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NATURAL FARMING: A CHEMICAL FREE AGRICULTURAL PRACTICE TOWARDS SUSTAINABLE AGRICULTURE

Abstract

India is predicted to overtake China as the most populous country in the world by 2050, with a population of nearly 1.7 billion. With the possibilities of horizontal expansion of arable land quickly diminishing, the nation must go after a policy of vertical productivity growth in order to feed this exponentially growing population. Moreover, continuous cropping depletes the nutrients in the soil, making it necessary to replenish the soil with important major and minor plant nutrients. To put an end to Silent Hunger and the morally reprehensible continuation of growing numbers of undernourished children and anemic mothers, the nation cannot compromise on the availability of nutritious food. Agro-ecological farming practices known as "Natural Farming" (NF) are thought to be a useful strategy for overcoming some of these difficulties. The nation plans to reorganize its agricultural production system, including research and development, in order to address growing issues. However, the 2018–19 economic survey made a compelling argument in favor of widespread adoption of "Natural Farming" widely known as "Zero

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Budget Natural Farming" (ZBNF), which would double farmers' income. Crop productivity will therefore continue to be low now-a- days, and with this level of output, farmers will be helpless. Today’s practices neither will able to earn enough to double their income nor will pay off their debt. We won't be able to meet the food and nutritional needs of the growing population at the national level either, which will prevent us from achieving the sustainable targets of "Zero Hunger and Poverty Elimination" by 2030. Therefore, using low-cost natural farming techniques, we can feed India and the rest of the world.

Keywords: Crop productivity, doubling income, sustainable, hunger elimination

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I. INTRODUCTION

Throughout human history, numerous breakthroughs have resulted from a belief that was subsequently supported by scientific evidence. Our ancestors used a variety of tools and raw materials to devise strategies for surviving on the planet. Everything was created by trial and error, and there was no understanding of science. In agriculture, this was also true; if we go back to our origins, we will find that the farming system was entirely reliant on inputs produced on the farm. But as the population grew exponentially, agricultural production had to increase quickly as well. This led to the development of Green Revolution technologies (GRTs), which introduced high-yielding crop varieties that responded well to irrigation and higher chemical fertilizer dosages, encouraging farmers to switch to intensive monocropping. Since GRTs were introduced in the mid-1960s, India's food production has increased five to ten times (Dasgupta, 1977). The input-intensive "Green Revolution," while successful, has obscured significant externalities in recent decades that have harmed human health, natural resources, and agriculture itself (Koner and Leha, 2021). Evidence also points to the resurgence of pests as a result of increased chemical fertilizer dosage. In areas with intensive agriculture, it is not uncommon to find heavy metal buildup in the soil, biodiversity losses, nitrate leaching, groundwater pollution. Pesticide residues were several times higher than the allowed limit in tainted drinking water and/or air (John *et al*., 2021). In rural India, the easy access to pesticides has caused suicide deaths, and the careless use of these chemicals has reduced pollinator populations (Baron *et al*., 2017). Subsequent governments (both central and state) have increased subsidies in different farm inputs (Fertilizer association of India report, 2021-22) for farmers in a variety of ways to lessen the load of the increasing crop production costs. These subsidies include free electricity for irrigation, interest subvention on agricultural credit, fertilizer subsidies and premium subsidies for crop insurance. For example, in India, 75% of all electricity subsidies were given to agricultural consumers between 2016 and 2019. There was a cross-subsidy of at least INR 750.27 billion and a direct subsidy of INR 1103.91 billion in 2019 alone (Aggarwal *et al*., 2020). Farmers have received free electricity from state governments, and other governments have subsidized agriculture with 75–80% of the total amount.

In 2020–2021, agricultural sectors received INR 15,754 billion in institutional credit. Even a 3% interest subvention would equate to INR 473 billion in subsidies (Ministry of Agriculture and Farmers welfare, 2022). In

2021, the federal government and state governments each contributed INR 570 billion toward a premium payment for crop insurance (National rainfed area authority, 2022). For tenant farmers and smallholders alike, as well as for the long-term viability of Indian agriculture, all of the aforementioned problems seem to combine to create a perfect storm. Indian farmers are consequently becoming more and more entrenched in an endless debt cycle, which exacerbates their already dire situation. Considered an agroecological approach, Natural Farming (NF) is a distinctive chemical-free farming method (Rosset *et al.*, 2012). Masanobu Fukuoka, a farmer in Japan, is credited with starting the agro-ecological practice. Sh. Subash Palekar, an Indian agriculturist, brought the locally tailored version of this practice to India in the mid-1990s under the moniker "Zero Budget Natural Farming (ZBNF)".

Approximately 58% of India's population makes their living from agriculture. India offers the second largest quantity of agricultural output in the world on its 159 million hectares of fertile land. This production is one of the most significant industries in India, accounting for almost 15% of the country's GDP. In the fiscal year 2020, the combined value added of agriculture, forestry, and fisheries was Rs 19.48 lac crore (US$ 276.37 billion). In 2020 fiscal year, at current prices, 17.8% of India's gross value added (GVA) came from agriculture and related businesses. India grew its proportion of global exports of agricultural products from 1.71 percent in 2010 to 2.1 percent in 2019 (Ministry of Commerce, 2021). It has been acknowledged that while the green revolution and the increased use of synthetic fertilizers and pesticides have increased crop yields, they have also had unfavorable effects on the environment (such as decreased water quality), human health (due to exposure to hazardous chemicals), and the economy (by trapping farmers in a debt cycle). Furthermore, growing costs for coal and natural gas, export bans and sanctions, and ambiguity surrounding Indian fertilizer subsidies might threaten the accessibility and affordability of synthetic inputs. The UN has stated that in order to eradicate hunger and malnutrition, agricultural systems that "work with nature"—that is, are robust, adaptive to change, and minimize their negative effects on the environment—are essential. As a result, implementing these systems could help achieve the UN Sustainable Development Goal No Hunger (SDG 2). Numerous sustainable farming systems, such as organic farming and Zero Budget Natural Farming (ZBNF), have been created as alternatives to conventional farming with heavy input (Willer and Lernoud, 2017).

Scientist Subhash Palekar introduced natural farming in Maharashtra in 2006 as a solution to the challenges that followed the Green Revolution. It is a free of chemicals, 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 objective of natural farming is to return to the agricultural practices of "pre-Green Revolution" times, with nearly zero production costs. This would appear to discourage growers from using agricultural chemicals, therefore saving them from debt. India's national government has put in place a program to promote farming practices across the country. Subhash Palekar was asked by the state governments of Himachal Pradesh, Andhra Pradesh, Chhattisgarh, Kerala, Karnataka and Uttarakhand to train their farmers in natural agricultural practices. A programme called “Prakritik Kheti Khushhal Kisan” was launched with a budget of Rs 35 crore (2019–2020) to encourage natural farming in Himachal Pradesh. Peasants will receive the necessary equipment and training under this program in order to encourage sustainable farming, which will double farmers' incomes and increase soil fertility and input costs. Even if there will always be a need to find a better solution, natural farming is currently an excellent substitute. With Sikkim (NE India) being named the world's first all-organic certified state, a large number of farms in India are now recognized as organic. Compared to traditional agriculture, organic farming may, in theory, have a smaller environmental impact due to the use of synthetic pesticides and fertilizers; however, this could also mean a lower crop yield and less temporal yield stability. In addition, although there are other contributing causes, the failed shift to organic agriculture and the complete prohibition of agrochemicals have been blamed for the worsening political and economic crises in Sri Lanka. Because of these drawbacks, some have questioned whether organic farming can feed the globe without destroying natural ecosystems or expanding croplands into them.

II. ZERO BUDGET NATURAL FARMING

ZBNF is a low-cost, grassroots agrarian movement that relies on homemade, locally sourced amendments. Therefore, ZBNF is not dependent on agribusiness or the use of agrochemicals, and it is anticipated that it will be able to accomplish the dual objectives of environmental preservation and global food security. ZNBF, also known as Andhra Pradesh Community-Managed Natural Farming, or APCNF, has gained a lot of traction in the southeast Indian state of

Andhra Pradesh. Through Rythu Sadhikara Samstha (RySS), a "not for profit" organization, the Andhra Pradesh Department of Agriculture is advocating for the implementation of ZBNF. By 2020, 580,000 farmers had adopted ZBNF methods. and there are intentions by the local government to expand this to six million farmers. The use of crop residues, intercropping to lessen soil disturbance, and less tillage are some of the ways that ZBNF and conservation agriculture are similar. But what distinguishes ZBNF is how these practices are combined with certain homemade modifications.

Zero budget natural farming (ZBNF), also referred to as zero budget spiritual farming (ZBSF), is a recently popular agricultural technique among farmers who have seen the detrimental effects of chemical farming. It has been extremely successful in southern India, particularly in Karnataka, where it originated (Kumar, 2012). It is currently rapidly spreading throughout India. ZBNF farming involves no out-of-pocket expenses for plant growth and harvesting. "Zero Budget" farming promises to reduce production cost and eliminates the need for loans, breaking the vicious cycle of debt for struggling farmers. Palekar assembled the fundamental "tool kit" of ZBNF techniques. He was born in Amravati, a small village in Maharashtra, India. With a strong commitment to improving his village farm, he conducted experiments that showed how constant chemical use affected the fertility of the soil and turned the field barren (Jannoura *et al*., 2014). The advantages of ZBNF include low to no cost, no chemical use, local seed use, reduced water requirements, no budgets, year-round income facilitation, and risk reduction. Another point made here is that ZBNF is a prime example of agro ecology.

III. NATURAL FARMING PRINCIPLES

1. **Natural Input:** In Zero Budget Farming, only naturally occurring on-farm inputs that are non-toxic and widely available in nature are permitted (Padmavathy and Poyyamoli, 2011).

2. **Farming with Little Input utilizing low-cost and Free Technologies:** Zero budget farming seeks to lower input costs across the board, empowering farmers to become self-sufficient. According to Kumar *et al*. (2013), these minimal inputs typically act as a natural catalyst for biological activity in the soil and as a natural defense against disease.

3. **Mulching:** Water is a limited resource, so it must be used carefully; excessive or insufficient irrigation lowers yield and negatively impacts crops. Palekar advises against flood irrigation and advises watering the crop only after midday since plants prefer to absorb water in the vapour form, which requires less metabolic energy to do so. Mulching has well-known benefits, such as preserving soil moisture, suppressing weed growth, protecting soil from wind and water erosion, and increasing soil organic matter, which in turn improves the microbial load and physico-chemical characteristics of the soil.

4. **Multi-cropping:** ZBNF primarily derives its moniker "Zero Budget" from this. It doesn't mean the farmer will have no expenses at all; rather, it means that any expenses will be nearly offset by intercrop revenue, making farming practically budget-free. It is essential to grow crops like pulses (nitrogen-fixing crops) whenever cereals are grown. Given that industrial nitrogen fixation is only 29 m.t. annually, while biological nitrogen fixation (BNF) is 190 m.t. Therefore, the world's factories are biological processes. By minimizing risk and acting as insurance coverage against crop failures, multi-cropping aims to maximize the use of both agricultural land along with input resources while giving farmers year-round income (Niyogi, 2018).

Other Crucial Principles

1. **Contours and Bunds:** Palekar proposed bunds and contours, farm ponds that maximize efficacy for various crops, as a way to preserve rainwater.

2. **Local Earthworm Species:** Palekar disagrees with the use of vermicompost. According to him, it is highly advised to restore the local deep soil earthworm population through an increase in organic matter.

3. **Cow Dung:** Compared to other cow breeds, Palekar claims that the dung of *Bos indicus* that is humped cows is the most advantageous and contains the highest amount of microorganisms. The Indian cow, which has traditionally been an integral component of Indian rural life, is the focal point of the entire ZBNF method.

IV. PRACTICES INCLUDED - THE FOUR PILLARS /WHEELS OF ZBNF

There are 4 pillars of ZBNF i.e. Jivamrita, Bijamrita, Acchhadana and Whappasa.

1. **Bijamrita/Beejamrutha:** Any planting material, including seeds and seedlings, can be treated with it. Bijamrita works well to shield young roots from fungal infections and soil- and seed-borne illnesses that frequently strike plants following the monsoon season. It is made of the same components as Jeevamrutha, including soil, lime, and cow dung from the area. Cow urine is a potent natural fungicide. Any crop's seeds can be coated and manually mixed with Bijamrita before being thoroughly dried and used for sowing. Simply dip and allow to dry for leguminous seeds (Priya and Vivek, 2016).

S. No.	Constituents	Amount
1.	Cow urine (Desi)	5 litres
2.	Cow dung (Desi)	5 kg
3.	Water	20 litres
4.	Lime	50 g
5.	One handful of soil from bund or forest land	-

(Goveanthan, 2016)

2. **Jiwamrita/Jeevamruth:** A fermented microbial culture is what it is. In addition to providing nutrients, it serves as a catalytic agent, which stimulates earthworm activity and the activity of microorganisms in the soil. During the 48-hour fermentation process, the aerobic and anaerobic bacteria found in the cow dung and urine multiply as they consume organic ingredients (like pulse flour). As an inoculant of native species of microbes and organisms, a handful of undisturbed soil is also added. Jeevamrutha also aids in the defense against bacterial and fungal plant illnesses. According to Palekar, Jeevamrutha is only required for first three years of the shift, after which the system can function on its own.

S. No.	Constituents	Amount
1.	Cow urine (Desi)	10 litres
2.	Cow dung (Desi)	10 kg
3.	Water	200 litres

4.	Jaggery	2 kg
5.	Any pulse flour	2 kg
6.	One handful of soil from bund or forest land	-

(Goveanthan, 2016)

Ghana-Jiwamrita: It is a good Jiwamrita formulation, particularly for dry areas, and has a composition that is comparable to Jiwamrita.

3. **Acchadana-Mulching:** According to Palekar, there are three types of mulching:

   - ***Soil mulch:*** This keeps topsoil intact during cultivation rather than destroying it through tilling. It encourages the soil to retain water and become more aerable. Palekar advises against deep plowing.

   - ***Straw mulch:*** Although Palekar points out, straw material can also consist of the decomposing remains of any living thing, it is commonly used to refer to the dried biomass waste of previous crops (plants, animals, etc). Palekar takes a very straightforward approach to soil fertility: give the soil biota, which is stimulated by microbial cultures, dry organic matter to break down and form humus.

   - ***Live mulch:*** Palekar asserts that in order to provide all necessary elements to the soil and crops, it is imperative to develop multiple cropping patterns of dicotyledons (dicotyledons seedlings have two seed leaves) and monocotyledons (monocots; monocotyledons seedlings have one seed leaf) grown in the same field. Legumes, for example, belong to the dicot group of plants that fix nitrogen. Additional elements like phosphate, sulfur, and potash are supplied by monocots like wheat and rice (Padmavathy and Poyyamoli, 2011).

4. **Waaphasa-Moisture:** Palekar refutes the notion that plant roots require a lot of water, which offsets the green revolution farmer's excessive reliance on irrigation. He said that water vapor is what roots require. He suggests reducing irrigation and only irrigating at noon in alternate furrows when the soil is in waaphasa, a condition where both air and water molecules are present. Farmers in ZBNF report that there is much less of a need for irrigation there (Priya and Vivek, 2016).

V. INSECT PEST AND DISEASE MANAGEMENT

1. **Agniastra:** It is a concocted mixture made from cow urine- 10 litres, tobacco- 1 kg, green chili and garlic paste-500 g, and neem pulp-5 kg. The mixture is then continuously boiled for 5 times then filtered. Mixture is then fermented for 24 hours before being used. Leaf roller, pod borer, stem borer and fruit borer are all successfully controlled by it (Münster, 2016).

S. No.	Constituents	Amount
1.	Tobacco	1 kg
2.	Garlic	500 g
3.	Green chillies	500 g
4.	Neem leaves	5 kg
5.	Cow urine (Desi)	10 litres

2. **Brahmastra:** It is a mixture that includes 3 kg of pulp, 2 kg of papaya, 2 kg of pomegranate, 2 kg of guava, 2 kg of Lantana camera, and 2 kg of white datura leaf pulp. Sitapal (custard apple) leaf pulp makes up 2 kg of the mixture. (If Datura leaves and Lantana camara are available, use them.) to be immersed, like Agniastra, in ten liters of cow urine The mixture is continuously boiled five times, then filtered and allowed to ferment for a full day. It works well to control fruit borers, pod borers, and sucking pests when sprayed at a concentration of 2%.

S. No.	Constituents	Amount	Active ingredient responsible for pest control
1.	Pomegranate leaves	2 kg	Delphinidin, Cyanidin
2.	Custard apple leaves	2 kg	Limonene, Pinene
3.	Papaya leaves	2 kg	Papain, Caricain
4.	*Lantana camara*	2 kg	Pentacyclic triterpenoids
5.	Guava leaves	2 kg	Guavonoic acid, Guyavolic acid and Eugenol
6.	*Datura metal*	2 kg	Tropine alkaloids, Scopolamine
7.	Neem leaves (Pulp)	3 kg	Nimbin, Azadirachtin and Nimbicidine
8.	Cow urine (Desi)	10 litres	Uric acid and Ammonia

3. **Neemastra:** The world's most insecticidal plant, neem, has been shown to be effective against 410 different species. It has been used as a botanical insecticide against pests since ancient times. Neem pulp is the main component of this mixture. Five kilograms of leaves are ground into a fine

paste, and five kilograms of cow dung are added to five liters of cow urine. The mixture is then allowed to ferment for a full day, filtered, and sprayed to protect against mealy bugs and sucking pests.

S. No.	Constituents	Amount
1.	Cow urine (Desi)	5 litres
2.	Cow dung (Desi)	5 kg
3.	Neem leaves pulp	5 kg

4. **Advantages of Natural Farming:** Food insecurity, health issues from pesticide and fertilizer residue in food and water, farmer distress, global warming, natural disasters and climate change are all resolved by natural farming.

- **Improve Yield:** Farmers who used natural farming reported yields that were comparable to those who used conventional farming. A greater yield per harvest were reported in multiple instances.

- **Ensures Better Health:** Synthetic chemicals are not used in natural farming. There is no health risks associated with the process. The food offers greater health benefits because it has a higher nutrition density.

- **Environment Conservation:** Better soil biology, increased agrobiodiversity, and prudent water use with significantly lower nitrogen and carbon footprints are all guaranteed by natural farming.

- **Increased Farmers' Income:** Natural farming tries to raise farmers' net incomes through lower costs, fewer risks, comparable yields, and intercropping revenue in order to make farming both viable and aspirational.

- **Employment Generation:** Because of value addition, local marketing, input businesses, and other factors, natural farming creates jobs. The extra money out of natural farming is used to improve the village.

- **Reduced Water Consumption:** Natural farming maximizes "crop per drop" by using a variety of crops that complement one another and cover the soil to stop needless water loss through evaporation.

- **Minimized Cost of Production:** By encouraging farmers to prepare vital biological inputs applying on-farm, natural, and home-grown resources, natural farming seeks to significantly reduce production costs.

- **Removes the use of artificial chemical inputs:** Overuse of synthetic fertilizers—particularly urea—as well as pesticides, herbicides, weedicides, and other chemicals changes the biology and structure of the soil, which reduces fertility and soil organic carbon.

- **Rejuvenates Soil Health:** Natural farming has the greatest direct effect on soil biology, specifically on microbes along with other living things like earthworms. The life within the soil is the only factor that determines its health.

- **Livestock Sustainability:** Natural farming relies heavily on the integration of livestock into the farming system, which aids in the ecosystem's restoration. Bio-inputs that are environmentally friendly, like Jeevamrit and Beejamrit, are made from natural materials like urine and cow dung.

VI. GOVERNMENT SCHEMES ENCOURAGING NATURAL FARMING

To encourage natural farming throughout the nation, the Bhartiya Prakritik Krishi Paddhati (BPKP) has been scaled up to form the National Mission on Natural Farming (NMNF). NMNF plans to create 15,000 clusters over a 7.5 lakh hectare area. Farmers who agree to apply natural farming practices on their land will be registered as members of a cluster; each cluster must consist of at least 50 farmers with 50 hectares of land. Under the NMNF, farmers can build infrastructure for the production of on-farm inputs with financial support of □ 15,000 per hectare per year for three years. The Indian government has heavily pushed natural farming in the past few years in an effort to encourage chemical-free farming. "ZBNF is a promising tool to limit farmers' dependence on inputs purchased; it decreases the cost by depending on traditional field-based technologies, which leads to upgraded soil health," the Prime Minister of India said in his speech to the nation on the 76th anniversary of India's independence programs like the National Mission on Natural Farming, the Bharatiya Prakritik Krishi Paddhati (BPKP) sub-mission of the Paramparagat Krishi Vikas Yojana (Conventional Agriculture Development Scheme),

Many initiatives, such as Mission Organic Value Chain Development for North Eastern Regions (MOVCDNER) and Andhra Pradesh Community Natural Farming (APCNF), are encouraging farmers throughout the nation to adopt natural farming practices. Financial support of INR 12,200/ha (roughly 147 USD/ha) is provided under the BPKP scheme for three years in order to facilitate cluster formation, capacity building, ongoing handholding, certification, and residue analysis. A study on the assessment of NF on specific crops has been started by the highest research body in India, the Indian Council of Agricultural Research (ICAR). Numerous societal groups have taken notice of NF due to its popularity. According to estimates, over 500,000 hectares of land in various Indian states are currently farmed naturally, and under the PKVY scheme, it's predicted that this number could rise to 14 million hectares of land by 2025. Farming practices may not be the only factors influencing the scaling up of NF; markets, social movements, pedagogical processes, public policies, leadership, and discourse are all important. One of the main forces behind the continued adoption of NF practice is farmer-led and farmer-focused knowledge exchange.

VII. CONCLUSION

The tenets of nature farming need to satisfy the following five conditions: (1) create food that is healthy, safe, and nutrient-rich; (2) benefit producers and consumers both financially and spiritually; (3) be easily attainable and sustainable; (4) preserve and safeguard the environment; and (5) produce enough high-quality food to feed a growing global population. In actuality, it is forbidden to use untreated animal waste or synthetic chemicals as soil amendments or fertilizers for crop production. Research has indicated that natural farming, utilizing minimal external inputs and supplementing with Jeevamruth, enhances soil fertility by augmenting the soil microflora and accessible nutrients. Multicropping and the biodiversity of both micro and macroflora are promoted by this technique. Production and labor costs are kept to a minimum. Thus, it is viewed as sustainable and friendly to the environment by many. However, these studies are only in the early stages; more research is required to confirm the advantages for all crops, the effectiveness of natural pesticides like Brahmastram and Neemastram, and the amount of time needed to enrich the contaminated soil.

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