

Sustainable Agriculture in India Through Natural Farming – An Explorative Study

*K. Malathi*¹
*Chris Ann Tomy*²

Abstract

Purpose : The purpose of the study was to explore how natural farming (NF) could be adopted to counter the adverse effects of the green revolution implemented for the past few decades. This purpose stems from the current need for economies to implement sustainable agricultural practices.

Methodology : The paper relied on the past literature and available data to critically analyze how NF has fared so far in the states that have adopted it. It analyzed how feasible it was to sustain yield as witnessed in conventional farming and what factors worked for and against its adoption.

Findings : We have concluded that results from the adoption of NF are ambiguous since every state has different support mechanisms offered to the farmers. Although input costs were lower, yield could not be sustained for certain crops. The nascent stage of natural farming, small farmer cohort, and short periods were drawbacks in finding out the net benefits of this system.

Practical Implication : Further research to determine which crops would be more suited for NF without endangering the country's food security, how much input costs can be lowered, and which states are most suited to adopt NF are some suggestions for the paper.

Originality : The purpose of the paper was to investigate NF's feasibility. The study found that, despite popular assumption, there is still uncertainty regarding NF's capacity to address every problem that occurs in the Indian farm industry.

Keywords : natural farming, indigenous cattle, sustainable agriculture, soil nutrients, yield, ZBNF

JEL Classification Codes : O1, O13, Q15

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The well-known definition of sustainability is the act of implementing policies for the present generation's growth while bearing in mind the demands and necessities of the next (United Nations, 1987). Economies are implementing scientific techniques to boost agricultural productivity in order to fulfill the rising demand for food. Using chemical fertilizers, insecticides, and high-yielding seeds are some of these techniques. The rampant use of artificial means to increase productivity has stripped the soil of its nutrients in the long term. Food and Agriculture Organization (FAO, 2015) declared that there would only be 60 harvesting years left at the current rate of chemical fertilizer use (Khurana & Kumar, 2020). The way agriculture is currently conducted needs to alter in order to stop the present generation from stealing the natural resources that belong to the future

¹ *Assistant Professor*, Department of Economics, University of Madras, Chepauk, Chennai - 600 005.
(Email : malathisharan10@gmail.com) ; ORCID iD : <https://orcid.org/0000000182082406>

² *Research Scholar*, Department of Economics, University of Madras, Chepauk, Chennai - 600 005.
(Email : raphaelchris94@gmail.com)

generation. This essay aims to investigate whether natural farming (NF), which relies on organic methods to boost output, can continue to grow the agricultural sector. Attributed mainly to the Japanese farmer Masanobu Fukuoka, it is also known as “do-nothing farming.” The NITI Aayog defines it as a chemical-free form of farming that incorporates trees, crops and livestock in the farming process. It is also mainly meant to counteract the rising costs of conventional farming and provide a solution for high indebtedness among farmers.

Four primary ideas were engaged in NF as practiced by the field's pioneer, M. Fukuoka:

- No tilling
- No fertilizer
- No weeding
- No pesticides

Fukuoka believed that the earth would cultivate itself through earthworms, small animals, microorganisms, and roots of plants, thereby doing away with the need for tilling the soil. He also believed that the earth would maintain its fertility as per the plant and animal cycle present on the land. He considered weeds a vital part of maintaining soil and biological fertility. He used straw mulch, white clover and flooding to control rather than eliminate weeds. Regarding harmful pests and diseases, Fukuoka believed that a natural level of pests would exist but not to such an extent that will requires the need of artificial means to get rid of them. He considered having a variety of plants growing together as a natural barrier to control pests and overcome the drawbacks of monoculture. According to the Ministry of Agriculture and Farmers Welfare, zero-budget natural farming (ZBNF) is growing crops without the use of artificial fertilizers; zero budget also means having no production costs.

Objectives

- (1) To give an overview of NF in India.
- (2) To examine the positive and negative impacts of NF.
- (3) To analyze how NF can be used to make agriculture sustainable.

Literature Review

The adoption of NF practices was sparked by a number of factors, including rising input costs, declining soil fertility, groundwater contamination, the eradication of beneficial microorganisms, and health problems resulting from the overuse of fertilizers and pesticides, according to Korav et al. (2020) in their paper on the contribution of ZBNF to sustainable agriculture. Devarinti (2016) agreed that NF contributes to better soil health by promoting the use of natural additives that boost nutrients and soil microorganisms without having the negative impacts of conventional fertilizers. They also point out that NF requires low inputs and minimal labor since it largely depends on nature to take its course. But this raises the question of how food security can be ensured if fertilizers are not used. Sahu (2019) pointed out how important food security is to the livelihood of the Bhuiya community in Jharkhand. The study concluded that because of their poor health and malnourishment, people who do not have enough food security are more susceptible to poverty. It is crucial to make sure that the process of making agriculture more sustainable does not have an impact on food security.

In their research, Singhal and Gupta (2020) discovered that one of the elements influencing the expansion of the agriculture industry was institutional financing. However, rising input costs in conventional farming resulted

in a high degree of farmer indebtedness. NF is proposed as a way out of this indebtedness since it doesn't originally require the use of any fertilizers or pesticides. But with the type of NF proposed in India, there seems to be the inclusion of traditional farm yard manures that require the use of native cattle breeds. This component can add some input cost, but comparative studies are to be done to find out the cost and benefit of following ZBNF against conventional farming in terms of input costs.

A study conducted by the Centre for Science, Technology and Policy on the effects of using NF found that adopting ZBNF can save around 1400–3500kl (kilo liter) of water on average and around 12–50 GJ (Gigajoules) of energy along with a fall of 1.4–6.6 mt (metric tons) CO₂ emission per acre. It was also found to have an increase of about ₹ 4,500 per acre in net annual revenue. It was, however, found that there was a decrease in yield in other crops except for rice and chili, and this is attributed to a shorter period of ZBNF practice, lack of experience with ZBNF, and a transition period for the soil to get used to the absence of inorganic fertilizers (Suresh et al., 2019). A caution against pushing farmers to adopt NF blindly is the uncertainty around the production of some crops. Its excellent environmental effects should be further investigated so that, while preventing environmental damage, the lower input costs of biofertilizers don't offset the overall advantages that farmers would have received.

The reduced input costs were also found in a study conducted by ICAR and the National Academy of Agriculture Management, which found that the yield did not necessarily increase by adopting NF, but supplementing that with farm yard manure or ghana jeevamritha helped improve the yield significantly. The study concludes that while NF might not produce large yields, it does contribute to lower production costs overall. Additionally, it has demonstrated superior quality, resulting in farmers receiving premium pricing (Kumar et al., 2020).

Studies by Kumbar and Devakumar (2017), Shubha et al. (2017), and Shyam et al. (2019) have found that the addition of jeevamritha and panchagavya improves yield, and a higher soil microbial population was also detected. However, the impact of NF on yield is still up for dispute. However, Kumar et al. (2018) 47-year study revealed that using NPK (nitrogen, phosphorus, and potassium) fertilizer continuously in the absence of farm yard manure promoted the growth of bacteria. This conclusion is echoed in a paper by “Is zero budget natural” (2021), who, too, have found claims of increased productivity inconclusive but have agreed on its positive effect on soil health. Kumar et al. (2020) found that NF with farm yard manure (FYM) was found to have a higher yield than when no FYM was used with NF or even in conventional farming.

NF has been the buzzword lately, but the studies mentioned above show that it does not ensure sustainability in the yield of cultivation. Most studies highlight the positives, such as reduced input cost, low labor requirement, less harm to soil nutrients, reduced leaching of chemicals into crops etc., but most studies fail to find a consensus on the sustainability of yield. There is a catch-22 situation as a result, and one must choose between sustaining production without compromising the farmer's revenue and concentrating on green agriculture. Either use conventional fertilizers, bear the increased cost and be assured of high yield or adopt NF, incur the lower cost and face uncertainty in yield. A significant portion of the study on the effectiveness of NF uses Andhra Pradesh as an example, as this state has had some success with NF. An interim report submitted to the Andhra Pradesh government states that farmers can save around ₹ 19,000 by not using agrochemicals while practicing NF (Institute for Development Studies Andhra Pradesh, 2023). But this is a case of one state where NF has been carried out to a limited extent.

Methodology

The study used secondary data from official sources to analyze how widespread NF was in the country and how it was used to achieve sustainable agriculture. In order to determine how successful Indian states that embraced NF had been in maintaining agricultural sustainability, it examined earlier research on the subject. A critical analysis of the literature helped to explore how feasible NF was in terms of providing yield when compared with

conventional farming techniques and the income potential for farmers. The paper mainly covers the years from 2015 to 2023 since the adoption of NF took place in earnest within the past decade.

Analysis and Results

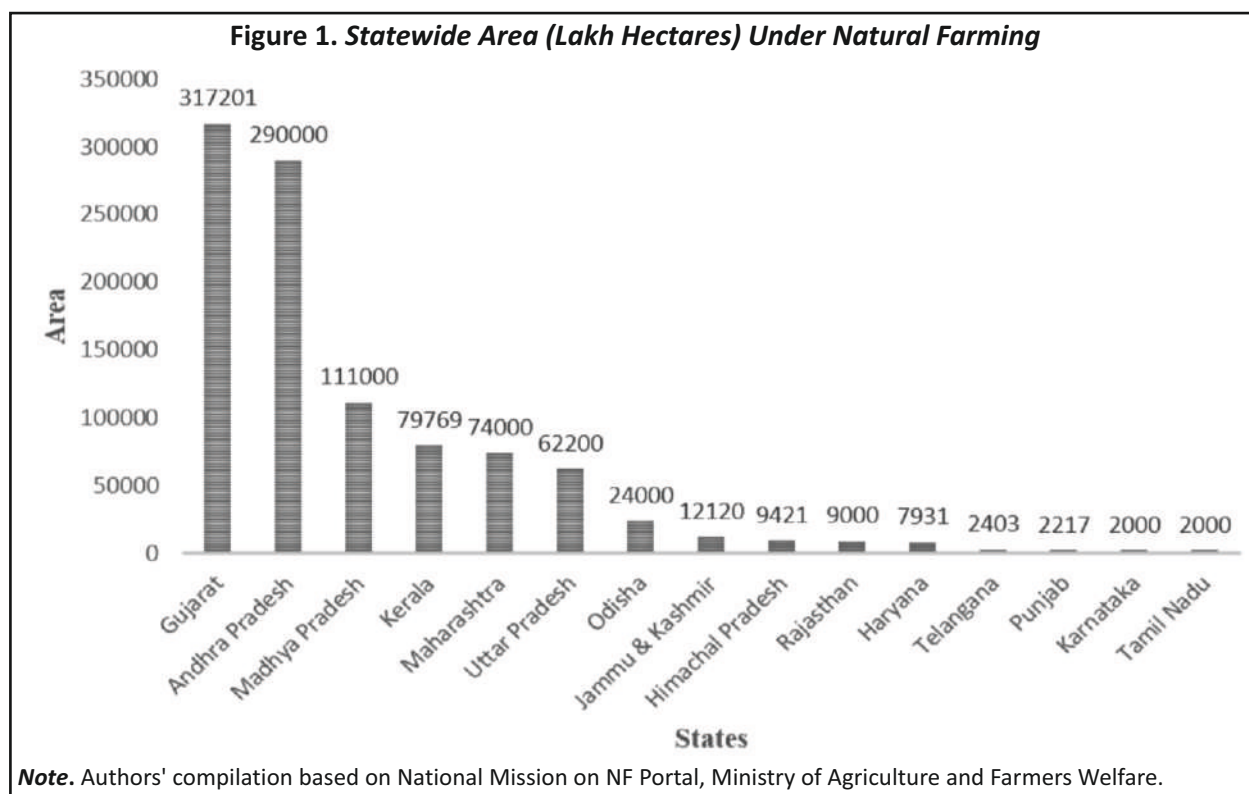
Natural Farming in India

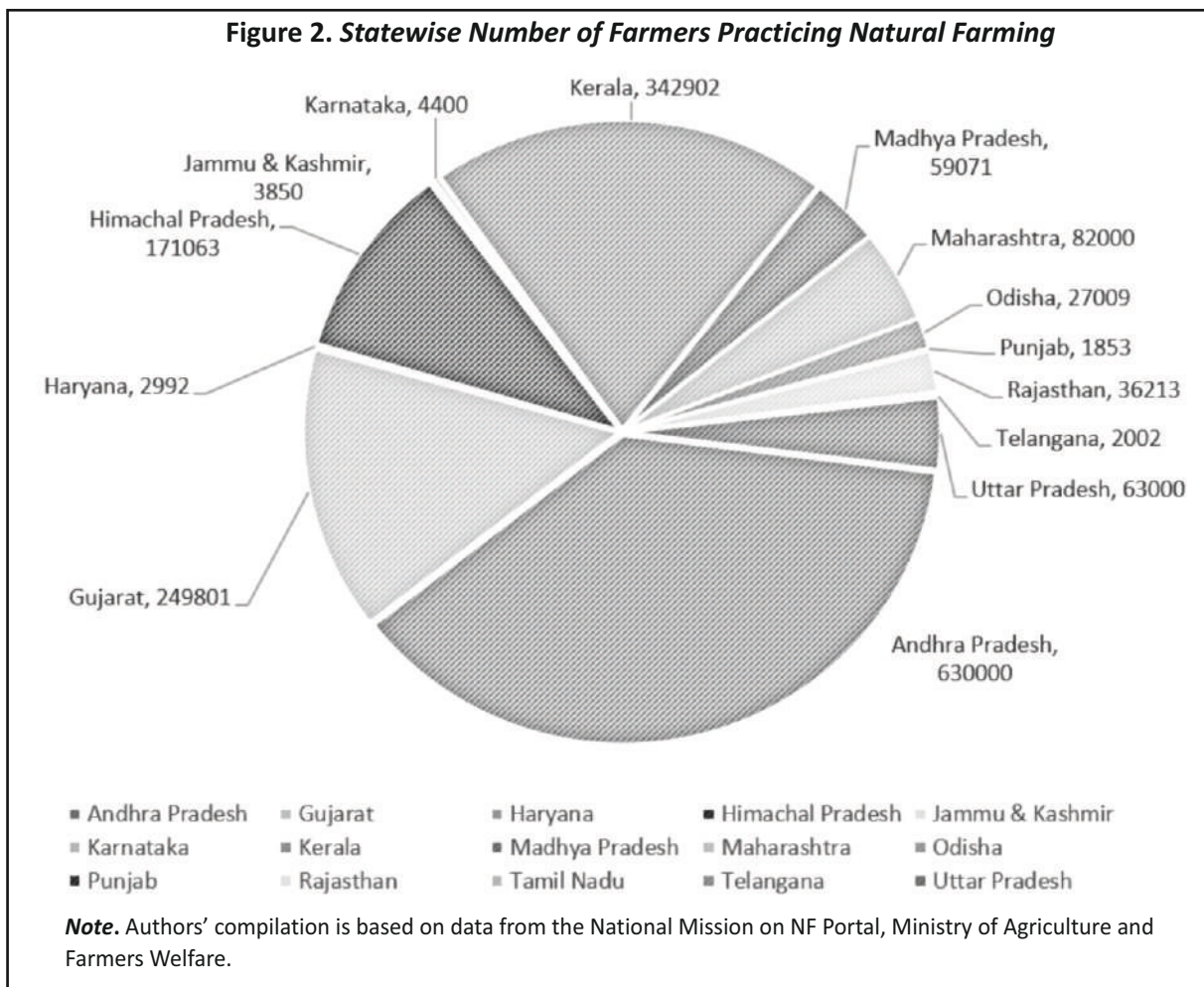
NF uses four major pillars, such as the ones listed below, when it is adapted to Indian norms and practices. Indian farmer Subhash Palekar introduced this technique. It includes four main components:

- ✦ **Jeevamritha** : Enhances the fertility of the soil using cow urine, dung, flour of pulses and jaggery concoction.
- ✦ **Mulching** : Creating micro climate using mulches with trees and crop biomass to conserve soil moisture.
- ✦ **Beejamritha** : Treatment of seed using cow dung, urine, and lime-based formulations.
- ✦ **Whapsa** : Activating earthworms in the soil to create vapor condensation.

India has produced a lot more food grains and agricultural goods but at a high cost. Higher output necessitated the use of agricultural techniques that have been shown to be harmful to the environment, water, and soil. Increased use of irrigation and high-yielding varieties has had manifold increases. The above four main points distinguish NF as propounded by the Japanese farmer Fukuoka and ZBNF put forward by the Indian agriculturist Subhash Palekar. These four pillars, also known as FYM, have helped increase yield in certain crops.

Figure 1 displays the entire statewide area covered by NF across the entire nation. The largest state on the list is Gujarat, which has an area of about 3.2 lakh hectares. Andhra Pradesh comes next with 2.9 lakh hectares,





followed by Madhya Pradesh, Kerala, and Maharashtra. Though Karnataka and Tamil Nadu were the first states to implement NF, their respective regions have one of the lowest percentages of NF land. Few studies address the outcomes of adopting NF in other states; most merely mention the successes of Andhra Pradesh, or reports of its adoption in other states focus on the numerous actions implemented by the state government.

Figure 2 shows the number of farmers practicing NF. Andhra Pradesh has the highest number of farmers practicing NF at 6,30,000, followed by Kerala. The least in the chart seems to be in Punjab at 1,853 farmers. A comparison of the previous two charts shows that states with the largest area under NF need not necessarily have the highest number of farmers practicing NF. For example, Gujarat is the state with the most NF area, but only the third most farmers engage in NF.

NF is promoted under the centrally sponsored scheme Paramparagat Krishi Vikas Yojana (PKVY) as *Bharatiya Prakritik Krishi Paddhati*. This scheme aims to promote traditional indigenous practices that depend on biomass recycling, mulching and use of cow urine and dung formulations. It has a total outlay of ₹ 4,645 crore from 2019–2020 to 2024–2025. The program aims to improve food quality, boost farmer income, create jobs, improve soil fertility, and promote rural development and growth. Eight states have chosen this method. Implementation status of BPKP in the states in India:

According to the *Bharatiya Prakritik Krishi Paddhati* program, Figure 3 indicates which state has the most acreage dedicated to NF. Andhra Pradesh, Madhya Pradesh, and Chhattisgarh have the largest areas covered by this scheme, according to the chart. With 2,000 hectares under this system, Tamil Nadu has the smallest acreage.

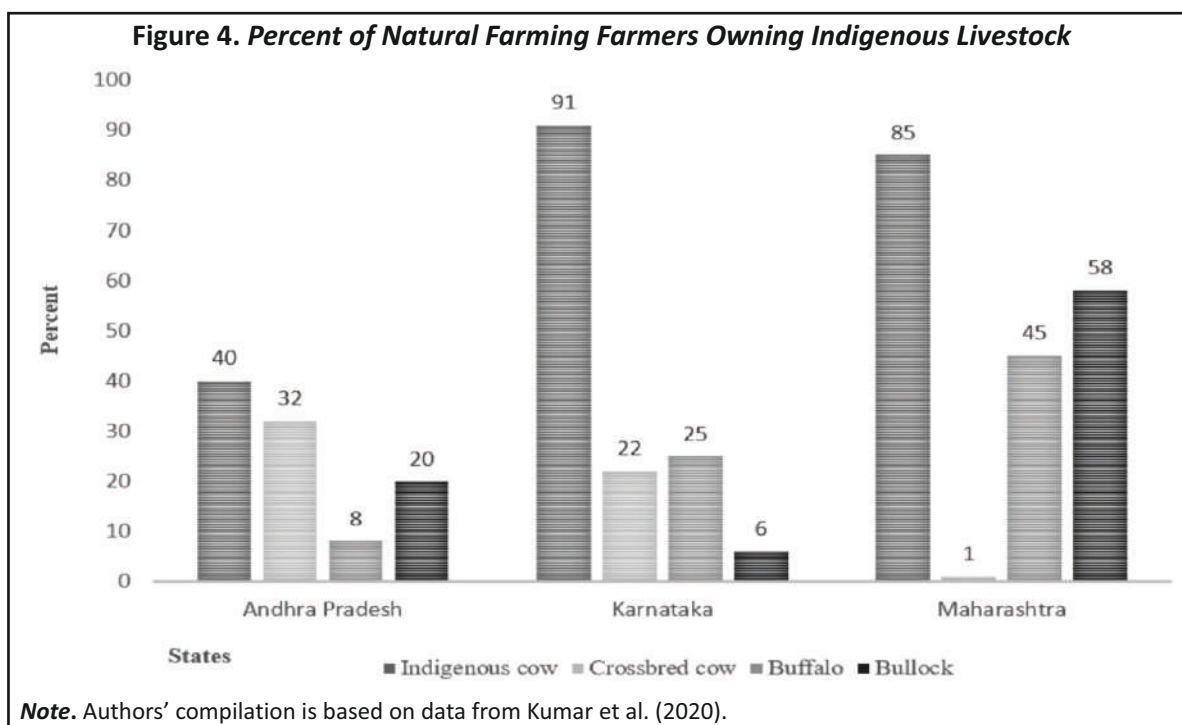
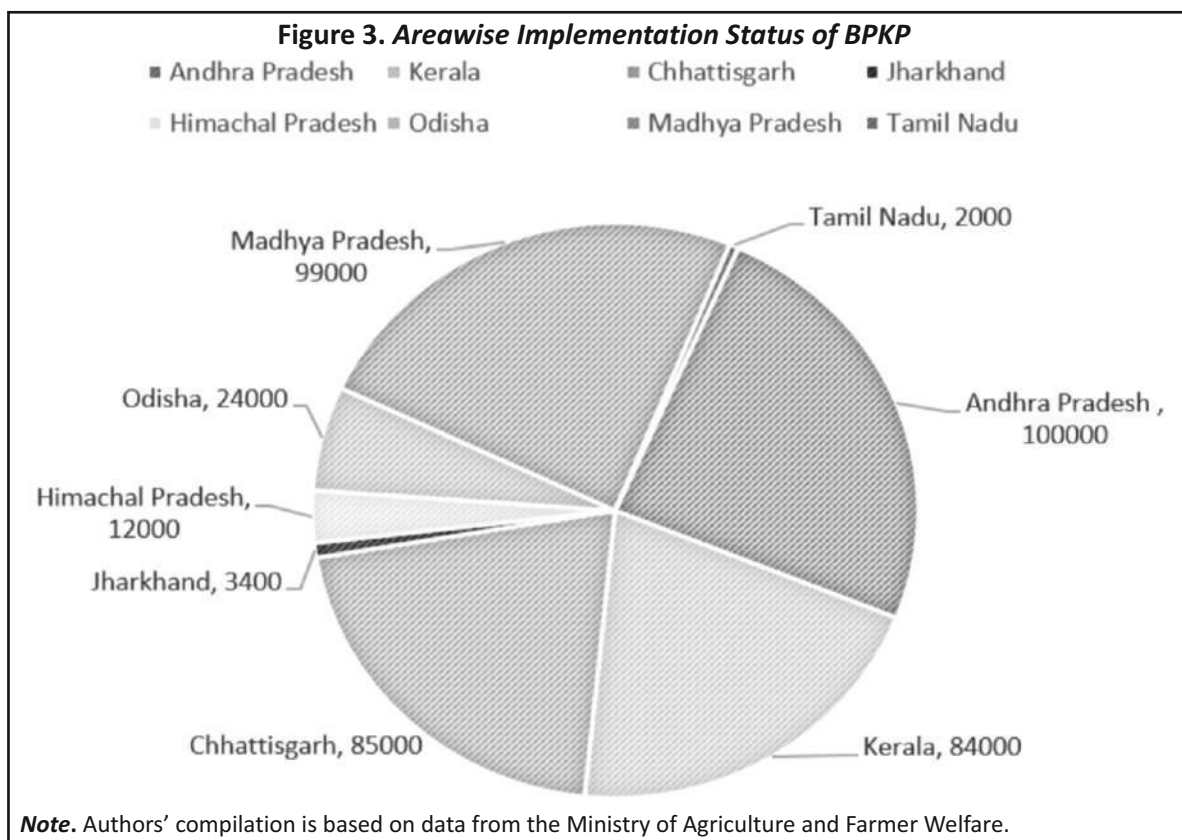


Figure 4 indicates the percentage of farmers that own indigenous livestock across the states of Andhra Pradesh, Karnataka, and Maharashtra. Among the four types of livestock, farmers who practiced NF had the greatest

number of native cows. Farmers who currently possess native cattle breeds can try NF without having to pay extra to get one. They also have the option to sell by-products like urine and dung from these cattle to those farmers who have no access to indigenous cattle. It can work as an additional stream of income for the indigenous cattle-owning farmer.

Importance of Natural Farming in Achieving Sustainable Agriculture

High yields of food grains have been achieved through increased use of chemical fertilizers and pesticides, high agricultural mechanization, increased irrigation through surface and groundwater exploitation, and high-yielding seeds. But this increase has come at the cost of harming the ecological balance and increasing dependence on synthetic inputs to increase yield. Some of the new practices, like the use of high-yield varieties, are fertilizer-dependent and are an easy target for pests (Mishra & Nayak, 2004). The increased pests necessitate the use of more pesticides, and the increased use of pesticides harms the soil more. Human health is at risk because the usage of these chemical inputs contaminates drinking water and food crops that enter the food chain. This never-ending cycle will persist unless a deliberate decision is made to stop using synthetic inputs and start relying more on organic farming methods.

Mishra and Nayak (2004) pointed out the contradiction that exists in our need for nutrition, food security, and environmental sustainability. Based on the current mode of doing things, nutrition and environmental sustainability are not ensured. It leads to a situation where man has to choose between the greater of the two necessities. The inculcation of NF strives to strike a balance between agricultural sustainability and productivity. It helps to ensure that the soil doesn't lose its fertility and that the microorganisms present will contribute to help improve the yield.

The essence of NF is such that it promotes using the bare minimum of inputs for crop growth. It relies mainly on the ecological cycle to affect the yield of the crops and diverges from the normal agricultural practices and includes the practice of mixed cropping, use of weeds to prevent pests, minimum tillage, dependence on earthworms and other microorganisms. In India, NF involves the use of cattle dung and urine along with other ingredients like chili, lime, pulses, and jaggery concoctions to add as inputs instead of inorganic fertilizers and pesticides. Additionally, NF supports limited tillage because it keeps nutrients in the topsoil intact and encourages the use of mulching. In addition to being low-cost, this technique aids in maintaining soil moisture, which promotes quick germination and optimal growing conditions.

Positive Aspects of Natural Farming

Environment Conservation

According to FAO studies, the largest greenhouse gas emissions are a direct result of agriculture, caused primarily by the excessive use of fertilizers. In 2016, 1.1 metric tons of CO₂/nutrient ton was produced for every fertilizer used (NITI Aayog, n.d.). The exploitative agriculture practiced in the past three decades resulted in loss of soil fertility and organic matter and the per year loss of soil nutrients was found to be between 5.37 to 8.40 million Mg per year (Singh, n.d.). NF fields were found to have better resistance to heavy winds during the 2018 cyclones, and the same was witnessed during the 2017 cyclones in Andhra Pradesh (NITI Aayog, n.d.).

Less Water Consumption

According to a 2016 World Wildlife Fund estimate, 70% of freshwater that is available worldwide is used for agricultural purposes. Because groundwater irrigation accounts for 60% of all irrigated land in India,

groundwater levels have significantly decreased. With its emphasis on relying on the natural biological cycle, NF mandates minimal water use, which enhances the water table through the formation of contours and bunds, which help to hold soil moisture and rains for longer periods. This happens mainly because NF makes the soil porous and thereby increases the moisture content in the soil (NITI Aayog, n.d.).

Employment Generation

Since NF involves the use of natural materials like earthworms, livestock, and microorganisms present in the soil, it creates an opportunity for employment by enabling farm workers to focus on one area of NF. This can involve ensuring a healthy presence of earthworms in the field and using straws to keep away weeds. One could focus on the use of livestock to make natural mixes, and another could focus on marketing these products.

Livestock Sustainability

Since NF involves the active use of livestock in the farming process, in India, this has led to the population of indigenous cows increasing as compared to crossbred livestock like buffaloes, cows, and bullocks. The use of manure from livestock acts as a natural fertilizer and also provides an opportunity for employment in animal husbandry. Livestock production also helps in carbon sequestration. Greater demand for livestock will spur local communities to care for indigenous varieties, thereby eliminating the need to depend on non-local varieties of cattle.

Premium Price

NF produces higher-quality and more flavorful products, according to farmers. This characteristic may be marketed to create a niche market akin to that of organic goods. It can act as a bridge between conventional farming products and organic products, as they are at the two ends of the price spectrum. Farmer demand for a better price and increased revenue will result from NF products receiving certification similar to that of organic products, particularly for small and marginal farms.

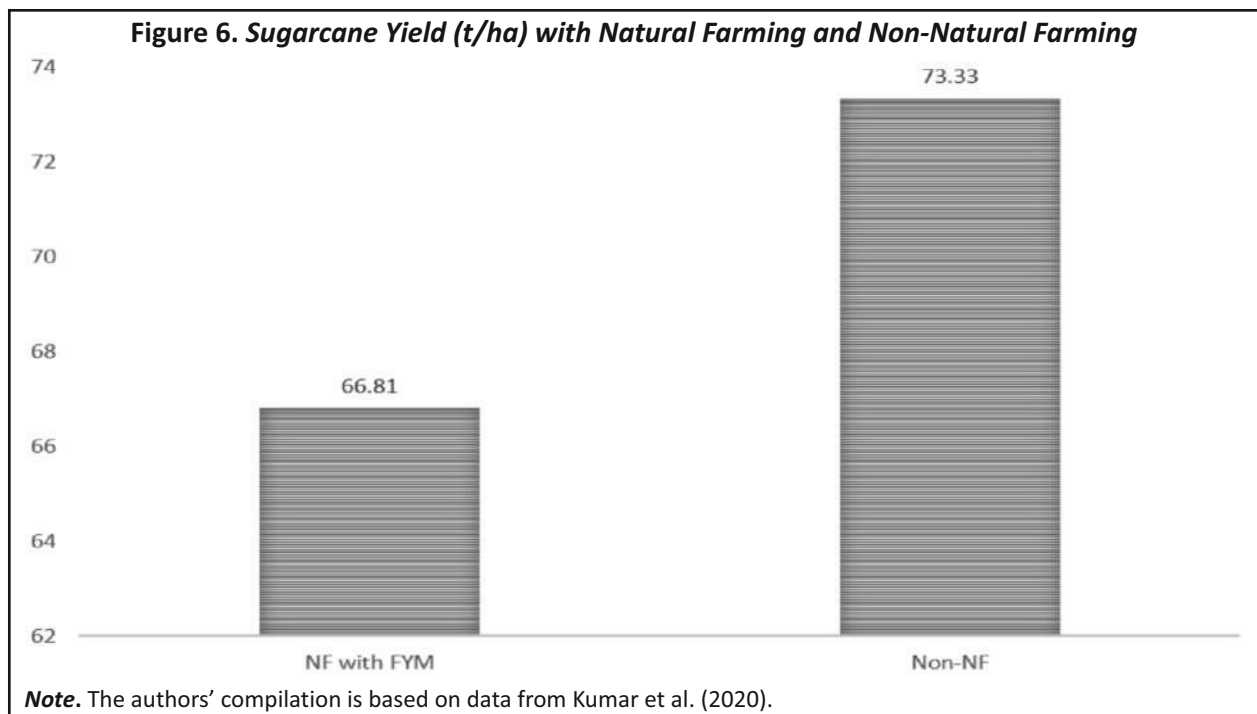
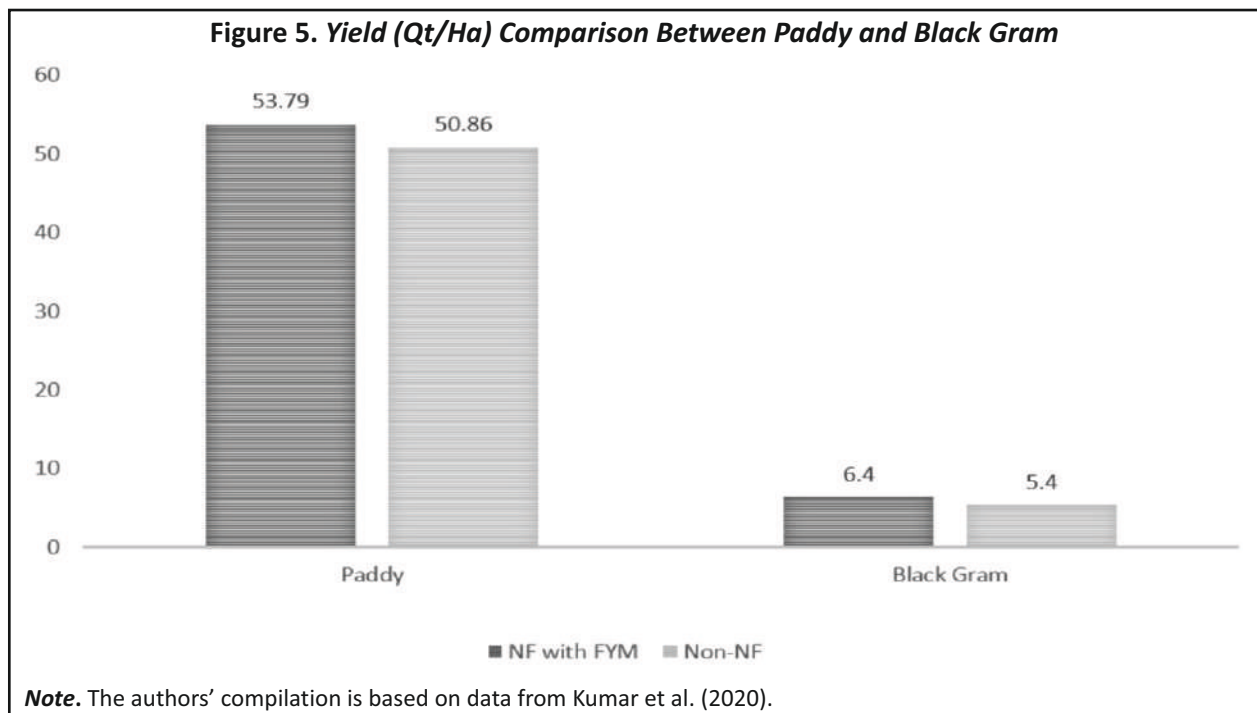
Negative Aspects of Natural Farming

Less Productivity

Even though NF has helped in preserving soil fertility, as far as productivity is concerned, it has not shown a massive improvement. There is a high possibility of the yield being less due to its total dependence on nature. The method of NF has not gained broad traction, and so its production sustainability may be questionable. This could result in problems with food security (Mohanapure & Chavhan, 2020). Getting hold of indigenous cow dung and urine was a challenge, as per the study conducted by the Center for Study of Science, Technology, and Policy (Suresh et al., 2019).

Figure 5 shows a comparison of the yield of two crops when NF with FYM and without FYM is practiced. Paddy and black gram both witnessed marginal increases in yield at 53.79 and 6.4 quintals/ha compared to lower yields in conventional farming methods.

Figure 6 reveals that sugarcane average yield in Andhra Pradesh for non-NF is higher at 73.33 tonnes/ha as compared to 66.81 tonnes/ha when NF with FYM was used. This is in contrast to the higher yield witnessed in paddy and black gram when FYM was used.



Less Income

When productivity is low in NF, the farmers have a lesser quantity of produce to sell, which impacts their income-earning ability. Even though NF is meant to have low input costs, the use of cattle, especially the preference for native stock, forces farmers to maintain livestock along with farming. The cost of cattle feed, the incidence of

cattle illness and declining grassland are adding to the cost of input. The price for cattle feed saw a 50% rise from 106.7 to 159.3 from 2012 to 2019 (Mohanapure & Chavhan, 2020). The 2011 census also shows that the indigenous cattle population fell by 8.1% while crossbreeds rose by 29.5%. All these factors can act as a depressant on farmer income.

Availability of Inputs

Since NF advocates the use of inputs like cow dung and urine of indigenous cows, jaggery, pulses etc., not all farmers have access to indigenous cows and have to depend on other farmers to provide the raw materials to create the various concoctions. This often adds to the cost of inputs wherein the whole practice of NF is advocated on the premise of its having a low-cost means of cultivation. The application of these concoctions also requires the added use of labor to prepare and apply these concoctions as per the schedule.

Lack of Clarity

There seems to be a lot of misinformation on the positive effects of using NF practices, with one group opposing the continued use of NF and the other group advocating its use and presenting it as the panacea for the ills caused by the Green Revolution. Farmers are stuck between the two opposing groups, having no clear indication of the way to go about adopting NF. More scientific study and dialogue between these groups are needed to resolve this bottleneck. Having a set of guidelines stipulating what farmers need to do in each case will help them make informed choices quickly and without ambiguity.

Conclusion

An analysis of the benefits of employing NF techniques has revealed mixed results. Although NF, as propounded by Fukuoka (i.e., without applying FYM), does not show much increase in yield, NF, along with the use of FYM, revealed an increase in yield for certain crops. There is immense potential in reaping the benefits of NF, but more empirical research has to be conducted before conclusions can be drawn. There is also potential for a niche market of NF products similar to organic products, which can be a source of increased income for farmers. Reduced fertilizer use has also been demonstrated to improve the quality and flavor of the food produced. Since organic matter is used in place of fertilizers and pesticides, NF has also decreased input prices. However, widespread adoption of NF should only happen after a thorough analysis is conducted to identify and address any shortcomings.

Limitations of the Study and Scope for Future Research

To reap the benefits of NF, it would be wise to introduce the practice in a phased manner with an initial study conducted to see how each crop reacts to the non-use of fertilizers so that modifications can be made based on each crop's needs. Past studies have also shown that the yield in NF is not necessarily high, and thereby, it would bode well for small and marginal farmers to adopt NF rather than farmers with large land holdings since mechanization has to be followed on large-scale farms, and this would add to the overall cost. Food security is an aspect that has to be kept in mind when bringing changes to any mode of agricultural practice.

The kind of cattle that can be utilized also needs more research. It will require empirical research to determine whether using native cattle instead of crossbreeds or even using buffaloes or bullocks instead of cows results in a much higher yield. Access to indigenous breeds of cattle must be ensured before shifting to NF since cattle by-products form the main component in making the manure. Without access to these breeds, and that too at a low

cost, it will be difficult for farmers to sustain yield and, consequently, their income. Past studies have also suggested that NF products ought to have a certification like organic products so that farmers will be incentivized to adopt this practice. Creating a niche market for produce obtained from NF will help create awareness among the citizens of the availability of better and natural food produce which in turn will help farmers get better and increased income. These products also are known to have better quality and taste as per studies mentioned in the literature review. If NF products can be certified, there may be positive spillover effects on the consumer goods sector. In order to guarantee that farmers obtain a fair price, companies might collaborate with them to promote their products. During this process, the business might also generate jobs by employing workers with the necessary skills for this specialized field. Additionally, it provides access to new markets and growth opportunities for the companies.

Intensive study needs to be done to find out how microbes react in the absence of inorganic fertilizers. Since NF can reduce greenhouse gases, policies to combat carbon should include NF in the framework. Soil health is the main area where NF has had an impact. Soil organic matter is stimulated by NF using FYM, which contributes to increased soil nutrition. It is necessary to create policies that will give farmers more access to native cattle breeds. To promote NF, local government procurement centers should set higher minimum prices for farmers, particularly small-scale farmers. As a result, farmer income should increase, and farmer income inequality should decrease.

Authors' Contribution

Dr. K. Malathi conceived the topic of NF and its practice in India. She also provided the overall framework for the paper. Ms. Chris Ann Tomy reviewed the past literature and data and analyzed them. Dr. K. Malathi wrote the paper as one of the authors and completed the final editing.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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About the Authors

Dr. K. Malathi is currently working as an Assistant Professor at the University of Madras. Her area of interest is agricultural, environmental, and development economics, and papers on the same have been published in UGC journals. She has undertaken projects funded by the UGC and RUSA.

Chris Ann Tomy is an economics and international relations graduate who is currently pursuing her PhD at the University of Madras. Her areas of interest include environmental and agricultural economics, and has presented papers on the same.