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ROLE OF NATURAL FARMING FOR SUSTAINABLE ENVIRONMENT: A REVIEW

YADAV A[1], KUMAR A[1*], KUMAR S[2] AND RAJPUT H[3]

1: Department of Agriculture, Faculty of Science, Swami Vivekanand Subharti University, Meerut, 250005, Uttar Pradesh, India

2: Department of Agriculture Engineering, SCRIT, Chaudhary Charan Singh University, Meerut, 250004, Uttar Pradesh, India

3: Department of food Technology, School of Advanced Agriculture Sciences and Technology, Chhatrapati Shahu Ji Maharaj University, Kanpur – 208024, Uttar Pradesh, India

***Corresponding Author: Mr. Amit Kumar: E Mail: amit.agbiotech1582@gmail.com**

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ABSTRACT

Natural Farming uses methods that observe the laws of nature and utilizes natural materials and products. It is based on the principle of interdependence among all living things. It aims to have a nurturing impact on the environment, in sharp contrast to the disadvantageous effects that often accompany modernized and commercialized agriculture. A chemical-free farming method with roots in Indian customs, natural farming incorporates contemporary ecological knowledge, resource recycling, and on-farm resource optimization. It is regarded as a varied farming system built on agroecology that incorporates animals, trees, and crops with useful biodiversity. It is primarily focused on biomass mulching, using on-farm cow dung-urine formulations, preserving soil aeration, and excluding any synthetic chemical inputs. It is primarily based on on-farm biomass recycling. Natural farming is expected to reduce dependency on purchased inputs Natural Farming inputs Indigenous Microorganisms (IMOs), Fermented Plant Juice (FPJ), Fermented Fruit

Juice (FFJ), and Earthworm are play the important role in increase the yield of the crops. The most potent and productive microorganisms for farming are those that have been a part of the soil for a considerable amount of time. In this review we can conclude that natural farming greatly increases agricultural output and eliminates the need for synthetic or chemical fertilizers, which are detrimental to the health of the humans and crops.

Keywords: Natural Farming, Current Status, Components, Nutritive Cycle Theory, Natural Farming Inputs

INTRODUCTION

In the Indian setting, natural farming is practiced, including zero-budget natural farming (ZBNF). In order to boost the microbial activities of the soil, it promotes farmers to use low-cost, locally sourced inputs including mulch, crop coverings, jaggery, pulse flour, dung, and urine from cows. Enhanced soil conditions by managing organic matter and soil biological activity; diversification of genetic resources; enhanced biomass recycling; and enhanced biological interactions" are the key goals of natural farming. The practice of natural farming on farms is guided by a set of principles: farms should be built around poly-cropping, which integrates trees with a variety of arable and perennial crops; no synthetic agroinputs, such as fertilizers, pesticides, or herbicides, should be used; soil should be covered with mulch or cover crops year-round; local seeds, which are more affordable and resilient than hybrids, should be used; In order to maximize the microbial activities of the soil, biostimulants, botanical extracts, and limited tillage should be employed. Additionally, integrating animals with crops can create both biological and financial synergies. Agroecological techniques such as composting, mulching, green manuring, crop rotations, intercropping, tree intercropping, and animal integration are all possible with natural farming since it adopts a comprehensive approach to farming systems. The yield of Natural Farming (NF) with Farm Yard Manure (FYM) was higher than that of NF without FYM and non-NF farms **[34]**. The market price of NF produce has marginally increased while the variable cost has decreased. According to Palekar **[39]** natural farming in Maharashtra in 2006 as a solution to the challenges that followed the Green Revolution. It is a chemical-free, climate-resilient farming approach. His techniques gained traction when farmers began implementing them. Following that, a large number of experts and researchers asserted that natural farming is a decent

substitute for chemical farming and has a favorable impact on sustainable development, either directly or indirectly. The aim of natural farming is to reduce the cost of production to almost zero and to come back to the "pre-Green Revolution" style of agriculture.

Khadse **[24]** reported that Natural farming is a unique type of agriculture in which the cost of obtaining necessary inputs from the market, such as seeds, fertilizers, and chemicals for plant protection, is nonexistent. Farmers are sincerely adopting natural farming, despite its early beginnings, as it is demonstrating more favorable outcomes. Farmers even mention that labor and manufacturing costs have dropped by 14–45% **[11]).** Natural farming primarily uses cropping systems based on traditional Indian agroecological methods; it does not necessitate any financial commitment for the acquisition of essential inputs. **[39]**. This study was carried out to determine the effects of the cropping system of natural farming on small and marginal farmers because of its adaptability, simplicity, and significant reduction in cultivation costs. Natural farming encourages the use of a variety of homemade pesticide formulations, such as neemastra, agniastra, and bramhastra. **[36]**. These are employed to manage pests like fruit, stem and pod borer, mealy bugs, sucking pests, leaf rollers, etc. It has been discovered that NF somewhat improves soil health; this may be due to the rapid development of flora and heterotrophic microbial communities as well as the rise in soil organic matter **[47, 48, 34, 42]**. Locally adapted plant and animal breeds that are better suited to regional environments can be employed when variety is promoted. Above all, genetic diversity in agriculture provides a fundamental safeguard against outbreaks of diseases that affect crops and cattle **[29, 30, 31]**.

The Present situation of Organic Farming

Natural farming is being practiced in numerous states. Among them, Andhra Pradesh, Madhya Pradesh, Rajasthan, Uttar Pradesh, Himachal Pradesh, Kerala, Gujarat, Jharkhand, Odisha, and Tamil Nadu are prominent states **(Figure 1)**. India currently has 6.5 lakh hectares under natural farming.

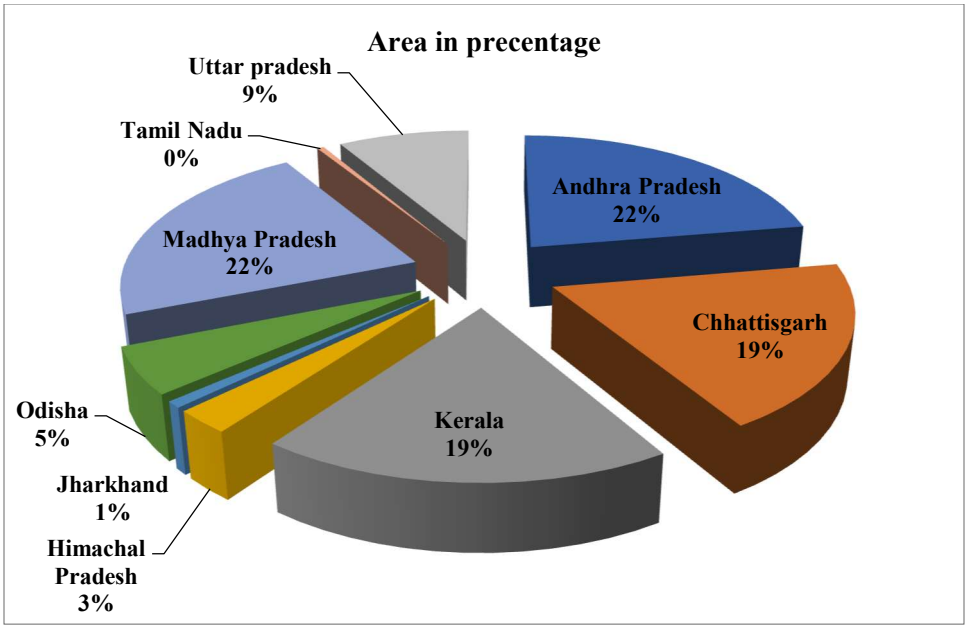

Figure 1: States of India involved in natural farming (Source: NITI Aayog)

The Indian government has made a major push toward natural farming in the past few years in an effort to encourage chemical-free farming. "ZBNF is a promising tool to minimize farmers' dependence on purchased inputs; it lowers the cost of agriculture by relying on traditional field-based technologies, which also leads to improved soil health," the Prime Minister of India said in his speech to the nation on the 76th of Independence Day **[12, 13, 15]**. Natural farming is becoming more and more popular among farmers across the nation thanks to programs like the National Mission on Natural Farming, Paramparagat Krishi Vikas Yojana (Conventional Agriculture Development Scheme) under the sub-mission of Bharatiya Prakritik Krishi Paddhati (BPKP), Andhra Pradesh Community Natural Farming (APCNF), Mission Organic Value Chain Development for North Eastern Regions (MOVCDNER), etc.

Financial support of INR 12,200/ha (about 147 USD/ha) is provided under the BPKP scheme for three years in order to facilitate cluster creation, capacity building, and ongoing assistance with certification and residue analysis. The highest research agency in India, the Indian Council of Agricultural Research (ICAR), has started a study on the assessment of NF on specific crops. Numerous societal groups have taken notice of NF because to its popularity. According to Economic Survey (2022), there are an estimated 500,000 hectares of land in India across various states that are currently being farmed under natural farming. This number is predicted to rise to 14 million hectares of land

under natural farming by 2025 under the PKVY scheme. Farming practices may not be the sole elements influencing the scaling up of NF; social movements, public policies, markets, educational procedures, leadership, and rhetoric are all important. **[25, 9, 26]**. The Knowledge sharing led and centered by farmers is essential to the long-term adoption of NF practice **[4]**.

Component of Natural Farming

The four primary components of natural farming are mulching, whapasa, jivamrit, and beejamrit **(Figure 2)**. A traditional method of sustainable agriculture is beejamrit. Seeds, three seedlings, or any other planting material can be utilized with it. The primary application of Beejamrit, an organic pesticide, is for the seed 34 treatment of many crops, including rice, wheat, maize, vegetables, fruits, etc. **[41]**. Three applications of beejamrit, a fermented microbial solution rich in microorganisms that are favorable to plants, are made as seed treatments. The term Beejamrit refers to Beej (meaning seed) dipped into Amrit (meaning magical liquid). It is a homemade organic input originally made up of cow dung and cow urine. It is a homemade organic input that was first created using 19 cow urine samples and cow manure. Overnight, the inflow is further enhanced with virgin forest soils and, in certain situations, limestone **[45, 50]**. In addition to its potential use as a seed 42 protector, this organic tonic is advised for use as a foliar spray on farms, especially for fruit and vegetable crops **[10]**. **According to Nileema and Sreenivasa [37],** Jivamrut is recently adopted liquid manure that improves soil fertility, productivity, and microbial population. It is made from cow dung, cow urine, pulse flour, jaggary, and soil that is collected from virgin 19 land or beneath the canopy of banyan trees. By encouraging the activity of microorganisms in the three types of soil and the activity of phyllospheric microorganisms when they are sprayed on leaves, Jivamrit functions as a biostimulant. It boosts the number of native earthworms and serves as a primer for microbial activity.

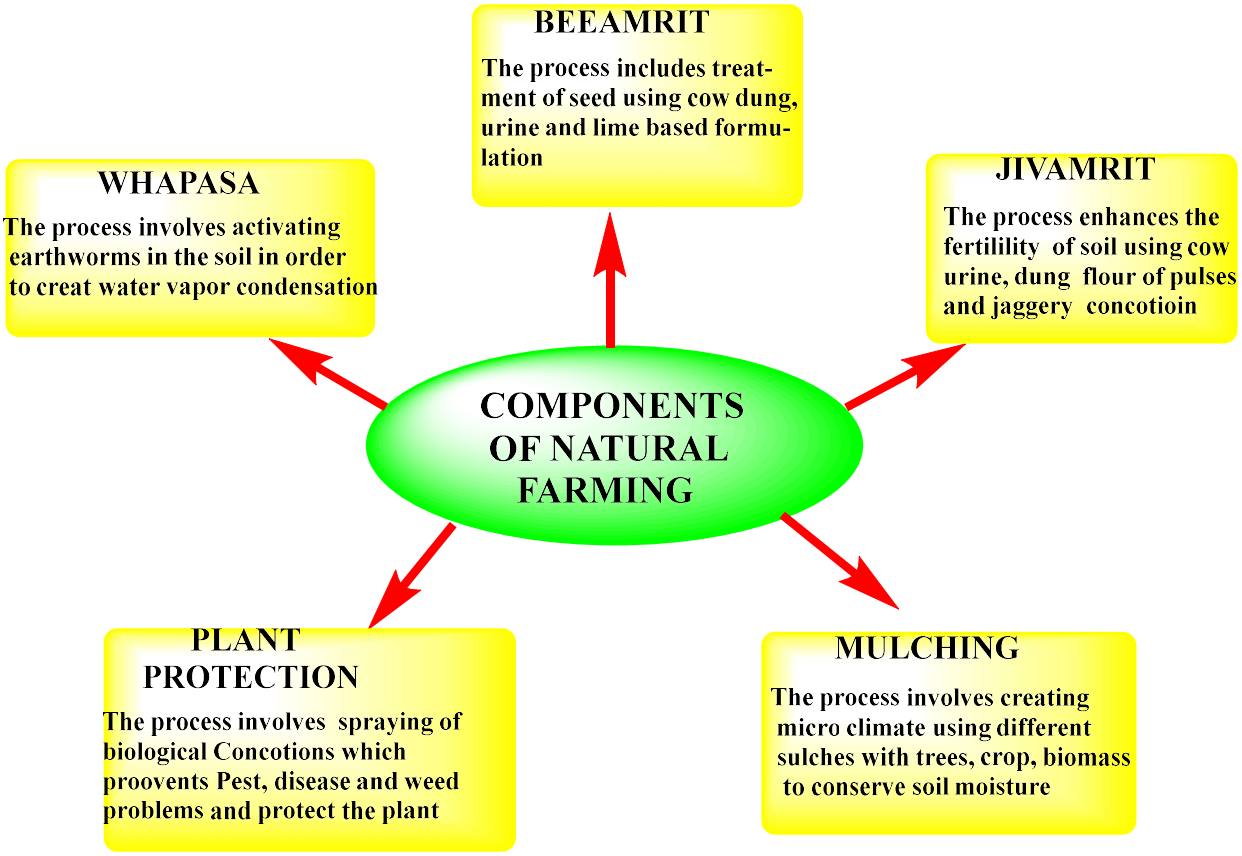

Figure 2: Component of Natural Farming

Jivamrit is marketed as a magic bullet for natural farming, which satisfies crops nutritional needs while also managing pests **[23]**. For reducing the indiscriminate use of chemicals in field crop production, there is a need of adopting jivamrit based natural farming. Jivamrut is a well-thought-out source of natural carbon, nitrogen, phosphorus, potassium, and many other micronutrients needed for crops. It is also widely utilized in organic farming, according to **[49]**. The term "whapasa" refers to the mixing of 50% water vapor and 50% air in the space between two soil particles. The majority of the moisture and some of the nutrients that soil organisms and roots need are found in the microclimate of the soil. Whapasa is a technique used to reduce the overall water requirements as mentioned in conventional farming, and improving the soil's water withholding capacity. The practice of Whapasa varies greatly depending on soil condition. Mulching in ZBNF method is covering the topsoil with cover crop and crop residues or applying a layer of organic material to the soil surface in order to prevent water evaporation, and to contribute to soil humus formation. Mulching is a common practice that involves applying materials to the field before, during, or soon after sowing in order to support and spread

over the soil surface, such as plastic material, crop residues, livestock manure, sands, rocks, and cement **[16]**. Mulching is the process of covering the topsoil with plant debris, such as leaves, grass, twigs, crop residues, straw, etc., according to International Federation of Organic Agriculture Movements **[52]**. The earthworms' and other soil creatures' activity is increased by a mulch layer. They contribute to the formation of a soil structure that has an abundance of both bigger and smaller pores that allow rainwater to readily permeate the soil and lower surface runoff. The amount of organic matter in the soil rises as the mulch material breaks down. Mulches can lessen the amount of irrigation that agricultural plants require, and occasionally they can eliminate the need for irrigation entirely **[1, 22, 18, 56]**. ZBNF mulching can have many different shapes. Cover crops consisting of a combination of monocotyledons (such as millets) and leguminous dichotyledons (like beans) are recommended for "live mulching." While the dicots aid in nitrogen fixation, the monocots supply nutrients like phosphate and potash. Additionally encouraged is straw mulching with dry crop leftovers **[25, 17]**.

Sustainable Practices of Natural Farming

In order to protect the environment and future generations, sustainable agriculture demands a limited use of non-renewable resources. The strategy promotes converting to renewable energy sources, minimizing land use, and getting rid of pollution in the environment. Farmers need for effective management solutions, and data for the most precise and trustworthy analytics is provided by remote sensing technologies in sustainable agriculture. Through the use of flood and heat resistant cultivars, crop diversity, and land management strategies, farmers are modifying agricultural methods and adjusting to climate unpredictability **[28, 29, 21]**. Various beneficial practices in natural Farming show in **Figure 3**.

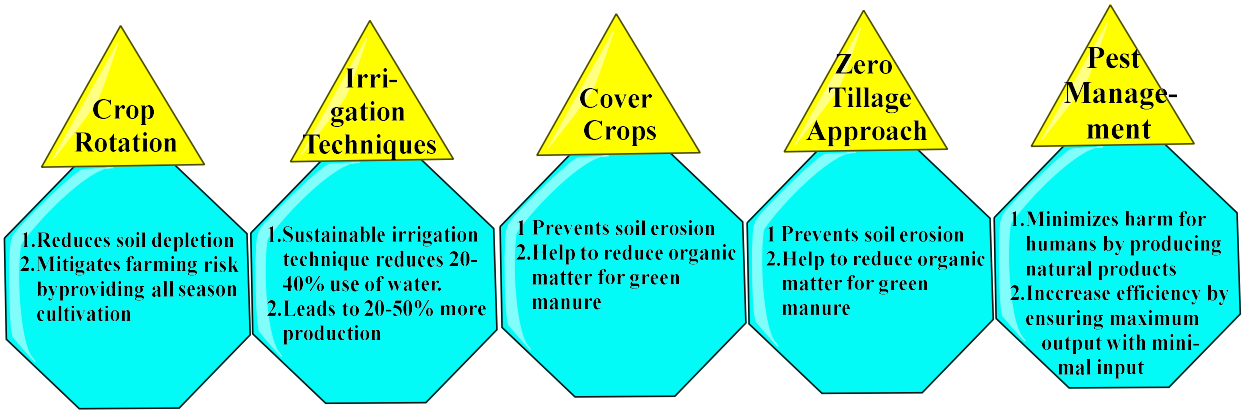

Figure 3: Various Practices of Natural Farming

Crop Rotation

Crop rotation helps prevent soil erosion and lowers farming hazards by allowing for year-round production. Crop rotation was essential to farming until chemically intensive methods became widely used, according to **[15, 58]**. Growers employed it to stop soil erosion, control weeds, and sometimes even fight against pests and illnesses. The crop rotation system is agronomic and ecological, even if it is not widely used today.

Irrigation Techniques in Sustainable Agriculture

Irrigation, which uses a lot of water and energy resources, is crucial to crop production. The practice of sustainable water usage in agriculture involves the use of intelligent irrigation techniques and the cultivation of crop species that require less water. Specifically, drip irrigation uses 20–40% less water than furrow (flood) irrigation while yielding 20–50% more crops.

According to **Rastogi *et al*. [35],** contemporary techniques for conserving water include technological developments in irrigation, such as mulching, crop rotation, and soil moisture management, as well as agronomic practices like drip irrigation, sprinkler systems, and subsurface irrigation. Together, these approaches improve water efficiency. The study delves into the significant impact of technology and innovation on Indian agriculture, with a focus on precision agriculture. Specifically, sensors and the Internet of Things (IoT) are highlighted for water management, remote sensing, satellite imagery, and data-driven approaches that integrate artificial intelligence, machine learning, and decision support systems. It also looks into innovative solutions including solar-powered irrigation systems and hydrogel technology for retaining soil water.

Sustainable Agriculture and Cover Crops

Farmers can prevent soil erosion on their farms by planting cover crops during the off-season. When cover crops are utilized for green manure, the method also aids in increasing the organic matter, lowering fertilizer costs. In addition, cover crops control weeds and hold onto soil moisture. Bee and other pollinator populations are naturally supported by flowering cover crops. **[5]** reported that by improving soil health, mitigating the effects of climate change, improving nutrient cycling, fertility, and crop output, cover crops are seen to be an alternative and economical way to promote sustainability. They are not, however, grown everywhere and are not regarded as a sustainability indicator.

Sustainable Agriculture Activities with minimum or zero tillage

Sairam *et al.* [44] reported that In contemporary agriculture, the effects of conservation tillage (CT) on soil health and the consequences for attaining agricultural sustainability are critical. The promise of conservation tillage techniques, like mulch tillage, ridge tillage, contour tillage, zero and reduced tillage, and others, to improve soil health while reducing negative environmental effects has drawn a lot of attention. There are various ways that CT technologies are known to enhance soil health. On the other hand, minimum tillage (MT) entails a minimal degree of soil disturbance and frequently requires plowing using primary tillage tools. **Angon [3]** stated that by minimizing soil disturbance, these techniques protect soil structure and stop erosion. Reduced or no-till farming methods, in contrast to routine plowing in conventional farming, stop soil erosion from wind and water. With the least amount of disturbance to the soil and biota, the no-tilling method recommends seeding directly into the crop residue. No-till agriculture reduces soil compaction, operating time, and fossil fuel emissions by having planters or drillers insert seeds right away after digging, which promotes ecological and economic stability.

Pest Management

Shivanand *et al.* [46] reported that A farming approach known as "natural farming" (NF) employs ecologically friendly methods to control pests and diseases. It offers an alternative to chemical farming in terms of environmentally friendly pest management for sustainable crop production because it does not utilize synthetic fertilizers, pesticides, or fungicides. Integrated pest management (IPM) uses a variety of additional approaches in addition to chemical pest control, which is even more effective when applied in a complicated way. IPM's function in sustainable agriculture is to reduce harm to non-target animals, humans, and the environment as a whole. Therefore, biological and cultural control are the mainstays of integrated pest management in sustainable agriculture. Specifically, biological methods involve (but are not restricted to) employing predators such as ladybugs to eliminate aphids or chickens to consume.

Natural Farming Inputs

According to Kumar *et al* [27] In natural farming, a few key inputs are readily available locally: cow dung, cow urine, handfuls of soil, jaggery, pulse flour, and botanicals for biopesticides. These inputs are utilized for seed treatments and soil inoculations. Another naturally occurring input that makes a big

difference in increasing crop yield and enhancing soil fertility is earthworms. Due to their involvement in the development of soil structure, plant disease suppression, nutrient cycling, and drainage and aeration, an increase in earthworm abundance can have a variety of indirect advantages on yield **[6, 40]**. Furthermore, research has demonstrated that earthworms are more advantageous in systems where crop residues are returned to the soil or applied which implies that earthworms may play a more significant role in ZBNF systems when crop residues are treated as mulch. **Omar *et al*, [38]** also reported in natural farming, Fermented Fruit Juice (FFJ) plays a vital role in increasing crop yields as an organic fertilizer. Fruits and molasses are used as natural ingredients in its production. Fermented fruit juice can be made from bananas, papayas, mangoes, grapes, melon, apples, and other non-citrus fruits. On the other hand, bananas, watermelons, and papayas have qualities that can make plants stronger and healthier **[57]**. According to **Vani *et al*. [57]**, the Bananas are high in potassium, which promotes fruiting, whereas watermelon and papaya have high chlorophyll and chromoplast concentrations in their plants. Crucial bacteria found in FFJ may also solubilize P and K for crop usage **[51]**. Another well-liked natural agricultural element is fermented plant juice (FPJ). Fermented plant juice (FPJ) is another popular natural farming ingredient. It can be made in this way: Collect plants that thrive in the spring and are hardy enough to withstand the winter. Plants with vigorous growth rates are also great options because of their very active growth hormones. You can use bamboo shoots if you gather them when they are tiny and remove the dirt but leave the outer layer intact. Strawberries, kiwis, and cucumbers (use the lateral buds of the latter, as they grow swiftly despite being less resistant to cold and illness) are other excellent plants to utilize for FPJ. Fermented plant juice boosts photosynthetic efficiency and makes more nitrogen available to plants. It also gives additional phosphorus and makes it easier for plants to absorb phosphorus from the soil. **Fathima and Rahman [14]** reported that the Fermented Plant Juice (FPJ) is a readily accessible organic alternative that can be used to make hydroponic fertilizer solutions without the need for expensive commercial competitors. As part of Korean natural farming, FPJ optimizes the necessary plant nutrients in a natural way.

CONCLUSION

Taking everything into account, we discovered that natural farming greatly increases agricultural output and eliminates

the need for synthetic or chemical fertilizers, which are detrimental to the health of the crops. Fermented plant juice, earthworms, fermented fruit juice, some indigenous microorganisms (IMO), and farmyard manure are all necessary for improving crop production and soil fertility. The primary goals of natural farming include "better soil conditions through management of organic matter and soil biological activity; genetic resource diversification; enhanced biomass recycling; and enhanced biological interactions." Natural farming improves soil health and considerably lowers agricultural expenses by utilizing conventional field-based approaches.

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