



International Journal of Research in Agronomy

E-ISSN: 2618-0618

P-ISSN: 2618-060X

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www.agronomyjournals.com

2024; 7(12): 642-647

Received: 23-10-2024

Accepted: 26-11-2024

Harshkumar D Patel

Ph.D. Research Scholar,
International Agribusiness
Management Institute, Anand
Agricultural University, Anand,
Gujarat, India

AB Mahera

Assistant professor, International
Agribusiness Management
Institute, Anand Agricultural
University, Gujarat, India

Natural farming: A sustainable path for modern agriculture

Harshkumar D Patel and AB Mahera

DOI: <https://doi.org/10.33545/2618060X.2024.v7.i12h.2236>

Abstract

Agriculture is the backbone of India, as over 50% of small and marginal farmers rely on it for their livelihoods. However, the extensive use of chemical fertilizers harms the soil, negatively impacting the quality of agricultural produce. This reliance on chemical inputs often drives farmers into substantial debt. In recent years, natural and organic farming has emerged as a sustainable solution to these challenges. Natural farming involves working with nature, avoiding chemical fertilizers, while organic farming uses ecologically-based pest control and fertilizers derived from animal and plant waste, along with nitrogen-fixing cover crops. Practices like no-tillage, mulching, and live mulching in natural farming support high-quality agricultural output and help preserve the ecosystem. Although natural and organic products tend to be more expensive than conventional ones, the higher prices offer farmers a pathway out of debt and a chance at a more sustainable livelihood.

Keywords: Natural farming, organic farming, mulching, Jeevamruth, beejamruth

Introduction

Since 1965, India's agriculture sector has significantly impacted the national economy, largely due to the Green Revolution, which boosted production and productivity. Natural farming, an alternative approach to conventional agriculture, applies nature's laws to farming practices. This method fosters the natural biodiversity of each farming area, allowing the complex ecosystem of plants and animals to flourish alongside food crops.

Natural farming was pioneered by Japanese farmer and philosopher Masanobu Fukuoka (1913-2008), introduced in his 1975 book *The One-Straw Revolution*. Known as "the Fukuoka Method," "the natural way of farming," or "do-nothing farming," this approach emphasizes minimal interference, avoiding manufactured inputs and heavy equipment. Despite its simplicity, natural farming aligns closely with various sustainable agriculture methods, such as organic farming, permaculture, agroecology, and eco-agriculture, though it is distinct from biodynamic agriculture.

Fukuoka regarded farming as both a food source and a spiritual endeavor, aiming at the "cultivation and perfection of human beings." His philosophy encouraged farmers to keenly observe local conditions, allowing nature to guide farming decisions. As a self-sustaining system, natural farming requires no external inputs, mimicking nature to maintain soil fertility and ecosystem balance.

Current scenario of Agriculture

Nowadays farmers need more yield for their crops which has cultivated in field. To obtain more yield farmers are applying huge quantity of fertilizers rather than recommended quantities. Excess use of chemical fertilizers which is highly hazardous for soil, animals & human health.

Effects of excess use of fertilizers

Excessive fertilizer use, particularly nitrogen-based, leads to oxygen depletion in water bodies through algal blooms, which reduce oxygen and harm aquatic life. Overuse also degrades soil structure, reducing its water-holding capacity and resilience in dry conditions. Fertilizers with animal manure can increase faecal organisms in the soil, risking water contamination and human

Corresponding Author:

Harshkumar D Patel

Ph.D. Research Scholar,
International Agribusiness
Management Institute, Anand
Agricultural University, Anand,
Gujarat, India

health. Initially used to enhance soil fertility, excessive fertilizers disrupt nutrient balance, leading to nutrient leaching and reduced productivity. Nitrogen fertilizers can convert to ammonia, reaching toxic levels that harm plants and soil organisms, reducing biodiversity. Beneficial organisms like earthworms and microbes, essential for soil health, are negatively impacted, and nutrient runoff promotes algal blooms that harm aquatic ecosystems. Fertilizers can also encourage weed growth, leading to increased competition for resources and a need for additional herbicides or management.

Crop wise consumption of chemical fertilizers in India

In India, farmers are thinking that application of more quantity

of fertilizers will give more yield, so farmers are applying more quantity of fertilizers rather than actual requirement. Rice and wheat are the major crops in India which consumed fertilizers were 37 percent and 24 percent respectively. The remaining food crops were consumed 8 percent of total fertilizer consumption. Cultivation land of pulses were too less which consumed only 3 percent of overall fertilizer consumption. The oilseed cultivation was comparatively high than pulses cultivation which consumed 9 percent of overall fertilizer. Sugarcane consumed 5 percent followed by cotton 3 percent, vegetables 4 percent, fruits 2 percent and other crops 5 percent in overall fertilizer consumption (Fertilizer Association of India, 2019) [6].

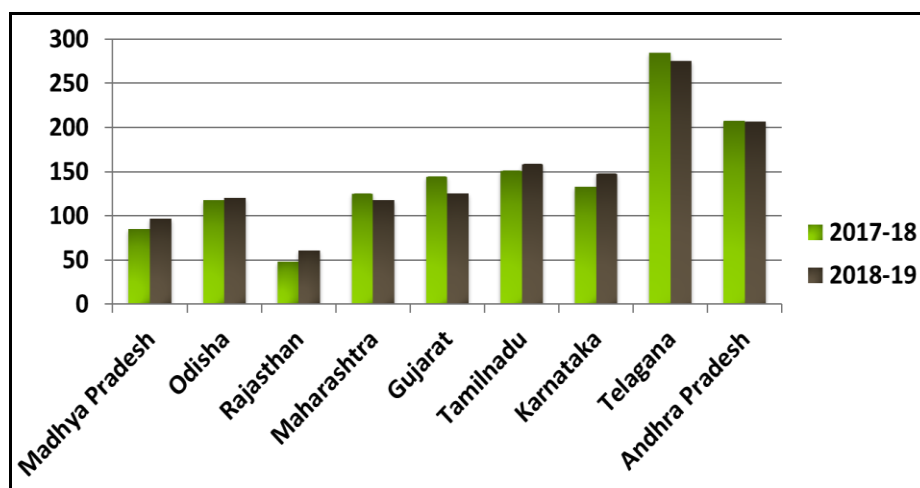


Fig 1: State wise fertilizer consumption in India during 2017-18 and 2018-19 (Metric tons)

Fig. 1. indicate the fertilizer consumption by predominant rainfed states of India during 2017-18 and 2018-19 in terms of metric tons. The consumption of fertilizer had been increasing from 2017-18 to 2018-19. Telangana and Andhra Pradesh were consuming more fertilizers over the year, both states were consumed more than 400 metric tones over the period.

Karnataka, Tamil Nadu, Gujarat, Maharashtra and Odisha were consumer each more than 100 metric tons. The consumption rate of fertilizers were below 100 metric tons in Rajasthan and Madhya Pradesh because which has dessert and forest region (Fertilizer Association of India, 2019) [6].

Table 1: Consumption of various fertilizers (MT)

Year	Urea	DAP	MOP	Complex	N	P	K	Total
2001-02	199.17	61.81	19.93	49.63	113.1	43.82	16.67	173.6
2002-02	184.93	54.73	19.12	48.1	104.74	40.19	16.01	160.94
2003-04	197.67	56.24	18.41	47.57	110.77	41.24	15.98	167.99
2004-05	206.65	62.56	24.06	55.08	117.13	46.24	20.61	183.98
2005-06	222.97	67.64	27.31	66.94	127.23	52.04	24.13	203.4
2006-07	243.37	73.81	25.86	67.99	137.73	55.43	23.35	216.51
2007-08	259.63	74.97	28.8	65.7	144.19	55.15	26.36	225.7
2008-09	266.49	92.31	40.78	68.05	150.9	65.06	33.13	249.09
2009-10	266.74	104.92	46.34	80.25	155.8	72.74	36.32	264.86
2010-11	281.12	108.7	39.31	97.64	165.58	80.5	35.14	281.22
2011-12	295.65	101.91	30.29	103.95	173	79.14	25.75	277.9
2012-13	300.02	91.54	22.11	75.27	168.21	66.53	20.62	255.36
2013-14	306	73.57	22.8	72.64	167.5	56.33	20.99	244.82
2014-15	306.1	76.26	28.53	82.78	169.46	60.98	25.32	255.76
2015-16	306.35	91.07	24.67	88.21	173.72	69.79	24.02	267.53
2016-17	296.14	89.64	28.63	84.14	167.35	67.05	25.08	259.49

(Fertilizer Association of India, 2019) [6]

Table 1 indicate that consumption rate various fertilizers in India from 2001-02 to 2016-19. Indian farmers are using various chemical fertilizers such as urea, DAP, MOP, complex, Nitrogen, Phosphorus and Potassium fertilizers for increasing

the yield of crops. The consumption rate of chemical fertilizers had been increasing in a last decade but in recent years it has been declining because farmers are aware about the side effects of over usage of chemical fertilizers in their field.

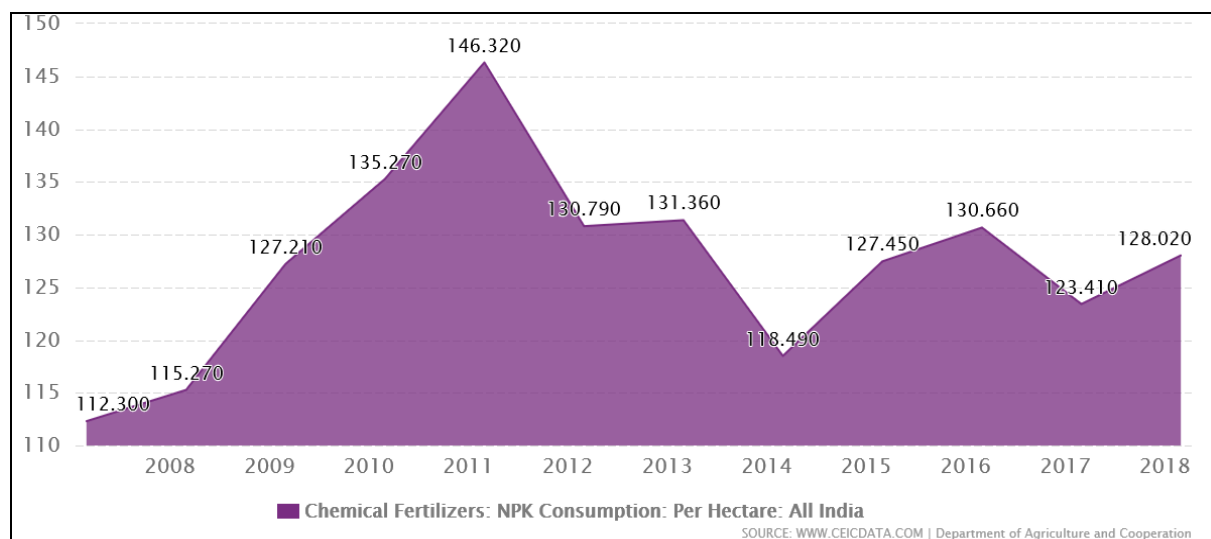


Fig 2: Chemical fertilizers: NPK Consumption per hectare in India

Fig. 2 indicated the NPK consumption per hectare in India from 2008 to 2018. In the above-mentioned decade, the consumption rate was increasing trend from 2008 and reached high at 146.320 kg/ha in 2011. After 2011 the consumption rate of NPK were decreasing trend and reached low as 118.490 kg/ha in 2014. After 2014 the consumption rate was again in increasing trend then it was in decreasing in trend because of awareness about natural farming as well organic farming among farmers.

Need of Natural Farming

When implemented effectively, natural farming prevents water pollution, protects biodiversity, and stops soil erosion, all while maintaining food production levels. It seeks to liberate farmers from the debt cycle exacerbated by the liberalization of the Indian economy and aims to make small-scale farming a sustainable livelihood. In numerous states, farmers are burdened with significant debt due to increasing agricultural costs associated with privatized seeds, expensive farm inputs, and limited access to markets. (Anon., 2020a) ^[1, 2].

The key principles of Natural Farming are

No tillage farming

Ploughing the soil alters the natural environment of the soil and promotes the growth of weeds (Anon., 2020a) ^[1, 2].

No weeding by tillage or herbicides

Weeds are not eliminated but can be suppressed by spreading straw over freshly sown land and growing ground cover (Anon., 2020a) ^[1, 2].

No chemical fertilizers

This is because adding chemical fertilizers help in the growth of the plant but not of the soil, which continues to deteriorate (Anon., 2020a) ^[1, 2].

No dependence on chemical pesticides

Nature's own balancing act prevents any one species from

gaining the upper hand (Anon., 2020a) ^[1, 2].

Importance of Natural Farming:

Soil degradation has affected the microbial community of the soil, altering the nutrient cycle, pest control and chemical transformation properties of soil. Natural farming is the solution to reducing all these hazards. The high-interest rates for credit or loans that the farmers take from the easiest available lender made farming unviable. Natural farming promises to cut down farming expenditure drastically and ends dependence on loans. It also reduces dependence on purchased inputs as it encourages use of own seeds and locally available natural fertilizers. This farming is done in synchronization with the nature not through chemical fertilizers. Natural farming recognizes soils as a fundamental natural asset. Ancient soils possess physical and chemical attributes that render them capable of generating and supporting life abundance. It can be argued that tilling actually degrades the delicate balance of a climax soil (Anon., 2020a) ^[1, 2].

Key differences between Natural Farming and Zero Budget Natural Farming

The word 'budget' refers to credit and expenses, thus the phrase 'Zero Budget' means without using any credit and without spending any money on purchased inputs. 'Natural farming' means farming with nature and without chemicals (Anon., 2021) ^[3].

Similarities between Natural Farming and Organic Farming

Natural and organic both are chemical free and more or less poison free farming methods. Both systems discourage farmers from using any chemical fertilizers, pesticides on plants and in all agricultural practices. Both farming methods encourage farmers to use local breeds of seeds, and native varieties of vegetables, grains, pulses and other crops. Organic and natural farming methods promote nonchemical and homemade pest control methods.

Table 2: Difference between organic farming and natural farming

Organic Farming	Natural Farming
Organic fertilizers and manures like compost, vermicompost, cow dung manure, etc. are used and added to farmlands from external sources.	Neither chemical nor organic fertilizers are added to the soil. In fact, no external fertilizers are added to soil or give to plants whatsoever.
It still requires basic agro practices like plowing, tilling, mixing of manures, weeding, etc. to be performed.	Decomposition of organic matter by microbes and earthworms is encouraged right on the soil surface itself, which gradually adds nutrition in the soil, over the period.
There is requirement of bulk manures and it has an ecological impact on surrounding environments.	There is no ploughing, no tilling of soil and no fertilizers, and no weeding is done just the way it would be in natural ecosystems.
It is expensive	It is an extremely low-cost farming method, completely molding with local biodiversity.

Different practices of Natural Farming

No-Tillage

When tillage is avoided soil moisture substance is increased, augment the propagation of earthworms. Earthworms are known to create the soil porous and enrich the soil with their castings. Seeds are scattered and enclosed by the straw before harvesting the previous crop. Seeds are germinated by the arrival of the next favorable period (Anon., 2021) ^[3].

Mulching

Grain crops, healthy orchard trees are developed with a ground cover of vegetables, weeds and white clover. Mulching with straw develops soil moisture content and conducive growth of the microorganisms and earthworms. It improves seed germination without tillage. Growth of covering crops like legumes increases the nitrogen fixation in the soil. Harvesting weed before flowering and covering the open land reduces area for the crop weed and develop the organic matter content in the soil. It is necessary to make the micro-climate under which microorganisms can best grow, that is 25 to 32 °C temperature, 65 to 72% moisture and darkness and warmth in soil. Mulching certainly conserves humidity of the soil (therefore the diminishing the need for irrigation), cools it and protects its microorganisms (Anon., 2021) ^[3]. Mulching can maximize the moisture content in the soil, forms the cover for the earthworms and minimizes the weed propagation (Devarinti, 2016) ^[5].

It can be done by three methods:

- (I) Plastic Mulching
- (II) Straw Mulching
- (III) Live Mulching

1) Plastic Mulching

Plastic mulch is a product used, in a similar fashion to mulch, to suppress weeds and conserve water in crop production and landscaping. Certain plastic mulches also act as a barrier to keep methyl bromide, both a powerful fumigant and ozone deplete, in the soil. Crops grow through slits or holes in thin plastic sheeting. Plastic mulch is often used in conjunction with drip irrigation. Some research has been done using different colors of mulch to affect crop growth. This method is predominant in large-scale vegetable growing, with millions of acres cultivated under plastic mulch worldwide each year. Disposal of plastic mulch is cited as an environmental problem; however, technologies exist to provide for the recycling of used/disposed plastic mulch into viable plastic resins for re-use in the plastics manufacturing industry (Anon., 2021). ^[3]

2) Straw Mulching

An organic mulch is made up of natural substance such as bark, wood chips, pine needles, dry grasses, paddy straw, dry leaves, saw dust, grass clipping, etc. But organic mulch attracts insects,

slugs and the cutworms that eat them. They get decomposed easily and need frequent replacements. Paddy and wheat straw are the commonest mulching materials used for fruit and vegetable production. Though straw is poor in nutrient value but after decomposition, it makes soil more fertile. Among organic mulching materials, straw has a long life in comparison to other mulches (grasses, leaves and leaf mould). Lucerne hay from alfalfa enriches soil with nitrogen as it decomposes, supporting plant health, while straw mulch prevents weed growth effectively. Composting meadow hay or alfalfa hay kills weed seeds, making it ideal for mulch. Straw mulch is also convenient, providing a low-maintenance alternative to soil tilling. Once applied, it typically lasts through the growing season, unless dispersed by wind. It's easy to manage and reduces the need for regular soil maintenance. (Anon., 2021) ^[3].

3) Live Mulching

It is a cover of crop interplanted or under sown with a main crop, and intended to serve the purposes of a mulch, such as weed suppression and regulation of soil temperature. Living mulches grow for a long time with the main crops, whereas cover crops are incorporated into the soil or killed with herbicides. Other benefits of mulches are slowing the growth of weeds, and protecting soil from water and wind erosion. Some living mulches were found to increase populations of the natural enemies of crop pests. Legumes used as living mulches also provide nitrogen fixation, reducing the need for fertilizer (Anon., 2021) ^[3].

Advantages of live mulching

When cover crops are turned over into the soil, they contribute nutrients to the main crop so that less chemical fertilizer is required. The amount of the contribution depends on the biomass, which varies over time and depends on rainfall and other factors. The greater the biomass, the greater the nutrient turnover of land. Legume cover crops turn over nitrogen fixed from the atmosphere. Reports indicate that legumes in general have higher foliar nitrogen contents, from 20 to 45 mg g⁻¹ (Anon., 2021) ^[3].

Disadvantages of live mulching

Unfortunately, living mulches compete for nutrients and water with the main crop and this can reduce yields. For example, Elkins *et al.* (1983) ^[8] examined the use of tall fescue, smooth brome grass and orchard grass as living mulches. They found that herbicides killed 50% to 70% of the mulches but corn yield was reduced 5% to 10% at the end of the harvest (Anon., 2021) ^[3].

Beejamruth

It is used for seed treatment. It is mixture of cow dung, cow urine, lime and handful of soil. Naturally occurring beneficial

microorganisms are present in cow dung. These microorganisms are cultured in the form of beejamruth and functional to the seeds as inoculum. It is reported that seed treatment with beejamruth protects crops from harmful soil-borne pathogens and helpful in producing IAA and GA.

Jeevamrut

It is important to provide a congenial environment to microorganisms that help in making available the essential nutrients for plant growth viz., nitrogen, phosphorus and potassium, to the plants. Soil microorganisms play an active function in soil fertility as they involve in the cycle of nutrients like carbon and nitrogen, which are required for plant growth. They are dependable for the decomposition of the organic matter entering the soil and therefore the inn the recycling of the nutrients in the soil. Cyanobacteria and mycorrhiza constitute soil microorganisms. They participate in decomposition mineralization and nutrient provide to the plants. Jeevamruta formulation can save nutrient dose which in turn will help farmer to reduce the cost (Manjunatha *et al.* 2022) ^[7]. Jeevamrutha method gives better benefit-cost ratio in rice (Amareswari & Sujathamma, 2014) ^[4].

Other forms of Natural Farming

1) Fertility Farming

In 1951, Newman Turner advocated the practice of "fertility farming", a system featuring the use of a cover crop, no tillage, no chemical fertilizers, no pesticides, no weeding and no composting. Although Turner was a commercial farmer and did not practice random seeding of seed balls, his "fertility farming" principles share similarities with Fukuoka's system of natural farming. Turner also advocates a "natural method" of animal husbandry (Anon., 2020) ^[1, 2].

2) Native American

Recent research in the field of traditional ecological knowledge finds that for over one hundred centuries, Native American tribes worked the land in strikingly similar ways to today's natural farmers. Author and researcher M. Kat Anderson writes that "According to contemporary Native Americans, it is only through interaction and relationships with native plants that mutual respect is established" (Anon., 2020) ^[1, 2].

3) Nature Farming

Japanese farmer and philosopher Mokichi Okada conceived of a "no fertilizer" farming system in the 1930s that predated Fukuoka. Okada used the same Chinese characters as Fukuoka's "natural farming" however, they are translated into English slightly differently, as nature farming. Agriculture researcher Hu-lian Xu claims that "nature farming" is the correct literal translation of the Japanese term (Anon., 2020) ^[1, 2].

4) Rishi Kheti

In India, natural farming of Masanobu Fukuoka was called "Rishi Kheti" by practitioners like Partap Agarwal. The Rishi Kheti use cow products like buttermilk, milk, curd and its waste urine for preparing growth promoters. The Rishi Kheti is regarded as non-violent farming without any usage of chemical fertilizer and pesticides. They obtain high quality natural or organic produce having medicinal values. Today still a small number of farmers in Madhya Pradesh, Punjab, Maharashtra and Andhra Pradesh, Tamil Nadu use this farming method in India (Anon., 2020) ^[1, 2].

5) Zero Budget Farming

Zero Budget Farming is a variation on natural farming developed in, and primarily practiced in southern India. It also called spiritual farming. This method involves mulching, intercropping, and the use of several preparations which include cow dung. These preparations, generated on-site, are central to the practice, and said to promote microbe and earthworm activity in the soil. Indian agriculturist Subhash Palekar has researched and written extensively on this method.

Scope of Natural Farming

Studies have shown that natural farming, with the minimum external inputs and by application of supplements like Jeevamruth, improves the soil fertility by increasing the soil micro flora and available nutrients. This method encourages multi cropping and biodiversity of micro and macro flora (Anon., 2021) ^[3].

Advantages of Natural Farming

Natural farming offers numerous environmental and health benefits, primarily by reducing reliance on synthetic chemicals and fostering healthier ecosystems. By minimizing pesticide and chemical fertilizer use, it protects farmers and consumers from harmful exposure, yielding safer food. Natural farming also enhances soil health through organic compost and crop rotation, increasing nutrient content and water retention, which boosts plant resilience and long-term productivity. Sustainable practices, such as no-till farming and cover cropping, combat soil erosion by maintaining soil structure, essential for agricultural sustainability.

Water conservation is another key advantage, achieved through efficient methods like drip irrigation and mulching, reducing evaporation and runoff. Furthermore, avoiding harmful chemicals prevents water pollution, ensuring cleaner water sources for both ecosystems and communities. Sustainable practices also support animal welfare by offering natural diets and humane living conditions, creating healthier food products and reducing disease risks.

Lower initial costs make natural farming more accessible, as it relies on on-farm resources like compost, beneficial insects, and green manure, minimizing expenses on synthetic inputs. Additionally, biodiversity is enhanced through crop variety and agroforestry, fostering a balanced ecosystem resilient to pests and climate impacts. Lastly, natural farming mitigates climate change by sequestering carbon in soil and plants and reducing greenhouse gas emissions through reduced chemical and fossil fuel use. In sum, natural farming promotes environmental health, resource conservation, and sustainable agriculture.

Disadvantages of Natural Farming

Natural farming, while eco-friendly, has several disadvantages that can hinder widespread adoption. Firstly, yields are often uncertain since natural farming relies on organic methods rather than synthetic chemicals, leaving crops vulnerable to pests, diseases, and weather extremes. The transition period from conventional farming can reduce yields initially as soil adjusts, impacting farmers financially. Unlike synthetic fertilizers, organic inputs release nutrients slowly, which may not meet fast-growing crops' needs, potentially leading to deficiencies.

Natural farming is labour-intensive, requiring more hands-on tasks like weeding, composting, and natural pest control, which can be challenging for those with limited labour access. Pest management relies on biological methods that may not control severe outbreaks as effectively as synthetic pesticides, posing

risks to crop health. Furthermore, there is often a gap in knowledge and training for farmers used to conventional practices, with limited extension support for natural farming.

Access to essential organic inputs, such as manure or natural pest repellents, can be difficult in regions without adequate livestock or resources. Market access and premium pricing are also barriers, as demand for natural produce may be limited, reducing economic incentives. Natural farming's dependency on weather conditions makes it harder to manage adverse effects like excessive rain or drought. Scalability remains an issue due to labor demands and management challenges on large farms, raising concerns about its economic viability. The transition costs and potentially lower yields can offset savings from reduced chemical use, making it less financially appealing without premium pricing or support.

Conclusion

Indiscriminate use of chemical fertilizers and pesticides posed a threat to the soil and environment. Many investigations have shown their adverse effects of change in soil nature, soil contamination, ground water pollution and decrease in soil micro flora etc. although precise information regarding the method and awareness is essential to produce the potential yield. By decreasing production cost and connecting quality produce to the markets, farmers' income can be increased. Natural farming has freed the farmers from the debts and it has helped them to be confident to make farming more viable.

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