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A Review on Natural Farming in Horticultural Crop Production

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This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Producing enough food to feed a growing population has been the world's top priority since independence. While the combination of high-yielding farming methods has contributed to the world's food abundance, it has also raised concerns about environmental contamination and soil health. Natural farming is a chemical-free farming method with Indian roots that has been enhanced by contemporary ecological knowledge, resource recycling, and on-farm resource optimization. It is regarded as a varied agricultural system based on agroecology that incorporates animals, trees, and crops with functional biodiversity. With a focus on biomass mulching, using on-farm cow dung-urine formulations, keeping soil aerated, and avoiding synthetic chemical inputs, it is primarily centered on on-farm biomass recycling. It's anticipated that natural farming would lessen reliance on commercial inputs. It is regarded as an economical agricultural method with potential to boost rural development and jobs. India's horticulture industry is dealing with a variety of issues. One solution to these issues is a mixed farming system, which increases production and offers farm owners larger revenue returns. The crop-livestock, crop-forestry, crop-horticulture, fish-pig, fish-duck, and paddy-fish are some examples of mixed farming. Increased revenue and productivity, lower production costs per unit area, and lower farmer risk are all benefits of mixed farming systems.

Keywords: Environmental contamination; farming systems; chemical-free farming; water scarcity.

1. INTRODUCTION

Increasing productivity has been the main emphasis of Indian horticulture for many years, and many fertilizers and pesticides have been utilized to achieve this. The 20th century saw technological advancements shape a number of industries, including horticulture. As time has gone on, it has become increasingly clear that these advancements have a detrimental effect on the nutritional and medicinal quality of plants as well as environmental changes like increased weather variability, soil degradation, water scarcity, and polluted water bodies. Amidst the deteriorating climate and diminishing resources, farmers are currently fighting to feed an increasing number of consumers with twentieth-century appetites. In the long term, climate warming in particular might lower farmer incomes in India by 20–25%. This problem would be made worse by the country's present water shortage and food spoiling issues. The depletion of natural energy supplies and the increasing global warming catastrophe are putting pressure on corporations to create goods that meet international standards (Ram & Pathak, 2016; Sathish et al., 2022; Ahmed & Babita, 2015; Beni et al., 2021). To put it simply, natural farming and natural farming solutions aim to optimize nature's capacity to provide ecosystem services that aid in resolving a human challenge, in this case, the production of food. Natural farming, sometimes referred to as traditional farming, is a method that does not use chemicals. It is an agroecologically based diversified agricultural system that combines animals, trees, and crops with functional biodiversity. The protagonist believes that one of the most promising crop-growing techniques for lowering production costs is natural farming, which lessens dependency on the market for essential input purchases (Reddy, 2012; Kayesh et al., 2023). As an agro-ecologically diverse farming method, it offers a range of ecological and socioeconomic advantages. Natural farming, also referred to as traditional farming, does not use chemicals. It is an agro-ecologically based diversified agricultural system that combines animals, trees, and crops with functional biodiversity. While biodynamic farming is different from natural farming, it is comparable to sustainable agriculture, agro-ecology, agro-forestry, permaculture, organic farming (though organic certification is not required), fertility farming, and eco-agricultural. Natural farming is a cutting-edge method of enhancing conventional and contemporary farming practices with the aim of safeguarding communities, the environment, and public health. Approaches to sustainable agriculture enable food production without endangering the needs of future generations. An effort has been made to gather knowledge on natural farming and its possible uses in the production of horticultural crops in this note (Dorais & Alsanius, 2015; Kumar et al., 2020; Kumar et al., 2020; Lastochkina et al., 2022; Ouma & Jeruto, 2010). The FAO estimates that in order to meet the demands of the world's burgeoning middle class and the world's expanding population, global

food production must rise by 70% by 2050. With 1.51 billion inhabitants, India is predicted to overtake all other nations as the world's most populated nation by 2030. Natural farming's main goals are to increase soil fertility, protect the environment, lower greenhouse gas emissions, and increase farmer income. Broadly speaking, natural farming is a well-known tactic to preserve the earth for coming generations. The majority of farmers in Andhra Pradesh (A.P.) who have embraced natural farming methods (NF) have done so within the last five years, whereas some farmers in Karnataka have been doing so for over 15 years. This could be as a result of the grassroots movement that occurred in Karnataka in 2002 as a result of the Karnataka Rajya Raitha Sangha's (KRRS) active participation (Khadse and Rosset, 2019).

2. SCOPE OF NATURAL FARMING IN INDIA

Now Modern cultures live on a farmed globe where 38 percent of the land is used for agriculture. In order to sustain agricultural and animal output—which makes up over 95% of global food production—humans mostly depend on soil capacity. A major source of large biogenic greenhouse gas emissions and a major contributor to soil and environmental degradation are agricultural systems. Contributing issues include deforestation, overgrazing, plowing, and poor farming practices. Fertilizer usage has surged in India, and the use of pesticides in agriculture is obvious to protect crops from weeds, fungus, and pests that harm them, among other things. Diseases, weeds, and pests contribute to the loss of 15–25% of potential agricultural output. The ecosystem and environment will eventually be weakened by excessive pesticide usage. On the other hand, natural farming may help the ecosystem and environment for present and future generations.

3. NATURAL FARMING FROM GLOBAL PERSPECTIVE

Globally, there is broad consensus that more sustainable agricultural methods must be progressively adopted in place of current ones. The adverse effects of careless pesticide usage are another reason why consumers are searching for "organic" labels on food. Therefore, it is essential to shift focus and employ a range of strategies to move toward sustainable agriculture, which is supported by natural farming, organic farming, and other approaches. India has traditionally been seen as a wealth of knowledge in the fields of biology, philosophy, and spirituality. To improve agricultural sustainability, the primary task at hand is how to repair damaged natural resources and lessen the impact of modern agricultural technology using an all-encompassing strategy that takes into account every component of the system.

4. WHAT IS NATURAL FARMING?

Natural farming is a climate-resilient, low-input, indigenous agricultural method that promotes the total abolition of synthetic chemical agro-inputs in India. In order to promote the microbiological activity of the soil, it instead urges farmers to employ inexpensive, locally obtained inputs including symbiotic intercropping, mulch, crop coverings, jaggery, pulse flour, cow dung, and urine, as well as natural mixes. It focuses on improving soil conditions by increasing organic matter and biological activity, diversifying crops, and recycling biomass more effectively while fostering richer biological interactions on the farm. Natural farming has a comprehensive approach to agricultural systems and permits a variety of agroecological techniques, such as crop rotation, mulching, composting, green manuring, intercropping, tree intercropping, and animal integration. Natural farming is guided by a set of principles, including: (i) polycropping, which involves integrating trees with a variety of arable and perennial crops; (ii) avoiding the use of synthetic agro-inputs such as fertilizers, pesticides, or herbicides; (iii) keeping the soil covered throughout the year with mulch or cover crops; (iv) using local seeds, which are more resilient and less expensive than hybrids; (v) using biostimulants as a catalyst to increase the soil's microbial activity; (vi) minimal tillage; and (vii) integrating livestock with crops for both biological and economic synergies. Gujarat, Andhra Pradesh, and Himachal Pradesh are the states that promote natural farming the most. Such farming is also practiced in other states, including Madhya Pradesh, Tamil Nadu, Himachal Pradesh, Chhattisgarh, Odisha, Uttar Pradesh, and Jharkhand. A natural agricultural promotion program called Bharatiya PrakritikKrishi Paddhati (BPKP), a sub-program of PKVY, was introduced by the central government in 2020–21. A total of 49.8 crore has been used to cover over 6.1 lakh hectares in the aforementioned states. Due to our country's many agroclimates and the abundance of traditional knowledge held by farmers, there are

several options to begin natural farming (Kumar et al., 2019).

5. PRINCIPLES OF NATURAL FARMING

Using trees, their parts, and their products is based on three principles in natural farming. Every growing technique is subject to a set of regulations. Certain tree species have been found, examined, and used. Over the last two years, the senior author has documented the use of plant extracts with secondary metabolites to promote growth, tree species with bio-pesticidal qualities to control pests and diseases, and leguminous trees to supply nutrients because of their high nutrient content and quick decomposition. It's past time to thoroughly examine the data found in ancient writings and look for a fresh route.

1. Biomass transfer technique (BMT):

In order to supply nutrients for crop growth, legumenous tree leaves are frequently used as manures and placed into soil before planting. The leaves of these plants are used for improved fallows, green manure, and even better animal manure output. In favorable circumstances, they can provide a workable method of guaranteeing a supply of nitrogen. BMT, which involves collecting tree leaf biomass from nearby locations or, if available, inside the farm itself, and applying it to the field, is how this is done. Leguminous tree species, preferably N-fixing trees with a high nitrogen content and a quick rate of decomposition, are used to make green leaf manure. The tree species listed below are utilized to make green leaf manure:

- *Acacia auriculoformis*
- *Acacia maggium*
- *Albizia lebbek (L.)* Benth.
- *Azadirachta indica*
- *Cassia siamea*
- *Delonix regia* Raf.
- *Erythirna indica*
- *Gliricidia sepium* (Jacq.)
- *Leucaena leucocephala*
- *Peltophorum ferrugineum* (DC.) Hayne.
- *Pongamia pinnata*
- *Sesbania grandiflora*

2. Tree leaf extracts:

Natural tree leaf extracts make attractive crop health tonics. These tonics can be used as seed treatments to promote early germination and development, as well as foliar nutrition during different stages of crop growth. Through physiological and biochemical alterations, secondary metabolites present in tree leaf extracts can promote plant development. Through physiological and biochemical alterations, secondary metabolites present in tree leaf extracts can promote plant development. Tree species suitable for horticulture that provide leaf extracts.

- *Mangifera indica*
- *Moringa oleifera*
- *Aegle marmellos*
- *Psidium gujava*
- *Phyllanthus emblica*
- *Phyllanthus acidus*
- *Erythrina indica.*
- *Morinda tinctoria*
- *Tabernaemontana coranaria*
- *Alstonia scholaris*
- *Dalbergia latifolia*
- *Dalbergia sissoo*
- *Sesbania grandiflora*

3. Tree leaf extracts for crop protection:

The increasing need for safe, selective, and environmentally friendly bio formulations for overall health care in crop production will lead to a widespread use of botanicals and other derivatives, such as oil, extracts, and powder made from tree leaves and other parts like seed, kernel, and bark, for weed and pest control. Leaf extracts of tree species with bio-pesticide capabilities will include secondary metabolites with antibacterial, fungicidal, and alkaloid qualities to help manage pests and diseases of the farmed crop. We'll choose tree species with a high secondary metabolite content. India has been aware of viral illnesses and their treatment options since ancient times. These tree species' leaf extracts, which have biopesticide properties, will be utilized to lessen the prevalence of pests and illnesses in the crop under cultivation. Most agricultural sectors use pesticides as their primary method of disease and insect management. Recently, bioactive compounds have become more selective and effective, which has led to a rise in the use of integrated management techniques. Many different types of plants that might be employed as botanical pesticides can be found in India. Secondary metabolites are used by botanical pesticides, which has grown in importance in contemporary

agriculture. Inhibiting the negative impacts of phytophagous insects on behavior, physiology, development, reproduction, and other activities has made them a useful weapon against agricultural pests. For more than a century, India has utilized plant products to lessen losses caused by pests. Crop protection in natural farming is more effective when using a variety of leaf extracts from tree species, including neem, Pongamia, Aegle marmelos, Vitex negundo, Albizia amara, Anthocephalus cadamba, *Adina cordifolia, Morinda tinctoria*, and dried fruits of "kadukkai." Leaf extracts that include secondary metabolites with antifungal, antibacterial, and biopesticidal properties may also help control pests and suppress spores. development and germination of fungi Leaf extracts with increased phenyl alanine, polyphenol oxidase, and peroxidase activities help lessen the threat of pests and diseases.

i. **Tree species with biopesticide properties:**

- *Adina cordifolia, Anthocephalus cadamba, Azadirachta indica, Eucalyptus camadulensis, Gliricidia sepium, Morinda tinctoria, Pongamia pinnata, Vitex negundo*

ii. **Plant species used for different biological activity in plant protection:**

- *Aconitum ferox, Acorus calamus, Adhatoda vasica, Aegle marmelos, Allium cepa, Allium sativum, Anethum sowa, Anacardium occidentale, Annona squamosa, Artemisia vulgaris, Artemisia capillaris, Azadirachta indica, Bambusa arundinacea, Brassica comprastis, Butea monosperma, Calotropis procera, Cannabis sativa, Cassia nigricans, Cassia occidentalis, Cassia tora, Catharanthus roseus, Chenopodiun anthelminticum, Chrysanthemum spp., Cinchona officinalis, Cinnamomum camphora, Citrus limon, Cymbopogan spp., Curcuma longa, Datura metel, Derris elliptica, Eucalyptus hybrid, Eucalyptus globulus, Eucalyptus rostrata, Euphorbia antiquorum, Foeniculam vulgare, Ginkgo biloba, Hydrocarpus spp., Ipomea carnea, Jatropha carcus, Lantana camera, Lawsonia inermis, Lycopersicon hirsutum, Melia azedarach, Mentha spicata, Moringa oleifera, Nerium oleander, Nicotiana tabacum, Ocimum basillicum, Ocimum sanctum, Parthenium hysterophorus, Piper nigrum, Plumbago zeylanica, Pongamia pinnata, Pidium guajava, Ricinus communis, Sapindus mukorossi, Sesamum indicum, Tagetes minuta, Tephrosia purpurea, Tephrosia vogelii, Vinca rosea, Vetiveria zizanioides, Vitex negundo, Zanthoxylum monophylum, Zanthoxylum monophylum, Zinziber officinal*.

4. Natural Farming Practices in Horticultural Crops:

a. Whapasa-moisture: Green revolution farmers claim that irrigation is overused in natural farming. When there is an accumulation of humus and air and water molecules in the soil, this is referred to as whapasa. The crops' moisture needs may thus be satisfied by irrigating just at midday in alternating furrows, which would significantly lower the amount of irrigation needed in natural farming. However, this method is rarely used by farmers. It enhances soil moisture profile and aeration while lowering an excessive dependency on irrigation.

b. Acchadana (Mulching): Three mulching techniques have been proposed under natural farming; they prevent tillage, enhance topsoil quality, and contribute nutrients and organic matter while boosting soil biota activity.

- **Soil Mulch:** This prevents tilling during farming from destroying topsoil. It enhances water retention and soil aeration. Therefore, deep plowing should be avoided.
- **Straw Mulch:** Dried biomass waste from previous crops is used to make straw mulch. Any kind of dry organic matter will break down and produce humus due to the activity of the soil biota, which is triggered by microbial cultures.
- **Live Mulch:** To provide all necessary components to the soil and crops, it is vital to design various cropping patterns of monocotyledons and dicotyledons cultivated in the same area. Nitrogen-fixing plants belong to the dicot group, which includes pulses. Other elements like potash, phosphate, and sulfur are supplied by monocots like wheat and rice.

c. Beejamritham (Seed treatment): Beejamritham is used to treat seeds, seedlings, and other planting materials. In addition to protecting new roots from fungus,

beejamritha also guards against soil-borne and seed-borne diseases that usually afflict plants after the rainy season. It boosts soil organic carbon, activates nutrients, and guards against illnesses spread by seeds and soil.

- **Beejamritha preparation:** Application of Beejamruth is followed in ZBNF. It is a seed treatment mixture prepared from cow dung, cow urine, lime and a handful of soil (Devarinti, S. R. (2016). To prepare beejamritha, combine local cow dung, which is said to be a natural fungicide, with lime, soil, and cow urine, an antibacterial liquid. For twelve hours, the feces is wrapped in a towel and immersed in urine. The dung is compressed, the urine is combined with 50g of lime, and the cow dung is removed from the urine.
- **Use as a seed treatment:** Apply beejamritha to the seeds of any crop, coat them by hand, let them dry completely, and then sow them. Leguminous seeds only need to be submerged in water and allowed to dry.

d. Jeevamritha/ Jeevamrutha (Liquid inoculant): A fermented microbial culture is called jeevamritha. In addition to providing nutrients, it also acts as a catalytic agent, boosting soil microbial activity and native earthworm populations.

- **Application of Jeevamritha:** Twice a month, Jeevamritha is applied on crops as a 10% foliar spray or in irrigation water. In the field, the preparation can be sprayed or combined with irrigation water after being kept for up to 15 days. The purpose of Jeevamritha is horticultural crops. Most farmers use Jeevamritha using the drip irrigation technique.

e. Ghanajeevamritha: Ghanajeevamritha, a solid variant of Jeevmaritha, is produced by farmers in areas with a restricted water supply. Ghanajeevamritha is produced by farmers during the off-season and stored for up to six months in preparation for the next crop season. Jaggery and pulse flour are mixed with cow dung and urine, then shaped into balls and let to dry in the shade. The dry substance is finely ground and kept in gunny bags prior to field application. Before planting the crop, farmers apply it using the Ghanajeevmritha broadcasting method.

Natural farming adoption in fruit crops:

Mango: Legumes are grown in young orchards for green manuring or as cover crops or intercroppings as needed. After fruit is harvested, organic manures (30–40 kg/tree) are applied using NADEP, vermi/biodynamic, in a trench 1.5 meters from the trunk of trees that are 10 years or older. After applying 100 g of Cow Pat Pit (CPP), mulch is applied by spraying cow horn dung (BD-500), 3% Panchagavya, and 20% Jeevamrita/Amritpani. For healthy growth and development, apply two foliar sprays of vermi-wash or biodynamic liquid manures at intervals of 15 days following fruit harvest.

Citrus: Since fertilization has a major impact on fruit quality, it is a cultural practice of enormous significance in citrus. the differences in internal and exterior citrus traits between conventional and organic agricultural methods, with a focus on vitamin C content. Physiologically mature fruits from various orchards demonstrated that mineral fertilization produced fruits with higher weight and diameter, thicker peels, and more vibrant colors. Comparing organic and conventionally produced fruits, the former exhibited a lower maturity index and higher soluble solids. The reaction varied by species and cultivar, but fruits from organic farming had the greatest vitamin C contents. In organic citrus cultivation, compost is the main source of fertilizer. Due to the slow mineralization of nitrogen from compost, the treatments must be made two to four weeks prior to the trees' anticipated nitrogen need (two to four weeks prior to flowering). Compost alone cannot be used as a nitrogen source if the nitrogen requirement is significant (> 50 kg/ha).

Guava: It is feasible to grow guavas organically because they are a horticulture crop whose fruits are often eaten fresh after harvest, together with their peel and pulp. Guava's vegetative growth characteristics, yield, and fruit quality were all enhanced by the combined application of various fertilizers, organic manures, and biofertilizer.

Beneficial effects of Panchagavya on fruit crops:

Mango:

- Increases the number of female flowers and induces dense blossoming.

- Improves quality retention for 12 days at room temperature

Acid lime:

- Continuous blooming is guaranteed all year round, and shelf life is increased by ten days.

Guava:

- Higher TSS
- Shelf life is extended by 5 days

Indigenous technical knowledge practices in fruit crops:

Mango:

- The hoppers are controlled by spraying neem oil.
- To encourage blossoming and ward off hoppers, dried leaves and twigs are burned and fumigated beneath the tree either in the early morning before dawn or in the late evening after sunset.
- In order to draw honeybees, which improve pollination and fruit production, sunflower is grown between mango trees.

Apple:

- The orchard grows intercrops like potatoes and peas, which provide the orchardist additional benefits;
- Sod culture is used to stop soil erosion.

Banana:

- To increase production, 500 g of groundnut cake is put to each banana crop sucker.
- Banana fruit bunches are dusted with lime solution to accelerate ripening.
- Neem leaves are placed between the bunches of bananas to facilitate their ripening.
- As a shelter crop to guard against wind damage, plant Sesbania spp. (trees) as a border crop around banana fields.
- Nematodes can be avoided by applying 150 g of neem cake powder per sucker in the third and fifth months.

Grapes:

- To prevent wind damage to the fruits, allow birds to freely enter the bower, and shield the grapes from burning during heat waves, cover the bower with coconut or palm fronds on the sides.

Guava:

- To suppress white flies, pound two kilograms of Calotropis spp. leaves with three kilograms of neem cake, soak them in twenty liters of water for four days, dissolve the extract in two hundred liters of water, combine it with fifty grams of detergent soap, and spray it over an acre.

Mandarin Orange (*Citrus reticulata*):

- Citrus trees that have been attacked by stem borer are treated with lime wash, and any holes are cleansed and sealed with cotton soaked in lime or wrapped in lemon grass.
- To prevent ant attacks, ash is combined with collected orange seeds.

Natural farming in vegetable production:

Mixed Farming: Growing two or more species or cultivars of the same species together in the same area is known as mixed cropping, which includes intercropping. This is the first type of systemized agricultural production Lizarazo et al. 2020). Combining the cultivation of crops with the rearing of animals is known as mixed farming. India, Malaysia, Indonesia, Afghanistan, South Africa, China, Central Europe, Canada, and Russia are just a few of the Asian nations that use this type of agriculture. Although it was first mostly used for personal use, nations like the US and Japan are increasingly using it for business. Mixed farming is the practice of growing crops and raising animals for meat, eggs, or milk. For instance, a mixed farm could raise cattle, sheep, pigs, or poultry in addition to grain crops like wheat or rye. Cattle manure is frequently used to fertilize cereal crops. There are several methods to categorize mixed agricultural systems, including by market orientation, geographic distribution, crop and animal types, and land size. Here, three main groups are defined in three distinct agricultural methods. These are the categories:

- On-farm versus between-farm mixing
- Mixing within crops or animal systems
- Diversified versus integrated systems

Need for mixed farming in vegetable crops: Most of the farmers are executing only one job (crop farming) hence their earning becomes fully dependent on value of produce. In addition, inefficient market scenario, mismanagement of demand and supply of crop also effect adversely

the revenue from crops. In order to ensure food security in developing countries, it is essential to increase farmers' capacity for sustainable agriculture with greater returns. One solution to these issues is the mixed farming system, which increases production and gives farm owners better financial returns. Under certain market and environmental conditions, farmers engaged in monoculture face more risks than those engaged in a variety of farming operations. Crop farming with cattle may be limited to monoculture. Agriculture income has reached unprecedented levels as a result of farm integration. Combining two or more separate agricultural pursuits on a same farm is known as mixed farming. In order to supplement land and labor demands throughout the year and increase revenue from various sources, farmers will engage in a variety of agricultural activities, such as raising livestock and cash crops. Crop-livestock, crop-forestry, crop-horticulture, fish-pig, fish-duck, and paddy-fish are some examples of mixed farming.

Advantages of mixed cropping under natural farming:

- **Boosts Soil Fertility:** Repetitive planting of the same crop type depletes certain minerals in the soil. Every crop variety releases and absorbs different sorts of nutrients and interacts with the soil's nutrients in a unique way. Crop rotation increases soil fertility by controlling surplus or deficient nutrients by either absorbing plentiful nutrients or replacing unavailable nutrients.
- **Boosts Crop Yield:** The cropping schedule raises the yield from a single seasonal harvest. In addition to a range of crops, one enjoys a general bountiful harvest every season due to the employment of many crop kinds. Crop rotation boosts crop yield by 10% to 25% compared to monoculture, according to scientific studies.
- **Boosts Soil Nutrients:** By using cropping patterns, the soil may regenerate and replenish its own nutrients without the need for fertilizers. The soil may restore the nutrients it lost from plant absorption during the previous season's harvest by having a season of bare ground.
- **Decreases Soil Erosion:** By keeping the top layer of soil intact, plants assist to lessen the impact of water droplets on the soil and soil erosion. In farmlands, planting crops and trees together reduces soil erosion.
- **Enhances Soil Structure:** By preventing soil compaction, cropping patterns can enhance the physical state of the soil. Crop rotation enhances the texture and structure of the soil. This makes it possible for roots to develop and seeds to germinate.
- **Diversification and Lower Production Costs:** Some crops may be grown with less equipment and manpower than others. It lowers the cost of crop production by distributing the workload and resources utilized throughout the year.

Other technological benefits of natural farming techniques:

- Mixed cropping enhances plant cover during the off-season and may decrease nitrate leaching by boosting mineral nitrogen absorption.
- Furthermore, because subsequent crops may reuse nitrogen (N) and other nutrients (including potassium, phosphorus, sulfur, etc.) that are left in the topsoil layer and crop waste, mixed cropping enhances nutrient cycling as the life cycle comes to a conclusion. When choosing harvested crops, the main goal is to enhance nitrogen efficiency in the cropping system and evaluate the efficiency of other nutrients from this standpoint, even if harvested crops may have an impact on the cycling of numerous nutrients.
- The best way to lessen nitrogen leaching is to use non-legume crops. They work well in a range of soil and weather situations and can reduce N leaching by as much as 50–81%. Rainfall and soil type affect nitrogen leaching. For example, a coarse sandy soil with significant rainfall has higher amounts of nitrogen leaching than a sandy loam with moderate rainfall.
- Legumes fix and retain atmospheric nitrogen (N), which increases N availability for the subsequent crop and reduces the need for external N fertilizer inputs, even if they are less successful at stopping N leaching. Legumes and non-legumes have been tested as catch crops in an effort to minimize the danger of N leaching and increase the amount of nitrogen available for the next crop.
- Leaching can be reduced by 27–56% with a legume catch crop and 48–82% with a combination of a non-legume and legume catch crop, according to estimations. In addition to reducing N leaching, legumes and mixed catch crops can increase grain output and grain N content by as much as 6%.

- The application of cover crops is stated to have enhanced the bulk density, aggregate size distribution, aggregate water stability, and soil organic matter, among other soil properties. Deeper-rooted crops, such fodder radish, have been demonstrated to improve gas diffusivity, reduce pore tortuosity, and enhance soil macro porosity—all of which may contribute to a reduction in soil compaction.
- Additional benefits of natural farming include a reduction in soil erosion, a reduction in phosphorus losses, an increase in the soil's overall N and C contents, and the avoidance of acidification of drain water. Because of the combined effect of these advantages, catch crops are often well recognized and a proven important management approach for agricultural policy schemes that are ecologically and climatic friendly. Catch crop contracts are the most advised way to lower greenhouse gas emissions and nutrient leaching when compared to other tactics like set-aside and fertilizer technology contracts.

6. CONCLUSION

Natural farming in the modern sense is a novel idea. But it is quickly gaining popularity across the world, particularly in industrialized nations. A natural farming system is an alternate and suitable management approach that will enhance the soil health environment, hence raising fruit crop quality and productivity. India has enormous potential for producing fruit and crops organically and becoming a significant global supplier of organic goods. Compared to traditional organic farming, natural farming offers a number of benefits, such as minimal capital costs and production per unit area of land that is almost identical. Moreover, working with soil has psychological advantages for natural farmers. Thanks to continuous study into the workings of nature, natural farming consistently delivers the finest quality food in terms of both human health and environmental integrity. For the benefit of society, horticulturists can experiment with various natural farming practices and carefully integrate them with contemporary technology. However, they must develop the necessary skills and processes to generate them by treating the subject as a serious research endeavor.

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Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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