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Natural farming a chemical-free, profitable, sustainable, and health maintaining farming in the temperate zone of Kashmir valley

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Abstract

India has gone from a food shortage to a food surplus due to agricultural intensification brought about by the "Green Revolution" (GR) and its associated technologies. But there have also been a number of negative effects from this. Uncertain market conditions and the effects of climate change have combined with increased use of chemical pesticides and fertilizers and stagnated or declining crop output to create unprofitable agriculture. In addition to health risks from significant exposure to toxic chemical pesticides, farmers have become indebted as a result of the growing cost of crop production. An agro-ecological farming method called Natural Farming (NF) is thought to be a useful means of overcoming some of these difficulties. The experiences of field-level farmers with NF adoption in the Kashmir Valley's Anantnag area are presented in this research. 180 NF adopted farmers, including 20 FLD farmers, and 225 non-NF adopted farmers were surveyed for the study between November and December 2024. It was discovered that while some upper belt farmers (tribals) have been using NF practices for over 20 years, others have only recently done so. The methods that the NF farmers employ vary as well. Farm Yard Manure (FYM) is being used by some farmers. Farmers in this district were also discovered to utilize Ghana jeevamritha, a solid form of jeevamritha, which is a liquid mixture of microbial inoculants. It was found that NF with FYM had a higher net return than NF without FYM and non-NF farms for the majority of crops. The market price of NF produce has slightly increased while the variable cost has decreased. According to the study, in addition to being economic and ecological, natural farming may be viewed as one of the alternative methods that could revitalize the agro-ecosystem.

Keywords: Natural farming, greater net returns, low-input, chemical-free, sustainable farming

Introduction

Numerous breakthroughs in human history have resulted from a belief followed by the finding of scientific proof. Using various tools and raw resources, our predecessors devised ways to live on the planet. Everything was created by trial and error, and there was no comprehension of science. In agriculture, this was also true; if we go back to the beginning, the farming system was entirely reliant on inputs produced on the farm. But as evolution progressed, the population's exponential growth necessitated rapid increases in agricultural output, which led to the development of Green Revolution technologies (GRTs). These technologies introduced high-yielding crop varieties that responded well to higher chemical fertilizer and irrigation dosages, encouraging farmers to engage in intensive monocropping. Since the implementation of GRTs in the middle of the 1960s, India's food production has grown five to ten times. Not with standing its achievements, the input-intensive "Green Revolution" has hidden significant externalities in recent decades that have harmed agriculture, human health, and natural resources [KonerN. And LahaA. 2021] [10]. Evidence also points to a recurrence of pests as a result of increased chemical fertilizer dose. The presence of pesticide residues multi-times higher than the prescribed limit in contaminated drinking water and/or air, biodiversity losses, nitrate leaching and pollution of groundwater, and heavy metal accumulation in the soil are quite common in intensive agriculture regions [John D.A.; and Babu G.R. 2021] [7]. In rural India, the easy access to pesticides has resulted in suicide deaths, and their careless use has caused pollinator populations to plummet [Baron G.L *et al* 2017] [3]. Subsequent state and federal governments have expanded input subsidies for farmers in a number of ways to lessen the impact of the growing cost of crop cultivation. These include the fertilizer subsidy (Appendix A, Figure A1), free irrigation electricity, interest subsidies on agricultural credit, and a premium subsidy for crop insurance. For example, in India, 75% of all electricity subsidies from 2016 to 2019 went to agricultural consumers. A cross-subsidy of at least INR 750.27 billion and a direct subsidy of INR 1103.91 billion were provided in 2019 alone [Aggarwal, P. *et al* 2022] [1]. While some state governments have offered 75-80% subsidies for agricultural uses, many have given farmers free power. In 2020-2021, agricultural

sectors received INR 15,754 billion in institutional financing. Even a 3% interest subvention would amount to INR 473 billion in subsidies. In 2021, the federal government and state governments paid INR 570 billion in premiums for crop insurance. For smallholders and tenant farmers, as well as for the long-term viability of Indian agriculture, the aforementioned problems seem to be a recipe for disaster. Indian farmers are thereby becoming more and more enmeshed in a never-ending debt cycle, which exacerbates their predicament. Agroecological in nature, Natural Farming (NF) is a unique method of farming without the use of chemicals [Rosset P.M. *et al* 2012] [16]. It is thought that Masanobu Fukuoka, a Japanese farmer, invented agro-ecological farming. In the mid-1990s, one of India's farmers, Sh. Subash Palekar, presented a locally tailored version of this approach in India under the term "Zero Budget Natural Farming (ZBNF)." The use of Jeevamritha and Beejamritha forms the basis of Natural Farming techniques. Jeevamritha is a liquid fermented mixture of cow dung, cow urine, jaggery, pulse flour, and bund soil mixed with water. It contains a lot of beneficial bacteria that work as a bio-stimulant, increasing the activity of phyllo spheric and soil microorganisms when applied to the field or foliage. Beejamritha, which is used to cure seeds, is also Jeevamritha without water. It is anticipated that beneficial microorganisms will infiltrate the roots and leaves of seeds that are germinating, supporting the plants' healthy growth. The use of native seeds, intercropping, and Achhadana (bio-mulching) are other crucial elements. Additionally, natural farming encourages the use of a variety of homemade formulations that function as bio-pesticides, such as Bramhastra, Agniastra, and Neemastra [Mishra S. 2018]. These are used to manage pests like fruit, stem and pod borer, leaf roller, mealy bugs, sucking pests, etc. Because of the rapid development of heterotrophic microbial communities and flora as well as the rise in soil organic matter, NF has been found to partially enhance soil health [Shyam D.M. *et al* 2019, Smith J. *et al* 2020, Saharan B.S. 2023] [19, 20, 18]. While some research [Kumar S. 2019] [11] found no loss in yield, others [Naik A.K. *et al* 2020] [15] showed one. The Indian government has heavily pushed natural farming in recent years in an effort to encourage farming that doesn't use chemicals. "ZBNF is a promising tool to minimize the dependence of farmers on purchased inputs, it reduces the cost of agriculture by relying on traditional field-based technologies which also leads to improved soil health," In his address to the nation on the 76th anniversary of India's independence, the prime minister of India stated [Duddigan S. *et al* 2022] [4]. Farmers all throughout the country are being encouraged to adopt natural farming through initiatives like the National Mission on Natural Farming, Andhra Pradesh Community Natural Farming (APCNF), Mission Organic Value Chain Development for North Eastern Regions (MOVCDNER), and Paramparagat Krishi Vikas Yojana (Conventional Agriculture Development Scheme), which is run by Bharatiya Prakritik Krishi Paddhati (BPKP). Under the BPKP initiative, INR 12,200/ha (about 147 USD/ha) is given for three years to fund residue analysis, cluster formation, capacity building, continuous handholding, and certification. An investigation into the assessment of NF on specific crops has been started by the Indian Council of Agricultural scientific (ICAR), the highest scientific authority. Numerous societal segments have taken notice of NF due to its appeal Agriculture 2023, 13, 647 3 of 16. According to estimates, over 500,000 hectares of land in various Indian states are currently under natural farming [Economic Survey 2022], and it is anticipated that, with the help of the PKVY scheme, this number could rise to 14 million hectares by 2025 [Jain S. 2023] [6]. Social variables including social movements, public policies, markets, pedagogical procedures, leadership, and language may be just as important in the scaling up of NF as farming techniques [Khadse, A. 2018] [9]. One of the main factors influencing the ongoing adoption of NF practice is farmer-led and farmer-focused knowledge exchange [Mitjans. S.B. 2020] [13]. With the background information mentioned above in mind, this study aims to address fundamental concerns like: How do Indian farmers implement natural farming? What would happen to farmers' incomes and agricultural yields? How can the agro-ecology benefit from natural farming methods? The field survey used for this study was carried out in three major Indian states Karnataka, Andhra Pradesh, and Maharashtra—where natural farming is thought to be widely practiced. In addition to estimating crop output and farm income under NF techniques in comparison to current farming practices, the study looked at how farmers adopted various NF components.

Materials and Methods

Summary of the Study As one of the few studies in this field, the research team had a number of difficulties in determining whether farmers qualified as Natural Farming adopters (NF-adopters). A comparative study is difficult since natural farming is not a consistent and standardized technique, and as a result, acceptance of a package of practices varies greatly. The field survey was carried out in the southern Kashmir Valley district between November and December of 2024. KVKs in blocks where a significant number of farmers have embraced the NF practice were identified based on discussions with agricultural universities. In the sample districts, snowball sampling was used to choose the farmers. NF-adopters were farmers who employed jeevamritha and did not use chemical pesticides or fertilizers in the previous two years; non-adopters (non-NF) were farmers who did not use any of these chemicals. Three villages with a greater percentage of farmers using natural agricultural methods were chosen from each block (Table 1). For comparison, non-NF farmers were also chosen from the same villages. Personal interviews were used to get information from the sample farms. In the district of Anantnag, 180 NF-adopted and 225 non-adopted farmers were surveyed using a pre-tested and organized survey protocol. During the field survey, it was very challenging to locate NF-adopted farmers in this district. There were only one or two NF-adopted farmers in most villages. As a result, a comprehensive survey covering 52 villages was conducted to identify NF adopted farmers.

Table 1: Distribution of sample farmers in the study.

District	Block	Name of Village Covered	NF Farmers adopted	Non-NF Adopted Farmers	Total Sample Farmers
Anantnag	Dooru	Zamalgam	20	25	45
		Manzmoo	20	25	45
		Tangloo	20	25	45
	Shahabad Bala	Chohan	20	25	45
		Her Gawass	20	25	45
		Halsidar	20	25	45
	Kokernag	Gadoel Alhan	20	25	45
		Nala Sunbarie	20	25	45
		Kandiwarian	20	25	45
			180	225	405

The collected data from the sample farmers were analyzed using descriptive statistics. One way ANOVA was used to test the difference in yield for selected crops under NF and non-NF.

Benefit: Cost Ratio (B:C Ratio) was used for selected crops under NF.

$$\text{B: C Ratio} = \frac{\text{Yield(q)} \times \text{Market price(|/q)}}{\text{Total Cost(|/q)}}$$

q-quintal(1q=100kg)
Change in economic parameters as well as change i n B:C ratio in NF from Non-NF for respective crops was also estimated.

$$\Delta EP = \frac{EPnf \times 100}{EPnnf}$$

Where ΔEP − Change in economic parameter EPnf − Economic parameter value under NF EPnnf − Economic parameter value under non−NF

Study Area Description
The study area comprising of three blocks in each block of the three villages were surveyed had the following geographical characteristics (Table2)

Table 2: Geographic l characteristics of the study area.

Particulars	UT of Jammu and Kashmir
District under study	Anantnag
Annual rainfall (mm)	800-900 mm (872.3 mm)
Main irrigation source	Bore well and canal
Soil type	Silty clay loam (80%) to Sandy clay loam (20%)
Major crops	Paddy, Maize, Oilseed, fruit crops, black gram, Rajmash, green gram, vegetables

Demographic Characteristics
There were both youthful and middle-aged farmers in the research region. Whether they engaged in Natural Farming (NF) or non-NF (conventional/chemical farming), the bulk of the farmers were in their forties (>30 years) and had at least two decades of farming experience. The percentage of young farmers (those under 30) in the Anantnag district who practiced NF was lower than the percentage of non-NF farmers. However, in lower belts where commercial farming is the primary source of revenue, the percentage of young farmers who engaged in NF was minimal. The majority of the NF farmers in all three districts had at least intermediate education or its equivalent when their educational backgrounds were analyzed. However, a disproportionately large proportion of NF farmers in the lower belts had a bachelor's degree or higher. In all three blocks, a greater proportion of non-NF farmers than NF farmers were illiterate. It was found that the tested farmers in all three blocks had an average family size of four to five, with one to two individuals working in each family.

Results and Discussion
Results
Adoption of Natural Farming
Although it has lately acquired popularity, farmers in some regions of the country have been practicing natural farming for several decades. Twenty-one percent of the farmers in the sample had been practicing NF for more than ten years. In the district of Anantnag, 26% had 6-10 years, 19% had 3-6 years, and 14% had less than 3 years. Many farmers in the UT of J & K have adopted NF in recent years as a result of the Natural Farming Project District in Anantnag's implementation and management of natural farming. A key suggested technique in natural farming is intercropping, which lessens soil stress by preventing the extraction of particular nutrients from the soil, as is the case with monocropping. Intercropping crops can sometimes enhance one another's nutrient cycling. However, just 26%, 52%, and 47% of NF farmers in Dooru, Shahabad Bala, and Kokernag, respectively, engage in intercropping, despite the fact that it is advised. Because paddy is the main crop in the study area's plains and is best grown as a single crop, there is a low percentage of intercropping. Among the study blocks, the intercropping rate was highest in the upper areas. The farmers in every block used Ghana jeevamritha, a solid kind of jeevamritha. Before planting in the field, the farmers broadcast Ghana jeevamritha (0.5-1 t ha−1). Depending on the crop, beejamritha was also employed as a seed treatment. In the field, hardly many farmers use jeevamritha. It was discovered that NF farmers applied FYM in the field prior to planting, despite the fact that NF practice does not recommend its usage. In Block Dooru, 26% of farmers did not use FYM at all, whereas 65% of farmers used it for all crops. FYM was utilized by the remaining 9% of farmers for particular crops like rice and oil seed. In Shahabad Bala, it was discovered that almost 75% of NF farmers used FYM in their fields, whereas 11% did not. While 21% of farmers in the Kokernag block did not apply FYM in their fields,

72% of farmers did. In their farms, almost 85% of NF farmers employed FYM for high-value crops like vegetables.

Farmers were found to follow mulching, a crucial aspect of NF, depending on the crop and the mulching material's availability. Farmers utilized a range of mulching materials, such as straw, other farm waste, and living mulch crops like cow peas.

Yield Variation

It was discovered that a number of vegetable crops as well as paddy, maize, oilseed, oats, soybeans, and black gram were grown in the study region. These blocks also included perennials like apple, pear, cheerful, peach, apricot, almond, and walnut. The yield of key crops was calculated for three farming practices: non-NF, NF without FYM, and NF with FYM (10-12 t ha−1 in paddy and 5-6 t ha−1 in oilseed/oats annually). In contrast, non-NF yields were shown to be higher than NF yields without FYM. In most crops, however, NF with FYM performed better than NF without FYM and non-NF farms. The discussion above paints a clear picture of farmer yield sustainability, indicating that conventional farming may yield more than natural farming methods alone. However, crop yields were consistently better than those from conventional/chemical farming when paired with a small dose of FYM. The crop yields under non-natural farming (non-NF), natural farming (NF) with FYM, and natural farming without FYM were analyzed using a one-way ANOVA (Tables 3).

Table 3: ANOVA result of yield comparison for paddy in District Anantnag

95% confidence interval for mean								
	n	**Mean**	**Std. Deviation**	**Std. Error**	**Lower Bound**	**Upper Bound**	**Minimum**	**Maximum**
Non-NF	45	58.19	12.94	2.62	52.94	63.44	39.60	82.50
NF without FYM	18	40.89	10.48	2.45	35.89	45.98	22.11	52.13
NF with FYM	52	54.03	16.76	3.17	47.71	60.36	24.12	78.10
Total	115	52.18	15.64	1.92	48.54	55.80	22.11	82.50

ANOVA					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	2926.77	2	1464.43	8.695	0.001
Within Groups	10,393.85	52	172.46		
Total	13,319.62	54			

Post Hoc Tests (Tukey HSD)		**Dependent Variable: Yield(q/ha)**				
(I) Group	**(J) Group**	**Mean Difference(I-J)**	**Std. Error**	**Sig.**	**95% confidence interval**	
					Lower Bound	**Upper Bound**
Non-NF	NF without FYM	18.40*	4.30	0.000	7.00	28.71
	NF with FYM	5.26	3.89	0.628	−3.83	14.34
NF without FYM	Non-NF	−16.20*	4.30	0.000	-28.71	-7.00
	NF with FYM	−12.05*	4.26	0.007	−24.21	−3.28
NF with FYM	Non-NF	−3.06	3.89	0.628	−14.34	5.04
	NF without FYM	14.25*	4.26	0.007	3.28	24.21

A statistically significant difference (At $p<0.05$) between the groups was found using a one-way ANOVA ($F(2.52) = 8.695$, $p=0.001$). A Turkey post hoc test revealed that the yield of NF without FYM (M=40.89, S.D.=10.48) was significantly lower than that of NF with FYM (M=54.03, S.D.=16.76, p=0.007) and NF with FYM (M=58.19, S.D.=12.94, $p<0.000$). There was a statistically significant difference between NF with FYM and non-NF.

In the paddy in district of Anantnag, NF without FYM had a significantly lower yield than NF with FYM (At $p < 0.05$), and NF without FYM had a significantly lower yield than NF with FYM (At $p < 0.1$).Furthermore, for vegetable crops in the district of Anantnag, NF without FYM had a significantly lower yield than NF with FYM (At $p < 0.05$), and NF without FYM had a significantly lower yield than NF with FYM (At $p < 0.1$). In other cases, it was impossible to identify the production difference since there were not enough farmers using alternative techniques. During the field study, crop yield from the previous three years with the NF farmers was also examined. The objective was to ascertain whether or not there has been an improvement in the productivity of important crops previously grown under NFP. It was found that almost all of the crop yields were approximately the same in all three Blocks over the 2022-2024 period.

Benefit-Cost Analysis of Natural Farming

The study calculated the paid-out cost and return for NF and non-NF farms and looked at how different inputs were used in the production of important crops. The different expenses associated with growing the main crops in the chosen states are listed in Table 4. Additionally displayed is the percentage of the corresponding cost with regard to on-NF crops. For NF farmers, material expenses comprise seed, jeevamritha, beejamritha, FYM, and a pest control solution; for non-NF farmers, the costs mostly consist of seed, fertilizer, FYM, and pesticide. The cost of labor, including harvesting, and land preparation are included in operational costs. In both circumstances, the total paid-out cost was calculated by adding these two. In the Anantnag district, NF farmers used roughly 85 and 96 percent of the materials for paddy and maize, respectively, compared to non-NF farmers. It was higher than NF farms in other states, despite being lower than that of non-NF farms. Given that just 34% of NF farmers have their own cows and rely on purchased products, it is possible that this is because many farmers utilize purchased FYM and Ghana jeevamritha in their fields. In the case of the same crops, the operational cost

was closer to the non-NF counterparts. As a result, the overall variable cost was reduced by 8% in maize and just 5% in paddy. Farmers could obtain a minimum of 100% more as in the case of maize and a maximum of 200 percent more as in the case of paddy. The total variable cost could be lowered by about 55% for the NF farmers. The fact that just 23% of farmers use FYM, compared to 65% and 85% of farmers who use it for maize and paddy, may be the result of lower material costs NF produce can fetch a little better price for farmers than non-NF goods. The B:C ratio was found to have improved in Anantnag for NF farmers, with the exception of maize. The majority of the vegetable crops grown in kitchen gardens for family consumption are home-made Beejamritha and Jeevamritha, which has led to a significant decrease in material costs to about 40%. Compared to their non-NF counterparts, the operational cost is somewhat lower. It should be mentioned that the benefit: cost ratio (B:C ratio) will rise three to four times higher than that of non-NF farmers if they grow high-value commodities with high market prices.

Table 4: Benefit-Cost comparison for major crops in district Anantnag.

Particulars	Rice			Maize			Beans		
	NF	Non-NF	% of non-NF	NF	Non-NF	% of non-NF	NF	Non-NF	% of non-NF
Yield	73	80	91.25	35	38	89.47	10.7	12.9	82.95
Total Cost	67270	85264	78.90	61200	76250	80.26	31000	49630	62.46
Total Returns	146000	160000	91.25	140000	152000	92.11	85600	103200	82.95
Net Returns	78730	74736	115.66	78800	75750	114.76	54600	53570	132.79
B:C ratio	2.17	1.87	105.34	2.28	1.99	104.02	2.76	2.08	101.92

All of the primary crops in the district of Anantnag had a fall in total cost (variable + fixed cost), which was 78.90% of non-NF rice. This was lowered by about 21% for rice, 20% for maize, and 38% for beans. Due to farmers' inability to reach the niche market for the sale of the NF produce, the market prices of all the crops increased marginally. In NF, the B: C ratio improved by more than 4% across all crops, and the net returns increased by more than 15% across all crops mentioned above. However, because the adopter farmers plant a range of crops, the study was unable to quantify the precise amount of water saved by natural farming practices. However, all adopter farmers stated that, depending on the crops cultivated using NF practices, they applied 0-2 irrigations, as opposed to 3-4 irrigations under non-NF farming. One significant effect of this is the preservation of irrigation water, which is quickly becoming one of the most valuable natural resources in agriculture.

Benefits Perceived by NF Farmers

Farmers thought that NF had several advantages. The majority of farmers in the district (74%) thought crop yields had dropped, while 26% thought they had increased.65% of farmers felt that NF practice decreased the cost of cultivation, whereas 35% felt that the cost of cultivation increased. About 82% of all the blocks that were chosen contained NF produce that was of higher grade than NF produce in terms of taste and quality. The produce was sold in the same market at much the same price because farmers in the district could not reach the designated market for the sale of NF produce; yet, 87% of the fruit could fetch a higher price in the local market. (Table 5).

Table 5: Benefits perceived by Natural Farming farmers.

Particulars	Percentage farmers	
	High	Lower
Crop yield	26	74
Cost of cultivation	35	65
Taste of produce	82	18
Selling price	87	13

Awareness among Non-NF Farmers

More than 63% of farmers in the non-NF category in three chosen blocks were not yet aware of NF, despite the fact that farmers saw a number of advantages from NF practice. 37% are aware of the clear advantages of NF, however 2-3% of farmers stopped using it and went back to the traditional method of farming (Figure 5). It was discovered that the reasons for cessation were lower crop output and no immediate control over pests and diseases. In a small number of cases, decreased landholding and inadequate family support were other factors contributing to termination.

Reasons for Non-Adoption among Non-NF Farmers

One of the main reasons for not adopting NF in the Anantnag district was the lack of inputs because of the extremely low rate of indigenous cattle ownership 70% of NF farmers, however, do not own native cows; instead, they purchase all inputs from the village's nutrient stores, and some even gather them from other farmers. One of the reasons non-adopted farmers (more than 40%) did not adopt NF was the expectation of low crop output.NF was thought to be more labor-intensive, and farmers were expected to provide regular monitoring. The farmer must pay constant attention to the preparation of jeevamritha and beejamritha as well as farm operations. Additionally, it deters farmers from implementing NF. Because the NF food is chemical-free, the farmers also anticipate greater prices. As a result, NF adoption has been hampered by the lack of a dedicated market for NF produce, similar to that of organic produce.

Discussion

There has been a rise in the number of farmers implementing NF, which may be the result of both state and Indian government initiatives. The government's efforts to promote natural farming through KVKs have resulted in a significant rise of NF farmers in recent years, which the study's findings strongly confirm. The variance observed in NF practice suggests that farmers in various regions have adjusted the suggested practice based on the availability of a certain input and the outcomes they have obtained from employing it. For example, Ghana jeevamritha, a solid version of jeevamritha, is used by farmers in the area of Anantnag. Actually, it was discovered that farmers were

using FYM, which is not regarded acceptable NF practice. It was discovered that NF by alone does not produce a higher yield. On the other hand, they increase when FYM is added. Research indicates that following NF reduces yield [Babalad H.B 2021, Naik A.K 2020, Kumar S 2019] [2, 15, 11].

Furthermore, the inconsistent results from different research highlight how crucial it is for farmers to keep learning and trying new things. Farmers may improve their methods and possibly create more effective NF applications that prioritize ecological health and yield sustainability by exchanging their experiences and outcomes.

This further emphasizes the value of government assistance and extension services. The acceptance and success of NF can be further increased by providing farmers with information on crop-specific requirements, managing soil health, and using inputs efficiently. Promoting cooperatives or farmer field schools as a means of fostering collaborative learning may also help farmers exchange ideas and methods that help them succeed more with natural farming methods.

In the end, even while the trend toward NF adoption is encouraging, it is imperative to keep an eye on, study, and assist farmers as they negotiate the challenges of switching to more ecologically sound and productive farming methods. Other research indicates that the switch to Natural Farming (NF) makes a strong case for farmers looking to enhance their ecological balance and financial viability. Under some circumstances, research showing higher yields [DuddiganS 2022] [4] may indicate that NF has the potential to be just as productive as traditional farming practices, especially when properly tailored to local situations.

A major factor in lessening the financial strain on farmers is NF's decreased dependency for chemical inputs like pesticides and fertilizers. Even if yield levels stay constant or fluctuate only little, NF can increase net profitability by lowering input costs. In agricultural regions, where rising input costs can ensnare farmers in debt cycles and health problems linked to pesticide exposure, this financial benefit is especially crucial.

Furthermore, NF's financial advantages go beyond simple cost reductions. NF techniques can boost soil fertility, water retention, and biodiversity by cultivating better ecosystems. These factors all add to the agricultural systems' long-term resilience. Over time, improved crop performance from healthier soils can further stabilize yields and possibly boost earnings.

It's also important to remember that NF's yield and profitability performance frequently depend on a number of variables, like as farmer education, the availability of organic farming supplies, and favorable government regulations. Giving farmers the tools and training they need to successfully apply NF techniques will help close the yield performance gap and guarantee a successful and long-lasting shift away from chemical inputs.

Furthermore, encouraging a cooperative approach, in which farmers pool resources and expertise, can improve learning and build a network of support that reaffirms the advantages of NF. By working together, we can allay any initial yield worries and reinforce the long-term financial benefits that NF provides.

In summary, although some research indicates higher yields in specific circumstances, NF's overall advantages lower expenses, better health outcomes [Jorgenson A.K. and Kuykendall K.A. 2008, Reddy V.R. and Galabs, S. 2006] [8, 17], and increased environmental resilience make it a desirable substitute for traditional farming methods. We can help create a more prosperous and sustainable agricultural landscape by continuing to assist farmers in this transformation.

Farmers' financial burden may be lessened by the possible decrease in input costs, which would lessen their reliance on loans and enable them to escape the long-standing debt cycle. This change has wider economic ramifications in addition to the immediate benefits to farmers, such as lowering government spending on fertilizer subsidies and freeing up money for other agricultural assistance programs.

Nevertheless, despite the creation of several programs and initiatives to support it, the shift to natural farming has not happened as quickly as one might anticipate. Furthermore, farmers may realize a higher price since they believe that the food is of higher quality and taste without the use of chemicals. However, price realization is being hampered by a lack of market access [Kumar V. A 2023] [12].

Several factors contribute to this slow pace

1. **Perception of food and Market Access:** Despite the fact that many farmers are realizing that chemical-free food has superior flavor and quality and can result in higher price realizations, they frequently struggle to get their produce into markets that appreciate these attributes. The financial incentives for switching to NF might not be completely fulfilled if there is insufficient market infrastructure or platforms to reach consumers who are prepared to pay higher prices for organic products.
2. **Availability of Inputs:** The switch to NF frequently depends on particular organic inputs that could not be easily found in nearby markets. Farmers may be discouraged from fully adopting NF techniques due to this difficulty, especially if they are unsure of where to find the necessary inputs or if alternative solutions are not priced competitively with chemical inputs.
3. **Labor Intensity:** When compared to traditional agricultural methods, NF practices frequently require more labor. For smallholder farmers or those without access to resources and labor help, the increased labor need might be a major obstacle. If farmers believe that adopting NF will take more time and effort than they can offer, they might be reluctant to do so.
4. **Knowledge and Support Systems:** Farmers' access to education and training is frequently crucial to the successful implementation of NF. It's possible that many farmers are still unaware of NF methods or advantages, which suggests that outreach and education initiatives need to be strengthened. Extension services, community workshops, and farmer field schools can all be quite helpful in filling in knowledge shortages.

In summary, although though NF has a lot of potential advantages, a more successful transition depends on resolving issues with labor intensity, market access, input availability, and education. Unlocking the full potential of Natural Farming for the agricultural community requires improved infrastructure, support networks, and programs that link farmers with customers interested in organic

products. Adoption of NF may become a more attractive and feasible choice for farmers when these obstacles are removed, eventually resulting in sustainable farming methods that improve the environment and farmers' livelihoods.

Limitations

The study has its own limitations because it was based on a field survey of farmers. Those who self-reported as adhering to the practice were crucial in the selection of the samples. It is crucial to recognize the limits of this study, especially considering its dependence on field surveys with farmers, even though it offers insightful information about the adoption and effects of Natural Farming (NF). The following criteria, which occasionally have downtime constraints, were used to gather information from farmers.

1. **Dependency on Self-Identification:** Farmers who self-identified as practicing NF were a major factor in the study's sample selection. Because some people may purposefully or inadvertently misrepresent their habits, this dependency raises the possibility of bias. The study might have missed farmers that actually use these practices but do not publicly identify as NF farmers because there is no official registry of NF practitioners.
2. **Recall Bias:** Recall, which might introduce errors, was the basis for the data gathered from farmers. Recall errors may result from farmers' inability to precisely recall previous farming methods, yields, or expenses. These errors may have an impact on the data's dependability, which may therefore have an impact on the study's conclusions.
3. **Diversity and Sample Size:** The results may not accurately reflect all NF farmers due to the size and geographic dispersion of the sample. Although they might not be sufficiently represented in a small sample, regional differences in temperature, soil composition, and socioeconomic circumstances can have an impact on farming results.
4. **Subjective Judgments:** The study is based on farmers' subjective assessments of their experiences with NF, such as their views on crop quality, yield, and market accessibility. These subjective evaluations can differ greatly from person to person and cannot accurately represent objective measurements, which could cause discrepancies in the final results.
5. **Temporal Constraints:** Because the data was gathered in a limited amount of time, seasonal variations and longer-term patterns in farming techniques might not have been taken into consideration. A cross-sectional snapshot might not adequately reflect the dynamics of agricultural practices and market conditions, which might alter gradually over time.
6. **Restricted Inquiry:** The study only looked at particular facets of NF practice and how it affected farmers. It did not, however, explore associated topics including the long-term sustainability of such approaches, comparative assessments with traditional farming beyond yields, or the wider environmental consequences of NF. The findings' comprehensiveness about the full impact of NF may be limited by this limited emphasis.

When interpreting the study's findings, these limitations need to be considered. A more thorough approach for future study might include the creation of official registries for NF practitioners, longitudinal studies to monitor changes over time, and a more thorough analysis of the economic and environmental effects of NF practices. By addressing these constraints, the opportunities and difficulties related to Natural Farming will become more apparent.

Conclusion

Although the adoption of natural farming (NF) began more than 15 years ago, it was relatively sporadic in Karnataka and Maharashtra. In contrast, NF was found to be widespread in Andhra Pradesh, where the majority had joined the bandwagon during the last five years. When compared to traditional farming, the crop output in NF was not higher. However, the crop yield dramatically increased when FYM/Ghana jeevamritha was added. It was also clear that, as a result of not using pricey agrochemicals, input costs were significantly lower in NF as than in non-NF. As a result, the cost of growing all the crops has significantly decreased. This has resulted in better profitability (B:C ratio) for NF farmers.

According to NF growers, there are numerous advantages, such as reduced cultivation costs, improved quality and flavor, and premium pricing. Even if many farmers do not benefit from the premium price, it opens up a new market for reaching the middle-class consumer sector, who want to eat fruit free of chemicals but are reluctant to pay high prices for organic product.

According to the report, Natural Farming (NF) is becoming increasingly popular in the Anantnag district, where some farmers have started using the technique for the past three years.

Among the research's main conclusions are:

1. **Yield Comparisons:** While crop yields in NF did not always surpass those in traditional farming, it has been demonstrated that adding organic supplements like Ghana jeevamritha or Farm Yard Manure (FYM) increases yields. This emphasizes how crucial it is to combine conventional organic procedures with NF techniques in order to increase productivity.
2. **Input Cost Reduction:** One of NF's main benefits is the sharp drop in input costs brought about by the avoidance of the usage of pricey agrochemicals. This change helps NF farmers become more profitable while simultaneously reducing the total cost of growing a variety of crops. The enhanced Benefit-Cost (B:C) ratio highlights NF's financial feasibility as a sustainable agricultural method.
3. **Perceived Benefits:** NF farmers cited a variety of advantages related to their methods, including as lower cultivation expenses, better produce quality and flavor, and chances for premium pricing. The market potential suggests that consumers are becoming more interested in produce that is free of chemicals, even though not all farmers have been able to command a higher price for their goods.
4. **Market Opportunities:** NF farmers have a significant chance to reach a middle-class consumer base that wants produce free of chemicals but could be put off by

the high costs of organic goods. NF farmers can increase their market presence and profitability by filling this gap.

In conclusion, although if Natural Farming's yield advantages might not be as great for all crops without organic supplementation, the advantages that come with it, especially in terms of lower input costs and increased profitability, make NF a competitive and sustainable option to conventional farming. The new market opportunities for chemical-free produce show great promise for expansion, both for farmers and in meeting the shifting tastes of consumers who are growing more ecologically and health-conscious. This move to NF signifies a change in farming methods as well as a reorganization of the agriculture industry's market dynamics. In order to encourage the expansion of Natural Farming and guarantee that its adoption benefits both farmers and consumers, future measures should concentrate on improving market access and supporting infrastructure.

Recommendations

1. Both human and environmental health appear to benefit from the practice. To verify the production system's long-term viability, however, and to investigate the nutrients' availability in the soil and crops, methodical research is needed. Therefore, in order to validate this hypothesis and theory of change, scientific proof must be produced prior to scaling up in other agroclimatic zones with various crop combinations. In light of the encouraging results regarding Natural Farming (NF) techniques, the following suggestions can be made to improve NF acceptance, sustainability, and farmer profitability:
2. **Promote NF as an Alternative Farming Practice:** NF should be presented as a workable substitute for areas with rainfed agriculture and less intensive farming, rather than solely as a way to increase productivity. The advantages of NF in enhancing soil health and decreasing reliance on chemical inputs should be highlighted in educational initiatives. This will give farmers who are struggling with low-input systems a sustainable alternative.
3. **Encourage Cost-Reduction Techniques:** Programs should be started to inform farmers on how to cut expenses by using locally accessible resources, like natural biofertilizers and organic matter. By decreasing reliance on pricey market-based inputs, this strategy can greatly increase net income.
4. **NF Produce Market Development:** As a specialized market segment that provides chemical-free items with improved quality and taste, NF produce has to be made more widely known. Farmers can raise the price of their product by differentiating NF produce from traditional options through the development of branding strategy and marketing campaigns.
5. **Stress Health and Environmental Benefits:** It's critical to emphasize NF's beneficial effects on both environmental sustainability and human health when promoting it. By educating customers on the health advantages of chemical-free produce, campaigns and workshops can boost demand and aid farmers in their transition to NF.
6. **Perform Systematic study:** Extensive study is necessary to confirm NF's long-term viability. Research ought to concentrate on evaluating the availability of nutrients in soil and crops under various agro climatic circumstances and crop combinations. In order to scale NF practices across many locations and ensure successful adoption and adaption, this scientific evidence will offer a strong foundation.
7. **Promote Knowledge Exchange:** By creating forums for NF practitioners to exchange knowledge, best practices and cutting-edge methods may be shared. Community workshops, farmer cooperatives, and field schools can all be excellent settings for exchanging knowledge and encouraging teamwork.
8. **Policy Support and Incentives:** When farmers are switching to NF practices, policymakers should think about offering them financial aid, organic input subsidies, and market access. Food security can be improved and wider adoption of sustainable farming practices can be promoted by strengthening policy frameworks.

Stakeholders may promote the expansion of Natural Farming methods by putting these suggestions into practice, which will benefit farmers monetarily, improve soil health, and result in the production of superior, chemical-free crops. The legitimacy and allure of NF as a sustainable farming alternative will be further enhanced by making sure that scientific studies continue to support these practices.

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