R-2186
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REVIEW ARTICLE Agricultural Reviews, Volume Issue : ( )

General Overview of Zero Budget Natural Farming (ZBNF)

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10.18805/ag.R-2186

ABSTRACT

India will surpass China as the most populated country in the world, with an estimated nearly 1.67 billion people by 2050 (World Population Data Sheet, October 2019). In order to feed this population, the country has to adopt a policy of vertical growth in productivity as the opportunities of further horizontal expansion of cultivated area are almost exhausted. Continuous cropping depletes the soilnutrient reserves and hence, the soils are to be replenished with the essential major andminor plant nutrients. In this context, Zero Budget Natural Farming (ZBNF) given by Subhash Palekar is not appropriate technology to adopt the farmers because in this technique, cannot provide adequate quantity of nutrients required forhigher crop productivity as soil has a limited nutrient supplying capacity. In addition, ZBNFrecommends use of traditional varieties of crops having almost half the yield potential ofmodern high yielding varieties. Thus, farmers will not earn enough to double their income with low crop productivity.

Key words: 4 pillars of ZBNF, Agniastra, Brahmastra, Natural farming, Neemastra, ZBNF.

Agriculture in India dates back to approximately 11,000 years during which the country witnessed numerous crests and troughs including famines andthe farmers had been mainly practicing natural farming. While the country imported 6-10 million tonnes (Mt) of wheat annually to feed 1/3rd of today's population (1.3 billion) during mid-1960s, the Green Revolution (GR) transformed the country to a state of self-sufficiency in early 1970s by adopting various modern methods and technology, It would be relevant to mention here that during the last 70 years starting from 1950, our food production has increased by more than 5 times (from 50.8 Mt in 1950-51 to 284.8 Mt during the year 2017-18) whereas the population grew only 3.5 times. This incredible achievement was made possible mainly by increasing the productivity of food crops (*viz.* wheat, rice andpulses) and partly by expanding the area (under these crops). However, farmers' income remained low in comparison to those working in non-farm sectors. In the meantime, realizing the declining total factor productivity and profitability of the farmers in general andsmall and marginal farmers in particular, the Government of India, particularly national institution for transforming India, national institution for transforming India (NITI) ayog, has been looking for alternative farming systems that could be more profitable with reduced input and cost and there came a few alternative farming methods like Vedic Farming, Agnihotra Farming, Amrutpani Farming, Homoeo Farming and Zero Budget Natural (Spiritual) Farming claiming exciting but scientifically unproven results. By adopting the Zero Budget Natural Farming (ZBNF) the nation cannot afford to compromise on the nutrient supply neededto overcome the "silent hunger" and the unethical perpetuation of high concentration ofstunted and wasted children also we cannot achieve the double farmers' income.

ZBNF practices

ZBNF is an agro-ecological farming approach that promotes growing crops in harmony with nature. The toolkit of ZBNF was developed by Subhash Palekar in the 1990's. ZBNF has two major axes, one agronomic and the other structural. On the one hand, it is about improving soil fertility through a number of agro-ecological principles, including diversification, nutrient recycling, increasing beneficial biological interactions, among others (Palekar 2006). ZBNF opposes use of external inputs or synthetic fertilizers. On the other hand, ZBNF is about de-linking farmers from external inputs and credit markets to create autonomy by not purchasing anything from external actors and especially from corporations (Rossetand Martínez-Torres 2012).

Four wheels of ZBNF

ZBNF is based on what Palekar calls the four wheels of ZBNF, shown in Table 1. Bijamrita (a seed treatment) and Jivamrita (a soil inoculant) are microbial mixtures which are ready in 48 hours. For those who do not have access to water or labour, a dry version of Jivamrita called Ghanajivamrita is prescribed; this can be prepared once and stored for a year. Both are sources of beneficial bacteria which have plant protective qualities and stimulate plant growth (Sreenivasa *et al.* 2009). Contrary to conventional agriculture, Palekar believes that the soil already has all the nutrients necessary for plant growth and thus no external inputs need to be added; instead, the existing nutrients have

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How to cite this article: Choudhary, S.K., Kumar, R., Seema and Kumar, A. (2022). General Overview of Zero Budget Natural Farming (ZBNF). Agricultural Reviews. DOI: 10.18805/ag.R-2186.

Submitted: 08-03-2021 **Accepted:** 08-03-2022 **Online:** 25-04-2022

Table 1: Four wheels of ZBNF, Source: (APZBNF 2018).

Methods	Preparation	Application	Benefits
Jivamrita/jeevamrutha is a fermented microbial culture. It provides nutrients, but most importantly, acts as a catalytic agent that promotes the activity of microorganisms in the soil, as well as increases earthworm activity; During the 48 hour fermentation process, the aerobic and anaerobic bacteria present in the cow dung and urine multiply as they eat up organic undisturbed soil is also added to the preparation, ingredients (like pulse flour). A handful of as inoculate of native species of microbes and organisms. Jeevamrutha also helps to prevent fungal and bacterial plant diseases. Palekar suggests that Jeevamrutha is only needed for the first 3 years of the transition, after which the system becomes self-sustaining.	Put 200 liters of water in a barrel; Add 10 kg fresh local cow dung and 5 to 10 liters aged cow urine; Add 2 kg of Jaggery (a local type of brown sugar), 2 kg of pulse flour and a handful of soil from the bund of the farm. Stir the solution well and let it ferment for 48 hours in the shade. Now jeevamrutha is ready for application. 200 liters of jeevamruta is sufficient for one acre of land.	Apply the jeevamrutha to the crops twice a month in the irrigation water or as a 10% foliar spray.	It provides nutrients, but most importantly, acts as a catalytic agent that promotes the activity of microorganisms in the soil, as well as increases earthworm activity. *Jeevamrutha* also helps to prevent fungal and bacterial plant diseases. That *Jeevamruthai*s only needed for the first 3 years of the transition, after which the system becomes self sustaining.
Bijamrita/beejamrutha is a treatment used for seeds, seedlings or any planting material. Bijamrita is effective in protecting young roots from fungus as well as from soil-borne and seed-borne diseases that commonly affect plants after the monsoon period. It is composed of similar ingredients as jeevamrutha-local cow dung, a powerful natural fungicide andcow urine, a strong anti-bacterial liquid, lime, soil.	It is basically made up of water (20 l), cow dung (5 kg), urine (5 l), lime (50 gm) and just a handful of soil.	Add Bijamrita to the seeds of any crop: Coat them, mixing by hand; dry them well and use them for sowing. For leguminous seeds, just dip them quickly and let them dry.	Bijamrita is a seed treatment, equipped in protecting young roots from fungus as well as from soil-borne and seed-borne diseases.
Acchadana-Mulching: According to Palekar, there are three types of mulching: **a. Soil mulch:** This protects topsoil during cultivation and does not destroy it by tilling. It promotes aeration and water retention in the soil. Palekar suggests avoiding deep ploughing. **b. Straw mulch:** Straw material usually refers to the dried biomass waste of previous crops, but as Palekar suggests, it can be composed of the dead material of any living being (plants, animals, etc). Palekar's approach to soil fertility is very simple-provide dry organic material which will decompose and form	It could be done by soil mulch, straw mulch or live mulch.		It conserves soil moisture, by reducing evaporation.

Table 1: Continue...

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humus through the activity of the soil biota which is activated by microbial cultures. **c. Live mulch (symbiotic intercrops and mixed crops):** According to Palekar, it is essential to develop multiple cropping patterns of monocotyledons (monocots; Monocotyledons seedlings have one seed leaf) and dicotyledons (dicots; Dicotyledons seedlings have two seed leaves) grown in the same field, to supply all essential elements to the soil and crops. For instance, legumes are of the dicot group and are nitrogen-fixing plants. Monocots such as rice and wheat supply other elements like potash, phosphate and sulphur.		
Whapasa-moisture: Palekar challenges the idea that plant roots need a lot of water, thus countering the over reliance on irrigation in green revolution farming. According to him, what roots need is water vapor. Whapasa is the condition where there are both air molecules and water molecules present in the soil andhe encourages reducing irrigation, irrigating only at noon, in alternate furrows ZBNF farmers report a significant decline in need for irrigation in ZBNF.	The irrigation should be reduced and irrigation shouldbe practiced only at noon, in alternate furrows.	Palekar challenges the idea that plant roots need a lot of water, in-fact, what roots need is watervapour andtherefore, Whapasa is the conditionwhere there exist both air molecules and watermolecules present in the soil.

to be "unlocked" and made bioavailable via jiwamruta (Palekar 2005)- this idea is called Annapurna(Sanskrit for abundant) by Palekar. Palekar claims that the urine and dung from one cow are enough for farming 30 acres of land andso cow ownership by each individual farmer is not necessary. In places where local cows are not available, other alternatives of other animals like buffalos or even human urine can be used (Palekar Training Camp, Guntur 2018), but Palekar claims that indigenous cow breeds have the most and best microbes and are preferable. Native cow breeds are less input intensive and easier to manage for resource-poor farmers, but their populations have dropped significantly (Balaraju *et al*, 2017). In Kerala (Münster 2016) some others were purchasing the dung and urine from other farmers or landless herders. In AP, the state government has provided support to farmers to access dung and urine of cows. He was collecting the dung and urine and selling these to neighbouring ZBNF farmer groups.

Mulching in ZBNF takes various forms. "Live mulching" is promoted with cover crops of a mix of monocotyledons (like millets) and leguminous dichotyledons (like beans). The monocots provide nutrients like potash or phosphate, while the dicots help in nitrogen-fixing (Palekar 2006). Straw mulching is also promoted, using dry crop residue (Khadse and Rosset 2019).

Waaphasa means water vapor. Palekar claims that roots absorb water vapour and not water. He promotes a microclimatic condition around the roots, where there is a mix of air and water molecules and rejects overwatering. He prescribes watering only when the sun is high at noon for optimum whaaphasa formation. Palekar claims that up to 90% of water use can be reduced through ZBNF practices making it ideal for rain-fed farming (Palekar 2006).

Palekar also prescribes a number of natural fungicides and pesticides made from locally sourced ingredients like neem leaves, chilies, garlic, tobacco, sour buttermilk, *etc.* Increasing functional diversity is a critical principle of ZBNF; a number of crop combinations, with a view of increasing functional bio-diversity is proposed by Palekar. He rejects any external additions, including vermicompost made by exotic worm species and instead supports the growth of local earthworms *in situ*.

Other important principles of ZBNF and points to note:

Intercropping

This is primarily how ZBNF gets its "Zero Budget" name. It doesn't mean that the farmer is going to have no costs at all, but rather that any costs will be compensated for by income from intercrops, making farming a close to zero budget activity. Palekar explains in detail the crop and tree associations that work well for the south Asian context.

Contours and bunds

To preserve rain water, Palekar explains in detail how to make the contours and bunds, which promote maximum efficacy for different crops.

Local species of earthworms

Palekar opposes the use of vermicompost. He claims that the revival of local deep soil earthworms through increased organic matter is most recommended.

Cow dung

Accroding to Palekar, dung from the Bosindicus (humped cow) is most beneficial and has the highest concentrations of micro-organisms as compared to European cow breeds such as Holstein. The entire ZBNF method is centred on the Indian cow, which historically has been part of Indian rural life.

Over six years of dedicated research, Palekar revealed that:

1. Only, the dung from local, Indian cows is effective in the re-enrichment of the barren soil. Dung from Jersey and Holstein cows is not as effective. If one is falling short of dung from local cows, one may even use the dung from bullocks or buffaloes.
2. Dung and urine of the black colored Kapila cow is believed to be miraculous.
3. To get the most out of the cow dung and urine, ensure that the dung is as fresh as possible and that the urine is as stale as possible.
4. An acre of land requires 10 kilograms of local cow dung per month. Since the average cow gives 11 kilograms of dung a day, dung from one cow can help fertilize 30 acres of land per month.
5. Urine, jaggery and dicot flour can be used as additives.
6. The lesser milk the cow gives, the more beneficial its dung is towards reviving the soil (Babu, 2008).

"ZBNF is self-nourishing and symbiotic in nature."- Subash Palekar (Palekar, 2014).

ZBNF has recently been re-christened as 'Subhash Palekar Natural Farming' (SPNF). But the system is supposed tohave existed since mid-1990s in southern India, notably in the state of Karnataka. Laterit was promoted by the Government of Andhra Pradesh during the last two decades as'Community Managed Sustainable Agriculture' (CMSA) or 'Climate Resilient Zero Budget Natural Farming' (CRZBNF). Apart from this, attempts are being made to promote this new method offarming in a big way by non-government organizations as well as governmental agenciesas presented below:

Endorsement by the Government of India

While the country has been planning to revamp its agricultural production system includingRandD to meet the formidable challenges being faced by it, the economic survey of 2018-19 made a fervent appeal for the adoption of 'Zero Budget Natural Farming' (ZBNF) in a bigway to double farmers' income and it was subsequently endorsed by the Hon'ble Finance Minister during her budget speech in the parliament. ZBNF is said to be 'Zero Cost or Zero Input Natural Farming' and, therefore, whatever quantity is harvested is treated as net profitto the farmer.

Need for scientific validation

There have been a few reviews and opinions of ZBNF (Munster, 2018; Agarwal, 2019; Rama Kumar and Arjun, 2019 and an editorial in 'Economic and Political Weekly' entitled 'Mirage of Zero Budget Farming' in July 27, 2019 issue). They claimsof ZBNF are questionable and need further scientific validation. Indian Institute of Farming Systems Research (ICAR-IIFSR), Modipuram has initiated work on its scientificValidity and examining the results of these multi location trials.

How to feeding world's largest population in 2025 and beyond by adoption of ZBNF?

India will soon become the most populous country in the world with an anticipated population of nearly 1.7 billion by 2050. In order to feed this population, the country has to adopt a policy of vertical growth in productivity as the chances of horizontal expansion in cultivatedarea are almost impossible. An assessment of projected requirement and ways and meansto produce adequate quantity is presented below:

Projected demand of food and nutrition

If India is to attain and maintain a GDP growth rate of 8.0%, then we need to produce 457Mt of food grains (including 50.3 Mt of pulses) by 2050. Similar increase in production level of other food items like edible oils (45.2 Mt), vegetables (438.6 Mt), fruits (183.4 Mt), milk (483.6 Mt), sugar (58.2 Mt), meat (18.1 Mt), eggs (202.5 billions) and fish (27.0 Mt) is also required (Chand, 2012). This would require a four-fold increase in land productivity, a three-fold increase in water productivity, doubling of energy use efficiency-abouthalf through labour and capital substitution and a six-fold increase in labour productivity (Chand, 2012). Assuming that ZBNF is adopted by half of the small and marginal farmers who constitute 86% of the total farmers in the country, what would be the likely impacton the food production? In order to answer this, we need to address the following questions:

a. Is it possible to meet the nutrient requirements of crops or will indigenous nutrient supply (even with microbial augmentation as suggested in ZBNF) suffice crop demand?
b. Can we produce enough and sustain the crop yields over the years to feed the growing population with ZBNF?
c. Are there adequate scientific evidences to support the advantage of ZBNF over scientifically proven crop management practices?
d. Do we want to take agriculture in India away from evidence-based Science and Technology?
e. Will reliance on ZBNF aid farmers to double their income and end the debt cycle?
f. Is the food produced by ZBNF superior in quality?

Can ZBNF meet the nutrient demand of the crops?

Continuous growing of crops which exhausts the soil nutrient reserves in soil profile and hence, soils have to bereplenished with essential major plant nutrients. Later, the deficiency of secondary and micronutrients also emerges which may become a yield limiting factor and this deficiency also needs to be eliminated. For example, in rice-wheat system with 10 t/ha productivity, the total uptake of N, P_2O_5, K_2O is 225, 100 and 315 kg (Tandon, 2004). This requirement cannot be fulfilled without the application of chemical fertilizers if higher productivity levels are to be maintained. In addition to NPK, the 10 t/ha productivity of R-W system also removes about 40, 62 and 38 kg of S, Ca and Mg, respectively along with substantial amounts of micronutrients. Continuous cropping without adequate replenishment of nutrients obviously depletes soil's native reserves and affects its health. In that sense, it is essential to monitor the soil nutrient status through soil testing at regular intervals and recommend balanced fertilization as per the requirement of the crop to maintain the soil health for sustaining higher productivity levels. Further, the nutrient requirement can also be supplemented with addition of organics and bio-fertilizers which reduces the input of nutrients through chemical fertilizers and also enhances biological activity and physical health of soil that, in turn, increases the nutrient and water use efficiency while maintaining and sustaining the productivity at higher levels over the years. ZBNF, however, cannot provide this much quantity of nutrients as soil has a limited nutrient supplying capacity and hence, the crop productivity will be maintained at a low level. With this low level of productivity (in ZBNF), the farmers will not be able to earn enoughto double their income and be free from the debt. Also, at the country level we will not beable to meet the food and nutritional demand of the growing population.

Crop productivity and yield sustainability

Studies initiated by the ICAR-(IIFSR), Modipuram at several locations in the country have clearly indicated that yield levels were drastically reduced in rice-wheat cropping system (the backbone of national food security) by 59% in wheat and 32% in basmati rice. Results of a three-year Natural Farming Experiment by the University of Agricultural Sciences (UAS), Dharwad indicated a yield decline of at least 30% in soybean-wheat, groundnut-sorghum and maize-chickpea cropping systems while it was 17% in cotton-groundnut inter-cropping system. These trials have clearly established that food security will be seriously challenged along with the farmers' income, if ZBNF is adopted.

ICAR-AICRP (All India Coordinated Research Project) on Long Term Fertilizer Experiments (LTFE) continuing for the last 50 years in different agro-eco regions and cropping systems of the country, have proved beyond doubt the significance of balanced fertilization (Singh and Wanjari, 2017). Apart from this, ZBNF also claims that dung and urine from one indigenous cow can support 30 acres (12 ha) of land. It is pertinent to mention here that one cow will be able to give around 5,000 kg dung in a year that will supply 12 kg N. The important question is: Can 12 kg N in

combination with so called Jeevamrit and Beejamrit support cultivation of 12 ha (30 acre) of agricultural land?

Are there adequate scientific evidences to support advantage of zbnf over scientifically proven crop management practices?

Although the work on ZBNF has been taken up by some states but no systematic datahave been generated so far to prove the superiority of this technology over the scientifically proven crop management practices. However, the proponents of ZBNF continue to defendthe technology without any scientific evidence (Palekar, 2019). This is intriguing and needsfurther discussion to clear the air around ZBNF.

Quality of the produce

Increasing consciousness about conservation of environment as well as of health hazards quality and safety, particularly in the developed countries. If Good Agricultural Practices (GAP) is strictly adhered to, safe and nutritious food could be produced by conventional integrated nutrient and pest management practices. It is a known fact that plants take nutrients in inorganic form only, even if we apply them through organic manure. As regards the claim (by the proponents of ZBNF) of superior quality of the produce under ZBNF, the produce of ZBNF will definitely be free from pesticide residue, but the farmers practicing ZBNF did not get premium price for their produce and thus the expectation of higher price for ZBNF produce has been belied resulting in their return to conventional farming practices using need-based chemical fertilizers, caused by agrochemicals has brought a major shift in consumer preference towards food.

Strategies for meeting the future demand of food need to focus ZBNF

The country has to adopt a number of strategies to meet the future demand of food and nutrition of the growing population. This includes bridging yield gaps between yield potential and the yield levels achieved at the farm in major crops. Apart from this, increasing total factor productivity, judicious use of nutrients especially of chemical fertilizers and pesticides, efficient management of natural resources like soil and water. Prevention/drastic reduction in post-harvest losses,processing and product development, integrated crop and pest management, adopting climate smart agricultural practices to avoid adverse impact of climate change on agriculture, giving special attention to developing technology for rain-fed areas, water harvesting, increasing water use efficiency, conservation agriculture, precision farming, empowering individuals, especially women in agriculture, food fortification and bio-fortification would ensure nutritional security. In order to overcome the widespread micronutrient deficiency in soil, application of compost has to be made mandatory along with application of balanced dose of chemical fertilizers.

Case study for ZBNF is totally based on imagination

a. Several Farm scientists' body dismisses idea of zero-budget natural farming, calls it an unproven technology.
b. Natural Academy of Agricultural Sciences (NAAS) said that the government should not needlessly invest capital and human resources towards promoting the ZBNF idea.

The Natural Academy of Agricultural Sciences (NAAS), the country's top body of farm scientists, has criticised zero-budget natural farming, calling it an "unproven" technology that will not bring tangible gain to either farmers or consumers, The Indian Express reported on zero budget natural farming relies on the idea that over 98% of the nutrients needed for crops for photosynthesis are supplied naturally through air and water. The remaining 2% are taken through the soil by the action of microorganisms. Therefore, farmers must apply microbial culture, a seed treatment solution, watering through the plant's canopy and cover them with a layer of dried straw or fallen leaves. The academy's criticism came even as Prime Minister told the United Nations Convention to Combat Desertification that India is focusing on zero-budget natural farming to improve farm incomes. Finance Minister had also highlighted the importance of this method.

c. Zero Budget Natural Farming has no scientific validation and its inclusion into agricultural policy appears unwise

Organic farming became an umbrella term that represented a variety of non-chemical and less-chemical oriented methods of farming. Rudolf Steiner's biodynamics, Masanobu Fukuoka's one-straw revolution and Madagascar's System of Rice Intensification (SRI) were examples of specific alternatives proposed. In India, such alternatives and their variants included, among others, homoeo-farming, Vedic farming, Natu-eco farming, Agnihotra farming and Amrutpani farming. Zero Budget Natural Farming (ZBNF), popularised by Subhash Palekar, is the most recent entry into this group. He labels chemical fertilizers and pesticides as "demonic substances", cross-bred cows as "demonic species" and biotechnology and tractors as "demonic technologies". At the same time, Mr.Palekar is also critical of organic farming. For him, "organic farming" is "more dangerous than chemical farming" and" worse than [an] atom bomb". He calls vermicomposting a "scandal" and *Eisenia foetida*, the red worm used to make vermicompost, as the "destructor beast". He also calls Steiner's biodynamic farming "bio-dynamite farming". His own alternative of ZBNF is, thus, posed against both inorganic farming and organic farming.

Mr. Palekar's premise is that soil has all the nutrients plants need. To make these nutrients available to plants, we need the intermediation of microorganisms. For this, he recommends the "four wheels of ZBNF": Bijamrit, Jivamrit, Mulching and Waaphasa. In addition, ZBNF includes three methods of insect and pest management: Agniastra, Brahmastra and Neemastra (all different preparations using

Table 2: Name, composition and controls of pest management (Source: Bishnoi and Bhati 2017).

Name of pest management formulae	Composition	Controls
Agriastra	It is composed of 10 litre Local Cow Urine and1 kg Tobacco, 500 gm of green chili, 500 Gram Local Garlic, 5 kg Neem leaves pulp (crushed in urine). For spraying, 2 l Brahmastra is taken in 100 l water.	It is effective against the pests like leaf roller, stem borer, fruit borer, pod.
Brahmastra	It is prepared by neem leaves, custard appleleaves, lantern camellia leaves, guava leaves, pomegranate leaves, papaya leaves and white dhatura leaves crushed and boiled in urine.	It is used to control all of the suckingpests, pod borer, fruit borer *etc.*
Neemastra,	It is made up of local cow urine (5 litre), cow dung (5 kg) and neem leaves and neem pulp (5 kg) fermented for 24 hrs.	It is used for sucking pests and mealy bug.

cow urine, cow dung, tobacco, fruits, green chilli, garlic and neem) (Table 2).

d. Unsubstantiated claims

There are no independent studies to validate the claims that ZBNF plots have a higher yield than non-ZBNF plots. One field trial is on-going at the G.B. Pant University of Agriculture and Technology, but its full results will be available only after five years. According to reliable sources, preliminary observations of these field trials have recorded a yield shortfall of about 30% in ZBNF plots when compared with non-ZBNF plots.

e. Standing reason on its head

Third, most of Mr. Palekar's claims stand agricultural science on its head. Indian soils are poor in organic matter content. About 59% of soils are low in available nitrogen; about 49% are low in available phosphorus; and about 48% are low or medium in available potassium. Indian soils are also varyingly deficient in micronutrients, such as zinc, iron, manganese, copper, molybdenum and boron. Micronutrient deficiencies are not just yield-limiting in themselves; they also disallow the full expression of other nutrients in the soil leading to an overall decline in fertility.

f. Scientific approach needed

Undoubtedly, improvement of soil health should be a priority agenda in India's agricultural policy. We need steps to check wind and water erosion of soils, minimise physical degradation of soils due to waterlogging, flooding and crusting, improve the fertility of saline, acidic, alkaline and toxic soils by reclaiming them and balanced fertilisation and integrated nutrient management. In this sense, the inclusion of ZBNF into our agricultural policy by the government appears unwise and imprudent.

CONCLUSION

From the above discussion, it is amply clear that ZBNF not practically possible in India and not supported by any science-led information. In the pre-green revolution period, India wasimporting food grains to feed the nation (Siegel, 2018). It is important to undertake scientific evaluation of these technologies and their likely impacton food security of the country. There is no scope for an incremental value gained by the farmer or the consumer through ZBNF many of them, conclude that the ZBNF are questionable and need scientific validation. Studies on ZBNF initiated by the ICAR-Indian Institute of Farming System Research (IIFSR), Modipuram at several locations in the country and University of Agricultural Sciences (UAS), Dharwad have clearly indicated that yield levels were drastically reduced in several cropping systems.Therefore, it would be premature to recommend its wide-spread adoption which may leadto massive damage to the hard-earned knowledge and benefits of agricultural.

Conflict of interest

There is no conflict of interests.

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