Natural Farming, an Approach for Sustainable Agriculture

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Edited by

R.S. Sengar, Reshu Chaudhary and Amit Kumar

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There is no teacher equal to mother
and there's nothing more contagious
that the dignity of father.

—The Editors

TABLE OF CONTENTS

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FOREWORD

I am delighted to endorse this timely and important book on natural farming. In an era marked by increasing environmental challenges and concerns about food security, the principles and practices of natural farming offer a compelling pathway towards sustainable agriculture. The agricultural heritage of India is a variegated and harmonious tapestry of farming methods. Natural farming is one strategy that sticks out among the others because it prioritizes biodiversity, sustainability, and harmony with the natural world.

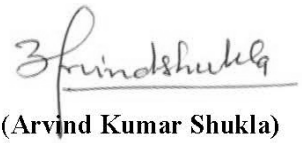
This book provides a comprehensive and accessible exploration of natural farming, seamlessly blending traditional wisdom with contemporary scientific understanding. It underscores the critical role of soil health, biodiversity, and ecological balance in cultivating resilient and productive agricultural systems. It aligns perfectly with our university's commitment to fostering research and education that addresses pressing global issues.

The authors have meticulously compiled a wealth of information, drawing upon both practical experience and rigorous scientific inquiry. This book

serves as a valuable resource for students, researchers, farmers, and anyone interested in exploring alternative agricultural paradigms. It not only provides practical guidance but also stimulates critical thinking about the long-term sustainability of our food systems. Historically, farmers worked alongside this Instead of strict rules, you'll find guiding principles and techniques to help you grow food in harmony with nature. We'll examine the importance of soil microorganisms, the benefits of composting, the wisdom of planting compatible species, and natural pest control methods. This book is for home gardeners, sustainable small-scale farmers, and anyone seeking a stronger connection with the earth. It's for those who understand that healthy people and a healthy planet are interdependent system, growing food that nourished both people and their spirits. However, the drive for increased production has led us to use artificial substances that disrupt nature's delicate balance.

This book encourages you to explore natural farming, a philosophy that respects the interconnectedness of all living things. It's a return to traditional agricultural practices, where healthy soil is the key to plentiful harvests, and biodiversity is valued. Natural farming is more than just a technique; it's a way of thinking, a dedication to caring for the land that supports us. It's a journey toward sustainable, abundant food production, where we grow food with respect for the natural world.

It is noted that this publication which has contributions from renowned experts will definitely be useful for scientists, officers, policy makers, students and farmers. The editors need to be congratulated for bringing out this publication.



(Arvind Kumar Shukla)

Prof. (Dr.) Arvind Kumar Shukla,
Vice Chancellor
Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior

PREFACE

Natural farming is characterized by a variety of farming systems that integrate crops, trees, and livestock without the use of chemicals. Natural farming creates its unique inputs using natural materials rather than chemicals. Farmers save money and turn waste into resources by using locally accessible and reasonably priced materials and making their own farming inputs rather than buying them from the market. Natural farming also enables the best use of functional biodiversity, which promotes the use of on-farm inputs supplied by the farmers. The urine and manure of other animals can also be utilized to make mixtures that enhance the ecological or natural processes that occur on or near farms. In natural farming, no chemical or organic fertilizers are introduced to the soil; instead, earthworms and bacteria break down organic matter directly on the soil's surface, adding nutrients to the soil over time. Plowing, soil tilting, and weeding are not done in natural farming; instead, the soil is left in a state similar to that of natural ecosystems. The secret to maintaining and increasing soil organic matter is a healthy soil microbiome. To improve soil fertility, mixtures are required. There are various methods for creating mixtures. The most widely used mixtures in India, such as Jeevamrit, Beejamrit, Ghanjeevamrit, and others, are made by fermenting animal feces and urine as well as uncontaminated soil. Despite its current popularity, natural farming is not without its difficulties. Natural farming necessitates a change in perspective, information sharing, research, and supportive policy frameworks in order to replace traditional agrochemical-led farming methods. By sharing our experiences, we hope to raise awareness of these obstacles and highlight the fixes and actions required to advance natural farming more broadly.

The Indian government supports natural farming through programs like the National Mission on Natural Farming, which encourages traditional indigenous methods that relieve farmers of their reliance on outside inputs. Natural farming is practiced on about 6.5 lakh hectares in India, primarily in areas like Andhra Pradesh, Himachal Pradesh, Chhattisgarh, and others. Through the Rythu Sadhikara Samstha (RySS), Andhra Pradesh is at the forefront of promoting Community-Managed Natural Farming (APCNF), with Himachal Pradesh following suit with the Prakritik Kheti Khushhal

Kisan (PK3) Yojana. Building the social and human capital required for sustainable agricultural output is the goal of Zero Budget Natural Farming. The idea for this book came from a clear understanding of how urgent it is to handle the changing agricultural situation. With its focus on regenerative techniques, harmony with nature, and minimum environmental effect, natural farming seems as a ray of hope in negotiating the intricacies of our era. Natural farming offers itself as a practical and sustainable solution at the nexus of environmental degradation and the need for food safety. This book is a thorough resource for comprehending the ideas, methods, and developments in natural farming. Designed to offer a comprehensive perspective, it covers the state of natural farming practices today, their effects on agricultural ecosystems, and their promise for the world's food production in the future.

The purpose of this book is to provide information on traditional natural farming methods used throughout world, including their scientific foundation, production processes, advantages for soil health, crop-specific procedures, waste recycling and composting systems, ways for improving soil fertility, and natural pest control. Such documentation supports local, national and international policy decisions by facilitating the assessment of soil quality, carbon footprint analysis, and economic evaluation of agro-ecosystem services. Teachers, researchers, and extension agents working in natural farming education, practice validation across many crops and agro-ecological zones, and farmer and entrepreneur skill development will find the book to be a useful resource. In addition to enhancing the conversation on the subject, I hope these stories help us rethink our agricultural systems and open the door to a more resilient and sustainable future. The commitment of the authors, who have examined many aspects of natural farming, is demonstrated in each chapter. The book discusses a variety of subjects, such as the development of natural farming, the fundamental ideas that underpin its methods, and case stories demonstrating effective applications, as well as conversations about how innovation and technology may advance natural agricultural practices. The contributors' knowledge allows them to present a fair assessment of the potential and difficulties involved in promoting natural farming locally, nationally, and internationally. We really appreciate to publisher for understanding of the value of natural farming and their assistance in providing knowledge to farmers, scientists, students, stakeholders, and extension agents nationwide to increase their understanding of natural farming.

Editors Prof. R.S. Sengar, Dr. Reshu Chaudhary and Dr. Amit Kumar are obliged to all contributors for giving their original thoughts and facts of

Indian agriculture on this particular as part of food production stability and sustainability of agriculture. Editors will remain grateful to all the authors and publisher, whose opinion and suggestions have we hope this text book will be useful to various academic sections and interested persons.

Dr. R.S. Sengar
Dr. Reshu Chaudhary
Dr. Amit Kumar

CHAPTER 1

A SUSTAINABLE PRACTICE TO ENHANCE FARMERS' INCOME: ZERO BUDGET NATURAL FARMING

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Abstract

Current agricultural trends include irrational resource use, land degradation, soil fertility loss, etc. Sustainable agriculture is the best option for dealing with emerging issues. Zero budget natural farming (ZBNF) is a root-regulating farming practice with numerous advantages, as it (1) improves soil health; (2) increases productivity; (3) increases the microflora rate; (4) reduces pests; (5) reduces waste management; and (6) doubles farmers' income. ZBNF reduces the agricultural budget input through four major pillars: *Jivamrita, Bijamrita, Acchadana* and *Whapasa*. In the state of Andhra Pradesh, approximately 5,23,000 farmers have adopted ZBNF. The Government of India has launched several programs due to their low input cost. The current chapter attempts to explain every aspect of ZBNF, such as its current acceptability proportion, major pillars, benefits, implementation challenges and policies, and includes a case study.

Keywords: Sustainable, zero budget, natural farming, farmers' income

Introduction

The burgeoning global population requires sufficient food for its existence. To accomplish its demand for available pieces of land without compromising future land fertility and excessive synthetic fertilizer use, sustainable agriculture practices are the only alternative (Korav et al., 2020). Sustainable agriculture is the most adequate way to achieve the yield as per the demand, in areas of deprived resources and without any input costs such as chemical fertilizer, mechanical instruments, etc. (Singh et al., 2011). Modern agricultural methods have numerous challenges in the supply of continuously increasing demographical needs (Korav et al., 2020). This is due to accessibility and cost, and the extensive use of insecticides, herbicides, and pesticides with chemicals. These synthetics may heavily pollute the soil profile and intermix through leaching with nearby water reservoirs, particularly toxic metals like cadmium, zinc, manganese, and chromium in groundwater. These heavy metals go into the soil, then into plants and finally into humans by becoming part of the food chain (Intawongse et al., 2006). To address many environmental concerns, adapting natural agricultural techniques is not only a requirement but the demand of the hour. Holistic agriculture is just one type of sustainable practice. This chapter not only contributes to the ideas of sustainable practice, but moves one step forward, i.e., toward "zero budget natural farming" (Koner and Laha, 2021).

Farming that does not incorporate any chemicals in agriculture is known as zero budget natural farming (Veluguri et al., 2021). Farmers who use zero budget natural farming in agriculture mostly use mulching, soil protection techniques, natural pesticides and fertilizers. In zero budget natural farming, the cost of production, including harvesting the plants is zero (Korav et al., 2020). As its title suggests, natural agriculture is a kind of farming which uses zero chemicals; it is natural farming that conserves biodiversity and maintains the balance of the ecosystem, enhances microbial proliferation, helps to restore soil health and decreases the rate of soil erosion (Neera et al., 1992). In essence, it returns to the exclusive utilization of the abundant natural resources, which ancient agriculture completely depended on. In this method, the expenditure for commodities acquired is very much reduced (Brown, 2018). Zero budget natural farming, in addition, encourages topsoil mulching, bunds, and intercropping,

thus limiting watering and soil erosion while discouraging deep plowing and intense irrigation (Korav et al., 2020).

About 58% of India's population relies primarily on agriculture as a supply of income, making India one of the key players in the global agricultural industry (Srijit Mishra, 2018). India's agriculture sector has the world's greatest area of agricultural land, employing approximately half of the country's population (Saikat Biswas, 2020). As a result, farmers become an essential component of the system to provide us with food. Most of the farmers are in a terrible condition (S. Mahendra Dev, 2011). Micro- or marginalized farmers make up the majority (approximately 80%) of India's farmers (S. Mahendra Dev, 2011).

After the introduction of the Green Revolution in India, a negative impact on soil health was noticed because the Green Revolution promoted any method to improve yield, such as using a lot of chemical fertilizers and pesticides (Parayil et al., 1992). Zero budget natural farming (ZBNF) is the best way to promote self-sustaining farming and help farmers solve the problem of high input costs and ultimately improve the contribution of the agriculture sector to the Indian economy (Ranjan et al., 2021). In some states of India like Andhra Pradesh and Telangana, where each household owns an average of one lakh, the level of indebtedness is nearly 90%, and zero budget natural farming becomes very important to overcome such major issues (Bharucha et al., 2020). It is the best remedy for the Indian farmers' debt crisis and for doubling their income (Tripathy et al., 2020). The term "zero budget" describes the zero-net cost of all agricultural production (intercrops, border crops, multi-crops) (Gupta et al., 2020). ZBNF lowers the requirement for taking out loans for farming because it completely relies on using internal or naturally occurring inputs (Khadse et al., 2018). Locally available manure and urine from cows are the inputs utilized for seed treatments and other inoculations (Asokan et al., 2020). Therefore, it may be a step toward reducing farmer homicide and bankruptcy, particularly among small and insignificant categories.

Around some lakhs in Karnataka, farming households are currently practicing zero budget natural farming (Khadse et al., 2009). Karnataka was the pioneer state that initialized zero budget natural farming (Bijarnia et al., 2020). Andhra Pradesh will approach the target of 100% natural farming by the year 2024 which will make it the first state to do so, and chemical farming will be completely banned from over 80,00,000 hectares of land (Anand et al., 2020). In Andhra Pradesh, the ZBNF movement began in 2015 (Biswas et al., 2020). Andhra Pradesh was the Indian state

that used the most pesticides before partition (Biswas., 2020). The state administration has been interested in this movement because of the state's chemical-based agriculture problems and its early accomplishments of ZBNF (Veluguri et al., 2021). By 2022, the Andhra Pradesh state legislature plans to switch the state's agriculture system from the first Green Revolution state in India to the first ZBNF state, as was declared in 2018 (Saldanha et al., 2018). To popularize ZBNF across Andhra Pradesh's farming population, the government established the "Rythu Sadhikara Samstha" scheme. In Andhra Pradesh, ZBNF has been agglomerated with simple methods that avoid agrochemicals and transgenics, rely on diversity, and require less water (Keerthi et al., 2018). It encourages farmers to avoid paying out over inputs supplied by sectors with only profit-driven goals and revive the variety of conventional seeds (Münster et al., 2016).

The acceptance of zero budget farming techniques is not region-specific; it occurs in PAN India (Saldanha, 2018). In Wardha district, Maharashtra, farmers have struggled for a long time with issues associated with chemical-based agriculture, such as high input costs, low productivity, the decline in the market price of produce, pest and disease issues, degradation of the soil, the environment, the health of producers and consumers, etc., as well as climatic anomalies (Biswas, 2020). Approximately 10,000 farmers have been inspired after participating in formal training and a demonstration of ZBNF and switching to natural methods of farming from modern machinery-mechanized agricultural practices (Bharucha et al., 2020). After implementing ZBNF techniques, farmers acknowledge a significant improvement in soil health and a simultaneous curtailment of 40-45% of input production costs (Naresh et al., 2018).

The Government of India's finance minister has given a major push to ZBNF in the Union Budget of 2019-20 in parliament and advised the states to adopt it (Biswas, 2020). Niti Aayog of the Government of India, is the foremost promoter of ZBNF (Saldanha, 2020). A couple of policies have also been launched by the Government of India to succeed the "Back to Basic" practices, such as the release of the project under the umbrella of ICAR's "Network Project on Organic Farming", etc. The preliminary findings regarding the viability of ZBNF are very favorable. This is because ZBNF has the potential to double farmers' income and address the major issues facing the current agro-based system in the context of food security (Bharucha et al., 2020).

The Pillars of Zero Budget Natural Farming

There are four major pillars of zero-budget natural farming assisted by the Government of India.

Jeevamrutha/Jivamrita

This refers to the cultivation of sour microbes known as *Jivamrita/Jeevamrutha*. In addition to providing nutrients, *Jeevamrutha* also aids in the prevention of bacterial and fungal plant diseases. The two types of *Jivamrita* are present as (1) the wet form (*Dhrava Jivamrita*) and (2) the dried form (*Ghana Jivamrita*). Specifically, *Jivamrita* could enhance the percentage of nitrogen in the soil because it accounts for non-symbiotic nitrogen fixation. The process to fully prepare *Jeevamrutha* or *Jivamrita* includes: fill a barrel with 200 liters of water + 10 kg of fresh local cow dung + 5 to 10 liters of old cow urine + 2 kg of jaggery + 2 kg of pulse flour + a few handfuls of dirt from the farm's bund; lastly, stir the mixture and let it ferment for 48 hours in shady conditions (Srijit Mishra, 2018). *Jeevamrutha* is now prepared for use and one acre of land requires 200 liters of *Jeevamrutha*. Diluted (10%) *Jeevamrutha* could also be used for a foliar application twice a month. There are multiple benefits of *Jeevamrutha,* such as (1) promoting plant development and productivity, (2) acting as a biopesticide/bioinsecticide, and (3) boosting the soil's organic carbon and stimulates the activity of beneficial organisms.

Bijamrita

Bijamrita is a seed/seedling treatment. To a certain extent, it improves the soil's nutrients and mainly accounts for the prevention of fungus contamination in immature roots and seed-borne diseases. *Bijamrita* is the agglomeration of a handful of dirt + 50 g of lime + 5 kg of cow dung + 5 liters of urine + 20 liters of water. It improves the advantageous microbes. A study by Sreenivasa et al. (2010) revealed that inoculating with *Bijamrita* protects the crop from fungal infection and helps to synthesize IAA and GA3 (Bishnoi et al., 2017).

Acchadana/Mulching

There are three main types of mulching performed: (i) soil mulching: the avoidance of tillage could preserve the topsoil. It encourages water retention and facilitates aeration. It is necessary to avoid deep plowing

(only up to 10-15 cm) if zero tillage is not possible; (2) straw/biomass mulching: *Jeevamrutha* and dry organic matter (the dead material of any living thing) will result in humus production and soil fertility improvement through decomposition; and (3) live mulching: this involves mixing monocots (seedlings with one seed leaf, like rice and wheat) and dicots (seedlings with two-seed leaves, like legumes) on the same piece of land, also known as intercropping or mixed-cropping. As a result, monocots provide nutrients such as sulfate and potash, while dicots struggle to fix nitrogen, and this will result in a synergistic connection (Khan et al., 2022).

Whapasa/Aeration

Water conservation and adequate watering of the crops as per their requirements are the key issues to address. Younger horizontal and vertical roots absorb more water and nutrients than older roots. Water and air are present in the soil in an equal ratio to the soil's mineral and organic components. Apart from the plants that thrive in more water, like rice, plants may die if excessive water is applied, causing the soil to retain air and causing an oxygen shortage. The treatment interval should be extended since soil aeration is a crucial factor in plant growth (Khan et al., 2022).

Practices Accepted in Zero Budget Natural Farming

Intercropping and Crop Rotation Methods

Intercropping occurs when two or more crops are cultivated together on farmland at the same time. Intercropping is preferred in zero budget natural farming because it gives superior yields due to the efficient utilization of available resources. The basic principle of intercropping is that a base crop is grown as the main source of income and intercrops are planted in the vacant spaces. Crop rotation is a useful practice as it helps in obtaining better yields by improving soil health, optimizing the soil's nutrients, and combating pests and weed growth and its pressure.

Cover crops and mixed cropping are also important in the case that if the main crop fails to give a significant yield, then it will provide subsistence.

No-Tillage Farming

Tilling construction is not involved in the no-tillage farming method. The soil horizon remains undisturbed except at the place where the seeds are germinated. The soil is not disturbed while crops are growing which decreases the amount of soil erosion specifically in less compact soils such as sandy and dry soils.

Chemical-free Natural Farming

In natural farming methods, no synthetic fertilizers are used or applied to the soil and plants. The decomposition by microbes of the essential nutrients is stimulated on the soil surface itself, which will slowly release nutrition in the soil over the period (Arora et al., 2022). The major benefits of natural farming include (Ranjan et al., 2021):

a) The protection of the soil and environmental quality;
b) A reduction in the number of pesticides and chemical residues in the soil;
c) The efficient use of natural resources;
d) More nutritional value is added in comparison.

Plant Protection

Neemastra, *Agniastra*, *Brahmastra*, and similar bio-pesticides manufactured from natural, organic, or bio-products are only allowed to be used in ZBNF during the periods of pest and disease outbreaks to protect the plants from reaching economic harm levels. They work well to manage a variety of seed, soil, and airborne diseases (Ranjan et al., 2021).

Table 1. Zero-budget plant protection techniques

Plant Protection	Define	Preparation	Usage
Agniastra	A herbal remedy called *Agniastra* is made from neem leaves, chili fruit, garlic, and cow's urine. It is used to control fruit borers, stem borers, and other kinds of crop caterpillars.	Add the tobacco leaves and pulps to the gomutra, and then continuously boil it for 5 minutes. While it cools, keep this solution in a quiet place. Next, filter the solution using a cotton cloth before storing it in a can or bottle.	Apply a foliar spray to standing crops using a 2.3-3.3% solution, or 2-3 liters of *Agniastra* mixed with 100 liters of water. Repeat after a 15-day break if the infection is severe. To enhance plant health, follow up with a foliar spray of 20% *Jeevamrutha.*
Neemastra	*Neemastra* is a neem and cow urine liquid composition. It takes about two to four days to prepare *Neemashtra* on a farm. To control insect pests like insects, jassids, mealy bugs, aphids, whiteflies, tiny caterpillars, and other sucking pests, fresh *Neemastra* is sprayed on crops.	Neem leaves should be carefully crushed in 50 liters of water to create the organic pesticide *Neemastra.* Crushed neem leaves, water, cow dung, and urine should be combined in an earthen or plastic pot. Place this solution in a shaded area for 24 hours to allow fermentation. Meanwhile, use a wooden stick to stir the mixture 5-6 times of per day. Keep this solution for 48 hours so that it can ferment during the winter. After 24 hours, filter these solutions with a soft cloth. This filtered solution can now be used on the plants after diluting it in 100 liters of water. For a farming area of one acre, utilize this solution.	This natural pesticide can be applied as a foliar spray once a month or on an ongoing basis. Alternatively, spray this solution in the mornings/evenings, anytime your plants or crops become afflicted with pests.

Brahmastra	This is a mixture made with flowers and cow's urine. It is used as a natural insecticide to control both large and small insects, including fruit and pod borers, thrips, aphids, and jassids.	Take 2 kg of *karanj (Pongamia pinnata*) leaves and 3 kg of fresh neem leaves. If the *karanj* leaves are not readily available, smash 5 kg of neem leaves into little pieces, and 2 kg each of custard apple and Datura leaves should be crushed into tiny pieces. Combine all the aforementioned crushed leaves with 10 liters of local cow's urine. Boil the mixture for 20-25 minutes. Let the mixture cools for 48 hours. Use a fine cotton cloth to filter the contents.	To spray one hectare, combine 5-6 liters of filtrate with 250 liters of water. Use a 4% foliar spray if the infection is severe. *Brahmastra* natural insecticides can be kept for six months.

Use of Indigenous Earthworm Species

Vermicomposting of the soil is not encouraged in ZBNF. There is no special need to use external vermicompost because deeper soil has its native earthworm species that may effectively increase soil fertility when any organic matter is introduced to the soil. *Eisenia fetida* is a particularly hazardous species of invasive earthworm because it contaminates the soil and groundwater by absorbing harmful metals.

Essential benefits of Zero Budget Natural Farming

The ecological advantages of specific ZBNF practices, such as the use of cow byproduct microbial assay, mulching, improving functional on-farm biodiversity, enhancing soil microbial activity, agroforestry systems, on-farm water conservation, cover cropping, and others are, however, well-supported by scientific research (Altieri, 2018). Zero budget farming helps farmers to avoid the consequences of arbitrary farming methods and curtail input costs by accepting the basics of natural farming and the requirements of site-specific plants and soil (Korav et al., 2020). After the increased practice of ZBNF, the cost of cultivation of paddy, Guli ragi, ragi, and black gram has been decreased by approximately 20% and the

farmer's income has increased by 50% as compared to non-ZBNF methods.

ZBNF's advantages come at little or no cost; 0% chemical use (which will encourage an increased yield by restoring soil organic matter and soil carbon); the use of local seeds, which are less expensive and more resistant to climate change than hybrids; less water is needed (resulting in more crops per drop); and trees and polycultures require no budget, which promotes year-round revenue and lowers risk (Bijarnia et al., 2020). A study has been done on a five-tiered cropping model (1100 square feet) of land that can increase food and nutritional security for the ultra-poor (the poorest 20%) and increase family income by $1000-$1250 per month (Mishra, 2018). It can also help farmers to be more climate-friendly and carbon-neutral, to better withstand long dry spells, and to better recover to a wet spell after a long dry spell (or, through protective irrigation).

In addition to aiding farmers in paying off debt, this method raises soil fertility, production, and product quality. Earthworms decompose plants and animals, which adds humus to the soil. The creation of tiny and huge pores in the soil also increases the soil's ability to store water and to breathe. This pest management strategy not only prevents insect harm but also shields us from the amusing side effects of chemical solutions including enlargement, pollution and carcinogens (Yang et al., 2021). For instance, unlike chemical fertilizers, it does not contribute to soil and water contamination or erosion.

Intercropping and crop rotation prevent the soil from becoming depleted of moisture and nutrients while mulching slows water evaporation and keeps the soil adequately wet. This offers a favorable habitat for the soil's microorganisms. The term "quality of the product" refers to the lack of undetectable disease-causing substances, which is of considerable concern nowadays. In conclusion, ZBNF is unquestionably a significant approach from an economic, social, biological, and physiological standpoint (Sujatha et al., 2021).

According to Palekar, the rising cost of external inputs in farmland was a major source of debt and suicide among farmers. In India the impact of chemicals and pesticide residue burning on the environment and long-term fertility was disastrous. As a result, he focused on low-input agriculture technologies that should be on-farm resources available within farmland and not harmful to soil health. For the first time, he implemented the natural farming concept in Karnataka, a neighboring state. In various

Indian states, he has converted over-50-lakh farmers to what he calls "Zero Budget Natural Farming" (ZBNF). This technique encourages soil aeration, low gilts, mixed cropping, irrigation, and mulched subsoil.

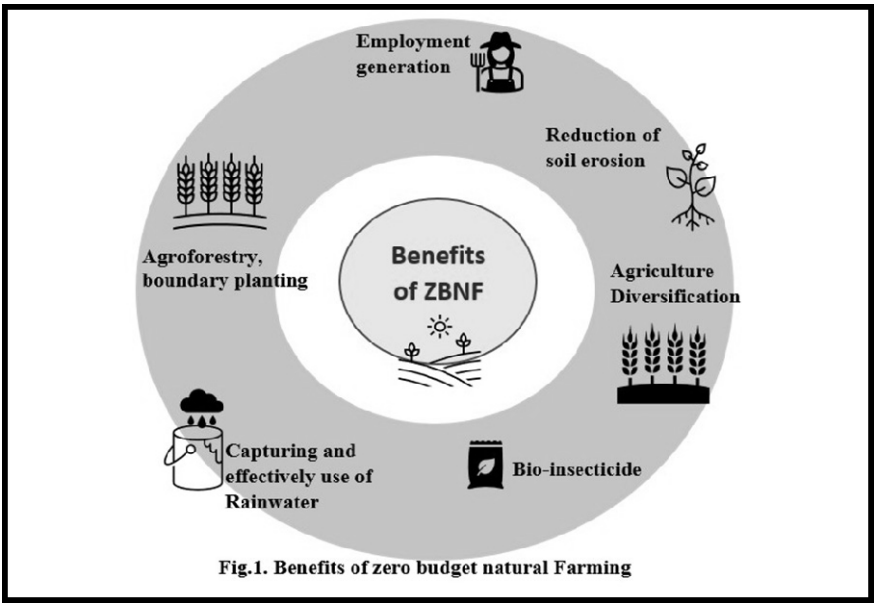

Fig.1. Benefits of zero budget natural Farming

The possible influence of nitrogen is supplied only by the soil. Practitioners of numerous ZBNF methods suggested that the nutrients utilized by the plants are not concomitant with the applied amendments or fixed by micro-organisms but are instead provided by the soil itself (Fitzpatrick et al., 2022). There would be a loss of soil organic matter (SOM) if the only way to supply nitrogen to a ZBNF system was to encourage nitrogen leakage from the soil. The average national ratio of nitrogen fertilizer application in traditional processes was used to determine the amount of nitrogen that would have to be provided by the soil, N_{soil}. N_{con}, in 118 kg/ha^{-1}yr^{-1} for a two-crop system, subtracted from the direct inputs of nitrogen in a ZBNF system, N_{ZBNF}

$$N_{soil} = N_{con;\,in} - N_{ZBNF;\,in}$$

ZBNF Government Initiatives

Given the benefits of ZBNF, our government has taken action to support it by designating ZBNF for the Paramparagat Krishi Vikas Yojana (PKVY) programs beginning in 2015-16. Rashtriya Krishi Vikas Yojana (RKVY), under which organic/natural farming projects are taken on by the appropriate State Level Sanctioning Committees (SLSCs), also includes various organic farming models, such as natural farming, Rishi farming, Vedic farming, cow farming, home farming, and ZBNF, from which farmers can choose (SLSCs) (Jaacks et al., 2022). The government sees ZBNF as a possible solution to the farming problem. Furthermore, during his speech at the 14th Conference of the International Organization on Desertification (COP-14), Prime Minister Narendra Modi informed the audience that India specializes in zero budget farming. In addition to highlighting ZBNF practices, Finance Minister N. Sitharaman also discussed the 2019-20 budget. ZBNF farming aims to double farmers' income by 2022 by eliminating the use of chemical pesticides, sustaining agriculture through environmentally friendly practices, and restoring soil fertility and organic matter (Jebaraj, 2019).

Challenges in Zero Budget Natural Farming

Future Challenges

ZBNF could provide a comprehensive alternative to the expensive chemical input-based agriculture model. However, several fundamental marketing issues must be addressed before the program can achieve its audacious goal of assisting farmers and increasing production. Furthermore, the agricultural market's infrastructure must be strengthened. The extension of the procurement mechanism to any or all food grain and non-food grain crops in any or all states, as well as the establishment of minimum support prices (MSP) consistent with crop cultivation costs, continue to be contentious issues. The government should act quickly to eliminate the minimum export price for agricultural products and enact legislation establishing the "right to sell at MSP." MGNREGS – the Mahatma Gandhi National Rural Employment Guarantee Scheme – must even be linked with farming to reduce the cost of agriculture, which has risen faster than inflation in recent years. Until these issues are resolved, the goal of tripling farmers' income by 2022 will remain a pipe dream. As a result, when responding to ZBNF's concerns, it is also critical to consider how easy it is for farmers to conduct business and their standard of living.

Case Study of Andhra Pradesh

The ZBNF movement in Andhra Pradesh began in 2015. Before the separation, Andhra Pradesh used the most pesticides of any state in India. Because of the state's chemical-based agriculture problems and ZBNF's early successes there, the authorities have taken note of this movement. The state government of Andhra Pradesh declared in 2018 that the state's agricultural system would be converted to ZBNF by 2022 (transitioning from India's first Green Revolution state to the country's first ZBNF state (Biswas et al., 2020). The government established Rythu Sadhikara Samstha, a non-profit organization, to spread ZBNF among Andhra Pradesh's farming population. The state government also collaborated with several domestic and foreign organizations to generate funds for the development of a viable ZBNF model. In 2017-18, 16,300 farmers from 972 villages across 13 districts joined ZBNF, and an action plan for 5,000,000 farmers was developed for 2018-19 (Saldanha et al., 2016). Furthermore, the government stated its intention to provide full cultivable land (8 million hectares) through ZBNF by the end of 2026, with 6 million farmers covered in 2024 (Bharucha et al., 2020). ZBNF farmers in Andhra Pradesh have seen decreases in input costs, increases in yields, fair trade on domestic and international markets, improved food and nutritional security, and a reduction in economic inequality by increasing the net income of tribal farmers, landless farmers, tenant farmers, single women farmers, and other types of farmers (Biswas et al., 2020).

ZBNF also improved the health of the farming community by replacing harmful pesticides and synthetic fertilizers. ZBNF began implementing integrated health and nutrition programs in 35 Andhra Pradesh communities in 2018 (Duddigan et al., 2022). Farmers who used ZBNF methods to cultivate rice, rain-fed groundnuts, and cotton received guaranteed increases in net income of 51%, 135%, and 87%, respectively, in 2017 (Rani et al., 2020). Rice and groundnut yields rose by 9% and 36%, respectively, in the ZBNF farmers' fields in Anantapur, Andhra Pradesh (Biswas et al., 2020). In 2017, the Andhra Pradesh government observed higher yields of rice (6416 kg/ha), irrigated groundnut (2868 kg/ha), black gram (1300 kg/ha), chili (10240 kg/ha), and maize (12844 kg/ha) from ZBNF fields compared to non-ZBNF fields (5816 kg/ha, 2233 kg/ha, 1027 kg/ha, 7740 kg/ha, and 11856 kg/ha, respectively for rice) (Biswas et al., 2020). Furthermore, this state has seen lower production costs and higher net revenue for a variety of other crops, including black gram and rice (Gupta et al., 2020).

ZBNF was successful in Andhra Pradesh in achieving gender equality at the cluster leadership level by allowing women and their self-help groups to actively participate in training, agricultural tasks, management and supervision of community- or group-based farming, and even entrepreneurship (Halstead et al., 2022). The ZBNF program expanded its goal to include capacity building, gaining information, developing skills, and spreading sustainable production technologies at the farming community's most basic levels via community resource people or expert growers (farmer-to-farmer dissemination), assisting in the creation of rural jobs in agriculture and related sectors. ZBNF was able to produce resilience to climatic abnormalities by strengthening soil and crop strength (Biswas et al., 2020). The pre-monsoon seeding of a combination of nine cereals and millets (*Navadhanya*) in Anantapur, Andhra Pradesh, for example, was able to capture water vapor in the air, and *Jivamrita* treatment enhanced soil health, which improved crop resilience to dry conditions. The rice grown in ZBNF fields in Vishakhapatnam, Andhra Pradesh in 2017 fared better against wind blow and water loading than that in conventional rice fields due to the ZBNF approach's creation of permeable soil, deep roots, and sturdy stems (Mishra et al., 2022). To accelerate ZBNF, the state government has taken ample initiatives, such as building custom hiring centers for group-based rentals of small machinery, organic selling stores for bio-pesticides and cow-based formulations, village seed banks, and so on (Khadse et al., 2019).

Conclusion

Population bursts due to the non-judicious use of natural reservoirs. In this deteriorating environment, natural farming with precise agricultural methods lead to a sustainable future. Zero budget natural farming methods such as *Jivamrita, Bijamrita, Acchadana* and *Whapasa* enhance the soil's health, nutrients, beneficial soil microbial diversity, and earthworm proliferation rate. Its numerous benefits in the context of soil and plant health, a yield reduction in the dependency on chemical fertilizer and adverse climate variability, emerge from various technical challenges. In Andhra Pradesh, the success in zero budget natural farming encourages millions of farmers to double their income and improve their standard of living. The Andhra Pradesh case study has become a model for the agricultural prime nation and national government to launch various programs and schemes to excel in agriculture with the least amount of synthetic and mechanical investment.

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