’s father believed in Gandhian Principles, and he applied them in farming practices. The basic philosophy behind his farming practices is ‘non-violence and harmonious coexistence.’ He considered his farm as his university. He was a primary school teacher when he started farming in 1948. Initially, he was practicing chemical farming. The initial four years of chemical farming made his profit, but gradually, he realized that the production did not grow after a point. The principles of Gandhiji also influenced him to move closer to nature, and since 1960, he has been following organic methods in his “Kalpavrukhsa” (Devine Tree) farm.

Overall Land use pattern: The total land of “Kalpavrukhsa” is 15 acres. On the farm, two acres are under paddy, and the other two are under coconut nursery and vegetables. The rest of the land encompasses an orchard with some intercrops. Some land is used for ponds and vermin compost units.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm

production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Moisture-Water Management

In "Kalpavrukhsa," water is conserved through harvesting. Farm water is diverted to the two pits on the farm, where it is filtered and brought to the well (50 feet deep). The farm water is used on the farm itself. The water requirement gets reduced to 80% in 'the platform and trench system of irrigation.'

Farmer Case 13 uses water from the open well for irrigation purposes. This big-sized open well has been located at the center of the farmland. The purpose is to provide water to every corner of the farmland. It is observed that water goes down 40 feet below the ground level in May. He uses a motor to pump out the water for irrigation purposes in the well. His annual irrigation expense is about Rs. 45500/-.

Despite the beautiful ecology and biomass on the farm, the minor water shortage in summer may be due to the location of the well. The cost of pumping water to the farm is also relatively higher. The location of the well has not been based on the principle of water drainage lines in the farm.

Ecology & Farm Forestry

Different types of trees in and around the farm have strengthened his local ecology, thereby protecting crops and plants grown on his farm. The availability of rich biomass enriches the soil health of the farm. About 3800 perennial trees are on this farm.

Soil Health

Farmer Case 13 has followed his father's principle of natural farming – all living creatures have equal right to live. Accordingly, he applies only organic manure to increase soil fertility. Further, adding crop residues has increased the biomass of his farm. His input cost is Rs. 5300/-. He has not tested the soil of his farmland. The soil sample of his farmland has been collected and tested at OUAT, Bhubaneswar. The soil testing report shows that the current pH level of the soil of his farmland is 6.71, which is near neutral, and the Organic Carbon is 1.45, which is high. The microbial activity of the farmland is adequate. Overall, the soil of this farmland is very fertile.

Seeds-sampling-livestock (genetic material composition)

'Kalpavrukhsa' saves its seeds to use. Other farmers often approach Farmer Case 13 for seeds. He uses local seeds to cultivate various crops. He argues that local Agri products are tastier and healthier. Its nutritious value is higher than that of those grown chemically. To him, local seeds are not expensive, and he can struggle with the local environment for survival. He spends Rs. 3500/- towards seed expenses, much lower than GM/hybrid seeds. Organic farming and using local seeds have strengthened his sustainable agriculture practices and farming environment.

The farm has devoted sufficient space for growing plant sampling. This farm grows coconut saplings in large quantities to sell to others. The cows on the farm are of indigenous variety, and Jersey cross-breed chickens are also of indigenous variety and freely grazed on the farm.

Farm Diversity (energy and production basket) management

Instead of mono-cropping, the farm has had diversified farming practices. Farming activities include growing paddy in the Monsoon, chickpeas and mustard in Rabi, and vegetables in summer and winter. Further, horticulture products like coconuts, sapota, and bananas are harvested yearly. Mango is harvested during April-May, and areca-nut in April-May.

He has also integrated dairy into his farming activities, which enables him to prepare organic manure for his farming activities. His diversified farming has strengthened his net income and his farm's biodiversity. The given image demonstrates the diversity of his farm.

Diversification of agriculture on the farm has ensured regular income for the farmer. It has reduced both climate risk and market risk. The farm's significant earnings come from horticultural activities that amount to Rs. 17,17000/-. His other significant earnings include selling coconut saplings that provide him Rs.1,82,000/- annually. After home consumption, annual earnings from the sale of milk are about Rs. 94000/- Similarly, after home consumption consisting of two large families, annual earnings from the sale of vegetables and curry leaves are about Rs. 21700/-. The detailed cost and income are given in the next section.

Ecosystem Services & Climate Resilience

Over sixty years, a teacher turned farmer who considered his farm as his university has systematically very well balanced the above five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), indigenous local seeds or genetic material and on-farm livestock.

All this has dramatically increased the ecological balance on his farm. This balance among the key factors has improved the ecosystem services regarding organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. The relatively higher yield of the farm, despite the slight rise in temperature and rainfall variations in recent years and the increase in total production, are some indicators to mark the climate resilience of the farm.

In recent years, Reliance Industries has set up a power plant in the area. It releases enormous amounts of fine dust. Despite the dust accumulation on the foliage of the farm, the farm is still sustaining its photosynthesis cycle and has remained profitable.

Diversity in Farm Production & Market Resilience

The high quality of the farm produce ensures good demand for its produce. The farm products have a high local demand in the local market and across the state. Given the quality of taste and nutrition, the farmer receives regular orders for various crops from many consumers. Regular income from the farm and a very high net income per hectare indicate the high demand and market resilience. All this also exhibits short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production and output from the farm for most of the year makes the farmer market resilient.

Benefit to Farmer & its Impact on Other Farmers

The natural farming practice on this farm has been quite educational for many and profitable for the farmer and his family. Two of his children were educated well and employed in the corporate sector. When I (principal investigator) met Farmer case 13 in 2013, he had a net bank balance of over INR 100,00,000 in addition to several fixed assets and vehicles on his farm.

Despite the high salaries in the corporate world, both children are involved in natural farming. The grandson has now taken complete charge of this natural farm. For decades, he has systematically challenged the paradigm of the green revolution in India. He has openly challenged the late Dr. M S Swaminathan, the leading Agricultural scientist, on the ill effects of green revolution technologies in agriculture. Interestingly, upon his retirement from active service in the government, Dr. Swaminathan went on to promote 'evergreen agriculture' that adopts natural-ecological farming.

He has made his farm highly profitable by adopting the natural farming system. Over three generations, the farm has used indigenous farming with improvised techniques of tree plantation, soil, water, diversity, and indigenous seeds. He has inspired many leading farmers in the country, trained many, and inspired all, including the well-known farmer, Japanese Fukuoka, who visited his farm during his visit to India.

Expenditure and Income Details

The gross annual income of this 15-acre Farm was estimated to be INR 20,14,700. The total annual cost of operation was estimated to be INR 3,63,100. Accordingly, the net annual income of the farm was found to be INR 20,59,600. The details are given below:

Estimated Net Income*(2021-22)

- Total Revenue (all through year activities based)= INR 4,08,000
- Total Revenue 2 (seasonal crop-wise) = INR 20,14,700
- Total Annual Income = INR 24,22,700
- Total Expenses = INR 3,63,100
- Total Net Income = INR 20,59,600
- Total Area: 15 acres = 6.07 hectares
- Net Income per hectare per year = INR 3,39,308
- Net Income per hectare per month = INR 28,276

The Farm's expenditure and income details are given in the tables on the following two pages.

It is also important to note that three generations of the family have been in this farming system and are happy to continue with this indigenous farming system.

Table 4.13.1: Total Revenue 1 (all through year activities based) of Case Study 13 Farm (April 2021 - March 2022)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	**Total**
Sources of Income:													
1.Milk (for home)	9000	9000	9000	9000	9000	9000	9000	9000	9000	9000	9000	9000	108000
2.Fruits (for home)	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	96000
3.Vegetables (for home)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	12000
4. Rice	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	192000
Total													408000

Table 4.13.2: Total Revenue 2 (seasonal crop-wise) of Case Study 13 Farm (April 2021 - March 2022)

Particulars	Pre-monsoon /Summer			Monsoon			Rabi Window						
	APR	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	Total
Tomato												10000	10000
Leafy								1000	1200	1200	1000	800	5200
Livestock													
Milk	10000	10000	10000	10000	10000	10000	9000	8000	5000	4000	4000	4000	94000
Horticulture													
Coconut	15000	10000	15000	15000	20000	30000	30000	40000	30000	20000	20000	20000	265000
Chickoo	20000	20000	10000			90000	130000	150000	180000	170000	140000	100000	1010000
Banana	5000	4000	7000	6000	4000	3000	2000	5000	7000	3000	8000	8000	62000
Arecanut	20000	20000						10000	30000	40000	40000	30000	190000
Mango	50000	140000											190000
Any Other													
Curry Leaves		1000				2000		1200		1500		800	6500
Coconut Saplings		40000	12000	80000	10000	20000	20000						182000
Sub Total													2014700

Table 4.13.3: Total Expenses of Case Study 13 Farm (April 2021 - March 2022)

Expenditure													
	Pre-Monsoon			Kharif			Winter						
	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	Total
Land Preparation			1000	5000			5000			1000			12000
Input Cost			900		1200		2000			1200			5300
Labour Cost	15000	20000	20000	18000	12000	10000	30000	40000	35000	30000	30000	35000	295000
Seeds			1800				2000			1500			5300
Water	8000	6000	4000	500				4000	5000	5000	6000	7000	45500
Total													363100

Farm Photos

Case Study 14

Case Abstract

Mr. Suchde, inspired by natural and ecological farming principles, have transformed their Madhya Pradesh farm into a vibrant model of sustainable agriculture. Their farm, initially established on a mere quarter-acre of land, now fulfills the nutritional needs of a five-member family through a diversity of crops, including vegetables, fruits, wheat, pulses, turmeric, and dairy. The farm's success is attributed to its non-intrusive soil management, 'Amrit Mitti' and 'Amrit Jal' for enhancing soil fertility and pest control, and the overall integration of natural resources to boost fertility and crop health. Their efforts underscore the potential of small-scale farming in achieving food security and nutritional sufficiency through sustainable practices.

District & State

Dewas district is located in the central part of Madhya Pradesh, on the level plains of the Malwa plateau. The land gently rises to the south towards the Vindhya Range, which is the source of the Chambal and Kali Sindh rivers. Dewas has a semi-tropical climate characterized by hot summers and well-distributed rainfall during the southwest monsoon season. Madhya Pradesh, the second-largest state in India, is situated in Central India. Agriculture is the primary source of livelihood for many of its people, with soybean, wheat, paddy, jowar, maize, gram, mustard, and tau as its main crops. The state has a subtropical climate with three distinct seasons: winter (December to February), summer (March to May), and the rainy season (June to October). In winter, temperatures range from a minimum of 1°C to a maximum of 25°C, with an average minimum temperature of 10°C.

Background of Farm & Farmers:

Initially, Mr. Suchde had 10 guntha (1/4 acre) farmland in Panvel, Maharashtra, under the umbrella of Malpani Trust. In 2006, he moved to Madhya Pradesh. Inspired by the work and experience of Prof. Dhabolkar on natural and ecological farming, he set out to educate farmers on natural-ecological farming to help them eradicate poverty. He established a farm in just one guntha land (1081 square feet), sufficient to fulfill the nutritional needs of a family with five members. On his farm, soil is never disturbed, and farm resources are used to enhance soil fertility, root treatment, and control pests. He uses ‘Amrit Mitti’ and ‘Amrit Jal’ in his farm and calls his farming ‘Amrit Krishi.’

Mr. Suchde has propagated Natueco (Natural Eco-friendly) farming. He teaches farmers about preparing “Amrit Jal” and “Amrit Mitti,” two essential elements of nature farming.

As per late Mr. Suchde, Natueco farming differs from natural and organic farming and is unrelated to commercial techniques. It is based on scientific inquiries and natural experiments. He said, “Nature farming is making friends with nature and understanding nature. In natural farming soil, roots and canopy are important elements.” As per this farming technique, farming can be done anywhere, like on rooftops, barren rock, and derelict land. Vatsal and Anjali are the son and daughter-in-law of the late farmer, who now are practicing this farming system and running a school for children on this farm premises.

The total land under Malpani Trust Farm is 6 acres, managed by Mr. Suchde now includes Vatsal and

Anjali. Tall trees are planted along the edge of 10 Guntha land to check soil erosion. Guntha each is allotted for a workshop and store, space for cattle and chicken, fruit trees, paddy and other grains, a nursery, water storage, cotton and fiber plants, and fast-growing fuel wood trees—half a guntha each is reserved for spices and oil seeds.

Balancing the Critical Factors of Production:

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Soil: In Natueco farming, the soil is not disturbed. The aim is to develop nursery soil into activated mineral soil. 'Amrit Mitti' enhances the fertility of the soil and helps the plant to grow. Green grasses obtained from the farm are crushed and dried and put in 'Amrit Jal' for a couple of days. Then, it is spread over the land, the top activated mineral soil collected from the farm is put on it, and layers are made to one foot high. The farm has developed a technique where, in 45 days, this becomes nutrient-rich compost.

The spread of amrit mitti (soil) and Amrit jal (microbial-rich solution) enhances the earthworm population, making the soil porous; hence, water quickly decreases. The soil on the farm hardly comes in direct contact with rain, sunlight, and wind, so the moisture remains longer. Except for water, the farm does not use any external input. The farm takes care of soil and environment by using biomass and top-activated mineral soil, which helps micro-organisms grow.

Seed: The farm prefers to use traditional and farm-produced seeds. Before sowing the seed, it is kept under the sun till 11 AM in the daytime. Then, it is dipped in 'Amrit Jal' for seven days, and the seeds floating on the water's surface are extracted. Top-activated soil and cow dung of the same amount is mixed with cow urine, and small balls are made. Seeds are inserted into the balls, dried in the shadow region, and thrown in the 'Amrit mitti' composted area without disturbing the soil.

Diversified Integrated Agriculture: The farm consists of wheat, cereals, vegetables, fruit trees, and livestock like cows, chickens etc. The diversity of crop production on the farm can be seen from the detailed information on the production of various crops, as well as their cost and income.

Water (Moisture): While there is a bore well on the farm, the primary source of water for the farm is the river Narmada. This farm is located on the bank of this river. Water required for the farm is pumped from the river through the water pump.

Ecology: The horticultural plants, including banana plants, drumstick trees, papaya, guava, and bamboo plantations on the fences, provide the ecological balance on the farm. The livestock in the farm also plays a vital role in ecological balance and farming practice as their excretion contains the necessary materials to grow crops.

Ecosystem Services & Climate Resilience

About a decade ago, among the practicing farmers, Mr. Suchde was the most vocal about building the vegetation cover on the farm. He pioneered enriching the farm with perennial trees that would subsequently contribute to all the other critical factors of production. Over time, the above five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), indigenous local seeds or genetic material and on-farm livestock, are very well balanced.

While Mr. Suchde spent most of his time experimenting and took it forward to train others, however during the later part, he paid more attention to developing his whole farm. His son and daughter-in-law have focused themselves on the farm and have greatly transformed the farm as Mr. Suchde imagined for all farmers. The balance among the key factors has improved the ecosystem services regarding organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. The relatively higher yield of the farm despite the slight rise in temperature and rainfall variations in recent years and the increase in total production are some indicators to mark the climate resilience of the farm.

Diversity in Farm Production & Market Resilience:

The quality and nutrition of the farm produce is very high. Accordingly, farm products are in high local demand and sold at a premium, not as a commodity. Given the quality of taste and nutrition, the farmer receives regular orders for various crops from many consumers. Regularity of income (daily income from milk and weekly income from greens, fruits, and vegetables) from the farm and a very high net income per hectare indicate the high demand and market resilience. These developments exhibit short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production and output from the farm for most of the year makes the farmer market resilient.

Benefit to Farmer & its Impact on Other Farmers:

Since Deepak Suchde passed away, Farmer Case 14 has taken forward the farming activities and started a school for the locality's children. Farm yield, total production, and net income have increased. While young children are exposed to natural farming early on, others are welcome to visit and learn from the farm. The farm has inspired many farmers and scientists in the country. The current estimated income from the farm is summarized below.

Estimated Net Income* (2021-22)

- Net Income 1 (all through year activities based) = - (INR 3,75,600)
- Net Income 2 (seasonal crop-wise) = INR 11,59,540
- Total Annual Net Income = INR 7,83,940
- Total Area: 6 acres = 2.36 hectares
- Net Income per hectare per year = INR 3,32,178
- Net Income per hectare per month = INR 27,681

*For more details, please see the detailed Information Sheet.

Detailed Information

Land Information:

Total Cultivable Land (in acres): 7

Total land used for Organic/Natural Farming/Ecological (in acres): 6

Ecosystem Services related Information of the Farm:

- Soil Test Report (please attach, if available).
- Organic Carbon of Farm (Date): 8.45gm in 100g of Amrut Mitti (8/10/2013)
- Water Source (if any open well / dug well / bore well): Narmada River for Irrigation and Dug well for home consumption.
- Please indicate the depth (in feet) from ground to water level in May:
- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): Every type of seed except GM variety
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety): Local
- Type & No. of Perennial Trees in and around Farm: Few deciduous perennial trees (Gliricidia) and more of evergreen perennial trees (Bamboo)

Table 4.14.1: Net Income 1 (all through year activities based) of Case Study 14 Farm (April 2021-March 2022)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Total (in INR)
Type of Expenditure													
1.Salary to Working families (10k/person/month x 3 laborers)	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000	360000
2.Electricity	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	12000
3.Cow feed (6000/- x 2 cows per month)	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	144000
Total													516000
Sources of Income:													
1.Milk (for home)	7200	7200	7200	7200	7200	7200	7200	7200	7200	7200	7200	7200	86400
2.Fruits (for home)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	18000
3.Commercial crops (for home)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	21600
4.Inome from Training	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	14400
Total													140400
Regular Net Income													**-375600**

Table 4.14.2: Net Income 2 (seasonal crop-wise) of Case Study 14 Farm (April 2021-March 2022)

Name of Product 1 (With area cultivated	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Lemon (1/2 acres)	50 Tree (15rs/plant)	750	2500kg	20 rupees per kg (Wholesale rate)	Approx. 50,000
	Total Expenses	750			
	Total Net Income (50000 – 750)				49250

Name of Product 2 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Mosambi (1/6th acres)	15 Saplings (30rs/plant)	450	3000kg Approx.	50rupees per kg	1,50,000
	Total Expenses	450			
	Total Net Income (150000 – 450)				149550

Name of Product 3 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Moringa Leaves (1 acres)	Seeds (5kg) (50rs/kg)	250	300Kg (in dry leaf form)	600rs/kg	1,80,000
	Total Expenses	250			
	Total Net Income: (180000 – 250)				179750

Name of Product 4 (with area cultivated)	Different Expenditures in farming this produce & value addition if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Curry Leaves (1/3rd acre)	200 Saplings (5rs/sapling)	1000	50kg	500rs/kg	25000
	Total Expenses	1000			
	Total Net Income (25000 – 1000)				24000

Name of Product 5 (With area cultivated	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Turmeric (1/8th acre)	Mother rhizome (50kg) (Bought in 2010 at 25rs per kg)	1250	200kg Powder	350rs/kg	70,000
	Total Expenses	1250			
	Total Net Income (70000 – 1250)				68750

Name of Product 6 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Moong (1/2 acre)	3kg moong (120rs/kg)	360	300kg	150rs/kg	45,000
	Total Expenses	360			
	Total Net Income: (45000 – 360)				44640

Name of Product 7 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Wheat (1 acre)	10kg seed (50rs/kg)	500	3000kg	35rs/kg	1,05,000
	Total Expanse	500			
	Total Net Income (105000-500)				104500

Name of Product 8 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Tur dal (1 acre)	5kg seed (100rs/kg)	500	2500kg	200/kg	5,00,000
	Total Expenses	500			
	Total Net Income (500000 – 500)				499500

Name of Product 9 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Vegetables	Expenses	00	Average 2 kg per day x 30 days = 60 kg	30/- per kg	1800 per month x 12= 21600

Name of Product 10 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Fruits	Expenses	00	Average 1 kg per day = 30 kg	50/- per kg	1500 per month x 12 = 18000

Farm Photos

Case Study 15

Case Abstract

Farmer Case 15, a tribal farmer from West Bengal, embodies the shift towards natural farming with the support of NABARD's Watershed program and local agency guidance. On her 3-acre farm, Farmer Case 15 cultivates a diverse array of crops, including paddy, oilseeds, pulses, and vegetables, alongside integrating livestock and fishery, transitioning from reliance on synthetic fertilizers to natural farming practices. Her journey reflects the empowerment and resilience of farmers adopting sustainable agricultural methods, demonstrating the effectiveness of natural diversified farming in enhancing productivity and ecosystem health.

District & State

Bankura district, located at 23.25°N 87.07°E in the northwestern part of West Bengal, experiences a scorching climate in summer and moderate temperatures in winter, with most rainfall occurring between June and September. West Bengal, the twelfth largest state in India by area, stretches from the Himalayas in the north to the Bay of Bengal in the south. Forests are found in the southern Sundarbans, the northern Tarai belt, and the state plateau area. The climate is cooler in the northern mountains than in the southern plains, with temperatures ranging from well below freezing in the hills during winter to about 45°C in the southern parts during summer. The southern part enjoys generally pleasant winters, with snowfall limited to the Himalayan regions and heavy rain during the monsoon season from June to September.

Background of the Farmer & Farm

Farmer Case 15 is a resident of Hansapahari village in the Bankura district in West Bengal. She has been practicing natural farming on her 3 acres of farmland with the help of NABARD’s Watershed program and as part of the climate change adaptation program guided by a local agency, viz., Development Research Communication & Services Centre (DRCSC). She is a tribal farmer, and her ailing husband is currently practicing a natural farming system. Following her association and training with DRCSC in 2015, she cultivates various crops in her 3 acres of farmland, like paddy, oilseeds, pulses, and vegetables. She gradually diversified her natural farming, integrating livestock and fishery activities.

Before adopting natural diversified farming practices, Farmer Case 15, like any other village farmer, used synthetic industrially produced fertilizers and pesticides. Her primary advisor for agriculture was the local dealer who sold chemical fertilizers and pesticides. As part of a NABARD project, climate change adaptation, when members of DRCSC approached the farmers of Hansapahari village of Bankura district to discuss natural farming, they resisted the change.

However, with some persuasion, DRCSC formed groups of women and men to discuss and deliberate on how to go about solving the water, food, and income problems. Even though farmers started making vermicompost for their use, they often applied both vermicompost and fertilizers to their farming in the early years of adopting natural farming. With the demonstration of the negating effect of this practice, the farmers learned to give up the use of synthetic fertilizers.

Gradually, in addition to diversifying field crops on farms from paddy to paddy, pulses, and mixed

cropping, Farmer Case 15 diversified her livestock from cows to cows, goats, ducks, and hens. Subsequently, the small water tanks were used to cultivate fishery. Training was provided to grow plant biomass and azolla for the livestock. As Ms. Sulekha Laha, one of the members of DRCSC, mentioned, "Addition of livestock not only increased their nutritional security, but it also served as an 'any time money' (ATM), a source to sell livestock and get immediate cash when in emergency need of money."

Before 2016, farming in Hansapahari village, including that of Farmer Case 15, was a loss-making activity. There was a shortage of water, farmer families had low levels of nutrition, and families had minimal assets. There was a food shortage in about 80% of farmers' families during March-April and September-October. The situation has greatly changed for the better over the last seven years. Like many women under the project, Farmer Case 15 says, "We now have sufficient food throughout the year." The asset base of individual farmers have also increased over time.

Among the many farmer families that adopted natural farming, Farmer Case 15 did well despite her ailing husband. He, however, fully supports Dipali and assists her in caring for the livestock of cows, goats, ducks, and fishery. Her son is now in school.

Balancing the Critical Factors of Production:

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five key factors of production?

Soil: Farmer Case 15 applies organic manure to improve her farmland's soil fertility. She prepares organic manure from cow dung. She applies vermicompost to foster soil fertility. Further, she prepares organic microbial solutions out of cow urine to control pest attacks and for better growth crops on her farm.

Water: She has erected one dug well to irrigate her farm crops. Besides, she also uses rainwater for farming purposes. In May, the water level is 22 feet below the ground level. This is a good level of groundwater in this region.

Seed: She uses local seeds for farming activities. Further, her farm's livestock, horticulture, and other plants are of local varieties. The local NGO, DRCSC, has supported Dipali and other farmers in procuring good quality seeds for farming activities.

Diversity: Farmer Case 15 has diversified her farming practices by integrating horticulture activities and animal husbandry with field crop cultivation. Her animal husbandry activities include local cow, duck, goat, and fisheries varieties.

Ecology: Her farm is surrounded by various perennial trees like Palmirah Palm, Date Palm, Neem, Arjun, Mahua, Moringa, Sirish, Dumur, Turmeric, Segun, Jam, Haritaki, Shal, Amlaki, Palash etc. All these perennial trees have balanced her farm ecology. She has also been part of a group that grows trees in about 4 acres of fallow land. This work has added diversity to fauna in the area and has become a source of income for other women.

Ecosystem Services & Climate Resilience

Though Farmer Case 15 has adopted natural farming only in the recent about 6-7 years, the systematic interventions on the above five factors of production, viz., ecology (trees on the farm), soil health improvements, increase in farm diversity both in field crops, indigenous local seeds or genetic material and on-farm livestock has improved ecological balance. This balance among the key factors has improved the ecosystem services regarding organic carbon in soil and water absorption capacity. The relatively higher yield of farms, despite a slight rise in temperature and rainfall variations in recent years and an increase in total production from a diverse production basket, are some indicators to mark the climate resilience of the farming system.

Diversity in Farm Production & Market Resilience

Diversity in farm production and output from the farm for most of the year makes the farmer market resilient. The farmers get better product prices as their customer base is significant, and many are direct consumers. Regular income from the farm and a high net income per hectare indicate the demand and market resilience and short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by Farmer Case 15.

Benefit to Farmer & its Impact on Other Farmers:

A farmer's family that suffered from a food shortage for about 4 months until 2016 is now very confident of sufficient food and nutrition for her family. This change signifies the success of adopting a natural farming system that uses indigenous farming with improvised techniques of tree plantation, soil, water, diversity, and indigenous seeds. She has inspired many farmers within the community, especially as a women-led farming family. The local agency DRCSC has adopted her as the local champion of the natural farming system. The current total net income of the farmer family is summarized below.

.

Estimated Net Income[f]* (2021-22)

- Net Income 1 (all through year activities based) = INR 1,39,550
- Net Income 2 (seasonal crop-wise) = INR 2,59,200
- Total Annual Net Income = INR 3,98,750
- Total Area: 3.0 acres = 1.21 hectares
- Net Income per hectare per year = INR 3,29,545
- Net Income per hectare per month = INR 27,462

[f] Projected for 1 Hectare

*For more details, please see the detailed information sheet below.

Table 4.15.1: Net Income 1 (all through year activities based) of Case Study 15 Farm (April 2021-March 2022)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Total (in INR)	Remarks
Type of Expenditure														
1.Salary to Working families/	1500	1500	1500	1500	3500	3500	0	0	7500	1750	0	0	22250	Hired Labors
3.Water														Own Dug well
4.Cow feed														Own
5.Power Tiller Fuel	0	500	2500	2000	0	0	1000	0	0	0	0	1000	7000	
Total													29250	
Sources of Income:														
1.Milk (for home)	600	650	550	600	600	600	600	600	600	700	500	600	7200	Average
3.Fruits (for home)	600	700	500	600	600	600	600	600	600	600	600	600	7200	Average
5.Vegetables (for home)	1500	1500	1600	1400	1500	1500	1400	1500	1600	1500	1500	1500	18000	Average
6.Vegetables (for sale)	18000	7000	7000	12000	3000	2000	2000	1500	2000	1500	8000	2000	66000	Average
7. Paddy (for Sale)												40000	40000	Average
8. Paddy (for home)												15000	15000	Average
9. Mustard (for Home)												2100	2100	Average
10. Pulses(for Home)	200	200	300	400	100	200	200	200	400	300	200	300	3000	Average
Fish (for Home)	400	600	400	450	550	400	500	400	400	400	500	1000	6000	Average
Meet &Egg	300	500	200	300	700	400	300	400	200	200	400	400	4300	Average
Total													168800	
Regular Net Income	(168800-29250)												**139550**	

Table 4.15.2: Net Income 2 (seasonal crop-wise) of **Case Study 15 Farm (April 2021-March 2022)**

Name of Product 1	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR
Paddy 3 acres	Seed-Own		4,200 kg	20	84000
	Fuel	4000			
	Manure, FYM-Own Slim-Own				
	Vermicompost - Own				
	Cow Urine- Own				
	Total	4000			
	Total Net Income: 84000-4000				80000

Name of Product 2	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR
Vegetables 1.33 acres	Seed-Own		5500Kg	25	137500
	Fuel	4000			
	Manure: FYM-Own				
	Vermicompost- Own				
	Cow Urine- Own				
	Total	4000			
	Total Net Income: 137500-4000				133500

Name of Product 3	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR
Mustard	Seed- own		30 kg	75/-	2250
	Fuel				
	Manure- FYM-Own				
	Vermi compost- Own				

0.5 acres	Cow Urine- Own				
	Total	00			
	Total Net Income: 2250-00				2250

Name of Product 4	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR
Pulses	Seed- own	-	20 kg	150/-	3000
	Fuel	-			
	Manure - FYM-Own	-			
0.33 acres	Vermicompost- Own	-			
	Cow Urine- Own	-			
	Total	00			
	Total Net Income: 3000-00				3000

Name of Product 5	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR
Livestock	Feed-own	-	233 kg	150/-	34,950
	Labor-own	-			
Goat- 12	Total	00			
Cow- 3 Hen- 5 Duck-4	Total Net Income: 34950-00				34,950

Name of Product 6	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR
Fishery	Fingerling	500	40 kg	150/-	6000
	Fish feed- own	-			
	Total	500			
	Total Net Income: 6000-500				5500

Farm Photos

Case Study 16

Case Abstract

The farm of Farmer Case 16 in Punjab demonstrates a comprehensive approach to agriculture and livestock management across 1.57 acres. Emphasizing soil health, water conservation, and biodiversity, Singh's farm incorporates a variety of crops and livestock, illustrating the benefits of integrated farming systems. This approach ensures a stable income and contributes to a balanced ecosystem, highlighting the practicality and sustainability of combining traditional farming practices with modern ecological insights.

District & State

Chandigarh, a city and union territory in India, is the capital of both Haryana and Punjab. It is situated in northwest India near the foothills of the Shivalik range of the Himalayas, covering around 114 km² and bordered by Haryana and Punjab. The city's exact coordinates are 30.74°N 76.79°E. Classified under Koeppen's CWG category, Chandigarh experiences a cold, dry winter, a hot summer, and a sub-tropical monsoon, evaporation often exceeding precipitation, resulting in generally dry weather. The city has four distinct seasons: summer (mid-March to mid-June), the rainy season (late June to mid-September), post-monsoon autumn/transition (mid-September to mid-November), and winter (mid-November to mid-March). Summers are typically long and dry but can feature occasional drizzles or thunderstorms.

Background of the Farm & Farmer

Farmer Case 16 is a young farmer. Like many farmers in the village, his father practiced chemical input-based mono-crop agriculture before he adopted natural farming in 2016. Before 2016, chemical input-based farming yielded little profit for the parents of farmer case 16. Further, the health of his father deteriorated due to the handling of chemicals and pesticides regularly in farming activities.

Before 2016, Farmer Case 16 worked with several NGOs, including the Khet Virasat Mission, to build farmers' awareness of organic and natural farming practices. Finally, in 2016, Amrit decided to adopt natural farming practices, and over the last few years, he has been gradually diversifying the farm with different crops from his initial mono-crop farming system. He has diversified his farm from primarily growing cereal crops with pulses, various vegetables, horticulture plants, flowers, and livestock. He has been quite active in his community of farmers and leads a farmer cooperative.

The 4-acre land of Farmer Case 16 is one patch. Chemical farming is practiced in other farmlands in rural Punjab. There is temporary fencing around the farm with perennial trees on two sides of the farm. The farm has been demarcated to grow different crops. Using the government's support, a vermin compost unit and an apiculture unit are part of the farm. Farmer Case 16 has been developing some basic infrastructure on the farm to provide on-farm training to farmers and visitors to the farm.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of

farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Moisture-Water (in-situ water conservation & harvest)

The farmer has a 3 HP Motor on the farm. He has a piping system to water his farm. He also developed a canal system within the farm for irrigating his farm. While the farmer is aware of a rich ecology on the farm for better water holding capacity, the farm forestry is under development. Currently, groundwater is pumped to irrigate the farm.

Ecology (farm forestry & biomass)

The entrance to the farm has good tree cover. There are a few perennial trees on one side of the farm. The farmer has been gradually developing the tree cover on his farm. Many fruit trees have been planted, and these plants will take a few years to grow to support ecosystem services on the farm.

Soil Health

The health of the soil looked quite good. The crop yield has increased over the years. The biomass on the farm crop residues is used to mulch the soil and is allowed to decompose on the farm. The farmer has a cow and three bullocks. The cattle dung is de-composted along with the farm biomass in the vermin compost unit and spread on the farm depending on the crop cycle. The soil, however, could be tested to know the details of soil health. The farmer also owns a tractor to plow his land and transport the fodder and cattle dung to the farm from his house.

Seeds-saplings-livestock (genetic material composition)

The farmer prefers using local seeds for his field crops and vegetables. He gets the plant saplings from the state horticulture department. The livestock comprising one cow and three bullocks are also of local breed. However, getting indigenous seeds has been difficult. Farmer Case 16, along with his other farmers in the organic group, coordinates the collection, growth, preservation, and sharing of local seeds with each other.

Farm diversity (energy and production basket)

The farmer has increased the diversity of field crops, vegetables, fruit-horticulture trees, and livestock. He has also added an apiary to the farm activity. Further, he is developing his farm as a training unit to train other farmers and visitors to his farm. Paddy, wheat, and ragi/barley are grown in the cereal category. Pulses such as green gram and black gram are grown. Onion, garlic, and fennel (soamph) are grown in the spices category. Various green vegetables, including potatoes, are grown on the farm. A limited number of fruits are harvested mainly for home consumption. Honey, however, is a regular production from the farm.

Ecosystem Services & Climate Resilience

Within six years, the young farmer has done well to get the farm closer to balancing the above five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), indigenous local seeds or genetic material and on-farm livestock. As this balance among the key factors improves

the ecosystem services in terms of organic carbon in the soil, water absorption capacity, and reduction in temperature on the farm will increase. The relatively higher yield of the farm, despite the slight rise in temperature and rainfall variations in recent years and the gradual increase in total production, are some indicators to mark the climate resilience of the farm.

Diversity in Farm Production & Market Resilience

The farm products are of good quality, meet local demand, and are sold at a reasonable price. Farmer Case 16 has also facilitated a Farmer Producer Organization (FPO), taking other similar farmers from the area, and hence, he can sell his farm produce through the FPO. Given the quality of taste and nutrition, the farmer receives regular orders for various crops from many consumers. Regularity of income (daily income from milk and seasonal fruits, vegetables, and flowers) from the farm and a high net income per hectare indicate high demand and market resilience. All these also exhibit short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production and livestock ensures regular output from the farm, making the farmer market resilient.

Benefit to Farmer & its Impact on Other Farmers

Since adopting natural farming, Farmer Case 16 says, "his farming has become profitable." Farm yield, total production, and net income have increased gradually. He has inspired many young farmers in the area and community. He communicates well as part of an NGO training other farmers on natural farming. By gaining experience in farming by doing it himself, he could become a very effective trainer and motivator of natural farming. The current estimated income from the farm is summarized below.

Expenditure and Income Details:

The gross annual income of this 4.0-acre Farm was estimated to be INR 5,83,000. The total annual cost of operation was estimated to be INR 1,60,000. Accordingly, the net annual income of the farm was found to be INR 4,23,800. The table below gives the details:

Estimated Net Income* (2020-21)

- Total Revenue = INR 5,83,800
- Total Expenses = INR 1,60,000
- Total Net Income = INR 4,23,800
- Total Area: 4 acres = 1.57 hectares
- Net Income per hectare per year = INR 2,69,936
- Net Income per hectare per month = INR 22,495

*For more details, please see the detailed information sheet below.

The breakdown of this figure is given below.

Monthly Income

The net monthly income of this 4.0-acre (1.57-hectare) farm has been estimated to be INR 35,316. Accordingly, the net monthly income of 1 hectare of land would amount to INR 22,495. This positive income of the farmer as compared to losses about five years ago when his father followed chemical farming on the same farm, is of great relief to the young farmer, Farmer Case 16. The farmer can build up its other strength, especially on farm forestry and horticulture diversification, to reduce the cost of maintaining soil health, reduce the cost of pest management, and enhance income from horticulture and livestock.

The cost of labor put in by the farmer and his family has not been accounted for in the cost of farming on this farm. Similarly, the above income does not include the value of milk, vegetables, fruits, pulses, and cereals consumed by the family. As per the farmer, the net additional income from the milk and sale of cattle calf amounts to about INR 150,000. Family consumption of vegetables, cereals, and pulses from the farm may amount to another INR 90,000. Adjusting the monetary value of this household consumption with the cost of family labor will show an increased monthly net income of the farmer by about INR 13,000 per hectare per month. Hence, effectively, at this farm, the net monthly income per hectare for the Farmer Case 16 amounts to INR 35,500.

Table 4.16.1: Total Expenses of Case Study 16 Farm (April 2020 - March 2021)

Particulars	Pre-Monsoon			Kharif			Winter						
	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	Total
Labor (2 labor for 10 months)													90000
seeds													5000
Rotavator (35000@10% deposit)													3500
Interest @ 10%													3500
Diesel													6000
Maintenance													3000
Miscellaneous													5000
Farmyard Manure (Labor)													2800
Sugar Cane processing													20000
Borewell/Tubewell (375Ft) 200000 Utilization (28%)													
Organic (56000@10% depreciation)													5600
Interest @ 10%													5600
Vermi compost fixed, spent 40000@5%													2000
Borewell Maintenance													4000
Manure Cost													4000
Total													1**60000**

Table 4.16.2: Total Revenue of Case Study 16 Farm (April 2020 - March 2021)

Particulars	Pre-monsoon /Summer			Monsoon			Rabi Window						
	APR	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	Total
Jaggery													110000
Haldi													15000
Nursery seeds													120000
Vermi Compost													20000
Potato													30000
Vegetables & Fruits													130000
Vegetables/													20000
Onion													25000
Ragi/Barley													15000
Soamph (Spices)													6800
Garlic													10000
Gram/Pulse													7000
Seeds (Indigenous)													10000
Onion Seeds													40000
Fruit (Home)													10000
Honey													15000
Total													**583800**

Farm Photos

Case Study 17

Case Abstract

Farmer Case 17 in Kerala utilizes 0.78 acres for an array of crops, including paddy, banana, and nearly 65 varieties of fruits, alongside beekeeping. His diverse farming practices, emphasizing organic methods and biodiversity, showcase a robust model for small-scale farming. Prakash's farm highlights the importance of diversity in crops and pollinators for enhancing productivity and sustainability, illustrating how integrated farming practices can lead to ecological resilience and improved livelihoods.

District & State

Palakkad, one of the fourteen districts of Kerala, lacks a coastline but connects the state to the rest of India through the Palakkad Gap. The district is characterized by its unique geographical position, rich history, educational prominence, tourism attractions, and diverse development activities. With a tropical wet and dry climate, Palakkad typically maintains moderate temperatures year-round, except for the hottest months of March and April. The district receives significant rainfall, primarily due to the southwest monsoon, with July being the wettest month. The total annual rainfall is around 100 cm. As one of Kerala's main granaries, Palakkad's economy is mainly agricultural. Kerala's climate is relatively consistent throughout the year and is significantly influenced by the southwest monsoon, which lasts from July to September, and the northeast monsoon, which occurs in October and November.

Background of the Farmer & Farm

From childhood, Farmer Case 17, one of the five siblings, was curious about farming. However, he was sent to study in a school. Between 1992 and 1995, the young Surya started some farming by using chemical fertilizers and pesticides. In 1994, during his 12th class, he attended a lecture at his school by Dr. Satish Chandran, Director of INTAC. Dr. Chandran's narration of the various problems in the natural environment touched young Farmer Case 17. He somewhat realized the mistakes of his farming practice as a student.

He undertook several activities as he continued his studies in an ITI college with automobiles as his subject. He started a newspaper distribution agency and became interested in learning more about forests and the environment. In 1996, he made friends with people like Reiji Joseph, a farmer and environmental activist. From 1998 onwards, he also volunteered to work in the Forest Department for free to learn about forests and the environment. In 2005, he was selected to join as a driver in the Ordinance Factory. As it was far from his village, he tried to find a transfer near it but failed. In due course of time, he tried to apply for other jobs closer to home so that he could work in the environment, forest, and agriculture. Finally, in 2011, he managed to get a clerical job in the RTO of the state department. His office was closer to his village, 70 KM from his village.

In 2012, he bought a piece of undeveloped land, which he has developed into the present farm. Although he took possession of the land, he had hardly done the primary work of tree plantation; he met with an accident and could start his work systematically only in 2015. Farmer case 17 has transformed this land into a food forest within seven years.

His total homestead land is 1.94 acres. He has been practicing natural-ecological farming. It is evolving as a beautiful food forest, rich with various fruit trees, berries, and a pond fed by natural spring water. The pond serves as a swimming pool for children, and fish are harvested naturally. This small farm includes many honey boxes with an excellent honey collection. The major crops grown on his farm include paddy, banana, rambutan fruit, areca-nut, & and honey.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Soil: The soil of his farmland is rich and fertile. He applies organic manure in his farmland to maintain soil fertility. The soil of his farmland was collected and given to OUAT for laboratory testing. The organic carbon is still low, but high vegetation covers the land and has good moisture-holding capacity, so the farm can soon gain high organic carbon.

Water: He has dug one open well on his farmland to irrigate his farm crops. The water in May 2023 was 3 feet below the ground level. The above data implies that the water holding capacity is very high and that spring water can be harvested well.

Seed: S Farmer Case 17 has planted various local varieties of fruit. He obtains good quality plants from local government nurseries, other farmers, and sources. He also uses indigenous seeds to cultivate various crops on his farm.

Diversity: He has diversified his farming activities by integrating horticulture activities and added beekeeping. The farm is like a perfect food forest during summer. He has over 70 varieties of different food crops on this farm.

Ecology: There is a good forest cover on three sides of his farm and household. The forest cover and horticultural trees planted on the farm are vital in balancing his farm ecology. He has planted several varieties of horticulture plants, including Trees- 190, Coconut tress- 27, and areca nut trees- 43

Ecosystem Services & Climate Resilience

Within seven years, Farmer Case 17 has done very well in balancing the above five factors of production, viz., soil health improvements, increase in farm diversity, horticulture plants, ecology (trees on the farm), indigenous local seeds or genetic material and on-farm livestock. As this balance among the key factors improves the ecosystem services in terms of biomass on the farm, water absorption capacity, and reduction in temperature on the farm has improved. The relatively higher yield of farms despite a slight rise in temperature and rainfall variations in recent years and the gradual increase in total production are some indicators to mark the climate resilience of the farm.

Diversity in Farm Production & Market Resilience

The farm products are of excellent quality and tasty. Given the quality of taste and nutrition, the farmer receives regular orders for various crops from many consumers. Regularity of income (daily income from milk and seasonal fruits, vegetables, and flowers) from the farm and a high net income per hectare indicate high demand and market resilience. Some fruits and crops are in this food forest at any time of the year. The above exhibits short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production and livestock ensures regular output from the farm, making the farmer market resilient.

Benefit to Farmer & its Impact on Other Farmers:

While he has pursued natural farming as a passion, Farmer Case 17 leads a healthy life with excellent profits from his farm. Farm yield, total production, and net income have increased gradually. He has inspired many young farmers in the area and community. He now trains many groups on the environment, forests, natural farming, and food forests to create a climate-resilient earth. He is now a sought-after food forest trainer in his district. The current estimated income from the farm is summarized below.

Estimated Net Income[*] (2021-22)

- Net Income 1 (all through year activities based) = INR 26,000
- Net Income 2 (seasonal crop-wise) = INR 1,68,675
- Total Net Income = INR 1,94,675
- Total Area: 1.94 acres = 0.78 hectares
- Net Income per hectare per year = INR 2,49,583
- Net Income per hectare per month = INR 20,799[c]

c projected for 1 hectare

*For more details, please see below the detailed Information Sheet

Detailed Information

Land Information:

Total Cultivable Land (in acres): 1.94 acres

Total land used for Natural Farming/Ecological (in acres): 1.94 acres

Ecosystem Services related Information of the Farm:

- Soil Test Report (please attach, if available): Not available
- Organic Carbon of Farm (Date): Not available
- Water Source (if any open well / dug well / bore well): Open well (Pond)
- Please indicate the depth (in feet) from ground to water level in May: 3 feet.

- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): Indigenous and improved varieties.
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety): Fish & Honeybee
- Type & No. of Perennial Trees in and around Farm: Fruit Trees- 190nos, Coconut tress- 27nos, Arecanut trees- 43 nos (Total 260 no

Table 4.17.1: Net Income 1 (all through year activities based) of Case Study 17 Farm (April 2021-March 2022)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	**Total**
Type of Expenditure													
1.Salary to Working families	9000	9000	10800	10200	9000	18000	9000	11200	8000	9000	13000	7000	123200
2.Electricity	490	490	490	180	180	180	180	180	310	440	490	490	4100
3.Organic fertilizer	31000	1200	4000	4500	1200	1200	1200	4000	1200	1200	4000	20000	74700
Total													202000
Sources of Income:													
1. Fruits (for home)	4000	6000	5000	6000	6000	4000	4000	3000	3000	3500	4000	3500	52000
2. Fruits (for sale)	2000	2000	2500	6000	8000	8000	8000	7000	1000	1000	1500	4000	51000
3.Vegetables (for home)	2200	2000	2500	2300	2800	3000	2700	2500	2100	2000	2200	2600	28900
4.Rice(for home)	2700	2700	2700	2700	2700	2700	2700	2700	2700	2700	2700	2700	32400
5.Rice(for sale)	2550	2800	2750	2200	2500	2850	3000	2650	2250	2350	2450	2550	30900
6.Honey (for home)	650	600	700	650	700	700	650	600	700	600	650	600	7800
7. Honey (for sale)	5000	7000	7000	3000	2000	500	500	0	0	0	0	0	25000
Total													228000
Regular Net Income	(228000-202000)												26000

Table 4.17.2: Net Income 2 (seasonal crop-wise) of Case Study 17 Farm (April 2021-March 2022)

Name of Product 1 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Banana 0.45 acre	Labor Charge	44200	2400 kg	Rs. 50/kg	Rs. 120000/-
	organic fertilizer	22000			
	Biocontrol	2000			
	Transportation	6500			
	Total Expenses	74700			
	Total Net Income: 120000-74700				45300

Name of Product 2 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Rice 0.51 acre	Labor Charge	9500	550kg	Rs. 85/Kg	Rs. Rs. 46750/-
	Organic fertilizer	7000			
	Processing charge	2500			
	Transportation	4300			
	Total Expenses	23300			
	Total Net Income: 46750-23300				23450

Name of Product 3 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Rambutan fruit	Labor Charge	1500	155 kg	Rs. 175/kg	Rs. 27125/-
	organic fertilizer	1500			

0.05 acre	Transpiration	2000			
	Total Expenses	5000			
	Total Net Income: 27125-5000				22125

Name of Product 4 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Areca-nut 0.05 acre	Labor Charge	5000	1200Kg	Rs.56/kg	Rs 67200/-
	organic fertilizer	6000			
	Biocontrol	800			
	Transportation	800			
	Total Expenses	12600			
	Total Net Income: 67200-12600				54600

Name of Product 5 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Honey	Labor Charge	5000	75kg	Rs.400/kg	Rs. 30000/-
	Equipment cost	1000			
	Food expenses	800			
	Total Expenses	6800			
	Total Net Income: 30000-6800				23200

Table 4.17.3: List of Fruit Trees & Food Plants of Case Study 17 Farm

1. Rambutan
2. West Indian Cherry
3. Baraba
4. Star fruit
5. Grape guava
6. Guava
7. Allahabad safed
8. Lucknow 49
9. Halith
10. Sweet orange
11. Avacado
12. Khumkat
13. White Jamun
14. Citron
15. Indian coffee plum
16. Kara
17. Malta lemon
18. Mango (6 varieties)
19. Variegated guava
20. Saporta
21. Curry lime
22. Lemon
23. Custard apple
24. Bakey cherry
25. Coconut
26. Arcanut
27. Garcinia cambogia
28. Pomelo
29. Mangosteen
30. Egg fruit
31. Surinam cherry
32. Vietenam superearly jack
33. Malay apple
34. Water apple
35. Jack fruit – 4 varieties
36. Bhedas
37. Curry leaves
38. Kokum plant
39. African chestnut
40. Breadfruit
41. Jamaican star fruit
42. Sourson plant
43. Velvet apple
44. Blueberry
45. Rolenion
46. Mulberry
47. Corsican
48. Strawberry guava
49. Achachairu
50. Miracle fruit
51. Chinese orange
52. Abiu
53. Pisonia grandis
54. Wild jack
55. Peanut butter fruit
56. Chaimansa
57. Sterculia guttata
58. Munja
59. Indian vael
60. Ashoka tree
61. Hibiscus plant
62. Mimsops Elengi
63. Akathi spinach
64. Passion fruit
65. Ivy gourd
66. Tapioca
67. Elephant yam
68. Alocasia
69. Ginger
70. Arrowroot
71. Turmeric
72. Black pepper
73. Indian trumpet tree
74. Purple yam
75. Pineapple
76. Baccaurea courtalnensis
77. Asian palmyra palm
78. Sweet Ambajham
79. Drumstick leaves
80. Banana
81. Sugar cne
82. Gliricidia
83. Gabaticaba
84. Chil

Farm Photos

Case Study 18

Case Abstract

Farmer Case 18 from Bihar combines crops and livestock on his 1.60-acre farm, employing organic farming to improve soil health and biodiversity. His farm's diversity, including paddy, maize, and livestock, showcases the symbiotic relationship between agriculture and animal husbandry. Yadav's approach demonstrates how integrated with organic practices, traditional farming methods can enhance farm productivity, sustainability, and resilience against environmental challenges.

District & State

Banka district, established on February 21, 1991, is headquartered in Banka Town and covers 3,020 square kilometers (1,170 sq mi). Its climate includes hot summers, pleasant winters, and the southwest monsoon generally arriving in late June, with most rain in July and August and some winter precipitation. Agriculture is the main occupation in this district, with seven of its eleven blocks having plain and fertile land, while the remaining four blocks (Chandan, Katoriya, and Bounsi) are hilly. Irrigation relies on canals and wells. Bihar, an eastern Indian state with Patna as its capital, is the third most populous and twelfth-largest state globally, spanning 94,163 square kilometers. It borders Uttar Pradesh, Jharkhand, and West Bengal, with a subtropical climate typical of temperate zones.

Background of Farmer & Farm:

Farmer Case 18 is a very hard-working farmer in the village. Along with his wife, the children studying in school have also been helping him with farming activities. Before adopting organic-natural farming practices, he adopted chemical-based farming. He used inorganic fertilizers and pesticides in his farming. During this chemical-based farming system, Farmer Case 18 says, “The soil was not fine. There was less harvest of crops and had very less profits.”

In 2012, Farmer Case 18 began to explore adopting organic-natural farming on his own. Through the support of NABARD and the local NGO Muktineiketan, he received good technical support for organic-natural farming. Mr. Pranav, Chief Executive from Muktineketan, has exposed several farmers in the area, including Farmer Case 18, to various organic farming techniques. Among the many farmers, Bisheshwar, with all dedication, undertook this organic-natural farming method.

Though the farmer has not yet mastered farming in summer, he has developed the capabilities of organic farming in the monsoon and winter seasons. In summer, he takes care of the cattle, cow, buffalo, and goats, which are excellent sources of income. His children, both daughter and son, are studying in school, are keen on agriculture, and are helping their father and mother with farming activities.

Farmer Case 18 has well-integrated livestock into his organic-natural farming system, i.e., cows, buffaloes, goats, and chickens. He has a vermicompost unit and a small nursery where seedlings can be grown. Bisheshwar says, “My soil has become fertile, and I get more harvest and earn more profits than before.’

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Soil: Farmer Case 18 prepares organic manure out of cow dung. He has also adopted simple mechanisms to prepare this organic manure. Furthermore, he also prepares microbial solutions like Amrit Jal and applies them to his farm crops. He applies compost to increase soil fertility and uses Amrit Jal to control pest attacks. All these measures help him to increase the yield of his farm crops. However, the soil of his farm is not very fertile, as the soil's organic carbon is only 0.37%. The soil remains exposed to sunlight during the summer months.

Water: He has dug a borewell to irrigate his farm crops. In May, the water level is 45 feet below the ground level. The above reveals that the water absorption capacity of his farmland is not up to mark. The soil porosity of his farmland still needed to be developed.

Seed: He uses hybrid seeds for his farming activities. However, he uses hybrid seeds but applies organic manure and organic microbial solutions as manure. This process helps him increase the yield of his farm crops. However, he is unable to preserve seeds out of it. Unlike local seeds, seeds collected from farm crops grown from hybrid seeds is not likely to work effectively in the subsequent farming cycles.

Diversity: Farmer Case 18 has diversified his farming practices by integrating animal husbandry. His livestock include cows, buffalo, and goats. All the livestock are of a local breed that adapts well to the hot climate. Though he adopts diversified farming practices, the tree cover of his farm is still low.

Ecology: His farm is surrounded by a limited variety of perennial trees like mango, kathal, and jamun in and around his farmland. Besides, some other perennial trees around his farm have grown naturally. Still, this farmer must undertake many systematic and scientific measures to strengthen the environment and ecology around his farmland.

Ecosystem Services & Climate Resilience

With training and experience, the farmer has largely integrated most of the five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, although there are few trees on the bunds of the farm; there are no trees including horticultural plants within his farm so far. He relies on indigenous local seeds. The livestock are all indigenous and genetically stable.

With limited forest cover, the area is less endowed with ecological balance. The farmer has been trained in farm-yard organic manure and vermicompost and hence has been improving his soil health. Diversified farming on the farm has further increased biomass for the soil, which enhances soil health. With these, the water-moisture holding capacity of the farm seems to have increased.

Relatively to other farmers in the area, the balance among the key factors has improved the ecosystem services regarding organic carbon in soil and water absorption capacity on the farm. The relatively

higher yield of the farm, despite a slight rise in temperature and rainfall variations in recent years, has increased the farm's total production. These indicate the climate resilience of Farmer Case 18's farmland.

Diversity in Farm Production & Market Resilience

Given their nutritional value and taste quality, farm products have high local demand and are sold at a higher price, not as a commodity. The farmer receives regular orders for various crops from many consumers. Customers often come to the farmer to buy. He also gets orders in advance. He has different types of crops for 10 months out of the 12 months. Due to a water shortage in peak summer, he cannot grow during the remaining two months of the year. Regularity of income (daily income from milk and weekly income from greens, fruits, and vegetables) from the farm and a very high net income per hectare indicate market resilience. The above also exhibit short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer.

Benefit to Farmer & its Impact on Other Farmers:

The farmer's crop yields have increased with the land's soil health and moisture retention capacity. With diversification, the regularity in income and total income have increased. The sound quality of his farm produce gives an excellent price to the farmer, and the total income substantially increases. He has also become a model farmer and trainer in the area. He has trained about 50 farmers from his village and nearby villages. The current estimated income from the farm is summarized below.

Estimated Net Income*(2022-23)

- Net Income 1 (all through year activities based) = INR 3,43,870
- Net Income 2 (seasonal crop-wise) = INR 46,470
- Total Annual Net Income = INR 3,90,340
- Total Area: 4 acres = 1.60 hectares
- Net Income per hectare per year = INR 2,43,963
- Net Income per hectare per month = INR 20,330

*For more details, please see the detailed information sheet below.

Detailed Information

Land Information:

Total Cultivable Land (in acres): 5-acre

Total land used for – 4acre Organic/Natural Farming/Ecological (in acres):

Other Information:

- Soil Test Report (please attach, if available).

- Organic Carbon of Farm (Date): 0.37% - 16/05/2023
- Water Source (if any open well / dug well / bore well): Bore well.
- Please indicate the depth (in feet) from ground to water level in May: 45ft.
- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): Hybrid
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety): Local Variety
- Type & No. of Perennial Trees in and around Farm: 4 Mango, 2 Kathal, 3 Jamun

Table 4.18.1: Net Income 1 (all through year activities based) of Case Study 18 Farm (April 2022-March 2023)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Total
Type of Expenditure													
1.Electricity	90	100	120	140	100	120	90	90	80	70	70	80	1150
2.Cow feed	7000	7500	8500	8500	7000	6500	6000	6500	7500	7000	7000	7000	86000
Total													87150
Sources of Income:													
1.Milk (for home)	4000	4000	4000	4000	4000	4500	4500	4500	4000	4000	4000	4000	49500
2.Milk (for sale)	15000	15000	12000	10000	10000	12000	8000	12000	12000	12000	12000	12000	142000
3.Fruits (for home)	0	0	2500	2000	3000	0	0	0	0	0	0	0	7500
5.Vegetables (for home)	1000	700	1200	1200	1000	700	800	800	800	700	1000	1000	10900
6.Vegetables (for sale)	8000	8000	10000	10000	12000	12000	12000	10000	10000	10000	8000	8000	118000
7. Goatery (for sale)		8000		8000			14000						30000
8. Paddy (for home)	1800	1800	2000	1800	1800	1500	1500	1500	1200	1200	1200	1500	18800
9.Paddy (for sale)					14000							18000	32000
10.Wheat (for home)	1080	1080	1080	1020	1020	1020	1080	1440	1440	1440	1280	1080	14060
11. Macca (for home)	810	810	810	540	540	540	540	600	640	810	810	810	8260
Total													431020
Regular Net Income	(431020-87150)												3,43,870

Table 4.18.2: Net Income 2 (seasonal crop-wise) of Case Study 18 Farm (April 2022-March 2023)

Name of Product 1	Different Expenditures in farming this produce & value addition, if any	Total	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Paddy (4 acres)	Ploughing		2500	15/Kg	37500
	Seed				
	Irrigation				
	Harvesting				
	Total Expenses	00			
	Total Net income: (37500-00)				37500

Name of Product 2	Different Expenditures in farming this produce & value addition, if any	Total	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Macca (1 acre)	Ploughing		300	18/Kg	5400
	Seed				
	Irrigation				
	Harvesting				
	Total Expenses	00			
	TotalNet Income: (5400-00)				5400

Name of Product 3	Different Expenditures in farming this produce & value addition, if any	Total	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Channa (0.5 acre)	Ploughing		40-50 (average-45)	50/Kg	2250
	Seed				
	Irrigation				
	Harvesting				
	Total Expenses:	00			
	Total Net Income: (2250-00)				2250

Name of Product 4	Different Expenditures in farming this produce & value addition, if any	Total	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Wheat (0.5 acre)	Ploughing		50-60 (average-55)	24/Kg	1320
	Seed				
	Irrigation				
	Harvesting				
	Total Expenses:	00			
	Total Net Income: (1320-00)				1320

Farm Photos

Case Study 19

Case Abstract

Farmer Case 19 in Odisha has revitalized his 5.27-acre farm through organic and natural farming practices. After experiencing soil degradation from chemical use, Farmer Case 19 transitioned back to organic farming with guidance from local experts. His farm, diversified with crops like paddy, black gram, vegetables, and cashews, alongside livestock and poultry, exemplifies the regeneration of soil fertility and farm productivity. His journey underscores the benefits of reverting to traditional, ecological farming methods for sustainable agriculture and improved food quality.

District & State

Rayagada District, located in southern Odisha, became a separate district in October 1992 and is primarily inhabited by tribal communities, mainly the Khonds and the Sauras. While Odia is the primary language, the indigenous population also speaks Kui and Saura. The district's economy is primarily agrarian, with paddy, wheat, ragi, green and black gram, groundnut, sweet potato, and maize as the main crops. The climate is tropical to subtropical, with three distinct seasons: summer, winter, and monsoon. Average annual rainfall varies between 1030.21 mm and 1569.50 mm. Odisha, located in eastern India along the Bay of Bengal, has an agrarian economy, with 60% of the population depending on agriculture and related activities for their livelihoods. High temperatures, elevated humidity, moderate to heavy rainfall, and short, mild winters characterize the climate. The southwest monsoon typically arrives on the coastal plain between June 5th and 10th, covering the entire state by July 1st, and the state is divided into ten agro-climatic zones based on climate type.

Background of Farmer & Farm

Farmer Case 19 is a progressive farmer of Surjiguda village of Guluguda GP in Rayagada district. His primary occupation is farming. As a farmer, he has cultivated paddy, black gram, and various vegetables in his 3 acres of agricultural land. Besides, he is practicing cashew cultivation. In addition, he also rears goats, cows, and poultry.

He started framing at the age of 20 years. Initially, he practiced organic-natural farming, following in his father's footsteps. He says, “At that time, our soil was fertile, we used our seeds, food was nutritious, and the harvest was higher than now.”

However, during 1988-95, he began to use chemical fertilizers and foundation seeds for more yield. He says, “This destroyed my soil fertility, hardened the soil, and gradually reduced farm production; the taste and quality went down.”

Through Nava Jyoti Producer Company, in which he was a Founding Director, in 2011, he met Dr. O P Rupela and Dr. K T Chandy, who systematically explained and trained the members of the FPO on organic-natural farming. In 2011, he then gradually re-adopted organic-natural farming. Subsequently, he had the opportunity to meet outstanding natural farmers like Mr. Subash Sharma, the Late Mr. Deepak Suchde, and Mr. Bharat Tyagi, who visited Nava Jyoti and talked to farmers of Nava Jyoti Producer Company. All these interactions enthused him to adopt natural farming methods fully.

Over the years, he has improved his understanding of natural farming practices by training on sustainable agricultural systems at various locations like Nava Jyoti, Padmapur Block, XIMB, and NISWASS. He took nearly seven years to stabilize his farms with organic farming principles. He has practiced organic/natural farming on his 5.27 acres of land.

The farmer's 5.27 acres of land are in different locations in Guluguda Gram Panchayat. The farmer puts temporary fences on specific plots where some crops are grown, especially when farmers in the GP leave their cattle for free grazing. Since this GP is part of the tribal region with good forest cover, many perennial trees are around his different pieces of land. The farmer has planted a good number of

horticultural plants on his farmland.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Moisture (in-situ water harvest conservation)

Farmer Case 19 depends upon stream water for irrigation. He has not dug an open well or set up a bore well on his farmland for irrigation purposes. Though there is a government scheme for open wells, he has become unable to mobilize it due to a lack of support at the concerned line departments' level. Due to the fragmented landholding of farmers and the inability to develop cooperation, they have not been able to put up an open well jointly, which is optimal when about 1 hectare of land can be irrigated from an open well or a bore well. Limited understanding of in-situ water harvesting in hilly areas and lack of cooperation among farmers in a cluster has limited farmers from adopting in-situ water conservation and harvesting rainwater through open wells.

Ecology (farm forestry & biomass)

Small hills surround his farmland. Besides, he has grown trees like Mahua, mango, sargi, and cashews in and around his farmland. Hence, the farmer is naturally endowed with much natural ecological support. However, smaller plots in one location and a lack of synergy among the nearby farmers have limited Farmer Case 19 from systematically building up the farm ecology with a more significant number of horticultural perennial trees in and around his farm plots.

Soil Health

Farmer Case 19 has been applying organic manure to improve soil health. He rears cattle, and these cattle dung supplements his organic manure. He applies about 7-8 tractor loads of farmyard manure on his land every year. This has increased microbes in his farmland. He is aware of the negative consequences of using external inputs that hinder the soil fertility and nutritional value of farm crops/produce. He spends about INR 32,000 annually on compost, transportation, and labor costs for carrying organic manure to his farmland. The increased yield and higher quality of crops have encouraged him to invest in this form of manure for his cultivation. A photo of one of his farm plots shows the soil's color, texture, and quality.

Seeds-saplings-livestock (genetic material composition)

He is wholly opposed to the use of Hybrid/GM seeds. He uses only local seeds for his farming purposes. He also preserves paddy seeds, cereals, and vegetables from his farmland before harvesting. He takes proper care of these seeds, which will be used for the next cycle. In addition, he invested about INR 11900 in procuring local seeds during pre-monsoon, monsoon, and winter periods.

Horticulture plants are usually taken from the state's agriculture department. The livestock, cows, goats, and chickens are all indigenous varieties. He is very well known as a goat farmer of the Block. He serves as a local guide for the agricultural officers in the Padmapur Block of Rayagada district.

Farm diversity (energy and production basket)

He has diversified his farming activities by adding horticultural and livestock activities. He spends INR 19,300 annually on charges of cowboy and doctor fees and medicine costs to protect farm animals from disease attacks. In return, he generated INR 3,15,000 from livestock activities. Likewise, he earned INR 1,91,000 from selling paddy, cereals, and pulses during 2022-23. Further, he has been able to earn INR 58,900 from horticulture activities. The details are provided in the tables at the end of this case.

Ecosystem Services & Climate Resilience

With training and experience, the farmer has gradually integrated all the five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), indigenous local seeds or genetic material and on-farm livestock are very well balanced.

Endowed with good flora and fauna, the farmer has the required ecological balance around the farm. This ecological balance provides cover from the rise in temperature. Agriculture land is usually fragmented, and farmers adopt free grazing from January to June, making farming challenging. The farmer has been trained in farm-yard organic manure and has been improving his soil health. Diversified farming on the farm has further increased biomass for the soil, which enhances soil health. With these, the water-moisture holding capacity of the farm increases.

The balance among the key factors has improved the **ecosystem services** regarding organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. The relatively higher yield of the farm, despite the slight rise in temperature and rainfall variations in recent years, and the increase in total production are some indicators to mark the climate resilience of the farm.

Diversity in Farm Production & Market Resilience

Given its nutritional value and taste quality, his farm products have a high local demand and are sold reasonably priced and not as a commodity. The farmer receives regular orders for various crops from many consumers. About four customers picked up all the surplus paddy he had grown on his farm. While most farmers have crops for about five months of the year, Farmer Case 19 has crops on his farm for nine 12 months. Regularity of income (daily income from milk and weekly income from greens, fruits, and vegetables) from the farm and a very high net income per hectare indicate market resilience. These results exhibit short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer.

Benefit to Farmer & its Impact on Other Farmers

The farmer's crop yields have increased with the increase in ecological balance and soil health. With diversification, the regularity in income and total income have increased. The excellent quality of his farm produce gives a reasonable price to the farmer, and the total income substantially increases. While he has been a model goat farmer for a long time, he has emerged as a lead natural farmer in the area and a good leader in his tribal community. He has also become a model farmer in the area. With time, he can emerge as a lead trainer in natural farming. The current estimated income from the farm is summarized below.

The net monthly income of 2.07 hectares of farmland has been estimated to be INR 2,12,295. Accordingly, the net monthly income of 1 hectare of land would be INR 17,691. This level of positive net income of the farmer in a rain-fed condition, hilly tribal area, and where the land is quite fragmented looks remarkable.

The farmer can build up its other strengths, especially in-situ water conservation and horticulture diversification, to reduce the cost of maintaining soil health, increase cropping intensity throughout the year, and enhance income from horticulture and vegetable farming.

The cost of labor put in by the farmer and his family has not been accounted for in the cost of farming on this farm. Similarly, the above income does not include the value of the family's consumed vegetables, fruits, pulses, and cereals. Adjusting the monetary value of this household consumption with the cost of family labor would show an increased monthly net income of the farmer.

Expenditure and Income Details

The gross annual income of this 2.07-hectare Farmland was estimated to be INR 5,72,900. The total annual cost of operation was estimated to be INR 1,33,450. Accordingly, the net annual income of the farm was found to be INR 4,39,450. The table below gives the details:

Estimated Net Income*(2020-21)

- Total Revenue = INR 5,72,900
- Total Expenses = INR 1,33,450
- Total Net Income = INR 4,39,450
- Total Area: 5.27 acres = 2.07 hectares
- Net Income per hectare per year = INR 2,12,295
- Net Income per hectare per month = INR 17,691

*For more details, please see below the detailed Information Sheet

The breakdown of this figure is given below.

Table 4.19.1: Total Expenses of Case Study 19 Farm (April 2020 - March 2021)

Expenses	Pre-Monsoon			Kharif			Winter						
	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	Total
Land Preparation													
Tractor & Bullock Ploughing													50000
Input cost													
Compost cost			12000				5000						17000
Tractor cost			5000				5000						10000
Labour cost			5000										5000
Labour cost (100 labour @ Rs.150/labour)			15000				5250						20250
Seed			3900				6000	2000					11900
Cowboy													1600
Vaccination													900
Fever & other disease													2000
For goats													1800
Vaccination													2000
Fever & other disease													8000
Poultry													3000
Total													**133450**

Table 4.19.2: Total Revenue of Case Study 19 Farm (April 2020 - March 2021)

Particulars	Pre-monsoon /Summer			Monsoon			Rabi Window						
	APR	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	Total
(Paddy) At Mandi								54000					54000
(Paddy) As Rice								96000					96000
Maize						12000							12000
Black Gram											25000		25000
Earned from selling as Seed											4000		4000
Vegetables (Janhi+Beans+Ladies Finger+Brinjal+Aladi)													8000
Livestock													
Poultry													15000
Goats													300000
Horticulture													
Jack fruit as vegetable	4000												4000
As Fruit (Ripe)		1950											1950
Mango			8000										8000
Cashew											42250		42250
Mahua flower												700	700
Coconut													2000
Total													**572900**

Farm Photos

Case Study 20

Case Abstract

The Solitude farm of Farmer Case 20 in Pondicherry cultivates an astonishing diversity of nearly 96 crop varieties on 4 acres, emphasizing local food systems and community engagement. Integrating permaculture principles, the farm stands as a model for ecological sustainability and educational outreach, showcasing the value of biodiversity in agriculture. The efforts of Farmer Case 20 to connect people with their food sources highlight the transformative potential of farms as centers for learning, community building, and ecological stewardship.

District & State

Auroville is an experimental township in the Viluppuram district of Tamil Nadu, India, with some parts extending into the Union Territory of Pondicherry. Viluppuram, the 23rd district of Tamil Nadu, was established on September 30, 1993, with its headquarters in Viluppuram. The district experiences a hot and humid climate characterized by a semi-arid tropical climate and moderate temperatures. Its average annual rainfall is 1060.3 mm, with coastal areas receiving more rain than the interior regions. Tamil Nadu, situated in the southernmost part of the Indian Peninsula, is recognized as the cradle of Dravidian culture. Its climate varies from dry sub-humid to semi-arid, and the state is divided into seven agro-climatic zones, including the highly productive Kaveri Delta. Tamil Nadu primarily depends on monsoon rainfall.

Background of the Farmer & Farm

The Farmer Case 20 is from the United Kingdom and settled in Auroville. Inspired by the concept of Auroville, Farmer Case 20 came from the UK to live and find meaningful work. Inspired by Masanobu Fukuoka, he gradually developed the farm in 1996 with natural farming and permaculture ideas. The ideas and practice gradually evolved during the first 12-15 years. Initially, he began working on natural dyes, especially indigo cultivation, and production in an organic manner. Since around 2011, Farmer Case 20 worked systematically on ecological farming. The farm has evolved into a beautiful ecological farm inching towards a natural balance and a food forest. The farm is named ‘Solitude Farm.’

Before the development of Solitude Farm, the land was barren like the rest of Auroville. Inspired by Fukuoka’s advice, Farmer Case 20 and his team constantly put all the bio-resources around them, such as leaves, weeds, and branches. The purpose has been to increase soil fertility. He did not use any chemical pesticides or fertilizers on the land. Gradually, the farm evolved into 100% non-tillage. Even machines and tractors were gradually eliminated. The farm is fully sustainable, boasting over 250 varieties of fruits, vegetables, grains, rice, edible weeds, and more.

To make the farm sustainable without compromising Fukuoka’s vision of natural farming, Farmer Case 20 started valuing and incorporating the local foods that grow around quickly. This thinking paved the way for the farm to plate café. Interestingly, there are about 20 organic farms of different sizes in Auroville, and they operate at different levels of ecological balance.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Soil: The soil of the Solitude Farm is very fertile. Organic manure, like compost, is applied to the soil to maintain its fertility and help increase microbial activities. The ecosystem of Solitude's farm has an impact on soil enrichment.

Water: As the soil health is excellent and largely mulched by the biomass from the rich fruit and other trees, the rainwater retention of the soil seems to be good. There are two bore wells from which water is drawn for use on the farm and in the café. A year ago, the whole farm was fixed with water sprinkling pipes. This technique has substantially improved the yield of different crops on the farm, especially in the summer months.

Seed: Local/Indigenous varieties of seeds are used for farming activities. The Aurovilians believe that local seeds can cope with the local environment, whereas this feature is lacking with Hybrid or GM seeds. Further, local seeds grow well with the application of organic manure. They opine that crops produced from this organically cultivated farm are highly hygienic. These crops have a tremendous positive impact on an individual's health. In this background, they initiated the process of the 'from farm to plate' café, which is currently very popular in Auroville. The farm-to-plate provides a perfect mixture of various farm products, organically grown and aligned with local food patterns.

Diversity: Diversified farming is the very basis of Solitude Farm. They have integrated animal husbandry with farming activity and diversified farming activities by planting various plants and trees. This approach has increased the farm's biodiversity and maintained soil fertility intact. Beekeeping is also another feature of their diversified organic farming processes.

Ecology: The Aurovillians have planted perennial and fruit trees in and around their farmland, strengthening their ecology. It protects the farm crops from wind speed and extreme temperature and provides a pleasant environment for pollination activities that help increase farm productivity. The farm has moved closer to a food forest.

Ecosystem Services & Climate Resilience

Gradually, over about twenty years and more especially during the last ten years, Farmer Case 20 has done very well to balance the above five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), and indigenous local seeds or genetic material. All this seemed to have significantly increased the ecological balance on his farm. This balance among the key factors has improved the ecosystem services regarding organic carbon in the soil, water absorption capacity, and reduced temperature on the farm. The relatively higher yield and increase in total production of the farm, despite a slight rise in temperature and rainfall variations in recent years, are clear indicators to mark the climate resilience of the farm.

Diversity in Farm Production & Market Resilience

The high quality of the farm produce ensures good demand for the produce. The farm products are in high local demand. Given the quality of taste and nutrition, the farmer receives regular orders for various crops from many consumers. Krishna also runs an organic restaurant that is usually a tourist attraction in Auroville. A large part of the farm production is consumed in this restaurant. Regular income from the farm and an excellent net income per hectare indicate the high demand and market resilience. These results exhibit short- and long-term efficiency or profitability of the improvised indigenous farming system adopted by the farmer. Diversity in farm production and output from the farm for most of the year makes the farmer market resilient. Further, Farmer Case 20 has developed mechanisms for processing, packing, advertising, and marketing organic produce.

Benefit to Farmer & its Impact on Other Farmers

By adopting the natural farming system, Farmer Case 20 has made his farm highly inspiring to others to learn about ecological farming and ecological living. He exhibits that ecological farming is profitable to the farmer and healthy for society and the planet. He uses indigenous farming with improvised techniques of tree plantation, soil, water management, diversity, and indigenous seeds. He has inspired many farmers and people who have visited his farm for several years. The current total net income of the farmer is summarized below.

Estimated Net Income*(2022-23)

- Net Income 1 (all through year activities based) = INR -3,31,200
- Total Revenue = INR 8,93,113
- Total Net Income = INR 5,61,913
- Total Area: 10 acres = 4 hectares
- Net Income per hectare per year = INR 1,40,478
- Net Income per hectare per month = INR 11,707

*For more details, please see the detailed information sheet below.

Table 4.20.1: Net Income 1 (all through year activities based) of Case Study 20 Farm (April 2022-March 2023)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	**Total**
Type of Expenditure													
1.Salary to Working families (Rs.7000/- x 4 per month)	28000	28000	28000	28000	28000	28000	28000	28000	28000	28000	28000	28000	336000
2.Data Entry (Rs.5000/- per month)	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	60000
Total													3,96,000
Sources of Income: The details of monthly food produce from the farm have been used to estimate income													
1.Fruits (for home)	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	2400	28,800
2.Vegetables (for home)	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	36,000
Total													64,800
Regular Net Income	(64800-396000)												-3,31,200

Fruits for home consumption per month: 60 Kg @ INR 40
Vegetables for home consumption per month: 50 Kg @ INR 60

Table 4.20.2: Total Revenue of Case Study 20 farm (April 2022-March 2023)

Month	Amount (in INR)
May, 2022	83,084.85
June, 2022	74,014.10
July, 2022	57,589.16
August, 2022	40,529.58
September, 2022	35,070.92
October, 2022	39,910.52
November, 2022	39910.55
December, 2022	71,084.27
January, 2023	117,105.91
February, 2023	142,456.58
March, 2023	135,479.00
April, 2023	56,877.22
Total Annual Income	**893,112.66**

Table 4.20.3: List of products of Case Study 20 Farm

Sl. No.	Produce name
1	Acerola
2	Amaranth leaves
3	Amla
4	Bael
5	Banana flower
6	Banana fruit
7	Banana stem
8	Basella spinach
9	Basil
10	Black velvet beans
11	Bottle gourd
12	Brinjal
13	Cherry tomato
14	Chicken spinach
15	Sapota (Chikku)
16	Chili green
17	Clove beans
18	Coconut
19	Coriander
20	corn
21	Dried Thippili
22	Drumstick leaves
23	Drumsticks
24	Guava
25	Green papaya
26	Hibiscus
27	Ladys finger
28	Lemon
29	Long beans
30	Mango fruit
31	Palm root
32	Papaya fruit
33	Plantain
34	Ponnangani spinach
35	Puple yam (vathalavalli)
36	Raddish
37	Ragi
38	Ramphal
39	Rocket leaves
40	Roselle Flower
41	Sangapoo
42	Soursop Fruit
43	Soursop Leaves
44	Spring onion
45	Sundakkai (Turkey Berry)
46	Thippali
47	Tomato
48	Wild salad weeds
49	Wild Spinach
50	Wing beans
51	Manathakkali
52	Tapioca
53	Pumpkin
54	Cluster beans
55	Sword beans
56	Cucumber
57	Capsicum
58	Lemon grass
59	Nartanga
60	Jackfruit
61	Jackfruit Cleaned
62	Jalepeno (Sweet Chili)
63	Bitter gourd
64	Pine apple
65	Green Mango
66	Star Fruit
67	Custard Apple
68	Mosambi
69	Bread Fruit
70	Snake gourd
71	Tangerine
72	Cucumber melon
73	Tippaili
74	Assameese Lemon (Gondoraj)
75	Badam
76	Kumquat
77	Kalapalam
78	Cow Pea Beans
79	Red Chilli Small
80	Turmeric
81	Sugar Cane
82	tooduvalai
83	Sweet Tangerine
84	Pumpkin Flower
85	Microgreens
86	Micro Tomato
87	salad greens
88	Red Radish
89	Podded Pea
90	Tumeric Powder
91	Eagle eye chili powder
92	sweet peppers
93	butterfly pea flowers
94	hibiscus flowers
95	SITA
96	passion fruit

Farm Photos

Case Study 21

Case Abstract

Farmer Case 21 in Odisha dedicates his farm to preserving indigenous seed varieties, cultivating paddy, green gram, mango, and lemon over 1.80 acres. Sarangi's commitment to biodiversity and traditional farming techniques enhances soil health and crop resilience and safeguards agricultural heritage. His seed bank initiative, promoting indigenous seeds among farmers, exemplifies a vital step towards sustainability and climate resilience in agriculture.

District & State

Khordha is a district in Odisha, India, where agriculture is crucial for economic development. Key commercial crops include paddy, pulses (like Arhar, Gram, and Green gram), oil seeds (such as Groundnut, Til, and Sunflower), vegetables like Okra and Brinjal, and fruits like Lime, Banana, and Guava. Odisha, located along the Bay of Bengal in eastern India, is primarily an agrarian economy, with 60% of its population relying on agriculture and related activities for their livelihoods. The state's climate features high temperatures, high humidity, moderate to heavy rainfall, and short, mild winters. The southwest monsoon arrives between June 5th and 10th, covering the entire state by July 1st. Odisha is divided into ten agro-climatic zones based on its varied climate.

Background of Farmer & Farmer

Farmer Case 21 is a teacher turned progressive farmer of Narisho village of Balipatna Tehsil in Khordha district since 1992. The farm was traditionally natural, but not before 1992. In 1992, he took responsibility for his farm and adopted chemical farming after his father's death. Till 1995, he continued using chemical fertilizers and pesticides, and until this time, he observed soil degradation but continued with green revolution techniques. After retiring from teaching in 1996, he started using high-yielding varieties given by CRRI and used all chemical inputs as per the instruction.

While spraying pesticides in the field, one of his workers lost consciousness and fell. He realized this was the cause of death for many insects and animals, like snakes, frogs, etc., on the farm. This was the turning point of his life, and he decided to stop using chemicals on his farm. His elder son inspired him to opt for natural farming, and he read ‘One Straw Revolution’ by Masanobu Fukuoka. In 1998, he adapted natural farming techniques using high-yielding varieties. He and his younger colleague, Mr. Jubaraj, collected many indigenous varieties of paddy. Farmer Case 21 says – ‘There is no pest problem in my farm. My farm remains green throughout the year.’

As a farmer, he has practiced farming on his 4.5 acres of agricultural land. His other earning sources are pisciculture and horticulture activities. As an organic-natural farming practitioner, he teaches other farmers the art and techniques of natural farming. To popularize natural farming, he has set up Rajendra Deshi Chasa Gabesana Kendra in his village – Narisho.

While indigenous paddy seed preservation has been the farmer's focus, Farmer Case 21 has gradually expanded to other activities to grow crops and form farmer-producer organizations to support the local farmers engaged in paddy cultivation and seed preservation. Due to the menace and crop

destruction caused by wild animals, the farmers in the area cannot grow fruits and vegetables throughout the year.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Soil: Farmer Case 21 applies organic manure to improve soil fertility. He treats the soil with cow-dung manure pot manure (locally known as Handi Khata). He applies oil cake and panchagabya (liquid organic manure) for pest control on his farm crops. Annually, he spends about Rs.18700/- on organic manure.

Water: Balipatna tehsil is an irrigated pocket. Farmers depend upon river water and canal water for irrigation purposes. Water in the canal is available throughout the year. Accordingly, Farmer Case 21 uses canal water to irrigate his farm crops. There is no shortage of water for his farming activities.

Seed: Farmer Case 21 uses his on-farm seeds, which has reduced his farming costs. Generally, he procures seeds from his farm crops. He has been practicing seed collection, treatment, and preservation techniques for over a decade, enabling him to store seeds for the next cycle without damage. To date, he has preserved over 550 varieties of local paddy seeds.

Diversity: He has diversified his farming practices by integrating limited horticultural activities and pisciculture. The primary threat is the monkey. Since the farming community generally practices paddy cultivation in one season, the farms have a little crop for most of the year. Although Farmer Case 21 has been growing vegetables throughout the year, many monkeys who have not found food elsewhere often destroy the vegetables and fruits of his farm and a few other farmers in the area. Due to this problem, he has stopped practicing vegetable cultivation and focused more on allied activities.

Ecology: The village is a highly irrigated area with suitable provision for water from the canal system. Most of the farmers practice paddy cultivation using fertilizers and pesticides. The area, therefore, has large stretches of land with few tall trees. The perennial green cover, therefore, is minimal in the area. However, the experienced Farmer Case 21 has grown about 300 trees in and around his farmland, which balances the ecology of his farm.

Ecosystem Services & Climate Resilience

As a master trainer and wise farmer, Farmer Case 21 properly understands the interrelationships of the five critical factors of production. Despite the challenges of the urban area and mono-cropping culture in the area, he has tried to integrate all the five factors of production, viz., soil health improvements, increase in farm diversity both in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), indigenous local seeds.

However, due to the general lack of tree cover in the area due to mono-cropping, the farmer, despite the knowledge, has difficulty managing the external environmental condition of temperature control.

Although the farm has a decent tree cover, its ecology does not get the required support from the external ecology of the area. Despite the support from the local ecosystem, the farm ecosystem can fairly balance the key factors and improve the ecosystem services in terms of organic carbon in the soil, water absorption capacity, and reduced temperature on the farm.

In recent years, the effects of climate change in terms of variations in rainfall and a slight temperature rise have been experienced in farming ecosystems. Crop yield and farm production have generally been impacted due to this change in weather conditions at respective farm levels. However, due to better ecological balance and related ecosystem services, the farm of Farmer Case 21 has a relatively higher yield and total production than other farmers in the area. These trends show that ecological balance facilitates better ecosystem services, leading to resilience in farm climate.

Diversity in Farm Production & Market Resilience:

Given its nutritional value and taste quality, his farm products are in higher local demand. The farmer receives regular orders for various crops from many consumers. Due to the higher diversity of his farm, the farmer can get regular income from his farm. As he is not dependent on a few large buyers but has several customers, he is more market-resilient than other farmers.

Benefit to Farmer & its Impact on Other Farmers:

The farmer's crop yields are higher with better ecological balance and soil health. With diversification, the regularity in income and total income has increased. The excellent quality of his farm produce gives a reasonable price to the farmer, and the total income is higher than that of other farmers in the community. He has also become a model farmer in the area and the master trainer in organic-natural farming in Odisha. He also earns some money by providing regular training on organic-natural farming to farmers. These training courses are approved and financed by the local District Agriculture Office. Farmers across the state also visit Farmer Case 21 and his Centre to learn about organic-natural farming. The current total net income of the farmer is summarized below.

Estimated Net Income* (2021-22)

- Net Income 1 (all through year activities based) = INR 23,250
- Net Income 2 (seasonal crop-wise) = INR 1,89,100
- Total Annual Net Income = INR 2,12,350
- Total Area: 4.5 acres = 1.80 hectares
- Net Income per hectare per year = INR 1,17,972
- Net Income per hectare per month = INR 9,831

*For more details, please see the detailed information sheet below.

Detailed Information

Land Information:

- Total Cultivable Land (in acres): 4.5
- Total land used for Organic/Natural Farming/Ecological (in acres): 4.5

Ecosystem Services related Information of the Farm:

- Soil Test Report (Not tested): To him, Natural farming does not need soil tests.
- Organic Carbon of Farm (Date):
- Water Source (if any open well / dug well / bore well): Canal water
- Please indicate the depth (in feet) from ground to water level in May: 25 feet.
- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): Indigenous
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety): Nil
- Type & No. of Perennial Trees in and around the Farm: 10 mango trees.

Table 4.21.1: Net Income 1 (all through year activities based) of Case Study 21 Farm (April 2021-March 2022)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Total (in INR)
Type of Expenditure													
1.Electricity													500
2. Fish feed (Fish seed + feed)													10000
Total													10500
Sources of Income:													
1.Paddy (for home)													22500
2.Training (15 nos. /year @ Rs.750/-													11250
Total													33750
Regular Net Income	(33750-10500)												23250

Table 4.21.2: Net Income 2 (seasonal crop-wise) of Case Study 21 Farm (April 2021-March 2022)

Name of Product 1 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Paddy (4.5 acres)	Land preparation	13500	6200	22.5	139500
	Seed sowing	900			
	Intercultural Operations	41500			
	Harvesting & Threshing	22500			
	Total Expenses	78400			
	Total Net Income (139500-78400)				61100

Name of Product 2 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Moong (4.5 acres)	Land preparation:	4500	1000	70	70000
	Seed on the farm (10 kg per acre @70/- pkg):	0			
	Seed sowing:	600			
	Harvesting & threshing -	5600			
	Total expenses	10700			
	Total Net Income (70000-10700)				59300

Name of Product 3 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Straw (4.5 acres0			9000 bundles	3	27000

Name of Product 4 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Fish (1 pond covering 5 Gunthas)	Fish seed + fish feed	10000	200	200	40000
	Turmeric & Lime powder	1000			
	Total Expenses	11000			
	Total Net Income (40000-11000)				29000

Name of Product 5 (with area cultivated)	Different Expenditures in farming this produce & value addition if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Mango (10 trees)	--	--	150		5000

Name of Product 6 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Coconut (5 trees)	--	--	200 pcs	25	5000

Name of Product 7 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Lemon	--	--	600 psc	2	1200

Name of Product 8 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Jackfruit	--	--	25 psc	60	1500

Farm Photos

Case Study 22

Case Abstract

Farmer Case 22 in Tamil Nadu utilizes 4 acres to blend crops and livestock, showcasing innovative water management and organic practices. His farm, emphasizing turmeric, banana, coconut, and vegetable cultivation alongside cow rearing, demonstrates the synergy between diverse cropping systems and animal husbandry in enhancing farm productivity and sustainability. His approach to farming offers insights into the effective integration of traditional knowledge with modern ecological practices.

District & State

Sathyamangalam is a town and municipality in the Erode district of Tamil Nadu, India. Historically, the Erode district was once part of Coimbatore, sharing much of its history due to their close association. Tamil Nadu is located at the southeastern tip of the Indian Peninsula and is characterized by a tropical climate inland and a maritime climate along its coast. Inland areas can experience extreme temperatures, while the coastal regions have moderate weather. The state receives an average annual rainfall of 945 mm. Vital agricultural products include rice and various pulses, while significant cash crops like sugarcane, tobacco, chilies, and cotton support thriving sugar, alcohol, and textile industries. Tamil Nadu's diverse agro-climatic conditions support the cultivation of nearly every type of fruit and vegetable.

Background of the Farmer & Farm

Farmer Case 22 belongs to a family where agriculture is the essential work. He belongs to Sathyamangalam town of Erode District in Tamil Nadu. After his Diploma in Electrical Engineering, he turned to the farming sector instead of searching for a job in the formal sector.

He had started farming using chemicals and gradually experienced a sharp decline in production. He realized that he had killed many organisms in the soil and then began to move towards organic farming. His farm’s name is ‘Satyamangalam’. Initially, he grew two-grain crops and one commercial crop (Jowar and ragi or bajra and ragi, then tobacco or paddy). He also grew chilies, cotton, and turmeric as cash crops. Initially, he had 50 acres of land, but due to periodic droughts, he was forced to sell most of his land.

From around 1995, he used methods to revive the soil, which took 5- 6 years to make the farm wholly organic. He says organic farming needs early planning and preparation. Initially, his farm's main crops were bananas and sugar cane. With time, he has been changing his cropping pattern and he says, ‘Farming is a social responsibility. Good yield can only be obtained by natural farming.’

Today, Farmer Case 22 is one of the leading organic-natural farmers in India. He does organic farming on his 10 acres of land irrigated through two open wells. He installed a drip irrigation system to handle the crops during frequent power cuts. Dr. Namalwar, a leading organic, natural farmer, inspired and guided Farmer Case 22. Mr. Balakrishna, prof. Dhabolkar and Dr. Narayan Reddy taught him many aspects of organic-natural-ecological farming.

With rich experience and commitment to organic-natural farming, Farmer Case 22 has been a teacher to many local farmers. He has provided advisory services to the Tamil Nadu government on organic farming techniques. He does not demand any specific price for his services and accepts whatever is offered.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sap, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Soil: Farmer Case 22 has enriched the soil fertility of his farmland through organic manure application. He has been applying these manuring techniques for the last 15 years. He is also preparing organic microbial solutions and applying them to his farm crops to protect them from pest attacks. He has also developed indigenous techniques for applying organic microbial solutions to farm crops through drip irrigation mechanisms. His farm has become the knowledge center for other farmers who come to his farm to learn both the preparation and application process of organic manure and organic microbial solutions.

Water: Farmer Case 22 has dug two open wells on his farm for irrigation. The depth of each open well is 100 feet. In May, the open wells' water level is 50 feet below the ground level. The drip irrigation system has been established to use the water from these two open wells to irrigate the farm crops. Further, Electricity is freed by the agriculture department.

Seed: He uses Local/Indigenous and GM/Hybrid varieties of seeds for farming activities. He mainly uses local variety seeds but sometimes uses GM/Hybrid seeds for farming. He applies the same organic manuring processes to these GM/Hybrid seeds as in the case of local seeds.

Diversity: Farmer Case 22 has diversified farming activities by integrating horticulture and livestock. He has reared two Sahiwal Cross - local variety – cows, one Saheeval Cross calf, and one Cross Bock Calf. His primary income comes from horticulture activities.

Ecology: Farmer Case 22 has planted various perennial trees in and around his farmland, strengthening his farm's ecology. It protects the farm crops from wind speed and extreme temperature and provides a nice environment for pollination activities that help increase farm productivity.

Ecosystem Services & Climate Resilience

As a master trainer and wise farmer, Farmer Case 22 understands the interrelationships of the five critical factors of production. He has been extremely good at culturing microbial populations using cow dung, cow urine, and curd. His soil health has drastically improved because of these very systematic techniques. So, he has succeeded in all five factors of production, viz., soil health improvements, farm diversity in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), and indigenous local seeds.

However, his understanding of tree cover in managing the micro-climate seems shorter. However, he has recently gradually increased the number of horticultural plants on his farm. With good soil health and year-round farming, the farm ecosystem can fairly balance the key factors and improve the ecosystem services in terms of organic carbon in the soil, water absorption capacity, and reduced temperature on the farm.

In recent years, the effects of climate change in terms of variations in rainfall and a slight temperature rise have been experienced in farming ecosystems. Crop yield and farm production have generally been impacted due to this change in weather conditions at respective farm levels. However, due to better ecological balance and related ecosystem services, his farm has had a relatively higher yield and total production than other farmers in the area. These developments show that ecological balance facilitates better ecosystem services, leading to resilience in farm climate.

Diversity in Farm Production & Market Resilience

Given its nutritional value and taste quality, his farm products are in higher local demand. The turmeric grown by Farmer Case 22 has a very high curcumin content and is in high demand. The farmer receives regular orders for various crops from many consumers. Due to the higher diversity of his farm, the farmer can get regular income from his farm. As he is not dependent on a few large buyers but has several customers, he is more market-resilient than other farmers. In addition, Farmer Case 22 and other farmers who adopted his method collated their produce and exported a large volume of turmeric. His son has been in charge of this export activity, which has helped farmers obtain reasonable prices from international markets.

Benefit to Farmer & its Impact on Other Farmers

The farmer's crop yields are higher with better ecological balance and soil health. With diversification, the regularity in income and total income has increased. The good quality of his farm produce gives a good price to the farmer, and the total income is higher than that of other farmers in the community. He has also become a great teacher to many farmers in the state. As identified as a trainer of organic-natural farming in the state, he must have trained thousands of farmers. As Farmer Case 22 said, "About 200 farmers across Tamil Nadu are currently adopting his farming methods. These farmers are also able to train other farmers in their communities." With age catching up, he has, however, stopped traveling for training purposes. The current total net income of the farmer is summarized below.

Estimated Net Income[*] (2021-22)

- Net Income 1 (all through year activities based) = INR 2000
- Net Income 2 (seasonal crop-wise) = INR 3,36,704
- Total Annual Net Income = INR 3,38,704
- Total Area: 8 acres = 3 hectares
- Net Income per hectare per year = INR 1,12,901
- Net Income per hectare per month = INR 9,408

Turmeric is one of the significant cultivation crops by Farmer Case 22, and his son, Mr. Unikrishnan, trades turmeric, which farmers in the region produce. The son of Farmer Case 22, who works with him,

earns about INR 10,00,000 annually from turmeric trading (Rs.1/- per kg). So, the monthly family income amounts to nearly INR 92,519 (9186 from farming + 83,333 from trading).

*For more details, please see the detailed information sheet below.

Detailed Information

Land Information:

Total Cultivable Land (in acres): 8 acres

Total land used for Natural Farming/Ecological (in acres): 8 acres (Coconut-2acres, Turmeric-2 acres, Banana-2 acres, Fodder-0.5 acre, vegetables – 0.5-acre, Dry Fodder – 1 acre)

Ecosystem Services related Information of the Farm:

- Soil Test Report (please attach, if available): Not available
- Organic Carbon of Farm (Date): not available
- Water Source (if any open well / dug well / bore well): 2 Open Wells – 100 feet depth each.
- Please indicate the depth (in feet) from ground to water level in May: 50 feet (each)
- Seeds & Plants (Local/Indigenous variety Vs. Hybrid/GM variety): Both varieties are used.
- Type of Farm Animals (Local/Indigenous variety Vs. Hybrid/GM variety): Local-
    i. Sahiwal Cross – 2
    ii. Sahiwal Cross calf – 1
    iii. Cross Breed Dock Calf -1
- Type & No. of Perennial Trees in and around Farm: NeemTree-2, Peeyam Tree -1 Timber Tree -10, Teak Tree- 2, Etty Tree-1, Nochi -5, Poovarsu-2, Pungam- 2, Agathi- 200

Table 4.22.1: Net Income 1 (all through year activities based) of Case Study 22 Farm (April 2021-March 2022)

	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	**Total**
Type of Expenditure													
1.Salary to Working families	13500	13500	13500	13500	13500	13500	13500	13500	13500	13500	13500	13500	162000
2.Electricity	Free	Supply	from	Agriculture									
3.Water	Drip	System											
4.Cow feed	Nil												
Total													162000
Sources of Income:													
1.Milk (for home) (4.5 liter @40/- per day)	5400	5400	5400	5400	5400	5400	5400	5400	5400	5400	5400	5400	64800
2.Fruits (for home) 3 kg @40/- per day (papaya, banana)	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	3600	43200
3.Vegetables (for home)	2000	2000	2000	2000									8000
4.Inome from Training	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	48000
Total													164000
Regular Net Income													**2000**

Table 4.22.2: Net Income 2 (seasonal crop-wise) of Case Study 22 Farm (April 2021-March 2022)

Name of Product 1 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Turmeric (PTS-10 variety) 2 acres	Land preparation (ploughing, ridge formation, Minitractor, & Seed Sowing)	55500	52quintals	12500 / quintal	650000
	Turmeric Seed-2000 kg Sowing labor	65000			
	Intercultural Operations	301000			
	Harvesting	184500			
	Total Expenses	606000			
	Total Net Income: 650000 - 606000				44000

Name of Product 2 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Banana (3 varieties – Q. Nendran-163, Red Banana-318, Monthana-60, Total-541 nos.) 2 acres	Land preparation	22675	541 nos. of banana bunches		307454
	Intercultural Operations	165650			
	541 banana sampling planting	10500			
	Total Expenses	198825			
	Total Net Income: 307454 - 198825				108629

Name of Product 3 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Coconut trees West Coast Tall variety	30-ton cow dung manure + tractor fare + labor	150000	22500 coconuts/year	12/coconut	270000
	3 to 4 months once inter-plough with Rotation + labor	36000			

2 acres (225 nos. of trees)	Coconut collection (labor cost per year)	22500			
	Total Expenses	208500			
	Total Net Income: 270000 – 208500				61500

Name of Product 4 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Green fodder crop (Super Nappier Variety) 0.5 acre	Land preparation	3500	66000	2	132000
	Cow dung compost (5 tones) + labor	20000			
	Seed + plantation labor + weeding	10725			
	Total Expenses	34225			
	Total Net Income: 132000 – 34225 Note: • Daily green fodder harvest started on 15.02.2022. • Harvested 200 kg of green fodder daily and used. • Daily harvesting labor is Rs. 200/- • Green fodder value is Rs.2/- per kg				97775

Name of Product 5 (with area cultivated)	Different Expenditures in farming this produce & value addition, if any	Amount (in INR)	Total Harvest (in Kgs)	Avg. Sale Price per Kg (in INR)	Total Income from the Sale of this Produce (in INR)
Jowar as fodder crop (local variety) 1.00 acre	Jowar seed (56 kg x 75/kg_	4200	12 loads of dry fodder (own use)		60000
	Rotavator plough	3950			
	Drip lateral laying and maintenance	1550			
	Hand weeding	1500			
	Fodder jowar plants harvest	9000			
	Bundle the straw, stock labor	15000			
	Total Expenses	35200			
	Total Net Income: 60000 – 35200				24800

Farm Photos

Case Study 23

Case Abstract

Farmer Case 23 from Andhra Pradesh transitioned his 3-acre farm to natural farming, spurred by state initiatives. Cultivating drumstick, gourd varieties, chili, and cotton organically, his farm lacks a systematic ecological focus but benefits from state-provided training and support. His journey highlights the role of governmental programs in promoting sustainable agriculture, though it also points to the need for comprehensive ecological planning and support.

District & State

Ganapavaram is located in the Palnadu district of Andhra Pradesh, which is bordered to the north by Telangana and Krishna Districts, to the west by Mahabub Nagar District, and the south by Prakasam District. The district has a total cropped area of 347,114 hectares, with 31,464 hectares being sown more than once annually. Andhra Pradesh, a southeastern Indian state, is bordered by Tamil Nadu to the south, Karnataka to the southwest and west, Telangana to the northwest and north, and Odisha to the northeast. Known as the "Rice Bowl of India," Andhra Pradesh's key crops include rice, cotton, groundnut, pigeon pea, sunflower, black gram, and sorghum. The state has a tropical climate with three main seasons: monsoon, summer, winter, and a brief spring.

Background of Farmer & Farm

Farmer Case 23 is a resident of Ganapavaram village of Palnadu District in Andhra Pradesh. He owns 3 acres of cultivable land and has been practicing organic/natural farming on these 3 acres of land for the last three years.

As part of the natural farming initiative of the state of Andhra Pradesh, the district officials approached Farmer Case 23 to adopt zero-budget farming of Subhash Palekar. With systemic training and some financial support, the farmer has adopted the above natural farming system in the last three years. Before this, Farmer Case 23 adopted inorganic chemical fertilizer and pesticide-based farming. Like most other small farmers in this farming system, he had been making losses. However, due to dependence on food from his farm, he continued with the inorganic fertilizer and pesticide-based farming system. The state initiative for natural farming has come as a boon to Farmer Case 23.

His principal crops are Drumstick, Ridge Gourd, and Bottle Gourd. Initially, he experimented with a kitchen garden in 2019, and chili cotton is organically grown. After becoming successful, he started natural farming. He has been provided training and exposure through the state government's community-managed natural farming program.

The three-acre farm has fencing around it. The farm has a large open well as a bore well. It has a small setup for the farmer to live on the farm. There were a few fruit trees but not many trees on the farm. Around the farm, however, there were a few trees. Only income-based crops are usually planted on the farm. Farm forestry with an ecological focus on the farm has not been planned for. The agricultural department has not focused on this issue.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five key factors of production?

Water - Moisture (in-situ water harvest & and conservation)

The farmer has dug 200 feet of bore-well and fitted it with a 5 HP pump set to pump out the water from the bore-well for all irrigation purposes. He runs the pump set for four hours once a week to irrigate the crops and plants. The open well is also attached to the pump set. However, it did not seem to be the preferred source of water. The effort to harvest and conserve rainwater has not been emphasized in the training under the community-managed natural farming of the State Agriculture Department, and hence, the farmer does not seem to adopt this systematically. Moisture retention in soil during the summer season is attempted through PMDS (pre-monsoon dry sowing).

Ecology (Farm Forestry & Biomass)

Along the farmland's boundary are tall and medium perennial trees. They are not planted systematically but seem to have been there for a long time and have not been cleared when the farmland might have been cleared of tall trees for farming purposes. Since the farm was under chemical farming five years ago, trees inside the farm were not the practice. The community-managed natural farming (CMNF) based on the Subhash Palekar method also does not seem to emphasize farm forestry. The already existing perennial trees on the farm's boundary can be observed from the photos of the farm below.

Soil Health

Farmer Case 23 applies compost prepared from cow dung as organic manure to improve soil fertility. He applies microbial solutions to protect farm crops from pest attacks and other diseases. However, the soil of his farmland has not been tested, and the soil testing has yet to be done by the department. In the last year, the farmer spent INR 65,200 towards input and labor costs.

Seeds-saplings-livestock (genetic material composition)

The farmer procures seeds from the market. He has not developed the practice of collecting seeds from his farm crops, which could have lowered his seed expenses. Last year, he spent INR 20000 towards the procurement of seeds. The state department officials facilitating community-managed natural farming have not given specific guidelines on the seeds, saplings, and livestock genetic materials. Some officials also believe that GM and hybrid seeds can adapt to local micro-climatic conditions and shall not harm farmers' sustainability.

Farm Diversity (energy and production basket)

The farmer has diversified his farming practices by cultivating drumsticks, ridge gourd, bottle gourd, flowers, leafy vegetables, and others. He has also integrated cattle into his farming practices. He has two buffaloes and two cows. The milk from these mulching animals is used for household consumption, which amounts to about INR 20,000 for eight months. While there is crop diversity, the lack of ecological diversity increases the efforts and cost of pest control on the farm. The farmer has been trained in pest control methods by the agricultural department.

Ecosystem Services & Climate Resilience

The Community Managed Natural Farming (CMNF) of the state government of Andhra Pradesh developed this method from the Zero-budget Farming (ZBF) system of Subhash Palekar. CMNF has done very well in taking care of soil health. By the method of PMDS (pre-monsoon dry sowing), the green cover that grows on the soil from the shower from the mid-summer rains protects the microbial life in the soil for a good part of the summer. The farmer is also encouraged to apply large quantities of organic manure on their farm. Once the soil health improves, the soil porosity increases, and water holding capacity dramatically increases. Subsequently, all the five factors of production, viz., soil health improvements, increase in farm diversity of field crops, indigenous local seeds, and ecology through some horticulture plants and exiting trees on the farm boundary, get stabilized.

With good soil health and year-round farming, the farm ecosystem can fairly balance the key factors and improve the ecosystem services regarding organic carbon in soil and water absorption capacity. However, this method does not emphasize tree cover in managing the micro-climate and ecological balance. The lack of tree cover increases the number of pests on the farm. Mechanical methods of using pheromone traps to eliminate pests on the farm have been encouraged.

In recent years, the effects of climate change in terms of variations in rainfall and a slight temperature rise have been experienced in the farming ecosystems. Crop yield and farm production have generally been impacted due to this change in weather conditions at respective farm levels. However, due to better ecological balance and related ecosystem services, Farmer Case 23’s farm has had a relatively higher yield and total production than other farmers in the area. These results show that ecological balance facilitates better ecosystem services, leading to farm climate resilience.

Diversity in Farm Production & Market Resilience

Given its nutritional value and taste quality, his farm products are in higher local demand. The Sapotas from the farm are in very high demand in the local market. The farmer receives regular orders for various crops from many consumers. He also maintains a few cows for milking purposes and gets regular income from these cows. Due to the diversity of his farm, the farmer can get regular income from his farm. As he is not dependent on a few large buyers but has several customers, he is more market-resilient than other farmers.

Benefit to Farmer & its Impact on Other Farmers

The farmer's crop yields are higher with better ecological balance and soil health. With diversification, the regularity in income and total income has increased. The excellent quality of his farm produce gives a reasonable price to the farmer, and the total income is higher than that of other farmers in the community. He has also become a great teacher to many farmers in the state. As a successful young farmer, he has emerged as a model farmer in the area. He has not only stabilized income for his farming and takes good care of his family, but he has also inspired many farmers in his community. The current total net income of the farmer is summarized below.

Expenditure and Income Details

The gross annual income of this 3.0-acre Farm was estimated to be INR 2,04,050. The total annual cost of operation was estimated to be INR 74,400. Accordingly, the net annual income of the farm was found to be INR 1,29,650. The table below gives the details:

Estimated Net Income* (2020-21)

- Total Revenue = INR 2,04,050
- Total Expenses = INR 74,400
- Total Net Income = INR 1,29,650
- Total Area: 3.0 acres = 1.21 hectares
- Net Income per hectare per year = INR 1,07,149
- Net Income per hectare per month = INR 8,929

The breakdown of this figure is given below.

Monthly Income:

The net monthly income of this 3.0-acre farm was estimated to be INR 1,07,149. Accordingly, the net monthly income of 1 hectare of land would be INR 8,929. This positive income of the farmer compared to losses about five years ago when his father followed chemical farming on the same farm is of great relief to the young Farmer Case 23. The farmer can build up its other strengths, especially on farm forestry and horticulture diversification, to reduce the cost of maintaining soil health, reduce the cost of pest management, and enhance income from horticulture and livestock.

The cost of labor the farmer and his family put in was not accounted for in the cost of farming on this farm. Similarly, the above income does not include the value of milk, vegetables, fruits, pulses, and cereals consumed by the family. For instance, the value of milk consumed by the family is to the tune of INR 20,000. Adjusting the monetary value of this household consumption with the cost of family labor shows an increased monthly net income of the farmer.

Table 4.23.1: Total Expenses of Case Study 23 Farm (April 2020 - March 2021)

Particulars	APR	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	Apr-21	May-21	Jun-21	Total
Rainfall Data																
Inputs & Labour Cost			500		2000	8300	7800	3400	3200	9000	18000	13000				65200
PMDS seed			1200													1200
Chili seeds					8000											8000
Harvesting																0
Total:	0	0	1700	0	10000	8300	7800	3400	3200	9000	18000	13000	0	0	0	74400

Table 4.23.2: Total Revenue of Case Study 23 Farm (April 2020 - March 2021)

Particulars	Pre-monsoon - Summer			Kharif window			Rabi Window						Total
	APR	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	
PMDS Fodder				2500									2500
Leafy vegetables				100×5=500			700						1200
Flowers							350						350
Chilli										15000×3= 45000	15000×7= 105000	10000×5= 50000	200000
Total:				3000			1050			45000	105000	50000	204050

Farm Photos


Latitude: 16.451198
Longitude: 80.049991
Elevation: 71.77±14 m
Accuracy: 14.0 m
Time: 03-11-2021 10:57
Note: 6301178382
Powered by NoteCam


Shot by Nanda Kumar

Case Study 24

Case Abstract

Farmer Case 24 in Odisha practices organic/natural farming on 10 acres, integrating crops, horticulture, and livestock. His farm benefits from Daringbadi's conducive climate, reducing reliance on external inputs. Pradhan's approach, balancing critical production factors, exemplifies sustainable agriculture's potential to improve livelihoods and ecosystem health. His journey underscores the importance of adapting farming practices to local environmental conditions for sustainability.

District & State

Kandhamal, a centrally located district in Odisha, is predominantly inhabited by tribal populations. It experiences a sub-tropical hot and dry climate in summer, while winters are dry and cold. The district records an average annual rainfall of 1522.95 mm. Odisha, located in eastern India, primarily has an agrarian economy, with 60% of the population relying on agriculture and related activities. The state's climate features high temperatures, high humidity, moderate to heavy rainfall, and mild winters. The southwest monsoon typically reaches the coastal plain between June 5th and 10th, covering the entire state by July 1st and withdrawing by October 15th, with some annual variation. The state has been divided into ten agro-climatic zones based on climate.

Background of Farm & Farmer

Farmer Case 24 is a progressive farmer of Kutuguda village of Greenbadi GP of Daringbadi block in Kandhamal District. Daringbadi Block in Kandhamal district is known for perfect weather throughout the year. Despite large-scale deforestation of the area for commercial cultivation purposes, the height of the area from mean sea level, and good forest cover in non-cultivated areas, the weather conditions of this area are suitable for farming throughout the year.

His total cultivable land is 10 acres, and he is practicing natural farming in all his 10 acres of cultivable land. Farmer Case 24 has been practicing organic/natural farming for the last 10 years, since around 2012. His family members are also helping him carry out farming activities, reducing the engagement of hired labor on his farm. His major crops are paddy, maize, pulses, millets, and different varieties of vegetables. He is carrying out horticultural and livestock activities. All these activities help him earn regularly throughout the year.

The 3.93-hectare farmland of Farmer Case 24 is in one patch of land beside a rivulet on one side. On the other side lies the state highway. On the third side is Daringbadi town, and on the fourth side is the forest area. This farm is in Daringbadi, the block headquarters of Kandhamal district, which has one of the highest forest covers in Odisha. Given its excellent weather conditions, Daringbadi is also one of the famous tourist locations in Odisha. The farm has been organized to grow multiple items throughout the year. Fencing is provided around three sides of the Farmland.

Before adopting natural farming in 2012, Farmer Case 24 adopted inorganic chemical and pesticide-based commercial crop farming, similar to most farmers in this tribal population-dominated district. Due to suitable weather conditions, commercial crop farmers adopting chemical fertilizer and pesticide-based farming continue to make some profit for just a couple of years longer than other farmers adopting this farming system downhill in the plains.

Balancing the Critical Factors of Production

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Water (in-situ water harvest conservation)

For irrigation, the farmer uses stream water, which is available throughout the year. His estimated annual expenditure towards operating the pump set is about INR 2200. Although this region is part of the hilly, rain-fed area due to a perennial stream, Farmer Case 24 has not considered alternative irrigation mechanisms like digging an open well or setting up a bore well. Nor has he thought about conserving and harvesting rainwater from his farm.

Ecology (farm forestry & biomass)

The farmland is in a small tribal town with forest cover on one end of the farm, and the farmer has not paid much attention to strengthening his farm forestry. There are a few grown-up horticulture trees on the farm. However, he has now planted more horticultural plants, which may total 300.

Soil Health

The soil of his farmland looks very fertile as he applies organic manure from time to time to increase the microbial population. He does not depend upon the outside market to procure compost as he uses his compost, thereby saving on input procurement costs. He spends only on transportation costs, which amount to INR 6000 annually. His annual land preparation cost is about INR 19,000. He also uses crop residues as biomass to increase the soil health of his farmland.

Seeds-saplings-livestock (genetic material composition)

Farmer Case 24 uses local seeds for his farming activities. Generally, he collects seeds during harvesting and preserves those for the next cycle. He spends about INR 4300 annually towards seed expenses. He has been able to reduce the dependency syndrome on external seeds. Horticulture plants are usually obtained from the local nursery of the State Horticulture Department. The livestock, including the cows of Farmer Case 24, are local breeds.

Farm diversity (energy and production basket)

Farmer Case 24 has diversified field crops by cultivating various field crops, viz. paddy, cereals, pulses, and different vegetables (Chili, Brinjal, Cabbage, Cauliflower, Bitter Gourd, Ridge Gourd, and Tapioca). His annual principal income of about INR 2,29,000 comes from selling vegetables. This diversification and crop rotation have helped him in strengthening crop productivity.

He further diversified his farming activities by growing horticulture plants, such as guava, banana, mango, jackfruit, and others. These activities enhances the biomass on the farm and increases soil health. Furthermore, he has integrated livestock into his farming activities. Annual income from livestock is about INR 15000.

Ecosystem Services & Climate Resilience:

Regularly adding farmyard manure has drastically improved the farm's soil health. The external ecological conditions are favorable; the general temperature is cool and conducive. The recent addition of horticulture trees on the farm is gradually improving the farm's micro-climate. So, he is gradually incorporating all five factors of production, viz., soil health improvements, farm diversity in field crops through intercropping techniques, horticulture plants, ecology (trees on the farm), and indigenous local seeds. With good soil health and year-round farming, the farm ecosystem can fairly balance the key factors and improve the ecosystem services in terms of organic carbon in the soil, water absorption capacity, and reduced temperature on the farm.

In recent years, the effects of climate change in terms of variations in rainfall and a slight temperature rise have been experienced in the farming ecosystems. Crop yield and farm production have generally been impacted due to this change in weather conditions at respective farm levels. However, due to better ecological balance and related ecosystem services, the farm of Farmer Case 24 has had a relatively higher yield and total production than other farmers in the area. These results show that ecological balance facilitates better ecosystem services, leading to farm climate resilience.

Diversity in Farm Production & Market Resilience

Over the years, Farmer Case 24 has gradually increased the diversity of his farm. Given its nutritional value and taste quality, his farm products are in higher local demand. Based at Block headquarters, he gets customers willing to pay a fair price for his organic produce. The farmer receives regular orders for various crops from many consumers. Due to the higher diversity of his farm, the farmer can get regular income from his farm. As he is not dependent on a few large buyers but has several customers, he is more market-resilient than other farmers.

Benefit to Farmer & its Impact on Other Farmers

The farmer's crop yields are higher with better ecological balance and soil health. With diversification, the regularity in income and total income has increased. The good quality of his farm produce gives the farmer a reasonable price, and the total income is higher than other farmers in the community. He can earn sufficient for his family and does not have to migrate out to work as a laborer in cities like many other farmers. With age on his side, Farmer Case 24 can emerge as a model farmer for the local area and the whole district.

Expenditure and Income Details

The gross annual income of this 10-acre (3.93-hectare) Farm was estimated to be INR 4,26,500. The total annual cost of operation was estimated to be INR 50,200. Accordingly, the net annual income of the farm was found to be INR 3,76,300. The table below gives the details:

Estimated Net Income* (2020-21)

- Total Revenue = INR 4,26,500
- Total Expenses = INR 50,200
- Total Net Income = INR 3,76,300
- Total Area: 10 acres = 3.93 hectares
- Net Income per hectare per year = INR 95,751
- Net Income per hectare per month = INR 7,979

* For more details, please see the detailed information sheet below.

Monthly Income:

The net monthly income of this 10.0-acre (3.93-hectare) farmland has been estimated to be INR 95,751. Accordingly, the net monthly income of 1 hectare of land would amount to INR 7,979. This level of positive net income for the farmer in a tribal region looks good. However, the farmer can do more than this, given the locational advantage of suitable natural ecology and closeness to a good market.

The farmer can build up its other strengths, especially in-situ water conservation, farm forestry, and horticulture diversification, to reduce the cost of maintaining soil health, increase cropping intensity throughout the year, and enhance income from horticulture and livestock.

The cost of labor put in by the farmer and his family has not been accounted for in the cost of farming on this farm. Similarly, the above income does not include the value of the family's consumed vegetables, fruits, pulses, and cereals. Adjusting the monetary value of his household consumption with the cost of family labor is likely to increase the monthly net income of the farmer slightly.

Table 4.24.1: Total Expenses of Case Study 24 Farm (April 2020 - March 2021)

Particulars	Pre-Monsoon			Kharif			Winter						
	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	Total
Land Preparation	5000			5000			5000			4000			19000
Input Cost	1500			1500			1500			1500			6000
Labor Cost	1000			1000			1000			1000			4000
Seeds	1200		6000	1300			1500			1500			11500
Any Other													
Irrigation (Pump Set)	900						400			900			2200
Transportation	3000			1000			2500			1000			7500
Sub Total													**50200**

Table 4.24.2: Total Revenue of Case Study 24 Farm (April 2020 - March 2021)

Particulars	Pre-monsoon /Summer			Monsoon			Rabi Window						
	APR	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	Total
Paddy								45000					45000
Millet								5000					5000
Maize							15000						15000
Arhar							12000						12000
Black Gram								2400					2400
Mung								2100					2100
Vegetables (Chili, Brinjal, Cabbage, Cauliflower, Bitter Gourd, Ridge Gourd, Tapioca etc.)													229000
Turmeric	30000												30000
Livestock													
Goat											15000		15000
Horticulture													
Banana			40000										40000
Tapioca													2000
Mango												16000	16000
Jackfruit			15000										15000
Sub Total													**426500**

* The Farmer has maintained his income & expenditure on seasonal produce and annual basis. In the above context, the study took the data from the farmers' format and arrived at the net income.

Farm Photos

Case Study 25

Case Abstract

The farm of Farmer Case 25 in Odisha, spanning 4.85 acres, represents an integrated approach to agriculture, combining cereals, pulses, vegetables, spices, and horticulture with livestock management. His practices emphasize soil health, biodiversity, and water conservation, showcasing the resilience and productivity of natural farming. His farm illustrates the effectiveness of diversified agriculture in sustaining livelihoods and enhancing ecosystem services, highlighting the benefits of holistic farm management strategies for sustainable development.

District & State

Farmer Case 25 resides in Ostapada village, Liligada GP, situated in Mohana Block of Gajapati District, one of Odisha's southern districts. This district, predominantly hilly with undulating terrain, is primarily rainfed and bordered to the east and partly to the north by Ganjam, its parent district. Odisha, located along the Bay of Bengal in eastern India, is primarily agrarian, with 60% of its population relying on agriculture and allied activities for their livelihood. High temperatures, high humidity, moderate to heavy rainfall, and short, mild winters characterize the state's climate. The southwest monsoon usually arrives between June 5th and 10th, covering the entire state by July 1st. Odisha is divided into ten agro-climatic zones based on different climate types.

Background of Farmer & Farming

Farmer Case 25 is the leading progressive farmer of Ostapada village of Liligada GP in Gajapati District. Earlier, he harvested paddy, maize, and vegetables from his 12 acres of farmland (Patta Land- 10 acres & Non Patta Land- 02 acres). He has been farming since the age of 12 years. About twenty years ago, the farmers in the community practiced the natural way of farming, and so did farmer Subash. However, by early 2000, modern farming had gained momentum in this remote and backward region.

Farmer Case 25 also adopted inorganic chemical fertilizer and pesticide agriculture as a lead farmer in the area. In about 4-5 years, the income from his farming activities started to drop, and it became difficult for Farmer Case 25 to manage the expenses of his growing family. He could not figure out what led to the losses from his farming; to make ends meet, he finally migrated to Chennai around 2009 to find work as a laborer. For three years, he struggled to earn additional income. He returned around 2012 and restarted agriculture with water pumps and farm machinery investments. He, however, continued his inorganic chemical fertilizer and pesticide-based farming system. He improved his income by giving out his farm machinery on a hire basis to other farmers.

In 2016, he was invited to join a training and demonstration of natural farming in Bhubaneswar by Mr. Subhash Sharma from Maharashtra. He saw through land leveling and land preparation techniques for in-situ water conservation, organic manure (cow dung cow urine), indigenous seeds, and the different aspects of natural farming. The above work was part of action research by XIMB that was carried out in a 1-hectare land of CEDEC-NISWASS in Bhubaneswar.

With the success of this action research on making farming sustainable through ecological farming methods, NABARD supported extending this action research in a few rural communities. Action research in Liligada GP, where Subash belonged, was also one of the three locations. This action research began in 2018. As part of this action and dissemination of ecological-natural farming in the community, some leading farmers who developed different aspects of the natural farming system visited the sites, including Liligada. Farmer Case 25 was introduced to some farming techniques from leading farmers like Subash Sharma, the late Deepak Suchde, and Bharat Bhushan Tyagi. Farmer Case 25 has gradually shifted to organic farming through this exposure, deliberations, and training since 2016.

The farmers' total land area is 12 acres in Liligada Gram Panchayat. The farmer puts temporary fences on specific plots where some crops are grown, especially when farmers in the GP leave their cattle for free grazing. The land is used mainly for growing commercial crops in different seasons. There are limited numbers of horticultural plants on the fragmented plots.

Balancing the Critical Factors of Production:

The five critical factors of production include (a) soil health, (b) water (in-situ water conservation and harvest), (c) seed (genetic material composition of seed, sapling, livestock), (d) diversity (of farm production), and (e) ecology (including horticulture & forest trees in and around the farm). How has the farmer balanced these five critical factors of production?

Water (in-situ water conservation harvest)

Farmer Case 25 depends upon stream water for irrigation purposes. He uses pump sets and pipes to channel water to his farm crops. His organic/natural farming practices are somewhat hindered due to a lack of perennial water sources for irrigation. The Liligada GP is part of the rain-fed region, with no irrigation facilities. So far, he has been unable to dig an open or bore well on any farm locations. Despite this water issue, he has been undertaking organic-natural farming. He spends Rs. 3200/- annually towards pump set charges. He has planned to go either for an open well or bore well on his farmland by mobilizing schemes with the help of his GP-level FPC.

Ecology (farm forestry & biomass)

Depending on the location, his different farm plots have different levels of forestry around his farm. The plot near his house has less forest cover, and the plots away from his village have greater forest cover. Following the training on regenerative agriculture from XIMB, he has planted around 100 mango trees and 2 jackfruit trees in and around his different farm plots. Still, this farmer has to undertake many initiatives to strengthen his farm's ecology.

Soil Health

The soil of most of his farm plots looked very fertile. He relies only on organic manure and prepares it from his cattle dung. He is skilled in soil treatment. He has experienced how applying organic manure has helped bring a sea change in soil fertility and the growth of microbes in his farmland. He has used organically prepared liquid manure on his farm crops to control pest attacks and other diseases. His input cost towards improving soil health is nil. The image below sheds some light on his practice of preparing organic manure from cow dung.

Seeds-saplings-livestock (genetic material composition)

His seed collection and preservation are the most critical aspects of his organic/natural farming. He preserved his seed for the next cycle. This practice has eliminated his dependency syndrome on market seeds. He grows his saplings for various crops and vegetables. The livestock, including cows, goats, and chickens, are indigenous breeds and hence resilient to his local ecosystem's warm tropical climate and rain-fed conditions.

Farm diversity (energy and production basket)

Farmer Case 25 has diversified his farming to various crops like paddy, pulses, cereals, different vegetables, and spices in his 12 acres of land, though all of these are not in one site but are in different locations in the GP. The images below show the variations in his cropping pattern. He is known as a progressive farmer in his GP and provides training on natural farming to other farmers in the area. All his organic farm products have high market demand, which has increased his net income. He also leads the farmer producer collective in his GP.

Apart from diversification of farm crops, he has integrated livestock, poultry, and fishery into his farming practices. He had about 40 goats last year and earned about Rs.84800/- from these livestock activities. He also undertakes local processing of his produce marketing.

Ecosystem Services & Climate Resilience

By regularly adding farmyard manure, the soil health of his different farmlands has improved. The lack of tree cover on his land closer to his house makes it difficult to maintain a suitable micro-climate for his land. The recent addition of horticulture trees on the farm would take some time to improve his farm’s resilience to climate change. However, he is gradually incorporating all the five factors of production, viz., soil health improvements, indigenous local seeds, increase in farm diversity in field crops, horticulture plants, and ecology (trees on the farm). With good soil health and water availability, he can farm for most of the years in some of his patches of land. The farm ecosystem shall take some time to balance the key factors fairly and improve the ecosystem services in terms of organic carbon in the soil, water absorption capacity, and reduced temperature on the farm.

In recent years, the effects of climate change in terms of variations in rainfall and a slight temperature rise have been experienced in the farming ecosystems. Crop yield and farm production have generally been impacted due to this change in weather conditions at respective farm levels. However, due to a slightly better ecological balance in organic carbon and moisture holding capacity, the farm has had a relatively higher yield and total production than other farmers in the area. These results show that as the ecological balance improves, it facilitates better ecosystem services, leading to the climate resilience of the farm.

Diversity in Farm Production & Market Resilience

Over the years, Farmer Case 25 has gradually increased the diversity of his farming through not much on a specific farm. However, given its quality in terms of nutritional value and taste, his farm products have a higher local demand. His marketing acumen also helps him to sell off his produce. He says he has around 30-40 regular customers and gets 4-5 orders daily. Due to the greater diversity

of his farming, including livestock, he can get regular income from his farm. As he is not dependent on a few large buyers but has several customers, he is more market-resilient than other farmers.

Benefit to Farmer & its Impact on Other Farmers

With better soil health, the farmer's crop yields are higher. With diversification, the regularity in income and total income has increased. The good quality of his farm produce gives a reasonable price to the farmer, and the total income is higher than that of other farmers in the community. He can earn sufficient for his family and does not have to migrate out to work as a laborer in cities like many other farmers. Farmer Case 25 is the current president of the Liligada GP FPO, whom NABARD also supported. He can be a model farmer for the local area and the whole district in the future if he can bring other farmers to natural farming, adopting indigenous methods of farming practices.

Expenditure and Income Details

The gross annual income of this 3.0-acre Farm was estimated to be INR 8,25,900. The total annual cost of operation was estimated to be INR 3,79,899. Accordingly, the net annual income of the farm was found to be INR 4,46,001. The table below gives the details:

Estimated Net Income* (2020-21)

- Total Revenue = INR 8,25,900
- Total Expenses = INR 3,79,899
- Total Net Income = INR 4,46,001
- Total Area: 12 acres = 4.72 hectares
- Net Income per hectare per year = INR 94,492
- Net Income per hectare per month = INR 7,874

* For more details, please see below the detailed Information Sheet

Monthly Income:

The net monthly income of this 12.0-acre (4.72-hectare) farmland has been estimated to be INR 37,167. Accordingly, the net monthly income of 1 hectare of land would be INR 7,874. This level of positive net income of the farmer in a rain-fed condition and where the land is quite fragmented looks remarkable.

The farmer can build up its other strengths, especially in-situ water conservation, farm forestry, and horticulture diversification, to reduce the cost of maintaining soil health, increase cropping intensity throughout the year, and enhance income from horticulture and livestock.

The cost of labor put in by the farmer and his family has not been accounted for in the cost of farming on this farm. Similarly, the above income does not include the value of milk, vegetables, fruits,

pulses, and cereals consumed by the family. Adjusting the monetary value of this household consumption with the cost of family labor would show an increased monthly net income of the farmer.

Table 4.25.1: Total Expenses of Case Study 25 Farm (April 2020 - March 2021)

Expenses	Pre-Monsoon			Kharif			Winter						
	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	Total
Land Preparation													
Tractor & Bullock Ploughing			50000				15000	10000					75000
Input cost													
Compost cost			12000				14400	6000					32400
Tractor cost			2400				2400	1200					6000
Labor cost			30000				1600	54000					85600
Seed													
Paddy			63750										63750
Millets			384										384
Maize			7875										7875
Pulses							610						610
Vegetables								4000					4000
Spices								82000					82000
Cowboy													12800
Vaccination													
For goats													3880
Fish Seeds													1400
Medicines													1000
Pump set Charges													3200
Total													**379899**

Table 4.25.2: Total Revenue of Case Study 25 Farm (April 2020 - March 2021)

Particulars	Pre-monsoon /Summer			Monsoon			Rabi Window						
	APR	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March	Total
Paddy								292500					292500
Millet							51200						51200
Maize						135000							135000
Black Gram											36000		36000
Moong											32000		32000
Horse Gram (Kolath)												15000	15000
Vegetables & Spices (Chili+Brinjal+Ladeis Fingr+Tomato+Canbbage													130550
+Cluster Bean+Radish)													
Turmeric (from 1 acre)										25000			25000
Ginger										8000			8000
Livestock													
Milk													28800
Poultry													6000
Goats													50000
Horticulture													
Jack fruit as vegetable	2000												2000
As Fruit (Ripe)		2000											2000
Mango		2250											2250
Income from Tractor Rent													9600
Total	**2000**	**4250**				**135000**	**51200**	**292500**		**33000**	**68000**	**15000**	**825900**

Farm Photos


SHOT ON POCO X3 | MY...SACHIDA


SHOT ON POCO X3 | MY...SACHIDA


SHOT ON POCO X3 | MY...SACHIDA

5.0 Major Findings & Observations

The significant findings and observations are provided in three critical and interrelated aspects, i.e., (a) Improvement in ecosystem services of a farm while adopting an ecological (indigenous+) farming system, (b) Reduction in Climate risk and Market risk – With improvements in organic carbon, on-farm water conservation & its harvest, on-farm manure, and biomass production, the ecosystem services improves in the farm. With increased diversity on a farm, pest attacks are reduced, reducing the cost of pest management. With better balancing of the five factors of production, ecosystem services improve, enhancing the ability of farmers to minimize climate risk and market risk, and (c) Increase in financial performance and regularity in the income of farmers with greater immersion in this system of ecological (indigenous+) farming system.

5.1 Improvement in Ecosystem Services

It was observed that the sample of farmers from different geographies across India had different ecological (indigenous+) farming system levels. Farmers who incorporated most of the five factors had better ecological balance and ecosystem services. Farms with systematic soil improvement efforts improved soil organic carbon. In turn, it increases moisture retention capacity or water holding capacity. Such farmers had a water supply throughout the year. Additionally, some farmers had regular water supply from external sources.

Farms with many trees (ecology) on and outside the farm had lower temperatures and could stabilize the micro-climate within the farm, providing a safe environment for honeybees, butterflies, and other flies that improved the pollination rates. On trees outside the farm area, most ecological farmers systematically planted trees around their farms. A few others had the natural endowment of the region, like farmers like Farmer Case 12 of Nagaland and Farmer Case 19 of Odisha. However, some farmers, such as Farmer Case 25 of Odisha and Farmer Case 18 of Bihar, have neither natural endowments nor knowledge or community support for maintaining tree cover in their respective areas.

Farms with greater farm diversity enhanced biomass production on the farm. It helped protect the micro life below and above the soil on the farm and produced more biomass for the livestock on the farm. This also helped farmers to produce crops throughout the year and get regular income from the farm. Depending on how each farmer had balanced all the five factors of production, the degree of ecosystem service was available to the farmers. In each case, the ecosystem service situation is mentioned. All farmers with high monthly incomes per hectare exhibit better balancing of the factors of production and have facilitated better ecosystem services. Farmers such as Farmer Case 1 from Maharashtra, Farmer Case 2 from Rajasthan, Farmer Case 3 from UP, Farmer Case 13 from Gujurat, Farmer Case 6 from Karnataka, Farmer Case 14 from Madhya Pradesh illustrates this well. The last five farmers in this list with lower net incomes, viz., Farmer Case 21, Farmer Case 22, Farmer Case 23, Farmer Case 24, and Farmer Case 25, though they know their farms are a little far from the balance required.

However, it is to be noted that balancing these variables simultaneously requires understanding and time. Maintaining this balance is dynamic and requires deep engagement, expertise, and skills. Farm expenses per hectare can rise early in this balancing act. However, as these variables are near balance, the expenses will go down, the yield will increase, and the farmer's net income per hectare per month will increase.

It can also be noticed that although the last five sample farmers have relatively more land than many others among the sample farmers, these five last have lower net income per hectare per month than the other farmers. Although each of these five farmers appreciates ecological, indigenous+ farming, they have not effectively balanced all the five critical variables of this farming system. This lacuna was also observed from field verifications.

5.2 Reduction in Climate risk and Market risk of Farmers

From the individual case studies, it was observed that farmers who had a better ecological balance on most of the factors of production had better ecosystem services, which reduced their climate risk. As mentioned above, farmers such as Farmer Case 1, Farmer Case 2, Farmer Case 3, Farmer Case 13, Farmer Case 6, and Farmer Case 14 are a few whose farm illustrates this.

While diversity in farm production contributes significantly to ecosystem services and climate resilience, it is the most critical aspect that protects farmers from climate and market risks. Diversity in farm production plans, including fruits, vegetables, cereals, pulses, spices, tubers, and a variety of livestock, facilitates the interconnectedness and interdependence in a natural circular production system. These processes help the soil systems to be alive and healthy, in-situ water harvesting, and reduce pest problems in farms with better ecological balance. All these farming methods can balance the variations in rainfall, rise in temperature, hot and dry winds (loo) flows in summer months, and balance the microclimate at the farm level. Further, even if a crop fails due to climate change, the diversity of production baskets limits the risk to the farmer.

The diversity of farm production baskets is better aligned to the farmer to meet the smaller quantities of supplies in the local market throughout the year. The farm produce remains fresh, nutritious, and unique to local taste. This strategy of ‘economies of scope’ in production keeps the farm produce from commodification and market price reduction due to oversupply as in the mono-cropping (strategy of economies of scale) farming system. While all the 25 farmers in this study exhibited diversity in their farming practices, the first set of 15 farmers exhibited a greater balance of the critical factors of production than the second set of 10 farmers.

5.3 Financial Performance of Farmers

The financial performance of farmers adopting ecological (indigenous+) climate-resilient farming systems seems robust. It can better handle climate risks and reduce production and market risks through a diversified farming system.

It was observed that farm performance in terms of its yield, production, and net income depended on various factors, i.e., the farmer’s local context, exposure, awareness, understanding, and commitment to ecological farming. Overall, it was observed that balancing the critical factors improved the ecosystem services in a farm, which reduced the farm's cost and performance in terms of quality, yield, and total harvest. With better ecosystem services, production costs are reduced, and net income accordingly increases.

For all the 25 farmers operating in better to worse ecologically balanced agroecological systems, the average net income per hectare per month is Rs. 28,970. However, for the first 15 farmers with greater ecological balance on their respective farms, the estimated average net monthly income per hectare is INR 39,147, whereas it is only INR 13,704 for the next 10 farmers whose farms are still in different

stages of ecological balance. From the sample cases of farmers, the farmer with a higher net monthly income per hectare is INR 79,274.

Table 5.4 below, on the Estimated Net Income of a Farmer, summarizes the diversity of produce from a farmer's field, including crops, vegetables, fruits, and livestock. The table also provides data on farm size, total net income per year, total net income per month, and estimated net income per month per hectare of land of all 25 sampled farmers. From the above observations, it can be inferred that the proposition of this study can be vindicated.

Table 5.4: Estimated Net Incomes of Farmers

Sl. No.	Name of the State	Name of Farmers	Production Diversity of the Farmer	Farm Size (In Hectare)	Year of Farm Data	Total Net Income per Year (In INR)	Net Income per month (in INR)	Net Income per month per Hectare (in INR)
1	Maharashtra	Case Study 1	Toor, Methi, Coriander, Haldi (Turmeric), Pumpkin, Palak, Fruits, Vegetables, Wheat, Livestock, Milk, etc.,	5.12	2021-22	4870600	405883	79,274
2	Rajasthan	Case Study 2	Milk, Fruits, Vegetables, Ducks, Field crops, Value addition on Farm, etc.	18.21	2021-22	11667896	972325	53,395
3	Uttar Pradesh	Case Study 3	Paddy, Spices, Sugar Cane, Turmeric, Mango, Fruits, Livestock of cows, Processing units	3.00	2021-22	1613155	134430	44,810
4	Gujarat	Case Study 4	Mango, Lemon, Coconut, Amla, Jamun, Water Apple, Custard Apple, Drumstick, Ram Phal, 5 Star Fruit, Banana	0.70	2020-21	368524	30710	43,872
5	Andhra Pradesh	Case Study 5	Drumstick, Field Bean, Chrysanthemum & Crossandra	0.80	2021-22	410000	34167	42,708
6	Karnataka	Case Study 6	Vegetable Seed production, Sapling Production of Fruit Plants & Ornamental Plants, Vegetables, Tubers, Fruits, livestock, Milk, etc	2.36	2022-23	1112500	92708	40,554
7	West Bengal	Case Study 7	Paddy, vegetables, pulses, oilseeds, fruits, livestock, Fishery	0.80	2021-22	362200	30183	37,729
8	Kerala	Case Study 8	Paddy, Vegetables, Horticulture, Livestock of cows and Chicken	0.80	2021-22	344810	28734	35,918
9	Gujarat	Case Study 9	Bottle guard, Parval, Sugarcane, Halid, Guava, apple bel, Mango, Milk, etc	4.72	2021-22	1876000	156333	33,121
10	Karnataka	Case Study 10	Coconut, Ragi, fruits, spices, Timber, livestock of cows and Goats	1.60	2021-22	614933	51244	32,028
11	Punjab	Case Study 11	Wheat, Alsi, Mustard, Maize, Ragi, Haldi, Vegetables, Mango, Grapefruit, Guava, Amla, Kinu, Milk, etc	2.20	2022-23	815900	67992	30,905

12	Nagaland	Case Study 12	Paddy, potato, onion, tomato, chili, soybean, dal, cabbage, pea, beans, garlic, fruits, Livestock of cows	1.60	2022-23	565808	47151	29,469
13	Gujarat	Case Study 13	Paddy, Chickpeas, Mustard, Vegetables, Curry leaves, Coconuts, Banana, Sapota, Milk, Coconut saplings	6.07	2021-22	2059600	171633	28,276
14	Madhya Pradesh	Case Study 14	Vegetables, Fruits, Wheat, Pulses, Turmeric, Milk, etc.	2.36	2021-22	783940	65328	27,681
15	West Bengal	Case Study 15	Paddy, vegetables, pulses, oilseeds, fruits, livestock, Fishery	1.21	2021-22	398750	33229	27,462
16	Punjab	Case Study 16	Cereals, Pulses, Vegetables, Horticulture, & Livestock (cow & buffalo)	1.57	2020-21	423800	35317	22,495
17	Kerala	Case Study 17	Paddy, banana, rambhuttan fruit, arecanut, nearly 65 varieties & honey	0.78	2021-22	194675	16223	20,799
18	Bihar	Case Study 18	Paddy, Maka (Maize), Chana, Wheat, Livestock of cows, buffaloes, and Goats	1.60	2022-23	390340	32528	20,330
19	Odisha	Case Study 19	Cereals, Pulses, Vegetables, Livestock, Horticulture	2.07	2020-21	4,39,450	36621	17,691
20	Pondicherry	Case Study 20	Paddy, Ragi, vegetables, Fruits, nearly 96 varieties	4.00	2022-23	561913	46826	11,707
21	Odisha	Case Study 21	Paddy, Green Gram, Mango, Lemon	1.80	2021-22	212350	17696	9,831
22	Tamil Nadu	Case Study 22	Turmeric, banana, coconut, vegetables, Livestock of cows	3.00	2021-22	338704	28225	9,408
23	Andhra Pradesh	Case Study 23	Chili, Cotton, Leafy Vegetables	1.21	2020-21	129650	10804	8,929
24	Odisha	Case Study 24	Cereals, Pulses, Vegetables, Livestock, & Horticulture	3.93	2020-21	376300	31358	7,979
25	Odisha	Case Study 25	Cereals, Pulses, Vegetables, Spices, Livestock, Horticulture	4.72	2020-21	446001	37167	7,874

6.0 Major Learning from the Study

Although the ecological (indigenous +) farming system is both climate resilient and market resilient, leading to greater farmer's prosperity, several hindrances exist to its large-scale adoption and replication. The interconnected issues that enable ecologically friendly production factors observed from this study and the learning for better policy formulation for ecological (indigenous +) farming practices for farmers' prosperity and long-term sustainability are provided here. The issues may be broadly categorized as (a) challenges of farmers in enabling ecosystem services in their respective farming clusters, (b) lack of awareness of the dynamic relationships of the critical factors of production, viz., water (jal), jungle (forest-ecology), jamin (land – soil), genetically stable indigenous seeds, and diversity of field crops, horticulture, and livestock, and (c) institutional and organizational issues of coordination and management in local habitats/clusters or lowest levels of community governance.

6.1 Ecosystem Services - Challenges Observed

The case study covered farmers from different contexts who had primarily succeeded in organizing their production to deal with climate change and market risks reasonably, ensuring better financial performance. Depending on the degree of adoption of critical factors of production as indicated above, ecosystem services in these farmers' farms have improved.

Improvement in soil health, improvement in water holding capacity of land, higher yield of nutritious food, lowered temperature on the farms, and lesser pest attacks on crops were some indicators of better ecosystem services on the respective farms. Many experienced farmers have been offering training to other farmers in their respective regions, states, and the national level. These farmers earned a decent amount of money from such training sessions. Some of these farms had also become training and learning centers for other farmers, youth, and children.

However, these set of select farmers were observed to be outliers in their respective ecosystems in different regions and states across the country. Although most other farmers around these successful farmers would like to adopt climate resilient and market-resilient farming, they cannot. The above seems to be primarily due to some of the systemic challenges.

The challenges relate to (a) poor grass cover of soil due to lack of moisture during the summer season leading to poor soil health, (b) poor tree cover of land leading to disruption of micro-life (butterflies, different flies, honey bees, birds, etc.,) above the ground that impact pollination and crop yield, (c) free grazing of different livestock during the months of January to July in many localities in India, (d) lack of genetically stable (indigenous) pool of seeds, planting materials and livestock, (e) land fragmentation and litigation with farmers having access to less than 1 hectare of land for farming, and (f) lack of coordination for production planning and marketing by the community of farmers at the village and GP level.

There are several challenges to adopting an indigenous climate-resilient, sustainable farming system. One or more of these challenges also apply to a few farmers from this list, especially the ones with relatively lower monthly net incomes per hectare. A brief description of these challenges is mentioned below.

Poor Grass cover of Soil

Successful farmers with higher net incomes have given emphasis and have systematically worked on facilitating the moisture-grass cover, temporary mulching, and soil health regenerative cycle. Most farmers, though they might be aware of the above cycle, are unable to do so because of their inability to hold water on their respective farms. Poor grass cover of soil leads to poor soil health due to lack of moisture during the summer season. This phenomenon increases the farmer's cost of enhancing soil fertility. Having grass cover on the land would not only protect micro-life in the soil and increase fertility but also provide local green fodder at little cost to the livestock of farmers in the community. Switzerland is a classic case of having built this regenerative cycle and strengthening its dairy industry. The photo image below showcases the grass cover of soil and livestock grazing in one part of it.

Source: Photo of a landscape around the city of Zug, Switzerland, by Amar KJR Nayak

Poor Tree-cover of Land

The tree cover of land in the farmland and other surroundings is part of the factor ‘Ecology or Farm Forestry’ observed during the case studies. Farmers with longer experience, greater exposure, and higher net incomes were observed to have taken good care of this factor or were in the process of strengthening this factor on their respective farms.

Poor tree cover of land leads to disruption of micro-life (butterflies, different flies, honeybees, and birds.) above ground. Lack of green cover accordingly impacts the pollination rate and yield of the farm's field crops, vegetables, and fruits.

Free Grazing

From January to June, the prevailing practice of free grazing of cattle has been a significant hurdle for farmers across many States of India. Farmers cannot grow crops for more than six months of a year. In contrast, it might appear that people in these communities did not care for their animals. However, the underlying reasons behind free grazing, as shared by farmers from different contexts, include the following:

- Lack of sufficient fodder and water for large heard of cattle
- It is costly to feed and time-consuming to take care of so many cattle during the dry period.
- While most farmers had a few cattle, a few farmers had large unmanageable numbers of cattle to take care of
- Owning cattle among farmers seemed to give a sense of good feeling rather than being a significant source of income.

Fear of crop damage by free-grazing cattle prevents smallholder farmers from planning any cultivation from January to June. A 'watch and ward' cost throughout the day and night is prohibitive. Hence, even if few farmers have access to water, cultivation in the summer months is not viable. The factor of free grazing alone reduces farming time during the whole year to only 50%. As crop (vegetable and oil seeds) prices that can be realized from crops during this period are higher than during the monsoon season, the overall productivity of the land is reduced by more than 50%.

Further, the dung and urine of the cattle cannot be collected during this period, which is a further loss to the farmers who own these cattle. Moreover, the decision to stop free grazing cannot be implemented if a few farmers in one village or hamlet decide to stop free grazing. Given the complexities of free grazing, all the villages in a GP need to jointly decide to stop free grazing.

Genetic Pool of Seeds, Planting Materials and Livestock

While mature and successful farmers largely resolve these issues through their well-cultivated farmer network and the saving of seeds and genetic material on their farms, the general community has little mechanism for this. This could be the most challenging factor for stabilization. Most of the farmers either sell them as grains or procure them for their household consumption purposes. Seed sharing among farmers has gradually become uncommon among most farmers in their larger community. In contrast, the genetic pool of cereals and pulses is manageable today. The genetic pool of vegetables, fruits, and local livestock needs attention. This will require working closely with the State Animal Husbandry and Veterinary Services.

Land Fragmentation & Size of Land Holding

Increasing fragmentation of land holdings makes land size commercial unviable and operationally unattractive for a smallholder farmer to undertake any systematically planned activity on the small holding (less than 1 hectare) throughout the year. The watch and ward of the fragmented pieces of land also make it harder for any farmer to undertake farming in the current context.

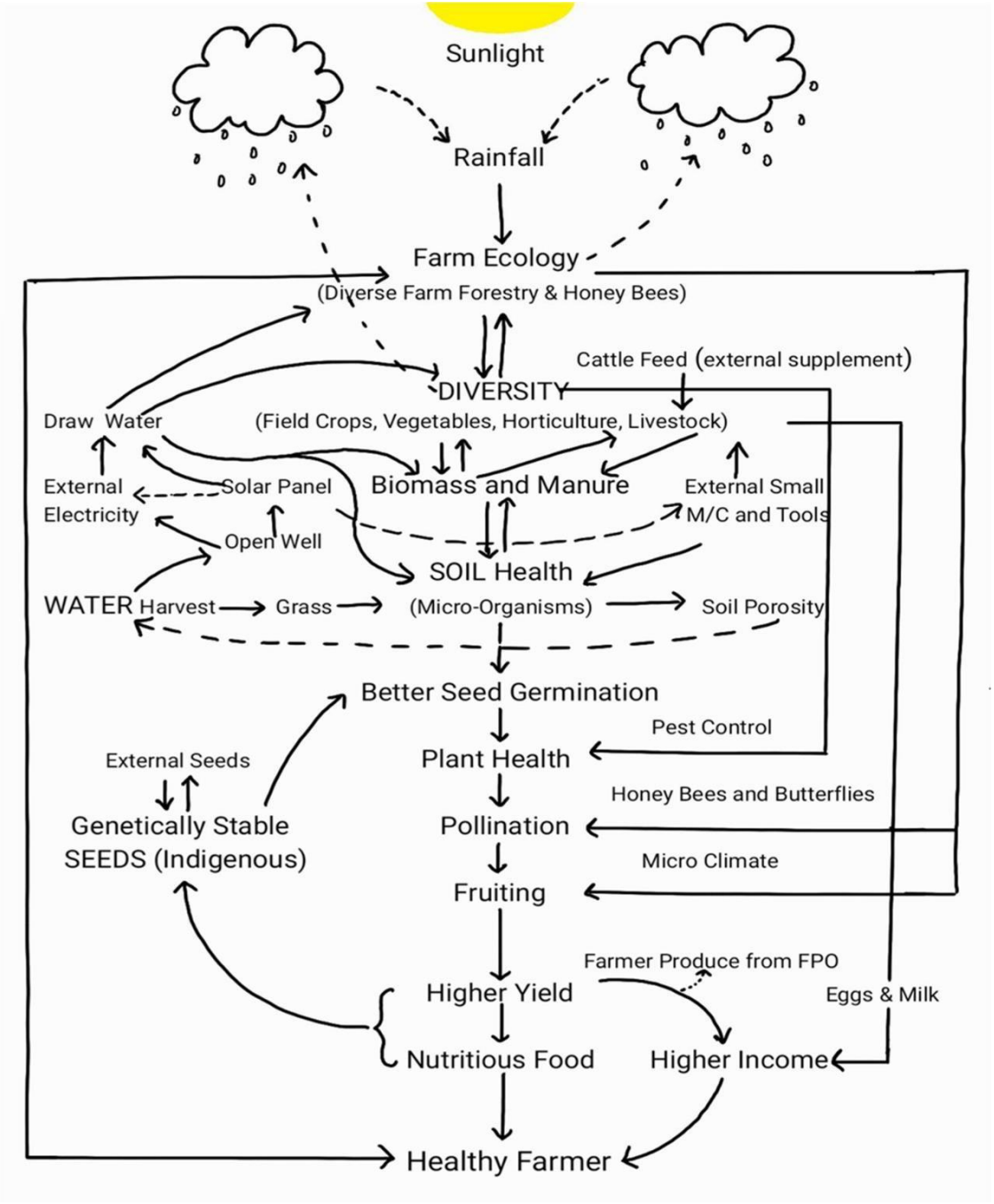
If a piece of land owned by a farmer is less than about a hectare, it will neither be technically nor commercially viable to undertake the measures for in-situ water conservation, digging an open well, and having an integrated farming system. Hence, small land holdings have severe limitations when adopting sustainable agriculture systems as proposed at the existing level of coordination in a village.

However, the issue of fragmented landholding could be dealt with if a few farmers of adjacent plots can come together and create common facilities for in-situ water conservation, open wells, pumping facilities, cattle sheds, and fencing, for, say, 1-2 hectares of land.

6.2 Key Production Factors & Systems Dynamics

The five key production factors of the study included moisture/water source, soil health, genetic stability of seed & livestock, farm diversity, and farm forestry/ecology. More specifically, the key variables of investigation in this study included (a) moisture retention through in-situ water harvesting, (b) soil system development through organic matter and on-farm diverse biomass that enables microbial activity in the soil, (c) seeds and livestock are indigenous, and (d) farm adopts diversified farming including a large number of fruit trees, a variety season-based field crops well integrated with livestock on a farm, and (e) deep farm forestry with perennial forest and fruits trees around the farm.

The study proposed that regenerative cycles will be initiated as the farmer picks up the ecological (indigenous +) climate resilient farming system variables, and the ecosystem services will improve on the farm. The study finds that soil health improves with better farm diversity and deeper farm forestry/ecology. With better soil health, in-situ water holding capacity becomes better. The greater the moisture available on the land, the more biomass and soil life improve. When the above four conditions are conducive, the indigenous seeds perform better and complement the farm's livestock. The on-farm manure, in turn, improves soil health and adds to farm biomass. Several virtuous regenerative production cycles become alive depending on the level of emphasis given to these factors of production in their respective farms. **Figure 6.2.1** below depicts the nature of the regenerative cycles.



Source: Nayak, 2022

Figure 6.2.1: Dynamic Interactive Cycles of Regenerative Farming System

All the cases were based on the above regenerative principle. The mature farms with higher farmers' experience had adopted many of the above production factors, and they showed extraordinary financial performance and regular income from various farm produce. Farmers who had newly adopted natural farming or lacked the depth of experience and exposure to this type of farming had comparatively lower levels of financial performance. These new adoptions by farmers were supported by either NABARD through the local NGOs or respective state governments, such as in Andhra Pradesh.

While farm diversity and soil health through farmyard manure is a common practice among farmers, in-situ water harvesting has taken place in farms of a few matured farmers where the ecological systems have gradually evolved. However, most farmers have not scientifically located their open or

bore wells on the farm. With greater experience of climate change and knowledge, several farmers have gradually deepened their respective farm ecologies. New and young farmers, particularly in Kerala and Pondicherry, were found to experiment with farms as food forests as a wholesome strategy to flourish.

There is no adequate research on the systems dynamics of this ecological (indigenous+) farming system. This valuable knowledge of regenerative agriculture is recorded mainly in fragmented extant literature, i.e., covering a few factors at a time. However, farmers have developed their systems through trial and error over long periods. This ecological farming knowledge system is climate resilient at the farmer level but can also help reverse climate change if adopted nationally and globally.

Systematic dissemination of this knowledge system, systematic research to better codify this knowledge system, and systemwide promotion of this knowledge system from the GP to district and across states are the needs of the hour.

6.3 Coordination for Production Planning and Marketing

One of the essential features of the successful farmers in this all-India case study was that each had developed a stable local market network. For most farmers in a community, the market linkages and networks have not developed optimally where farmers, traders, and consumers can negotiate well. The lack of coordination for production planning and collective marketing by the community of farmers at the village level or GP level is at the heart of farmers' ability to bargain fair prices for different agricultural produce.

The lack of coordination among the farmers in a community or cluster about production planning leads to surplus production of agricultural produce that dampens the prices of produce. All farmers in the given community or cluster lose in the above conditions. Had farmers planned together based on the demand for different agricultural produce before producing them, they would obtain better prices for all their produce.

Collective planning and coordination could help smallholder farmers adopt small-group farming using regenerative climate-resilient farming techniques and increase overall farm productivity and incomes for smallholder farmers. It would help the farmers' community manage their seed requirements well, improve understanding and cooperation among themselves, help them find ways to stop free grazing, and achieve better convergence and utilization of the schemes and programmes of the different government departments.

Collective marketing would further enhance their ability to connect to actual consumers who would typically offer a better price than the market intermediaries. Even with the market intermediaries, collective marketing would give the farmers better bargaining power on price and other terms of trade. To facilitate better coordination among the community of farmers in their respective clusters, collective planning, and collective marketing, GP-level FPO can be promoted as per the National Scheme on FPOs.

7.0 Recommendations

Based on the close observations of farmers in different contexts in terms of their awareness, knowledge, and competence of ecological (indigenous farming) and their local social-ecological-institutional-organization contexts, the recommendations are suggested on (a) Policy Formulation, (b) Policy Execution and (c) Research Support for Ecological Climate Resilient Agriculture.

Policy Formulation

- Given the manifestations of climate change in terms of rise in temperatures, abnormal rainfall patterns, subsequent loss of biodiversity, and very high risks to agriculture and food production, both the National Government and the State Governments need to provide a clear and firm policy direction for ecological, regenerative climate resilient agriculture.

- The ecological regenerative agriculture, i.e., an improved version of our indigenous system of farming with the following features, viz., (a) moisture in farmland is retained through in-situ water harvesting method, (b) soil system is developed through organic matter and on-farm diverse biomass that enables microbial activity in the soil, (c) genetically stable seeds and livestock (indigenous or improved varieties), and (d) diversified farming including a large number of fruit trees, a variety season-based field crops well integrated with livestock on a farm, and (e) deep farm forestry with perennial forest and fruits trees around each optimally sized farm need to adopted.

- In addition to the technical challenges, Agricultural Policy also needs to address several other inter-related challenges (social, institutional, organizational): (a) poor grass cover of soil leading to poor soil health which is due to lack of moisture during summer season, (b) poor tree cover of land leading to disruption of micro-life (butterflies, different flies, honey bees, birds) above ground that impact pollination and crop yield, (c) free grazing of different livestock during January to July in many localities in India, (d) lack of genetically stable (indigenous) pool of seeds, planting materials and livestock, (e) land fragmentation and litigation with farmers having access to less than 1 hectare of land for farming, and (f) lack of coordination for production planning and marketing by individual farmers at the village and GP level.

- Formulate a Policy to promote and strengthen FPOs at the GP level such that it can facilitate in converging the various schemes of the state department and the national government for the smallholder farmers and that it can facilitate the active participation of smallholder producers with other local institutions of a GP including SHGs, FIGs, Pani Panchayats, Vana Surakhya Samitis, and Gram Panchayat Development Plan.

Programme Execution

- The State Agriculture Department, RKVY, and Extension Centers need to set up a 1-hectare Ecological Farming System in each Gram Panchayat to motivate and encourage smallholder farmers to showcase its benefits & develop their confidence to adopt the techniques of Ecological Agriculture.

- Provide systematic training to farmers on the Ecological - Regenerative Agricultural System methods.

- Invest in physical infrastructure for water harvesting and in-situ water conservation in every village and farmers' fields.

- Invest in Fodder cultivation and Cattle sheds at the farmer/village level.

- Promote natural resource management and common cattle grazing at the GP/Ward level.

- Invest in developing seed banks in every GP to promote indigenous seeds for various crops and vegetables.

- Make provisions for carbon credits for farmers adopting the ecological regenerative agricultural system for carbon sequestration in their respective ecologically regenerative climate-resilient farms.

- Promote Family Farming among small and marginal farmers to facilitate Diversity in agricultural production and timely care.

- To deal with land fragmentation and capacity to invest in ecological & climate resilient farming, promote a small farmer group of 3-5 smallholder farmers with land adjacent to each other to undertake ecological farming jointly in their 1-2 hectares of land.

- Facilitate and fund the establishment of GP-level multi-product, multi-service FPO as an institution for farmers to support farmers in adopting ecological farming and diversifying its production.

Research Approach and Support

- Agricultural Universities and Research Institutions should undertake research on Ecological Agriculture that is regenerative in nature and climate-resilient.

- Students, doctoral scholars, and scientists in agricultural science need to know systems science and systems dynamics in nature and agroecological systems.

- Research in System Dynamics related to key production factors of Ecological Agriculture, i.e., moisture, soil, genetic matter, diversity, and ecology, needs to be studied through field experiments and action research.

- Research on whether ecological agriculture can reduce the cost of farming in different contexts and reduce the growing burden of subsidies on the state exchequer needs to be studied.

In conclusion[5], the study indicates that ecological (indigenous+) farming practices improve ecosystem services by balancing the five critical factors of agricultural production, i.e., Jal (water), Jamin (land - soil health), jungle (forest - ecology), + farm diversity and indigenous seeds (genetically stable genetic materials). As a farm gets closer to balancing these five ecological factors of production, the regenerative production cycles are initiated, and farm ecosystem services improve. In turn, this leads to higher yield, more significant total production of the farm, regularity in farm production from diverse produce, including seasonal field crops, and all-through-the-year farm produce (vegetables, fruits, different outputs from on-farm livestock including milk and egg).

Overall, farmers adopting ecological (indigenous+) farming systems have performed well. For all the 25 farmers operating in different contexts, better to worse ecologically balanced agroecological systems, the average net income per hectare per month is Rs. 28,970. However, for the first set of 15 farmers with greater ecological balance on their respective farms, the estimated average net monthly income per hectare is INR 39,147, whereas it is only INR 13,704 for the second set of 10 farmers whose farms are still in different stages of ecological balance. From the sample cases of farmers, the farmer with a higher net monthly income per hectare is INR 79,274. Most importantly, the study on ecological (indigenous+) farming practices provides a potential clue at a smallholder farm level to resolving the impending climate crises that India and the World face today.

In the context of increasing vulnerability of markets and climate, as suggested by the Review Committee of this Report, it may also be helpful to broadly compare the performance of mainstream farming practices in India and ecological (indigenous+) farming practices as observed in this study. The state-wise average household income per month as per the Ministry of Agriculture & Farmers Welfare, Government of India, and the average monthly net income per hectare of sample farmers from this study is in Table 7.1.

For an accurate interpretation of the above comparison, please note that as per the Agricultural Census 2014, the average landholding of farmers in India was 1.15 hectares. Monthly income reported by the Ministry of Agriculture & Farmers Welfare refers to monthly net income per household. As indicated above, the current study has estimated average monthly net incomes per 1.0 hectares of the sample farmers.

[5] The case studies in this report include some of the best practices of climate resilient indigenous+ sustainable agriculture in India. The study also includes a few cases that do not exhibit high financial performance as the majority of the 25 cases have exhibited. Therefore, it is to be noted that depending on the adherence to best practices of climate resilient indigenous+ sustainable farming, the farm performance can vary. Appropriate exposure and necessary training of farmers in the domain of climate resilient indigenous+ sustainable agriculture will therefore be required to get the best effect of this system of farming.

Based on the data from the Ministry of Agriculture & Farmers Welfare, Government of India, the average monthly net income per household is INR 10,218. This figure is for all farming practices in India. Based on the 25 case studies of farmers adopting ecological (indigenous+) farming as per this study, the average monthly net income is INR 28,970. This figure for the net income of farmers adopting ecological (indigenous+) farming is 183 % higher than that of the national average.

Twenty-two of the twenty-five farmers in the study show a higher average net income than their respective state average monthly net income. The highest net income of a farmer, Subhash Sharma, is about 590 % higher than the average in the respective state (Maharashtra). However, the net incomes of three sample farmers from the above study, viz., Case Study 23, Case Study 22, and Case Study 16, are slightly lower (15 – 21%) than their respective state averages. As reported, these farmers are among those who are still in the process of balancing the ecological (indigenous+) variables in their respective farms. Table 7.1 provides the details.

Table 7.1: Comparison of state-wise average monthly net income of farmers with sample farmers adopting indigenous+ farming

State/ Group of UTs	Average monthly income per agricultural household (in INR), 2018-19 *	Name of Sample Farmer adopting Ecological (indigenous+) farming	Sample Farmer Net Income/ Ha /Month (in INR), 2021-23	% Higher or Lower of sample farmers than that of the respective state average
Andhra Pradesh	10,480	Case Study 5	42708	308 %
		Case Study 23	8929	-15 %
Arunachal Pradesh	19,225			
Assam	10,675			
Bihar	7,542	Case Study18	20330	170 %
Chhattisgarh	9,677			
Gujarat	12,631	Case Study 4	43872	247 %
		Case Study 9	33,121	162 %
		Case Study13	28276	124 %
Haryana	22,841			
Himachal Pradesh	12,153			
Jammu & Kashmir	18,918			
Jharkhand	4,895			
Karnataka	13,441	Case Study10	32,028	138 %
		Case Study 6	40,554	201 %
Kerala	17,915	Case Study 8	35,918	100 %
		Case Study 17	20799	16 %
Madhya Pradesh	8,339	Case Study 14	27681	232 %
Maharashtra	11,492	Case Study 1	79274	589 %
Manipur	11,227			
Meghalaya	29,348			

State/ Group of UTs	Average monthly income per agricultural household (in INR), 2018-19 *	Name of Sample Farmer adopting Ecological (indigenous+) farming	Sample Farmer Net Income/ Ha /Month (in INR), 2021-23	% Higher or Lower of sample farmers than that of the respective state average
Mizoram	17,964			
Nagaland	9,877	Case Study 12	29,469	198 %
Odisha	5,112	Case Study 19	17691	246 %
		Case Study 21	9831	92 %
		Case Study 24	7979	56 %
		Case Study 25	7874	54 %
Punjab	26,701	Case Study 11	30,905	15 %
		Case Study 16	22495	-16 %
Pondicherry		Case Study 20	11707	--
Rajasthan	12,520	Case Study 2	53395	326 %
Sikkim	12,447			
Tamil Nadu	11,924	Case Study 22	9,408	-21 %
Telangana	9,403			
Tripura	9,918			
Uttarakhand	13,552			
Uttar Pradesh	8,061	Case Study 3	44810	455%
West Bengal	6,762	Case Study 7	37,729	458 %
		Case Study 15	27.462	306 %
Group of N E States	16,863			
Group of UTs	18,511			
All India	10,218		30282	183 %

* Source: Ministry of Agriculture & Farmers Welfare, State -wise Income of Farmers under the mainstream (all types of farming included) system (2022), https://pib.gov.in/PressReleasePage.aspx?PRID=1884228 <accessed on 18th April 19, 2024

राष्ट्रीय कृषि और ग्रामीण विकास बैंक, मुंबई

NATIONAL BANK FOR AGRICULTURE AND RURAL DEVELOPMENT

www.nabard.org /nabardonline