

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

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 a modern technique of farming named Zero Budget Natural Farming (ZBNF) found to be effective. The word 'budget' represents as credit and expenditures and 'Zero Budget' refers to without any expenses or 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 , 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.
- Consumers' preference is changing. Nowadays farmers moving towards chemical-free safe food.

Comment [amr1]: Do you mean "consumers"?

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. If desi cow is not available then other animal dung and urine can be used [8]. Four pillars of ZBNF are elaborated here below.

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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 [9, 10]. 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 [11]. The rich microbes of soil organic material transform the soil organic material which boosts the soil fertility and yield [12]. 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 [13]. 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 [14]. 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 [15]. 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 [16].

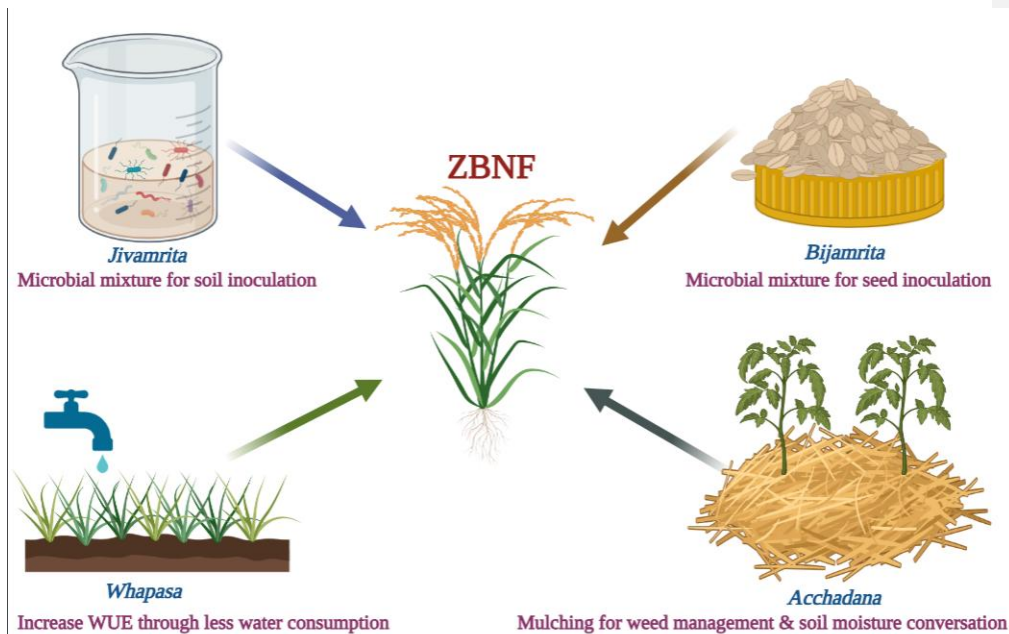


Fig. 1. Four pillars of ZBNF

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 [17]. 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 [18]. Mulching helps to some extent control weed emergence while also protecting the soil erosion, enhancing soil ventilation, preserving soil moisture by reducing evaporation, and improving soil fertility. It has been seen that monocot crops provide phosphorus and potash and dicot crop fixes nitrogen. Straw mulching and dust mulching are also used [19]. As mulching rates increased, the physical characteristics of the soil are also improved [20]. *Acchadana* is recommended before sowing crops to cover the naked soil [21].

5.4 Whapasa

Palekar suggested that plants do not require a lot of water, plants absorb water vapour only. So, he encourages us to reduce the irrigation and suggested applying water in very fewer amounts in alternative furrows only. It reduces over-reliance on irrigation and maintains a favourable soil moisture profile as well as improves the quality of soil [22]. It is very helpful for rainfed areas as it saves 90 percent of water use [19].

Comment [amr3]: Explain how this water saving occurs, if it is supposed to be rainwater.

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 [23]. Organic farming is a production system that ensures the soil health, ecosystem and people by relying upon internal local input rather than external input [24]. Organic agriculture is the proper combination of tradition, innovation, and science [25]. In different studies, it has been found that organic farming is more economically viable than conventional chemical farming systems [26, 27]. There are various forms of organic farming that are now practiced worldwide as well as in India [28]. 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 fertility, the concept of crop rotation, composting, manure, and vermicompost from external sources may use and biofertilizer is suggested. Where in ZBNF *Jivamrita*, *Bijamrita*, *Acchadana* and *Wapasa* are used. In organic farming general agricultural practices like ploughing, tilling, weeding may practice but in zero-budget natural farming these types of operations are completely avoided. Organic farming is still expensive as it requires a huge amount of organic compost as input cost 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 *Beejamrit* 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 Zn, Fe, Cu, and 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 [29, 13]. 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 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* and *Mesorhizobium*. 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. PGPR increase crop productivity by direct or indirect facilitation of the plant growth and soil fertility. The plant-growth-promoting features like phosphate solubilization, IAA production, siderophore, and enzyme production, antifungal metabolites, chitinase, 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 [13].

8. KEY CHALLENGES TO IMPLEMENTING ZBNF

Though the ZBNF is ecologically sound and economically viable, still a very less number of farmers adopted this technology due to some shortcomings in this technology. Here we will discuss about some challenges of zero-budget natural farming.

- 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 consensus. In such a setting, both stakeholders and farmers will 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 [30, 31].
- It is not conceivable to feed the vast majority of people in the country using traditional varieties that only have half the yield potential of HYVs and hybrids [32].
- 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 expenses 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 proved successful in reviving many small-scale farmers around the country. 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.

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Comment [amr4]: The Introduction mentions that: The adoption of the Zero Budget Spiritual Farming (ZBSF) movement, also known as Zero Budget Natural Farming (ZBNF) movement, has now spread across most of the Indian states, which seems to contradict the statement in this paragraph.

Comment [amr5]: It is of interest to define the type of farmer to whom ZBNF can be recommended.

Comment [amr6]: In this case, it is necessary to define the type of farmer to whom ZBNF is recommended.

Comment [amr7]: As it states in the CONCLUSION, that ZBN has successfully reactivated many small farmers throughout the country, with them should seek to answer what scientists say about the region, agro-climatic zone and soil type in which ZBNF offers better results.

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