



Zero Budget Natural Farming: An Agricultural Revolution, Prospects and Problems

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Authors' contributions

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

Article Information

DOI: 10.9734/IJPSS/2023/v35i203802

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/105496>

Review Article

Received: 06/07/2023

Accepted: 09/09/2023

Published: 19/09/2023

ABSTRACT

Traditional agricultural practice and progressive improved technical implementation made our food system not only self-sufficient but also a potential food surplus source. But continuous application of such latest techniques is damaging our ecosystem as well as become the reason for farmers' debt. Excessive application of agro-chemicals has become the major reason behind soil and water pollution. In order to ameliorate such irreversible damage adaptation of a modern farming technique named Zero Budget Natural Farming (ZBNF) has been found to be effective. The word 'budget' represents as credit and expenditures and 'Zero Budget' refers to without any expenses or

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purchasing any input. 'Natural farming' means farming naturally by avoiding synthetic chemicals. This ZBNF is initiated by Indian agriculturist Subhash Palekar. ZBNF is based on soil mulching to conserve soil moisture, use of natural organic manures and pesticides, etc. Cultural practices like crop rotation, application of green manures and compost, biological and cultural pest management are the key ingredient in ZBNF. ZBNF found ecologically sustainable and an effective tool to achieve Sustainable Development Goal (SDG) as well as cost-effective as it made farmers debt free.

Keywords: Natural farming; sustainable agriculture; sustainable development goal; ZBNF.

1. INTRODUCTION

As a result of the green revolution, agricultural production expanded more than three times in last few decades [1] but, the application of synthetic chemical fertilizers and pesticides during high-input agriculture era, has led to serious environmental degradation posing adverse health effects to living beings [2]. To overcome these problems environmental solution was badly needed at that time. As a result, the requirement of agro-ecology along with sustainable intensification has arisen [3]. Parmentier (2014) [4] scientifically proved that introduction of diverse agro-ecological farming is more productive and has numerous ecological as well as social benefits. For instance, southern India has a successful peasant movement that has scaled up agro-ecology. The adoption of Zero Budget Spiritual Farming (ZBSF) movement, also known as the Zero Budget Natural Farming (ZBNF) movement, has presently spread across most Indian states [5]. The concept of Zero Budget Natural Farming refers to inherent cultivation practices without investing any money. This idea basically holds up the possibility of liberating the farmers from the debt cycle caused due to high cost of cultivation, high rate of interest, and unstable rate of crops in the market.

2. HISTORY OF ZBNF

Indian agriculturist Subhas Palekar was the first person who introduce the concept of ZBNF. According to him, ZBNF is basically an agro-ecological farming method that encourages cultivating plants in harmony with the environment. Subhash Palekar, the initiator of ZBNF, created the organization's toolbox during 1990's. He used the Green Revolution strategy for chemical farming and from 1972 to 1985 he got success in terms of better crop yield. But the crop yield started to decline after 1985. After three years of this research, it is concluded that agriculture science is established on erroneous principles. Then, using Dr. Clark and Dr.

Washington's theory, as their inspiration chemical-free farming methods were put into practice in this field. Palekar investigated forest flora from 1986 to 1988 while looking for sustainable agricultural techniques and identified the natural system at work in forests that preserves the health of ecosystems. ZBNF has become very popular when the Finance Minister of India, Smt. Nirmala Sitharaman, discussed it in her 2019 budget speech in doubling farmers' incomes.

3. SIGNIFICANCE OF ZBNF

- The cost of production is rising daily due to abrupt increase in cost of inputs.
- Most of the farmers are trapped in debt. As a result of this suicide rate of farmers is increasing. As per National Crime Records Bureau's (NCRB) report, around 5563 agricultural workers committed suicide in 2021. The number increased by 9 percent as compared to 2020 [6].
- Environmental concerns are rising, which was neglected at the time of the green revolution.
- Farmers are moving towards the chemical-free safe food to meet consumers' demand as the preference of consumer is changing now-a-days.

4. ADVANTAGES OF ZBNF

The advantages of ZBNF are discussed hereunder:

- Farmers in ZBNF are not required to buy inputs as the entire farming procedure is fully connected with nature and hence, the production cost is zero.
- It is a particularly extreme instance of Low External Input Sustainable Agriculture (LEISA), in which all inputs are readily available on-site and the majority of the output from one farming component is used as an input in another.

- It provides a suitable environment for all crops.
- It provides safe and nutritious food.

5. FOUR PILLARS OF ZBNF

ZBNF is based on what Palekar refers to as its four wheels: *Jivamrita* (Soil inoculation), *Bijamrita* (Seed treatment), *Acchadana* and *Whapasa*. Among these *Jivamrita* and *Bijamrita* are microbial mixtures that are prepared in less than 48 hours [7]. The concept of “Annapurna” was introduced to unlock the existing soil nutrient via *Jivamrita*. According to this concept one cow's manure and urine are sufficient to cultivate 30 acres of soil, so no need for cow ownership for each farm family [8]. If desi cow is not available then other animal dung and urine can be used [9]. Four pillars of ZBNF are elaborated here below.

5.1 *Jivamrita*

Jivamrita is a home-made natural liquid bio-fertilizer, which is made up of cow urine, cow dung, water, jaggery and inoculant of local micro-organisms. An increased microbial population diversity index increases the soil ecosystem's resilience and stability [10,11]. In soil fertility soil micro-organism plays an important role, they also contribute to the nutrient cycle like Carbon and Nitrogen cycle, which are essential for crop development [12]. The rich microbes of soil organic material transform the soil organic material which boosts the soil fertility and yield [13]. The introduction and adoption of these environmentally friendly methods on a global scale will help to preserve the ecosystem and reduce the negative impacts of agrochemicals [14]. We can use *Ghanajivamrita*, a dry form of *Jivamrita* that can be maintained and stored for a year [7]. For the preparation of *jivamrita*, 200 lit of water is mixed with 10 kg of desi cow dung and 5-10 lit of cow urine. Then, 2 kg of jaggery and pulse flour are added to it and mixed properly. The mixture can be kept in a shady area for 48 hours for fermentation [15]. Use irrigation water or a 10% foliar spray to the crops twice a month to apply *Jivamrita*.

5.2 *Bijamrita*

Bijamrita is also a homemade microbial seed treatment that can be effective on seeds, seedlings, or any other type of planting material. It is prepared from elements that are like those in *Jivamrita*. It works well to keep young roots free of fungus and to shield seedlings from diseases

that are transmitted through the soil or seeds [5]. It is not only used as a protectant for plants, but it also helped as a growth promoter [16]. It is made using the same ingredients as *Jivamrita* or *Jeevamrutha* (locally-bred Indian cow dung and urine, lime, water, and soil). Specifically, a container with 20 litres of water is filled with 5 litres of cow urine and 5 kg of cow dung. Then it is thoroughly mixed with 50 g of lime and a fist of local soil. The seed must be soaked with *Bijamrita* before being applied to the soil, and then it must be shaded and sown [17].

5.3 *Acchadana*

Acchadana is called mulching. Mulching is the process of covering the soil with a layer of mulch. Mulching is another important component of ZBNF. For optimum development, reproduction, and activity, *Jivamrita*'s beneficial microbes need a particular environment. This environment supplies through three ways, these are live mulching, straw mulching, dust mulching. Mulching is an effective strategy for increasing crop quality and yield by controlling soil temperature, preserving moisture, and lowering soil evaporation [18]. Covering the soil with plant or dust debris (*acchadana* /mulching) has a number of advantages. Mulch aids in maintaining soil moisture, which is one of its important benefits [19]. Mulching helps to control weed emergence, prevent the soil erosion, enhance soil ventilation as well as preserve soil moisture by reducing evaporation, and thereby, improve soil fertility status. It has been observed that monocot crops have the ability to supply phosphorus and potash and dicot crop can fix nitrogen efficiently. Straw and dust can also be used as mulching material [20]. The physico-chemical and biological characteristics of the soil are improved with the application of mulching [21]. *Acchadana* is recommended before sowing crops to cover the bare soil [22].

5.4 *Whapasa*

Palekar suggested that plants absorb water vapour only instead of liquid water. So, he encouraged us to reduce the irrigation and suggested applying water in very fewer amounts in alternative furrows only. It reduces over-reliance on irrigation, maintains a favourable soil moisture profile and improves the quality of soil [23]. In rainfed areas, rain water doesn't evaporate quickly because of mulching. It is very helpful for rain-fed areas and potentially saves 90 percent of water use [20].

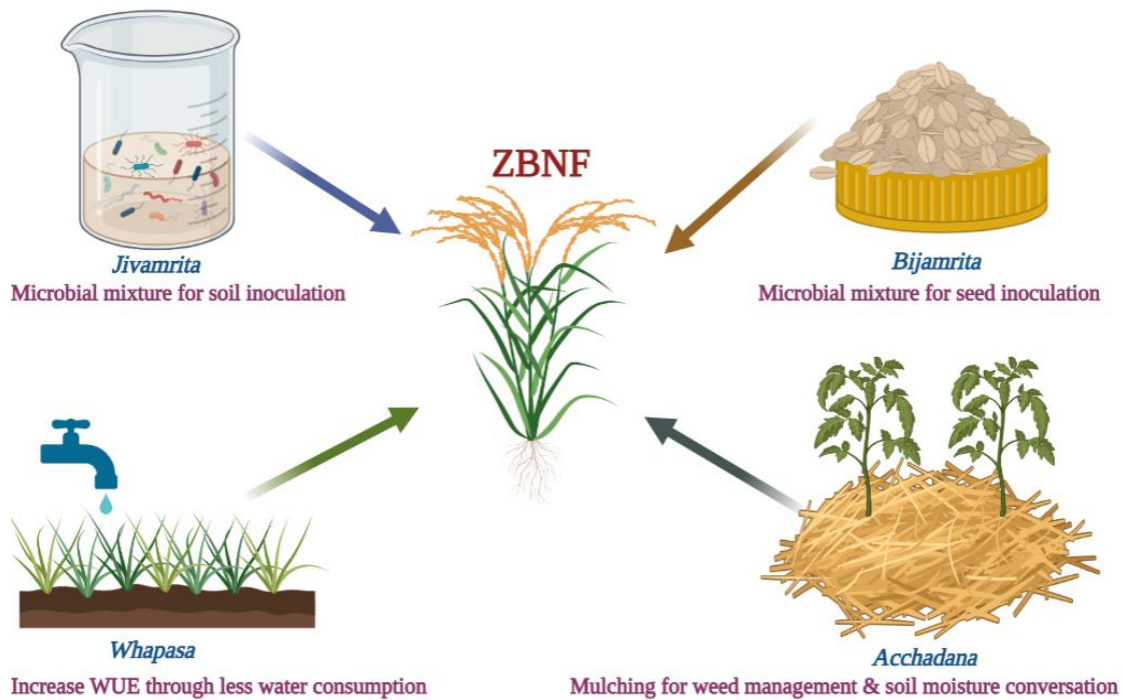


Fig. 1. Four pillars of ZBNF

6. ORGANIC FARMING VS ZBNF

From the last decade, organic farming has arisen as a different option in farming systems against conventional farming systems. Organic farming pays attention to many people because of its budding ability to address the problems relating to sustainability in agriculture [24]. Organic farming is a production system that ensures the soil health, ecosystem and people by relying upon internal local input rather than external input [25]. Organic agriculture is the proper combination of tradition, innovation, and science [26]. In different studies, it has been found that organic farming is more economically viable than conventional chemical farming systems [27,28]. There are various forms of organic farming that are now practiced worldwide as well as in India [29]. Among these alternative forms of the organic farming model, ZBNF gets attention among the people. There are a few differences between organic farming and zero-budget natural farming. In organic farming for the maintenance of soil health, the concept of crop rotation, application of compost, manure, vermicompost and bio-fertilizer from external sources can be suggested while, in ZBNF *Jivamrita*, *Bijamrita*, *Acchadana* and *Wapasa* are used. In organic farming general agricultural practices including ploughing, tilling and weeding are recommended,

but, in ZBNF, these types of operations are completely excluded. Organic farming is still expensive as it requires a huge amount of organic compost but in ZBNF, the cost of cultivation is negligible.

7. MOLECULAR INSIGHTS IN ZBNF

Zero Budget Natural Farming has become very popular throughout the nation by using natural resources, cropping systems, and livestock waste-based products for soil biology improvement. Few recent microbial studies and subsequent molecular biology studies support this. The application of various popular ZBNF formulations, namely *Jeevamrit*, *Panchgavya* and *Beejamarit* increases microbial population as well as earthworm ultimately enhancing soil nutrient availability for crops for better crop yield. Such excellent microbial population primarily improves the soil stability and soil resistance too. Soil organic matter and nutrients for plants are improved due to presence of such number of microbes. Soil organic carbon increased and specially enhancement of available phosphorus, available potassium was found more than 100%. Micronutrients like zinc (Zn), iron (Fe), copper (Cu), and manganese (Mn) are also increased in ZBNF farm than traditional farm. The effect of ZBNF formulation on soil chemical and microbial properties of the ZBNF field and associated

metagenomic analysis justify the excellence of ZBNF. Beside this the Shannon–Weaver index (which is the indication for species diversity, normal value of the Shannon Weaver diversity index ranges from 1.5 to 3.5 and in exceptional cases it goes beyond 4.5) of the sample was 4.978 signifying good species diversity [30,14]. Microbial species diversity of soil is soil ecosystem quality determining factor and soil from ZBNF farm found excellent from this point of view too. The total microbial content of soil from ZBNF found higher than soil from the farmer's field. ZBNF soil was vivaciously loaded with the bacterial population than soil of farmers' fields (total bacterial count in the soils was 528 times higher than the soil from farmers' fields). Each gram of soil of ZBNF farm represents 1610 million CFU (Colony-Forming Unit) compared to 3.05 million in the soil of farmers' fields. More than 35 bacterial phyla were found from ZBNF rhizosphere. Among those most abundant phyla recorded as Proteobacteria (40%) followed by Actinobacteria (21%), Firmicutes (7%), Cyanobacteria (5%) and others. The major genera were *Streptomyces* (5%), *Bacillus* (4%), *Pseudomonas* (4%), and *Rhizobium* (4%) along with *Paenibacillus*, *Bradyrhizobium*, *Microbacterium*, *Sphingomina*s and *Mesorhizoniu*. These bacterial genera directly and indirectly associated with nutrient cycle especially organic matter degradation, nitrogen cycle and carbon cycling. The dominating fungal phyla was Ascomycota. A significant representation of genes/enzymes associated with biomolecules (amino acids and carbohydrate) metabolism vis-à-vis soil fertility, defence, plant growth, and development were found from functional analyses. Plant-Growth-Promoting- Rhizobacteria (PGPR) increases crop productivity by direct or indirect facilitation of the plant growth and soil fertility. The plant-growth-promoting features like phosphate solubilization, indole acetic acid (IAA) production, siderophore, and enzyme production, antifungal metabolites, chitinase, acetyl co-enzyme (ACC) deaminase, and protease, in vitro biological nitrogen fixation, and antifungal activities was found in the isolated bacteria and fungi. Thus, ZBNF practices found to be effective in the multiplication of microbes in the soil which accelerate the process of nutrient enrichment of soil [14].

8. KEY CHALLENGES TO IMPLEMENT ZBNF

Though the ZBNF is ecologically sound and economically viable, still a very less number of

farmers are aware of this technology. Here we will discuss about some challenges of ZBNF.

- If the research institutes are not producing scientific data and proof of the success of ZBNF, it will be difficult for the scientific community to reach a desired goal. In such a setting, both stakeholders and farmers may have doubts about the program's efficacy. If the research institutes have various points of view automatically farmers would be in a state of uncertainty.
- Regular field inspections are required as part of ZBNF practice to look for weed and insect infestations as well as nutrient deficiencies. Because of this, the need for labour to create a lot of *Jivamrita* and apply it frequently could raise the price of crop production. As a result, the practice might be more appropriate for small-scale farmers who only have one or two family members who work from home. As a result, deploying the technique would be extremely difficult for huge farm-sized estates.
- This farming method adheres to strict do's and don'ts, what will a farmer do if they lack all the raw materials needed in ZBNF? For instance, the indigenous cow (*Bos indicus*) is occasionally unavailable. Is there a provision for using the second-best option in that case? The lack of proper clarification in this area causes uncertainty among farmers [31,32].
- It is not conceivable to feed the vast majority of people in the country using traditional varieties which only have the half yield potential of HYVs and hybrids [33].
- Moreover, a question arises always why it is named "Zero budget natural farming" since farming cannot be done without financial investment. When raw materials are produced on one's own farm, some income must be given up. This is the case for all ZBNF activities. There are some expanses when buying raw materials from other sources. Even so, there are farming-related activities that the farmer and his or her family are involved in that have financial worth. Another expense is the cost of raising native cows, one of the principles of this method [7].

9. CONCLUSION

Despite of numerous controversies and opposing opinions, ZBNF has been introduced positively as a beneficial concept to serve the entire farming community. In fact, it has been proven successful in reviving many small-scale farmers around the country. It has been seen that ZBNF is more popular in the south Indian states of India as compared to north Indian states. ZBNF's lengthy journey has only just begun. However, it has managed to demonstrate its value. Farmers seeking an alternative to chemical farming have already expressed interest in it. Andhra Pradesh, Karnataka, Kerala, Himachal Pradesh, Uttarakhand, and Chhattisgarh are the six Indian states that have begun to make significant inroads towards ZBNF. Punjab and Bihar have both expressed a strong interest in it. Gujarat, Rajasthan, and Meghalaya are also monitoring it. Success stories, particularly in the states of Karnataka and Andhra Pradesh, are encouraging people all throughout the country to give it a shot at least once. However, more scientific studies and evaluation are of urgent need to recommend this technique and validate its claim. In the naked eye, introduction of ZBNF has been reported as a cost-effective as well as eco-friendly technique. Though, many scientists suggested that the success of ZBNF maybe region or agro-climatic zone or soil specific. Therefore, multi-location trials are required to realise the result of ZBNF in different kinds of soils and agro-climatic regions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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