



Zero Budget Natural Farming in India: Aiming Back to the Basics

Saikat Biswas^{1*}

¹*Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal-741252, India.*

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ABSTRACT

Crisis of Indian agriculture is very pertinent at this moment as green revolution is gradually losing its hope. Excessive, pointless exploitation of broods of green revolution has left bad footprints on country's food security and environmental safety. With the motto to ensure food security by reviving Indian agriculture in environmentally safe way as well as to release farmers from debt cycle and suicides, zero budget natural farming (ZBNF) has come in the picture, which discards uses of all the chemical farming inputs and relies on natural way of farming i.e. rejuvenating soil and crop health through its own practices (*Jivamrita*, *Bijamrita*, mulching, soil aeration, intercropping, crop diversification, bunds, bio-pesticides etc.). ZBNF movement right now is the most popular agrarian movement which begun in 2002 in Karnataka and later successfully spread in many states (specially, of South India) of the nation through numbers of trainings, demonstrations and various promotional activities. Successful outcomes from farmers' fields of south Indian states like Andhra Pradesh, Karnataka etc. are encouraging and grabbing attention of farmers, public and private organisations towards ZBNF in recent times. Yet, various controversies regarding its transparency, inadequate information, efficacy, practices, idealisms, even the term 'zero budget' etc. have agglutinated around ZBNF over the years since it debuted. Critics in fact have cited several references of drastic yield reductions with ZBNF practices in many places.

*Corresponding author: E-mail: sbsaikatbiswas27@gmail.com;

Adequate scientific evaluation or monitoring of ZBNF's successes or failures through multi-locational trials is now therefore the needful before allowing or restraining its run in Indian agriculture.

Keywords: Environmental safety; food security; green revolution; Indian agriculture; zero budget natural farming.

1. INTRODUCTION

India is known worldwide for its agrarian economy. History speaks that agriculture in India has progressed much from when it debuted. Being a country with second largest population globally, India is always under immense pressure to feed its ever increasing countrymen. Currently, the fiery examples of malnutrition, poverty and hunger etc. portray that in spite of being backboned by agriculture, India still fails to address its complete food security. One obvious reason behind it is the consistent reduction of agricultural land with population and urbanisation rises. Another lesser highlighted issue comprises farmers' reluctance to farming. Relevant question arises here, "Why is so grimier situation when India is blessed with environment and resources for agricultural practice?" Among few answers, the most shocking one is unfortunately the green revolution. For sprinkling further light in this context, there is a need to emphasise on pre and post periods of that historic revolution. In ancient Indian times, natural resource based agriculture was solely practiced in collaboration with indigenous knowledge and experience of the farmers, which was not only able to safeguard the nation of less population with food assurance successfully but also its environment from getting polluted. Green revolution in India came into the picture in mid-60s in urge of foods from post-independence rapidly increasing population which ancient agriculture was suffering to sustain. Over uses of chemical fertilizers, pesticides, synthetic substances etc. with the motto to produce more and more food from limited land coverage, have consciously led India to sacrifice its environmental safety. Further with the introduction of hybrids and GM crops, many indigenous traditional landraces have been forced to extinct. Green revolution although has incurred a marked influence on agricultural sector by initial boosting up of crop productivity, from late-90s onwards it has begun to lose its hope. Extensive and unscientific propulsion of chemical based agriculture has led to stagnation in production rate as a consequence of long term soil health deterioration and exposed the inner beast of green revolution. In recent years,

fulsome ascent of both use and price of external inputs and jeopardized market system of agricultural produce go hand in hand together to throttle the farmers especially of small and marginal categories. What green revolution had done in the name of metamorphosing India from hungry one to food exporter, was temporarily a bliss and in long term, a conspiracy to slaughter the nation. For maintenance of agriculture with sharp rise of heavily relied inputs, capital less farmers are forced to take debt from private money lenders and not only in years of crop failure due to vagaries of weather, but also in usual days, due to production plateau imprecated from poor mother soil through spread of chemical and mechanised form of package of farming practice, return they get is far below the expenditure. Further, euphoria of middlemen in agricultural market makes a clear disparity between consumers' buying and farmers' selling prices. In order to get extrication from the clutches of money lenders, farmers have no option but to suicide. Since 2002, on an average, one farmer commits suicide every 30 minutes in India and 3/4th of the suicides have the coverage from small and medium farming communities [1]. Voices have been raised and deputation, strikes have been imposed many times. Still government has no lingering solution to this major issue. In consequence, new generation of farming community gets demotivated under such distressed paradigm.

Movements for sustainable alternatives of chemical based agriculture have substantiated that India can overcome and improve the present emaciated scenario. Although it is sceptical as most of the searched alternatives instead of spreading to grass root level, remain at the place of origin as topical wave of change [2] and do not connect the peasants in true sense [3], still some of them enlighten the hope of recuperation of moribund agriculture. A recent addition to the list of curers is zero budget natural farming (ZBNF). This chemical free farming practice which was first formulated during mid-90s by Maharashtrian agriculturist, Padma Shri, Subhashh Palekar to get rid of green revolution's curse, is now getting the spotlight as this 'back to basics' approach

has reportedly increased the crop productivity in several parts of South India [4]. In the following sections, this article will impartially highlight the term, benefits, practices, movement, success and controversies of zero budget natural farming with the aim to introduce it in front of the world.

2. ZERO BUDGET NATURAL FARMING (ZBNF)

As the name speaks, ZBNF is a natural way of farming without any capital investment. It basically goes back to sole use of rich natural resources which ancient agriculture fully relied on. Expenditure on purchased inputs is completely excluded in this system. If some cost is incurred by any chance, it is compensated by the profitable production. In the present context of sharp increase of production cost and stagnation in production rate coupled with environmental footprints associated with chemical fertilizers/pesticides, ZBNF is gaining momentum as it rejuvenates soil health for sustainable crop production through diversification, microbial activities, nutrient recycling, beneficial biological interactions [5]. Besides, in rain fed areas where green revolution holds less significance, ZBNF can be a promising option under uncertainty of weather. It is an extreme form of low external input sustainable agriculture (LEISA), where all the inputs are locally (on farm) available and output of one farming system is mostly used as input in other farming system.

3. BENEFITS OF ZBNF

New York Times headlined on June 26, 2018, 'Bringing farming back to nature' and critically pointed out the catastrophe in farming if nature is ignored [6]. True example covers green revolution which has now become obsolete one as its artificial techniques fail to boost up the yield and leave environmental consequences. In the context of food crisis, global warming, climate change, destruction of natural resources, migration and suicides of farmers [7], ZBNF is possibly the most successful agrarian movement in the world in terms of its reach [8]. There are several benefits of shifting modern day agriculture to 'back to the basics' approach through zero budget natural farming. ZBNF curtails down the need of taking loans for farming activities as it completely relies on use of internal inputs. Therefore, it can be a measure to minimise indebtedness and suicide in farming community (particularly of the small and marginal categories). Further, through exclusion of

chemicals (viz. fertilizers, pesticides) from farming activities, ZBNF can check further deterioration and effectively revive the environmental and soil health. It also helps in sovereignty of traditional land races, encourages soil aeration, bunds and top soil mulching, intercropping and less water application which although do not bring sudden increase in productivity but can uplift farmers' income by developing self-sustaining system after at least 3 years of conversion period. Ecological benefits of ZBNF have been also reported [9,10]. Besides, in present context of labour crisis (due to reluctance to take farming as occupation and therefore, migration towards urban areas for other jobs), ZBNF can be a suitable option as it does not promote various intercultural operations and consequently the involvement of hired manual labours. As there is no peak season in ZBNF models (such as 5 years model, [11]) due to diversified culture, need to hire labour in a particular time (specially, in labour crisis) can be minimised. In consequence, ZBNF can be able to reduce energy intensity per unit of gross domestic product [12]. Moreover, ZBNF can reduce material footprint per unit capita and per unit value added in agriculture by reducing external inputs and encourage waste recycling instead of dumping or burning.

4. DIFFERENCE BETWEEN ZBNF AND ORGANIC FARMING

Difference between ZBNF and organic farming is mainly based on cost of farming as latter is an expensive approach. Further, release of greenhouse gases from organic farming is also a major factor which makes ZBNF different one. Another difference is that ZBNF requires lesser effort and time to practice than organic farming activities. For instance, preparation of organic manures takes weeks to months while in ZBNF, within 2-3 days, organic formulations (*Jivamrita/Jeevamrutha* and *Bijamrita/Beejamrutha*) can be prepared [13].

5. FUNDAMENTAL PRACTICES OF ZBNF

Mr. Palekar, himself the victim of chemical aided agriculture in his own land back in early 90s, is known among the ZBNF farmers as 'Guru' (master) as he suggested 4 fundamental practices of ZBNF [8] which are described below.

5.1 Jivamrita/Jeevamrutha

It is basically a kind of bio-fertilizer which adds nutrients to the soil for plants' uptake. Further,

this fermented microbial culture when applied to the soil, catalyses soil microbial and earth worms activities to make them do all the benefits. Bacterial inoculums present in cow faeces as well as in fist of native soil during fermentation process obtain nourishment from organic sources of nutrients and multiply. Even, the applied fermented culture attracts and enhances the activities of other beneficial micro-organisms already present in the soil [14]. On application, these microbes start to act and improve nutrient availability for the crop. Palekar [15] stated that there is actually no need for external application of fertilizers as the soil is a treasure box of all nutrients which is unlocked by micro-organisms when their activities get improved by application of *Jivamrita/Jeevamrutha* (or 'nectar of life'). It is known to check various soil borne diseases also. In situation of labour and water crisis, dry form of *Jivamrita/Jeevamrutha* called *Ghanajivamrita* is prepared which can be stored for one year [13].

5.2 *Bijamrita/Beejamrutha*

Bijamrita/Beejamrutha is used as a treatment option of seed/seedling/planting material to reduce mortality rate and ensure good or vigorous crop stand on the field by checking various seed and soil borne diseases of younger seedlings. Like *Jivamrita/Jeevamrutha*, *Bijamrita/Beejamrutha* also contains beneficial bacteria which are not only helpful in plant protection but also in stimulation of plant growth [16].

5.3 *Acchadana/mulching*

There are several benefits of covering the soil with dust or plant materials (*Acchadana/mulching*). It protects the top soil from erosion. Besides, it improves soil aeration and conserves soil moisture by checking evaporation water loss. Weed emergence is to some extent checked through mulching. Further, Organic type of mulches such as dried plants additionally produces humus on decomposition, which supplies nutrients to the crop. As mulching reduces the requirement of tillage (Deep ploughing is strongly avoided in ZBNF.), labour shortages (in present days) can be compensated. Live mulch (using different plants) is helpful as different nutrients can be added in the soil (Monocots supply potassium, phosphorus etc. while dicots or legumes fix atmospheric nitrogen.) [5].

5.4 *Whapasa/moisture*

Whapasa/moisture focuses on improving water use efficiency by reducing the quantity and frequency of irrigation water applied as only a limited amount of water is needed (in form of vapour) for the crop growth. Therefore, it provides resilience from drought. Ideal situation to mix up of air and water molecules renders suitable soil aeration and reduces 90% water use which is helpful in rain fed agriculture [5].

The preparations/ types and applications of these 4 practices are listed in Table 1.

6. OTHER PRACTICES OF ZBNF

6.1 Intercropping and Crop Rotation

Intercropping is cultivation of two or more different crops together on a land at a time. Better harvesting of solar radiation, utilization of land and other resources and checking evaporation and erosion etc. are some major objectives of intercropping. Besides, it helps to enhance farmers' income or provide subsistence in case of main crop failure. Leguminous crops, millets, cereals, vegetables, fruit trees, medicinal plants etc. form the component crops of intercropping system. Diversification of cropping system is another important practice of ZBNF as it breaks the habitat and consequently the build-up of pests and diseases.

6.2 Plant Protection

Bio-pesticides (*Neemastra*, *Agniastra*, *Bramhastra* etc.) made through natural or organic or bio-products (Fig. 1 and Table 2) are only permitted to use in ZBNF during the times of pest and disease outbreaks to protect the plants to reach economic injury levels. They are effective in controlling various seed, soil and air borne diseases as well as insects like aphids, jassids, mealy bugs, white flies etc.

6.3 Bunds and Contours

Bunds and contours are constructed with the aim to reduce water borne erosion of land and conserve rain water for crop production.

6.4 Indigenous Earth Worm Species

In ZBNF, addition of vermicompost in to the soil is not promoted. According to Palekar, deeper soil has its own indigenous earth

worm species which can efficiently enhance soil fertility when any organic matter is added to the soil and there is no particular need of use of external vermicompost. He stated that exotic earth worm species specially, *Eisenia foetida* is dangerous as it absorbs toxic metals and contaminates ground water and soil [20].

Table 1. Name, preparation and application of 4 major practices of ZBNF [17]

Name	Preparations/ types	Applications
<i>Jivamrita/Jeevamrutha</i>	200 litres of water is poured in a barrel/container. 10 kg fresh local Indian bred cow dung and 5-10 litres of aged cow urine are put inside it. Then, 2 kg each of <i>jaggery</i> (brown sugar) and pulse flour and a fist of soil from chemical less area are added in to it and mixed thoroughly. Mixture (<i>Jivamrita/Jeevamrutha</i>) is kept further in shade for 48 hours for fermentation.	Soil application of 200 litres of <i>Jivamrita/Jeevamrutha</i> in irrigation water on 1 acre of land twice a month or foliar application of 10% solution
<i>Bijamrita/Beejamrutha</i>	It is prepared similarly as <i>Jivamrita/Jeevamrutha</i> (local Indian bred cow dung and urine, lime, water and soil). Specifically, 5 litres of urine and 5 kg of dung of local Indian bred cow are put inside a container containing 20 litres of water. 50 g of lime and a fist of native soil are then added into it and thoroughly mixed.	Coating and mixing the seeds by hand or leguminous seed dipping in <i>Bijamrita/Beejamrutha</i> solution followed by drying in shade and sowing
<i>Acchadana/mulching</i>	Three types of mulching are used viz. soil mulch (friable soil/dust coverage on top soil), straw mulch (dried residues of previous crops, dead materials of plants and/or animals) and live mulch (symbiotic mixed or intercrops preferably with monocot and dicot such as cereal-legume cropping).	Application of soil or straw mulch before sowing the seeds or sowing (cultivation) of crops to cover land spaces (live mulch)
<i>Whapasa/moisture</i>	It is making soil to provide water vapour to plant roots by reducing irrigation quantity and frequency.	Irrigation during noon in alternate furrows to make air and water molecules to remain in soil

Table 2. Ingredients with their quantities used for preparation of some other bio-pesticides [19]

Fungicide/Insecticide	Ingredients	Quantity used in mixture
Fungicide-I	Butter milk fermented for 5 days	5 litres
	Water	50 litres
Fungicide-II	Indian bred cow milk	5 litres
	Black Pepper Powder	200 g
	Water	200 litres
Insecticide-I	Neem seed or leaf powder	20 kg
	Water	200 litres
Insecticide-II	Indian bred cow urine	5 kg
	Indian bred cow dung	10 litres
	<i>Neem</i> leaves	10 kg
	Water	200 litres
Insecticide-III	Neem leaves soaked in cow urine for 10 days	10 kg
	Tobacco powder soaked in cow urine for 10 days	3 kg
	Garlic paste soaked in cow urine for 10 days	3 kg
	Green chilli paste soaked in cow urine for 10 days	4 kg

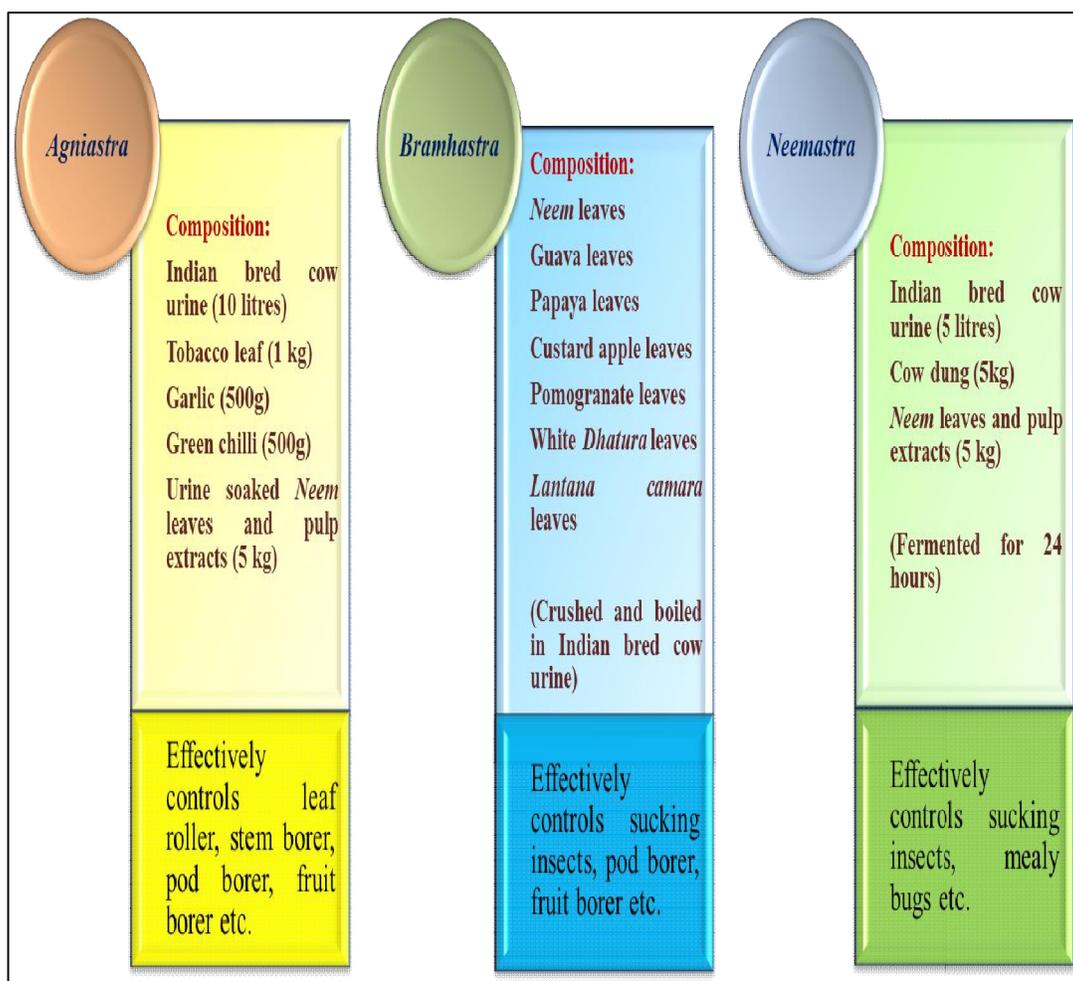


Fig. 1. Compositions of *Agniashtra*, *Bramhastra* and *Neemastra* [18]

6.5 Cow Dung

Faeces of local Indian cows (*Bos indicus*) are only recommended in ZBNF activities as Indian species contain more beneficial micro-organisms (around 3-5 crores) than foreign breeds. According to Palekar, lots of harmful bacteria, fungus and other pathogens are present in dung of foreign breeds and Indian breed is found to be solely efficient for crop cultivation. One Local indigenous cattle breed can cultivate 30 acres of land. ZBNF promoters therefore suggest not to mingle the faeces between Indian and foreign cattle breeds and ask farmers to use dung and urine of local Indian cow in ZBNF and those of foreign breeds in biogas or fuel generation [14]. Most of the ZBNF followers quit consumption of milk and its products as they avoid dairyfication of local cow to let these precious species shower benefits in crop production purpose only.

7. ZBNF MOVEMENT

ZBNF is a sustainable agricultural movement which mainly composed of and run autonomously by small and marginal farmers of rural India [8]. Although, it was started back in 2002 in Karnataka and subsequently in other states (particularly of South India) as a collective or social movement made by rural farming community, it did not grab any attention of public and private organisations, policy makers and scientists until recent times [13]. ZBNF movement since its debut has critically raised questions on significance of modern day, so called 'techno-scientific' or mainstream agriculture. La Via Campesina [17] reported that ZBNF movement has improved not only crop yield but also socio-economic status of adopters as it reduces farm expenses to a minimum and makes the farmers self-sufficient. At local level,

ZBNF movement spreads through informal connection between farmers. Community resource person or master farmer from group trains the other farmers. At state level, ZBNF movement has networks of volunteers (leaders, political party representatives, independents, Palekar and his devotees) which organise training camps. Training covers ecology, principles, philosophy, success stories etc [17]. Initially, in obvious case, Palekar did not have mass base and got mixed response as farmers were unsure about the efficacy of his technology. Only few farmers got inspired by him and adopted ZBNF. The successful outcomes from their ZBNF fields convinced others and as a result, more and more farmers started to adopt this technology. From 2006 onwards, ZBNF got momentum as many new allies, volunteers were coming to be a part of this movement and they started to organise many training camps in order to spread ZBNF among farming community [13]. For instance, Palekar and his followers organised a successful training programme in Wayanad, Kerala back in 2008. Farmers of many parts of Kerala and even from other states, who were losing faith in chemical based agriculture, participated in that programme with the hope of alternative solution of green revolution (rather, suicide revolution). It is worthy to mention that many alternative forms of agriculture were already developed by many historic names. But according to Palekar, all of those were unscientific and part of foreign exploiter system [21]. He calls himself as a prime critic of certification of organic farm and its produce and states that natural farming or its produce can be certified by nature only, not by any third party [22]. He has cited the instance of forest as natural system where fruits are produced without any interference of organic or chemical farming and mentioned that likewise the natural system, ZBNF is self-developing, self-nourishing and self-sustaining [22]. With the success of the training programme in Wayanad, ZBNF movement has been spread to grass-root level of farmers through collective approach between successful farmers and ZBNF promoters. Training camps in presence of Subhash Palekar as chief speaker have been organised in many states (specially, of South India) and are still going on to spread this 'back to the basics' approach to the farming community. In all the training programmes, Palekar and other ZBNF activists have severely criticised green revolution and its devotees (agricultural universities, Govt. policies, researchers etc.) [23] and promoted ZBNF through 'seeing is believing' approach. Khadse

and Rosset [13] recognised Palekar's way of communication to the farmers in their own farming language during training programmes and consideration of simple practices rather than sophisticated ones to explain at initial stage for better understanding as some key factors behind the popularity of ZBNF among the farming community. Later, with the joining of IT professionals, ZBNF movement has got much bigger dimension as it has not only remained confined to physical workshops or training programmes but also got disseminated through various social media platforms (Facebook, Whatsapp, Twitter, Youtube, LinkedIn etc.), mobile phones to farming community of entire India and even to international farmers (such as Sri Lanka, Nepal etc.) [24]. It is noted that apart from Palekar's workshops, practical trainings at grass root level through local master farmers for others (farmer to farmer communications) have also resulted in massive spread of knowledge about ZBNF [8]. Participation of farmers is therefore not only limited in Palekar's training or demonstration camps but also gets extended in their own field and successful responses in many cases have grabbed the attention of government and private organisations in recent times as they are joining hands with ZBNF approach and various initiatives are therefore now coming up. However, there is further need of suitable policy for ZBNF to take off properly. Nevertheless, Palekar's movement (ZBNF) is arguably the most popular and widespread movement so far in the context of Indian agro-ecological system [23].

8. SUCCESS STORIES OF ZBNF

The long journey of ZBNF has just only begun. Still, it has been able to show its merit. Farmers tired of chemical farming are already showing interests on this alternative form of agriculture. Six states of India (Andhra Pradesh, Karnataka, Kerala, Himachal Pradesh Uttarakhand and Chhattishgarh) have started to give major thrusts on ZBNF. Bihar and Punjab have expressed their keen interests on it. Rajasthan, Meghalaya and Gujarat are also keeping eye on it [25]. Successful outcomes in states specially, Karnataka and Andhra Pradesh are inspiring the whole nation to give it a try at least once.

8.1 Karnataka Story

In 2002, in order to promote ZBNF in Karnataka, state farmers association named Karnataka Rajya Raitha Sangha (KRRS) collaborated with Subhash Palekar. KRRS was the main among

many allies, which played significant role to mobilise farmers towards ZBNF through various training camps [17]. Khadse *et al.* [8] reported several reasons for which farmers were interested in adoption of ZBNF: family health (54%), food security (46%), environmental safety (42%), reduction of cultivation costs (38%), reduction of reliance on various corporate sectors (33%), reduction of debt (30%), and spiritual purpose (30%). Rough estimate states that around 1 lakh farm families (mostly of middle class categories) in Karnataka have already shifted from conventional agriculture to ZBNF and all of them have their own lands, irrigation facilities and majority have at least one cow [17]. Khadse *et al.* [8] found that adoption of ZBNF has positively met all those purpose of Karnataka farmers (100% health improvement, income improvement for 85.7% households, quality of produce improvement for 91.1% households, yield improvement for 78.7% households, selling price improvement for 57.9% households, pest problem mitigation for 84.1% households, reduction of debt for 92.5% households, declination of cultivation cost for 90.9% households, increased soil conservation for 93.6% households, increased seed autonomy for 92.7% households, improved food autonomy for 87.8% households, improvement of seed diversity for 76.9% households) and thereby successfully addressed the risks of farming.

8.2 Andhra Pradesh Story

ZBNF movement in Andhra Pradesh was first started in 2015. Before division, Andhra Pradesh was the highest pesticide consuming state of India. Suffering from chemical based agriculture and simultaneously the preliminary successes of ZBNF in this state have grabbed the attention of state government towards this movement. In 2018, Andhra Pradesh government announced to shift state's agriculture system to ZBNF by 2022 (i.e. shift from India's first green revolution state to first ZBNF state) [26]. Government installed one non-profit organisation Rythu Sadhikara Samstha to spread ZBNF to farming community of Andhra Pradesh. Further, the state government collaborated with various national and international organisations to raise funding to make successful ZBNF model. In 2017-18, 16300 farmers from 972 villages of 13 districts have adopted ZBNF and in 2018-19, action plan was created to cover 5,00,000 farmers [26]. Government also expressed its aim to cover 6 million farmers in 2024 and entire cultivable area (8 million hectare) by ZBNF at the

end of 2026 [26]. ZBNF farmers in Andhra Pradesh have observed decline in input costs, increment of yields, fair trade in domestic and international markets, improved food and nutritional securities and reduction in inequality of economic position by improving net income of tribal farmers, landless farmers, tenant farmers, single woman farmers etc. In 2017, cultivations of rice, rain fed groundnut and cotton through ZBNF practices ensured the farmers to achieve 51%, 135% and 87% increase in net incomes respectively. There were 9% and 36% increments of rice and groundnut yields respectively in ZBNF farmers' fields of Anantapur, Andhra Pradesh [12]. Government of Andhra Pradesh in 2017 from its various crop cutting experiments in the state observed higher yields of rice (6416 kg/ha), irrigated groundnut (2868 kg/ha), black gram (1300 kg/ha), chilli (10240 kg/ha) and maize (12844 kg/ha) from ZBNF fields over non-ZBNF fields (5816 kg/ha, 2233 kg/ha, 1027 kg/ha, 7740 kg/ha 11856 kg/ha respectively for rice, irrigated groundnut, black gram, chilli and maize) [20]. Besides, reduction of cost of cultivation and increment of net income in rice, black gram and various other crops by adopting ZBNF have been also reported in this state [27,28]. Comparative performance of ZBNF and non-ZBNF during monsoon season for various rain fed crops are shown in Table 3 [25]. Moreover, by replacing the harmful pesticides and chemical fertilizers, ZBNF was able to improve health condition of farming community. From 2018, ZBNF rolled out integrated health and nutrition plans in 35 villages of Andhra Pradesh [12]. ZBNF programme further extended its target to ensure capacity building, knowledge, skill development and dissemination of sustainable production technologies to grass root levels of farming community through community resource persons or master farmers (farmer to farmer dissemination) and thus helped in rural employment generation in agriculture and its related sectors. In Andhra Pradesh, ZBNF was also successful in achieving equality of gender in cluster leadership level by providing direct participation of women and their self-help groups in trainings, agricultural works, direction and monitoring of community or group based farming and even in entrepreneurship [12]. ZBNF was further able to build resilience against climatic anomalies by improving strength of soil and crop. For instances, In Anantapur, Andhra Pradesh, pre monsoon sowing of combination of 9 cereals and millets (*Navdhanya*) was able to harness water vapour in air and application of *Jivamrita* improved soil health which altogether improved

crops' robustness to fight against drought condition. In 2017, when Vishakhapatnam, Andhra Pradesh experienced devastating cyclone, rice grown by ZBNF better withstood wind blow and water logging than conventional rice fields as ZBNF approach produced porous soil, deep roots and robust stem [12]. Several initiatives like installing custom hiring centres for group based rent of small machineries, non-pesticides shops for selling bio-pesticides and cow based formulations, village seed banks etc. have been taken by the state government recently to make ZBNF to run at accelerated pace [26].

8.3 Maharashtra Story

Wardha district of vidarbha region of Maharashtra is mostly agriculture oriented. Farmers of the district were facing problems of chemical based agriculture (high input costs, low productivity, decline in market price of the produce, pest and disease problems, degradation of soil, environment and health of producers and consumers etc.) as well as climatic anomalies since long time. Through ZBNF trainings and demonstrations, almost 10 thousand farmers have been encouraged for a transition to natural way of farming. Following the ZBNF practices, farmers have been able to cut down the expenditure by 40-45% and improve soil health and consequently the productivity. They have got high profit by selling their produce directly in the market without allowing interference of middlemen.

Some key ZBNF farmers' feedback and case studies are shown in Table 4.

As these initial results regarding feasibility of ZBNF are very much promising, in order to double the farmers' income and to address the major challenges of current agricultural system in the context of food security, finance minister of government of India in the Union budget of 2019-20 in parliament has therefore given a major thrust on ZBNF and advised the states to adopt it [31]. Niti Aayog, government of India is now

promoting ZBNF as a model in this country and UNEP on global basis [26]. ZBNF has been recently included in revised norms of schemes like *Rashtriya Krishi Vikas Yojana* (RKVY) and *Paramaparagat Krishi Vikas Yojana* (PKVY) by government of India.

9. CONTROVERSIES AND CRITICISMS ON ZBNF

Although ZBNF has already brought a remarkable revolution in agrarian society, reports are also available regarding its missing magic as it fails to return after few years, what it has claimed earlier in many parts of India including Palekar's native Maharashtra, where it was spontaneously adopted as an alternative of chemical based agriculture. Many ZBNF critics have already warned not to go for complete conversion of conventional farming to ZBNF without visualizing sufficient proof of its success. Also, some are in views that chemical based agriculture cannot be completely ignored and replaced by ZBNF considering the business point of view. The success of ZBNF in limited crops and in certain locations further raises questions on its uniformity in nation-wide agriculture. In fact, some already available mixed bag results of ZBNF project it as an overhyped agrarian movement. Critics have pointed out several questions as follows, which remain unanswered till date.

- Why is ZBNF to be given prime importance as an agro-ecological technique by rejecting others, since rests are also the part of regenerative agriculture like it [26]?
- Why is not the authority totally transparent in sharing information about ZBNF activities, performance, reach etc. on public domain? Why is there so much secrecy to share information with public about agreements between organisations, studies on its feasibility? Why is there only the anecdotal success reports presented in websites of its promoters? Is ZBNF promoters biased on their technique [26]?

Table 3. Comparative performance of ZBNF and non-ZBNF practices during monsoon season of 2017 for various rain fed crops [25]**

Particular(s)	ZBNF	Non-ZBNF	ZBNF compared to non-ZBNF
Yield (t/ha)	4.80	4.12	+16.5%
Cost of cultivation (000 INR.)	22.9	30.0	-23.7%
Gross return (000 INR.)	80.6	70.6	+14.2%
Net return (000 INR.)	54.0	36.0	+49.2%

**Total plots: 1531 for each of the farming; Crops grown: rice, maize, groundnut, finger millet, cotton

Table 4. Farmers' feedbacks after shifting to ZBNF and some individual case studies

Particular(s)	Observation(s)	Reference(s)
Farmers' feedback		
Crop performance under changing climate	Crops of ZBNF fields in Andhra Pradesh were healthy, robust and resilient to climatic anomalies.	[25]
Biodiversity	There were some practical observations on improvement of biodiversity with ZBNF practices. For instances, in 480 samples collected from 13 districts of Andhra Pradesh, numbers of earthworms from ZBNF and non- ZBNF plots were 232/m ² and 32/m ² respectively. Population of pollinators and pest antagonists were also improved in vicinity of ZBNF fields.	[29]
Income and Household transition	There was significant increase of farm income that thereby reflected on socio-economic status, life style and household transition (for instance, from mud houses to concrete ones) of farmers.	[25]
Individual Case study (**Farmers' names changed)		
Arjun, a farmer of Anantapur, Andhra Pradesh, was cultivating papaya in most of his 2 ha land for last 5 years. In 2017, he got to know ZBNF and inspired by self-help groups through loan facilities. He then tried ZBNF practices for his papaya cultivation.	Within 7 months, Arjun found remarkable yield and quality improvements of papaya and got higher market value than previous years. His story was inspiring to other farmers as many of them shifted to ZBNF subsequently.	[25]
Raju, a farmer of Vandanmedu, Kerala, was cultivating cardamom in his 14 acre land following chemical based farming methods. He was suffering from high input cost of synthetic pesticide. He then shifted towards ZBNF.	Raju successfully controlled the pests through botanicals and achieved sustainable production of cardamom.	[30]
Nakul, a farmer of Prakasam, Andhra Pradesh, tried ZBNF for papaya cultivation in 13 acre land.	Nakul got 16t/acre more yield and INR. 1,28,000 more net return through practicing ZBNF rather than non-ZBNF.	[12]
Laxman, a farmer of Andhra Pradesh, got pissed off from harmful effects of toxic pesticides and chemical fertilizers on soil and therefore, shifted to ZBNF after participation in one week training programme.	Laxman observed significant improvement of soil health as well as high production and income round the year.	[25]
Mahasin, a farmer of Muttukad, Kerala, started ZBNF in his 7 acre land for multiple crops, specially pepper, nutmeg, clove and vegetables.	Mahasin found significant yield increments of these crops with ZBNF practices. He also achieved pest free cultivation of crops.	[30]
Sachin, a farmer of Guntur, Andhra Pradesh, was previously practicing chemical farming in his 1 acre land for 5 years. His production return was offset by input costs. In 2016, he shifted to ZBNF. He started cultivating banana and yam in half an acre land each.	Sachin noticed high yield of the crops and betterment of soil health He made a profit of INR. 1,55,000 through practicing ZBNF.	[12]

- What will a farmer do if he/she does not have all the raw materials required in ZBNF as this farming approach follows strict guidelines of do's and don'ts? For example, native cow (*Bos indicus*) is not always available [32,33]. In that case, is there any provision of using second best option? Clarification in this regard is inadequate and thus leads to confusion among farmers.
- Palekar always expresses his intolerance against every 'western' thing and promotes 'Indian-ness'. For example, he prefers native cow in place foreign breeds and urges others to treat it as 'God' (sacred). However, don't he and his devotees think that this idea of Indian-ness is limited to elite Hindu ideals [33]? Although, any ZBNF training or various related statements did not openly promote a particular religion till date (For instance, many ZBNF farmers in Kerala are Christian by religion.), question may still arise in this regard.
- Is there the own charisma of ZBNF practices that works behind its adoption by the farming community or the charisma of Palekar's vision, dedication, motivational speeches, leadership behind the promotion of his brainchild? Instances are there that many farmers adopted ZBNF as they got influenced by Palekar's speech. In those cases, only biasness prevailed rather than debate before adoption [13,33].
- What has the authority done so far to resolve the matter that in many places, the master farmers (community resource persons) mostly act to impose the technique rather than to facilitate it, which ultimately leads not only to the dilution of learning process but also to confinement of knowledge within few farmers as the movement remains as a mere dissemination of ZBNF [34]?
- Why don't ZBNF promoters give adequate attention regarding marketing of ZBNF produce as reports are available that both ZBNF and non ZBNF produces are being sold together in many places in same market in same price [17]?
- Why is massive funding required to make success of ZBNF movement (for instance, in Andhra Pradesh, around \$2.3 billion credit) when ZBNF promoters at their start asserted that it doesn't need any external input (materials or credit) [26]?
- Why is it called 'Zero budget natural farming' when it is not possible to do farming in zero monetary investment? In ZBNF activities, the raw materials required have some price (When raw materials used are the products of own farm, some income is sacrificed. When the raw materials are bought from others, some expenses are there.). Even, there are involvements of the farmer and his/her family in farming activities, which also have some values in terms of money. Further, expenditure is there in rearing native cow which is one of the cornerstones of this technique. Although, recently the term 'Zero budget natural farming' has been replaced by 'Subhash Palekar natural (spiritual) farming', still in most places it is popular in its former name and thus raises controversy among the farming community [13].
- What is the reason to give suddenly the prime importance to ZBNF in place of various other projects when they have earlier performed successfully on promotion of organic/natural farming? For instance, although 'Community managed Sustainable Agriculture' performed well in Andhra Pradesh and was popular among the farmers, government has replaced it by ZBNF [26].
- Why does ZBNF remain mostly as a South Indian agricultural movement rather than a Nation-wide agricultural movement till date?
- Why are the key proponents of ZBNF promoting components of conventional agriculture also? For instances, Niti Aayog, government of India, beside promoting ZBNF in nation, is also supporting the use of transgenic or genetically modified crops/seeds in agricultural activities. Andhra Pradesh government is allowing various national and international organisations to be the part of ZBNF movement in the state, and those organisations are also associated in promoting various components of chemical based agriculture and even, in some

activities related to environmental degradation. The dual speaks of them are confusing and questionable [26].

- Who are the actual beneficiaries of ZBNF-farmers or various corporate organisations?
- What are the backup plans for such big credits if ZBNF model fails due to marketing and other issues and financiers opt to relinquish their support or go to other high returning option [26]?
- Is it possible to achieve food security of nation's enormous population using traditional varieties with half of yield potential of HYVs and hybrids [31]?
- Why are the farmers kept only as mere consumers of this technique, not as advisers to put their own knowledge inputs?
- How will farmers keep perseverance and patience during transitional period due to lingering effect of chemical farming, if the funds allocated for ZBNF is totally used for its promotional purpose only and not mobilised to them for their survival [26]?
- Does ZBNF provide adequate nutrition for high crop productivity as nutrient level of soil declines with intensive cropping? Is it possible enough to cover 30 acre of land with faeces of Indian cow breed providing on an average only 12 kg N per annum [31]?
- Is it feasible to promote ZBNF without considering substantial evidences of its benefits?
- Is ZBNF really able to help farmers in doubling their income?

Apart from these, there is also controversy related to the way of digitising information by foreign organisations, which can be exploited for proprietary gains, not for the actual benefits of farmers [26]. NAAS [31] has concluded ZBNF as a myth and critically emphasised that although there may be some maundering instances of yield increments with ZBNF, quantum jump in the same is not possible without considering chemical based agriculture. Detailed reviews by many [23,35,36,37,38] have also put ZBNF

under question. Saldanha [26] has mentioned that in spite of various promotional activities on ZBNF, very little communications regarding its socio-economic feasibility and environmental impacts have been actually made. Studies across India by ICAR-IIFSR (Modipuram), UAS (Dharwad) and others have already pointed out yield reductions in basmati rice-wheat (59% and 32% respectively), soybean-wheat, groundnut-sorghum, maize-chickpea (30%), cotton+groundnut (17%) systems [31]. Reports are also available on shifting back to chemical farming from ZBNF even by the farmers of Palekar's native Maharashtra [39].

10. CONCLUSION

Regardless the controversies and critics' points of view, there is nothing to deny the fact that ZBNF has been evolved with very positive mentality to benefit farming community. In fact, it has been able to rejuvenate many small-scale farmers of the nation. However, before its recommendation, it needs strong scientific evaluation or validation of its claim. For this, multi-locational trials by unbiased, autonomous bodies such as ICAR to study ZBNF's impacts on soil, land and environment health, socio-economic status of farmers and food security of nation are very much needed at this hour. Periodic monitoring, collection of data through various ICT tools, E-tracking practices and impartial showcase of the information on public domain are some pertinent strategies here to go forward. Further, ZBNF movement should be in compliance with adequate transparency, impartiality, democratic reviews, opinions, suitable precautions and futuristic vision. However, it is not the ZBNF only, but also the several other alternatives of chemical farming which deserve equal relevancy in this regard. It is distressful to highlight that crisis of Indian agriculture is real and farmers' repeated protests has received nothing but silence. ZBNF or other such initiative has been therefore given birth as a cherub to revamp country's agricultural system just as similar as green revolution did after post-independence. In fact, it is not at all the green revolution, but its unscientific, excessive exploitation which is the culprit for such crisis. Therefore, it will be premature right now to recommend or discard any of ZBNF (and/or other similar approaches) and chemical farming as both are actually aiming to ensure nation's food security. Rather, both the practices are needed to allow for some run side by side until confirmation regarding the efficacy and suitability

of any in the present agro-climatic and social scenarios is completely established.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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