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The ABCs of natural farming: Principles, components and features: A review

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Abstract
Natural farming is a traditional farming strategy that minimises artificial methods and external inputs in an effort to work with nature. It is considered as agroecology based diversified farming system which integrates crops, trees and livestock with functional biodiversity. The use of natural resources, processes and capabilities are prioritized in this farming practice in a way to sustain biodiversity, resource recycling and on-farm resource optimization, improving soil fertility, health and microbial diversity, supplementing carbon sequestration, increased resilience to climate change and bringing nutrient-rich vegetation. By creating nutrient-rich, chemical-free food and lowering exposure to dangerous pesticides, it enhances food security and human health thus promoting a sustainable and holistic approach to agriculture. Future perspectives of natural farming feature its potential to address global food security challenges and minimize the adverse effects of conventional agriculture in long run.

Keywords: Agroecology, human health, natural resources, resilience, soil fertility

Introduction
The legacy of conventional agriculture is a double-edged sword. While it has brought about surplus of food for everyone on the planet meanwhile exacted a heavy toll on our ecology, climate, health and environment. The unrestrained use of chemicals and pesticides has left our soil polluted, waterways contaminated, and ecosystems in chaos. Upon excessive use of pesticides, some heavy metals like Cd, Cu, Mn, and Zn can contaminate soil profiles and upon seepage, reach groundwater. These elements are then absorbed by the plant in sink parts for a longer time which causes major health issues when consumed (Byrnes, 1990; Barabasz *et al*. 2002) [4, 2]. Cadmium and lead (among the heavy metals) have high accumulation potential and toxic (Wolnik *et al*., 1983) [19]. The Green Revolution has been the main agricultural strategy in India for more than 40 years, and by raising agricultural productivity and output, it has had a big economic impact. However, these intensive agricultural approaches have serious negative impact on our ecosystem. There are doubts about the Green Revolution's capacity to solve ecological, social, and health aspects because these issues are not fully addressed by it. In addition to lowering the nutritional value of our produce, over-reliance on synthetic fertilizers has caused nutrient imbalances in our diet. Excessive tillage, a fundamental component of conventional farming, has exacerbated soil erosion and depleted the planet's natural resilience. As a result of these practices, soil health is deteriorating at an alarming rate, posing a grave threat to the future of agriculture and, consequently, to human well-being. In response to these challenges, natural farming emerges as a ray of hope. It represents a holistic strategy that encourages sustainable agriculture. It follows the key principles that priorities soil and human health, encourage biodiversity, and reduce external inputs. It is a chemical-free farming strategy backed by our Indian tradition supplemented with modern concepts of ecology, farm resource optimization with the approaches of reduce-reuse and recycle. It is characterized as an agroecology-based, multimodal farming system that makes the best possible way to integrate crops, animals, trees along with their biproduct. It is primarily focused on on-farm biomass recycling, mulching, using on-farm cow dung-urine formulations, regulating soil aeration, and excluding any synthetic chemical inputs. It is expected to reduce dependency on purchased inputs. It is regarded as a cost- effective economic practice with a potential to boost employment and promote rural development. As we address this crucial issue, embracing natural farming principles is a crucial step toward a more sustainable and harmonious coexistence with our planet.

Scenario of natural farming in India

Numerous states have recently adopted natural farming and created effective models. Andhra Pradesh, Himachal Pradesh, Gujarat, Haryana, Maharashtra, Karnataka, and Kerala are some of the prime states promoting it. When it comes to mass-implementation, Andhra Pradesh leads all other states. According to the government of Andhra Pradesh, for March 2020, 0.62 million farmers (10.5 percent of all farmers) were registered in the programme out of which 0.44 million farmers (7.5 percent), were actually practising it on an area of 0.45 million acres, which works out to 2.9 percent of the net sown area spread across 3,011-gram panchayats. Karnataka state recently initiated execution of zero budget natural farming (ZBNF) on a pilot basis in 2,000 hectares in each of the 10 agro-climatic zones. In other states, very few farmers have been engaging in this on an individual basis. Himachal Pradesh has also set an ambitious target of transforming entire state to natural farming by 2022. Since May 2018, it has already executed the state-funded scheme Prakritik Kheti Khushal Kisan. States like Kerala, Haryana and Gujarat have already conducted mass level multiple awareness programmes, trainings and workshops for more than thousands of farmers to promote natural farming.

Principles of Natural farming

According to National Mission on Natural Farming Management and Knowledge Portal, Government of India, Natural farming encompasses following principles**:**

1. Implementation of diversified cropping system-based agriculture
2. Recycling of naturally available nutrients in fields
3. Reuse and recycle of on-farm generated biomass
4. Use of locally developed and refined practices based on plant, animal and microbial source as raw materials
5. Farmers employ innovative techniques that are always evolving in response to cropping patterns, regional climates, altitude, soil quality, insect and pest intensity and variability, etc.

A healthy soil microbiome is crucial for soil, plant, animal, and human health. To achieve this, farmers should maintain diverse crops, practice minimal soil disturbance like no-till or shallow tillage, and integrate animals into farming. Integrated farming systems and the use of bio-stimulants, often produced through the fermentation of animal dung and uncontaminated soil, are vital. Returning organic residues like crop leftovers and compost to the soil is essential. Pest management should prioritize agronomic practices and botanical pesticides over synthetic chemicals, as these harm the regenerative process. Synthetic fertilizers and biocides should be avoided.

Zero Budget Natural farming (ZBNF)

Zero Budget Natural Farming (ZBNF) is an innovative agricultural approach that was popularized by Subhash Palekar, an Indian agriculturist and advocate for sustainable farming practices. This method is gaining recognition for its potential to transform traditional agriculture into a more environmentally friendly and economically sustainable system. ZBNF is self-nourishing and symbiotic in nature (Palekar, 2014) [16].

Results of over six years of dedicated research by Palekar revealed that:

1. The only thing that may effectively replenish the depleted soil is the manure from Indian cows. Dung from Holstein and Jersey cows is less efficient. Bullock or buffalo dung can also be used if there isn't enough dung from local cows.
2. Urine and dung of the black colored Kapila cow is believed to be remarkable.
3. Make sure the urine is as stale as possible and the dung is as fresh as possible to receive the most benefit from the cow dung and urine.
4. 10 kg of local cow dung must be applied to 1 acre of land each month. One cow's dung can help fertilize 30 acres of land each month, as the average cow produces 11 kg of dung every day.
5. As additions, urine, jaggery, and dicot flour can be utilized.
6. The lesser milk the cow gives, its dung is more beneficial towards reviving the soil (Babu, 2008) [1].

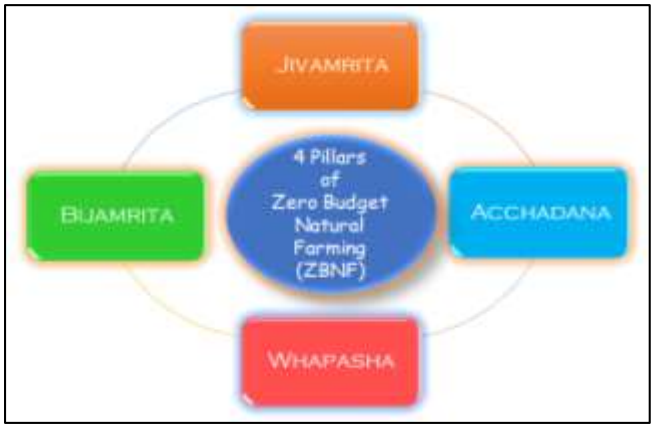

Fig 1: Four pillars of natural farming

Components of natural farming

1. **Jivamrita/jeevamrutha:** It is a beneficial organic bio-stimulant made by fermenting well-rotted cow dung, cow urine, jaggery, and water for around 48 hours. This nutrient-rich liquid fertilizer enhances soil fertility, stimulates microbial activity, and aids plant nutrient absorption, contributing to sustainable agriculture by reducing the need for synthetic inputs
2. **Bijamrita/Beejamrutha:** Bijamrita is a natural seed treatment solution for crops, prepared by soaking seeds in a mixture of cow dung, water, lime and cow urine. After soaking, the seeds are dried and then sown. This traditional practice is believed to enhance seed germination, protect against diseases, and promote healthy plant growth in an organic and sustainable manner.
3. **Acchadana – Mulching:** Subhash Palekar suggests the following types of mulching:

a) **Soil Mulch:** Preserves topsoil during farming and refrains from tilling it. Furthermore, it helps the soil retain water and aerate. Palekar has recommended against deep ploughing.

b) **Straw Mulch:** The dried biomass waste from earlier crops is hinted to by the straw particles. As Palekar indicates, this could consist of the decomposing remains of any living thing, including plants, animals, etc.

4. **Live Mulch (symbiotic intercrops and mixed crops):** To provide the necessary elements to the soil and crops, Palekar suggests that it is crucial to construct various cropping patterns of monocotyledons and dicotyledons cultivated in the same area.

5. **Whapasa – Moisture:** Palekar disputes the widespread notion that plant roots require a lot of water. He challenges the over-reliance on irrigation in green revolution farming in this way. He firmly believes that water vapour is necessary for the roots. He refers to this as Whapasa, the state in which air and water molecules are present in the soil. He stresses using irrigation just at midday and promotes cutting back on its use.

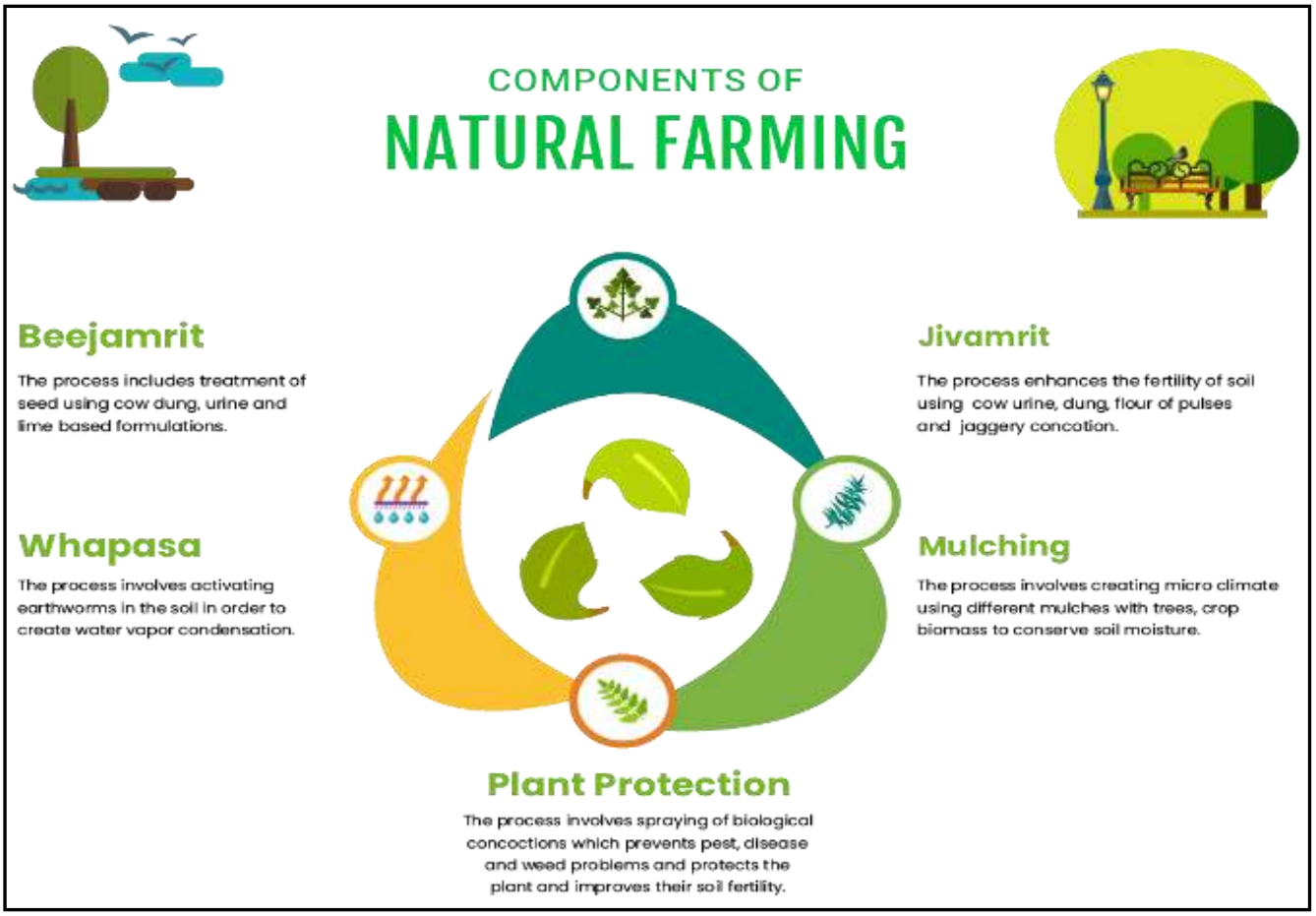

Fig 2: Components of natural farming

6. **Plant protection measures:** Natural farming emphasizes the use of traditional, organic, and plant-based solutions for pest and disease management. Different "astras" or botanical preparations are utilized for plant protection**:**

a) **Neemastra:** It is used to eradicate insects or larvae that consume plant foliage and drink plant sap, as well as to prevent or treat diseases. Additionally, this aids in preventing the spread of dangerous insects. Neemastra is a bioinsecticide and pest deterrent for natural farming that is incredibly simple to manufacture.

b) **Agniastra:** Neem leaf pulp, tobacco powder, green chilli powder, garlic paste, and turmeric powder are combined to create a natural insecticide. All sucking pests and caterpillars, such as Leaf Roller, Stem Borer, Fruit Borer, and Pod Borer, are controlled with it.

c) **Brahmastra:** This all-natural insecticide is made from neem, karanj, custard apple, and daphnia leaves, which contain certain alkaloids that deter pests. All sucking pests and concealed caterpillars found in fruit pods are managed by it.

d) **Dashaparni ark:** It serves as an alternative to Agniastra, Bramhastra, and Neemastra. Depending on what's available, it's made with tobacco powder, ginger paste, turmeric powder, Asafoetida, chilli pulp, garlic paste, and any ten leaves. We can utilise the leaves of several plants, such as neem, pogoamia pinnata, *Annona sqamosa*, Castor, Datura, Rui, Hibiscus, mango, *lantana camara*, and guava. Depending on the extent of the infestation, it is used to control various kinds of pests.

e) **Fungicide:** It is made with cow milk and curd which is found to be very successful in controlling and managing fungal infection.

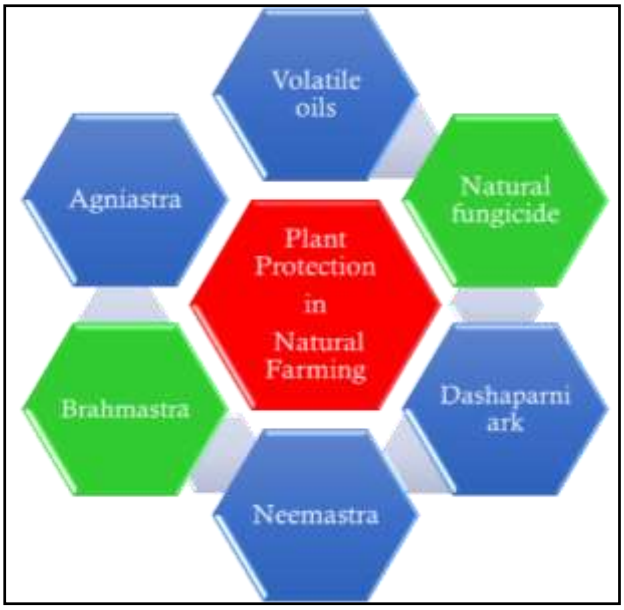

Fig 3: Plant protection components in natural farming

Features of natural farming

1. **Nutrient uptake from air and sunlight:** Natural farming practices hold that plants obtain 98% of their nutrients from the air, water, and sunlight, with only 2% coming from the soil, emphasizing the importance of healthy soil with beneficial microbes.
2. **Organic mulch for soil health:** Continuous soil coverage with organic mulch is essential in natural farming. This practice generates humus and fosters the development of beneficial microbes.
3. **Bio-cultures instead of fertilizers:** Instead of conventional fertilizers, natural farming employs farm-made bio-cultures like Jeevamrit and Beejamrit, crafted from indigenous cow breed cow manure and urine, to enhance the microflora in the soil.
4. **Environmental and economic benefits:** Natural farming has the potential to increase farmers' income while offering numerous advantages, including mitigating greenhouse gas emissions, restoring soil fertility, and promoting environmental health.
5. **Dependence on Indian breed Cows:** The process relies on cow dung and cow urine (Gomutra) obtained from cows of Indian breeds, particularly the Desi cow, which possesses a microbiologically favourable composition**.**
6. **Exclusion of exogenous fertilizers:** Natural farming refrains from using any chemical or organic exogenous fertilizers in both the soil and on the crops.
7. **Encouragement of soil Microbes and earthworms:** Natural farming encourages the activity of earthworms and bacteria to decompose organic materials on the soil surface, gradually enriching the soil with nutrients.
8. **Natural weeding Practices:** Weeding in natural farming mimics the processes found in natural ecosystems and avoids the use of fertilizers, ploughing, or soil disruption.
9. **Natural pest control:** To combat pests and diseases, natural farming utilizes natural insecticides like Dashparni Ark and Neem astra.
10. **Role of weeds as mulch:** Weeds are intentionally employed as live or dead mulch layers and are considered essential for maintaining the ecological balance.
11. **Emphasis on multiple cropping:** Natural farming advocates for multiple cropping over monoculture, which enhances biodiversity and contributes to soil health.

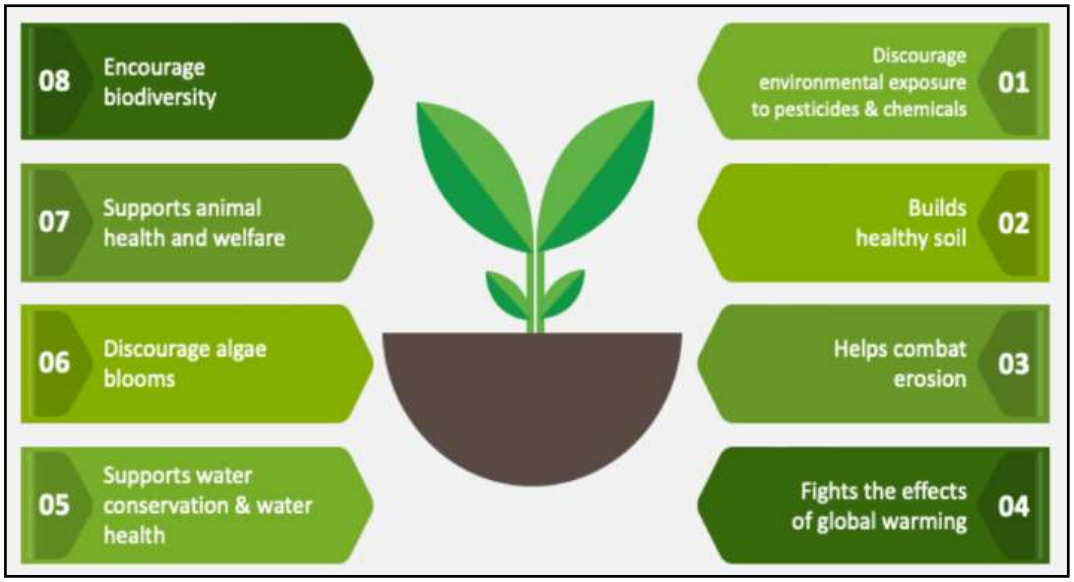

Fig 4: Benefits of natural farming

Constrains

Some major constrains of natural farming are as follows:

1. Pest and disease management limitations.
2. Lower crop yields compared to conventional methods.
3. Labor-intensive weed control.
4. Transition period with lower yields and added costs.
5. Certification requirements and costs.
6. Need for knowledge and training.
7. Vulnerability to weather fluctuations.
8. Competition with conventional agriculture.

Government initiatives

By expanding the Bhartiya Prakritik Krishi Paddati, the government has created the National Mission on Natural Farming (NMNF), a distinct and autonomous programme that will run from 2023 to 2024, with the goal of encouraging farmers to switch to chemical-free farming and expanding the reach of natural farming (BPKP). Under the 1 lakh crore Agriculture Infrastructure Fund (AIF) of Aatmanirbhar Bharat, state agencies, Primary Agricultural Credit Societies (PACS), Farmer Producer Organizations (FPOs), and entrepreneurs, among others, can apply for loans for the establishment of post-harvest infrastructure for value addition to organic produce.

Success stories

A. Adaribariki Seethamma, a leading natural farmer in Pedalabudu village, Andhra Pradesh, achieved remarkable results through sustainable practices. In 2019, she utilized pre-monsoon dry sowing, minimal ploughing, and 200 kg of Ghanajivamrit for soil enrichment. Seethamma sowed a diverse range of crops, including rajma, maize, tomato, red gram, and more, treating the seeds with Beejamrit. She used dry grass as mulch and implemented thorn-fencing for protection. Regular application of Dravajivamrit and Neemastra controlled pests. Her meticulous crop monitoring and the use of PMDS led to impressive results, yielding an income of Rs 28,000 from 0.30 acres with minimal costs, mainly from daily harvests of leafy vegetables and

increasing rajma yields.

B. Babasaheb Shankar Koot, a farmer from Pimpalgaon Khurd, Maharashtra, adopted natural farming and multi-cropping techniques on his 6-acre land. He produced vermicompost and employed various organic inputs like Jivamrit, Dashparni Ark, and Pheromone traps. Rearing desi cows for agri-inputs, he cultivated multiple crops, including sugarcane, soybean, and intercrops like lady's finger and chili. Additionally, he planted various fruit trees and vegetables. The impact was impressive, with a net income of Rs 2,28,000 from field crops, Rs 16,67,000 from fruit crops and high-value wood trees, and Rs 41,000 from cow-rearing and poultry services. Koot's diverse and sustainable approach yielded substantial returns.

C. Smt. Rani, a dedicated natural farming practitioner in Sambepalli Mandal, Andhra Pradesh, has achieved remarkable success since 2019. Utilizing pre-monsoon dry sowing on her one-acre field, she applied Ghanajivamrit, protected her crops with mulching and fencing, and used organic treatments like Beejamrit, Dravajivamrit, and Neemastra. Rani cultivated a diverse array of crops, including millets, pulses, vegetables, and tubers. Her efforts resulted in healthy crops and a total income of Rs 33,710, with cultivation costs at Rs 4,800. Her net income was Rs 28,910, and she expected an additional Rs 5,000 from standing crops. Furthermore, Rani's practices improved soil quality, enhancing water-holding capacity and porosity through year-long green cover maintenance.

D. Gagan Pal, residing in Sayar Doba village, Bilaspur, Himachal Pradesh, has transformed his 8 Bigha farmland into a thriving natural farming haven. Cultivating a diverse range of crops, including maize, soybean, moong, and more, he has entirely transitioned to natural farming. Gagan incurred Rs 64,000 in expenses but reaped a substantial income of Rs 1,44,000 from his natural farming efforts, demonstrating its economic viability. This transition marked a significant change from his previous chemical farming, which incurred higher costs at Rs 72,000 and yielded Rs 1,12,000, underlining the advantages and profitability of adopting natural farming methods in the region.

Future thrust

The future of natural farming holds promising prospects as global agriculture grapples with sustainability and environmental concerns. As consumers increasingly prioritize health and eco-conscious choices, the demand for pesticide-free, organic produce is on the rise. Natural farming's ability to mitigate greenhouse gas emissions, enhance soil fertility, and promote ecological health positions it as a sustainable solution. Moreover, its potential to increase farmers' income through reduced input costs and premium prices for organic products makes it economically appealing. With ongoing research and knowledge sharing, the adoption of natural farming practices is likely to expand, offering a pathway to a more sustainable and environmentally-friendly agricultural future.

Conclusion

Natural farming, rooted in ecological balance and organic principles, offers a sustainable and environmentally friendly approach to agriculture. By prioritizing soil and human health, biodiversity, and responsible farming practices, it presents a compelling solution to meet the growing demand for pesticide-free and eco-conscious food, while also benefitting farmers and the environment.

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