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Organic farming and its impact on crop management in India

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Abstract
The ancient agriculture is entirely different from present day agriculture, the later being more commercialized. Keeping in view of income generation to the farmer the modern organic farming practices are now available which give the benefits of traditional ancient agriculture. At international level IFOAM helps in establishing the standards and procedures in organic farming. In India, which is the birth place of organic farming, it is taking its glory back. India has a greater scope of developing the Indigenous Technical Knowledge (ITKs) in many aspects of farming. In addition, Indian government is providing many incentives to promote organic farming under PKVY, PGS, NPOP etc., But what the farmer at ground level, need to know is the inputs he can use for getting the produce organically certified. Certification process in India is relatively complicated with more paper work, but at the same time the Indian certification is valid while exporting the produce to other countries like EU, Switzerland and USDA. The other possible option to escape this certification process to farmers who sell their produce in domestic market is the Participatory Guarantee System, which eliminated third party registration.

Keywords: Organic farming, PGS-India, NPOP, PKVY, Organic certification

Introduction
In the context of current agriculture being highly exploitive to the ecosystem, organic agriculture and its refitting's are correct alternatives in present needy situation. In 1921, the pioneer of Organic farming Albert Howard along with his wife founded an institute in India to improve traditional farming methods which are already a part of Indian agriculture. He became to be known as "Father of Organic Farming" for his works in incorporating scientific methods and principles in this traditional farming. After almost a century organic farming is occupying its previous position in agriculture. Although organic farming always requires 65-200% more field area than conventional farming, it will create a healthy sustainable environment along with reducing the cost of production. However, organic milk, cereals and pork generate higher greenhouse gases per product than conventional ones (Anonymous 2019a) [2].
The International Federation of Organic Agriculture Movements (IFOAM) formed in 1972 has defined organic farming in this way. "Organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible" (IFOAM, 2005) [8].

Principles of Organic farming
IFOAM definition is based on four principles (Yadav, 2010) [22]
1. Principle of Health: The health of consumers cannot be separated from health of ecosystems.
2. Principle of Ecology: Organic agriculture should work with and sustain the living ecosystems and cycles. The principle states that agriculture should be synchronized with the living systems.
3. Principle of Fairness: Fairness is characterized by equity, respect, justice, both among people and in their relations to other living beings.
4. Principle of Care: Organic agriculture should be managed in a precautionary and responsible manner to protect health of current and future generations and environment.

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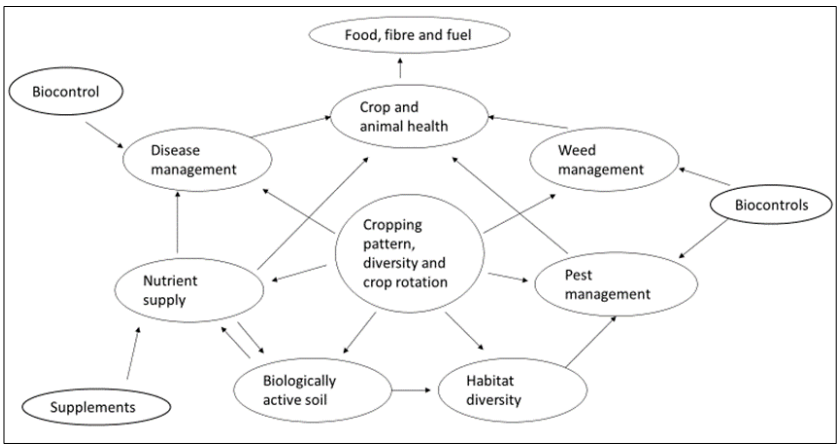

Fig 1: Organic Management Practices

Methods of conversion to organic farming

According to the report of Ashok Dalwai Committee on "Doubling of Farmers Income", it takes nearly a decade to attain the previous yield levels bore conversion (Pandey and Sengupta, 2018). A sudden shift to organic methods may not give significant results unless the steps are followed systematically (Shukla *et al.*, 2017) [18].

1. Development of farm facilities: 3 to 5 per cent of farm space should be left for utilitieslike cattle, vermicompost bed, composting tanks, water unknit, percolation unit etc. 5 to 7 trees should be planted to provide shade for these facilities.
2. Habitat and biodiversity development: This can be achieved by ensuring crop diversity as per climatic suitability. In plains, for a 10 acre farm, plant at least 5-6 neem trees, 1-2 tamarind trees, 2 gular, 8-10 ber, 1-2 aonla and 1-2 drumstick plants both for alternate income and to make organic on farm inputs. Fruit orchards need to maintain 3-5 types of fruit plants along with above nonfruit trees. There may some loss in productivity due to shading effect, but this loss can be compensated with natural biocontrol of pests and diseases.
3. Crop rotation: For keeping the soil healthy and allow all natural microbial systems work, crop rotation is a must process. 3 to 4 year rotation plan can be followed. Rotation can be based on nutrient requirement (High nutrient required crop followed by low input crop) and Pest incidence (host and nonhost crop). According to Network Project on Organic Farming (NPOF of ICAR), some crop rotations for organic cultivation are found economical in the country. Example: Maize-cotton, chillies-onion and brinjal-sunflower at Coimbatore. Sorghum-pea-okra at Modipuram, Uttar Pradesh.
4. Multiple cropping: In every season care must be taken to maintain atleast 40 per cent legumes in the field. Different plants drawing nutrients from different depths are planted together.
5. Improving the status of Organic content in soil: A live organic soil should have organic c between 0.8-1.5 per cent. All round the year decomposing matter should be present for the sustenance of microflora and fauna. The microbial load should be above 10^8 per gram of soil. Atleast 3-5 earthworms/ cubic feet of soil along with insect diversity should be present.
6. Seed/ Planting material: In organic farming, use of disease and pest free seed stock and resistant varieties is a best practice and a low-cost option. Some of the seed treating options can followed like: Hotwater at 53^0C for 20-30 min, Trichoderma (4g/kg seed), *Pseudomonas flourscens* (10g/kg seed), and also rhizobium inoculation.
7. Manuring: Plays important role during conversion period. Well-fed healthy soil rich in microflora and fauna take care of crop nutrient requirements of the plant for further growth.

Table 1: Products used in fertilization of an organic farm

Input	Status	Input	Status
I) Matter produced on an organic farm unit		III) By products from the industries	
Farmyard and poultry manure, slurry, urine	Permitted	By products from oil palm, coconut and cocoa (including fruit bunch, palm oil mill effluent, cocoa peat and empty cocoa pods	Restricted
Crop residues and green manure	Permitted	By-products of industries processing ingredients from organic agriculture	Restricted
Straw and other mulches	Permitted	Extracts from mushroom, Chlorella, Fermented product from Aspergillus, natural acids (vinegar)	Restricted
Composts and Vermicompost	Permitted	By-products from the food and textile industries of biodegradable material of microbial, plant or animal origin without any synthetic additives	Restricted
II) Matter produced outside the organic farm		IV) Mineral origin	
Blood meal, meat meal, bone meal and feather meal without Preservatives	Restricted	Basic slag, Calcareous and magnesium rock	Restricted
Compost made from plant residues and animal excrement	Restricted	Lime, limestone, gypsum, Calcium chloride Permitted	Permitted
Farmyard manure, slurry, urine	Restricted	Calcified sea weed	Permitted
Fish and fish products without preservatives	Restricted	Mineral potassium with low chlorine content (e.g. sulphate of potash,	Restricted

		kainite, sylvinite, patenkali), Natural phosphates (rock phosphate)	
Guano	Restricted	V) Trace elements	Permitted
Human excrement	Prohibited	Sulphur	Permitted
Wood, bark, sawdust, wood shavings, wood ash, wood charcoal	Restricted	Clay (bentonite, perlite, zeolite)	Permitted
Straw, animal charcoal, compost and spent mushroom and vermiculate substances	Restricted	Microbiological origin	
Compost from organic household	Restricted	Bacterial preparations (biofertilizers)	Permitted
Compost from plant residues	Restricted	Biodynamic preparations	Permitted
Sea weed and sea weed products	Restricted	Plant preparations and botanical extracts	Permitted

(Shukla *et al.*, 2017) [18]

Stress should be given on use of on-farm products which may greatly reduce the external input needs. Liquid manures are also incorporated during crop stand. The efficacy of microbial biofertilizer formulations is very high under no chemical use situations.

1. Management of temperature: In a long-term experiment by ICRISAT, it showed that the surface biological mulch on a hottest day in 2002, reduced the soil temperature 6.5 to 7.3^0 C at 5-10cm depth. Temperatures can also be controlled by planting trees like neem, aonla, gliricidia etc. on bunds.
2. Pest management: In the process of pest management in an organic farm, the first priority goes to prevention of pest using cultural methods (like trap cropping, habitat manipulation, crop rotation etc.). If the pest appeared, Physical and mechanical management methods should come in to operation. Some of them are removal and destruction of infected parts, installing bird perches, light traps, sticky traps, pheromone traps etc. As a final option of pest being not controlled, biocontrol with predators, parasitoids and microbial formulations should come into light. In this phase any of the pesticide can be used as given in the table 2.

Table 2: Conditions for the use of pest control products in organic farming

Inputs	Status	Inputs	Status
Substances from plant and animal origin		Minerals	
Azadirachta indica [neem preparations (neem oil)]	Restricted	Chloride of lime/soda	Restricted
Preparation of rotenone from *Derris elliptica*, *Lonchocarpus*, *Thephrosia* spp.	Restricted	Clay (e.g. bentonite, perlite, vermiculite, zeolite)	Permitted
Gelatine	Permitted	Copper salts / inorganic salts (Bordeaux mix, copper hydroxide, copper oxychloride)	Restricted used as a fungicide, maximum 8 kg per ha per year depending upon the crop and under the supervision of inspection and certification agency
Propolis	Restricted	Mineral powders (stone meal, silicates)	Not allowed
Plant based extracts (e.g. neem, garlic, pongamia, etc.)	Permitted	Diatomaceous earth	Restricted
Preparation on basis of pyrethrins extracted from *Chrysanthemum cinerariaefolium*, containing possibly a synergist pyrethrum cinerafolium	Restricted	Light mineral oils	Restricted
Preparation from *Quassia amara*, *Ryania sp.*	Restricted	Permanganate of potash	Restricted
Release of parasite predators of insect pests	Restricted	Lime sulphur (calcium polysulphide	Restricted
Tobacco tea	Not allowed	Silicates (sodium silicate, quartz)	Restricted
Lecithin	Restricted	Sodium bicarbonate	Permitted
Casein	Permitted	Sulphur (as a fungicide, acaricide, repellent)	Restricted
Sea weeds, sea weed meal, sea weed extracts, sea salt and salty water	Restricted	Microorganisms / Biocontrol agents	
Extract from mushroom (Shiitake fungus), Chorella	Permitted	Viral preparations (e.g., GV, NPV etc.).	Permitted
Fermented product from Aspergillus	Restricted	Fungal preparations (e.g., Trichoderma species etc.)	Permitted
Natural acids (vinegar)	Restricted	Parasites, predators and sterilized insects.”	Permitted
Others		Bacterial preparations (e.g., Bacillus species etc.)	Permitted
Carbon dioxide and nitrogen gas	Restricted	Traps	
Soft soap (potassium soap), Homeopathic and Ayurvedic preparations, Herbal and biodynamic preparations	Permitted	Physical methods (e.g., chromatic traps, mechanical traps, light traps, sticky traps and pheromones)	Permitted
Ethyl alcohol	Not allowed	Mulches, nets	Permitted

Shukla *et al.*, 2017 [18]

Some famous Indigenous technical knowledge (ITKs) developed by progressive organic farmers which have been

scientifically validated by universities/ organizations. These can be exploited in a far better way in organic production (Booklet on ITKs, 2018) [6].

Table 3: Some of the ITKs recognized

Product	Purpose	Source	Validated by
Bijamrut	Seed treatment		TNAU, Coimbatore and CSKHPKV, Palampur
Sanjivak	Soil and foliar application		University of Stellenbosch, South Africa
Jivamrut	Soil fertility enhancer		TNAU, Coimbatore, CSKHPKV, Palampur and UAS, Bangalore
Amrit pani	Soil fertility enhancer		NEERI (CSIR Institute), Nagpur
Panchagavya and Panchagavya enriched	Seed and seedling dip Soil application		TNAU, Coimbatore, CSKHPKV, Palampur, UAS, Bangalore and MPUAT, Udaipur
Enriched amrutghol	Fertility enhancer Promotes growth and flowering	Akhil Bharatiya Sajiv Kheti Samaj, Mapusa, Goa	Yet to be done
Anda arkh	Disease control	Akhil Bharatiya Sajiv Kheti Samaj, Mapusa, Goa	Yet to be done
Fish arkh	Disease control	Akhil Bharatiya Sajiv Kheti Samaj, Mapusa, Goa	Yet to be done
Coconut buttermilk gohl	Fungal diseases and insect control	Akhil Bharatiya Sajiv Kheti Samaj, Mapusa, Goa	Yet to be done
Khajara Khata	Biofertilizer	S K Parija Method, Bhubaneswar	Yet to be done
Amrit jal	Biofertilizer	S K Parija Method, Bhubaneswar	Yet to be done
Kitchen waste compost and mineral solution	Biofertilizer	S K Parija Method, Bhubaneswar	Yet to be done
Bilb rasyan	Increase potassium in soil	Tara Chand Balji Method, Madhya Pradesh	Yet to be done
Gaajar Ghaas Svaras	Increase nitrogen in soil	Tara Chand Balji Method, Madhya Pradesh	Yet to be done
Phusp rasyan	Increase boron in soil	Tara Chand Balji Method, Madhya Pradesh	Yet to be done
Amrit Dhara	Sucking pest control	Tara Chand Balji Method, Madhya Pradesh	Yet to be done
Calcium arkh	Increase calcium in soil	Tara Chand Balji Method, Madhya Pradesh	Yet to be done
Harad rasyan	Increase iron in soil	Tara Chand Balji Method, Madhya Pradesh	Yet to be done

Booklet on ITKs, 2018 [6]

Regulatory bodies in India

India has internationally acclaimed certification process for export, import and domestic markets. The National Programme for Organic Production (NPOP) is launched in 2001 by Ministry of commerce and National Project of Organic Farming (NOPF) in 2004 by Ministry of agriculture and farmers welfare. FSSAI operationalized the food safety and standards (organic food) regulation, 2017. The regulation recognizes both NPOP and PG-India as certified organic products. NPOP notified under Foreign Trade Development and Regulation Act (FTDR) looks after the export requirement. NPOP has equivalence agreement with EU and Switzerland, USDA also accepted NPOP assessment system. The Indian certified products can be exported without the need for recertification in these countries (Yadav 2010) [22]

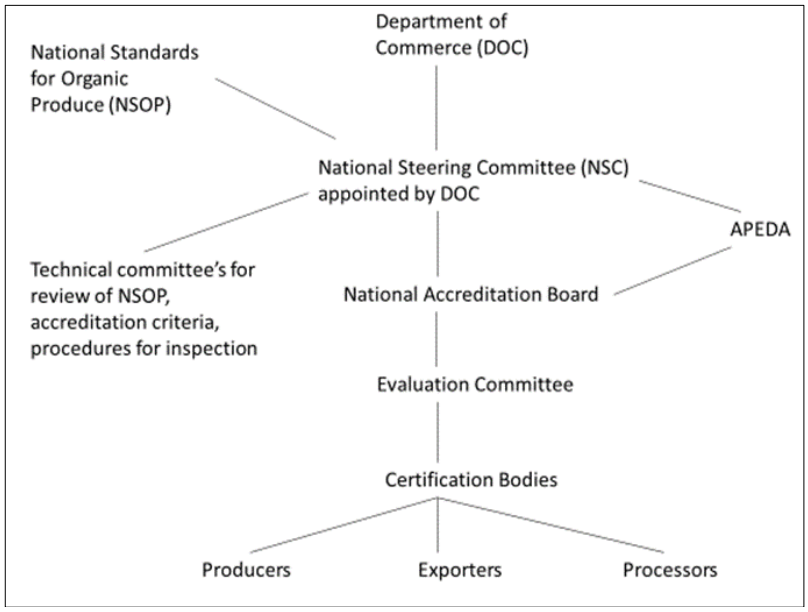

Fig 2: Operational structure of NPOP

The certification bodies are accredited by NAB with APEDA being secretariat. The certification body should have clear policies and procedures in their quality and operating manuals. The body may be a private or government company but should be present in India. It should have adequate infrastructure for analysis and residue testing with total accountability and responsibility. The set of guidelines for inspection, its procedures, methods and frequencies are given to the certification bodies. Once all requirements are met accreditation is given once in 3 years for these bodies. In India there are 30 accreditation bodies under NPOP (Anonymous 2018) [1].

To look after the requirement of import and domestic market the same NPOP has been notified under Agriculture Produce Grading, Marking and Certification Act (APGMC). Regulatory body of NPOP under FTDR act is Agricultural and Processed Foods Export Development Authority (APEDA) under Ministry of Commerce and of NPOP under APGMC act is Agricultural Marketing Advisor (AMA) under Ministry of Agriculture. Under the APGMC 10 Certification Agencies to whom Certificate of Authorization granted for Grading and Marking of Organic Agriculture Produce under Agmark (Shukla *et al.*, 2017) [18].

The certification is given if the standard requirements like choice of crops and varieties, duration of conversion period (usually 12-18 months), fertilization policy, pest and weed control policies, soil and water conservation, food processing, handling, packaging, labelling, storage and transport, are met.

Grower groups with a minimum of 25 to maximum of 500 farmers can also get certification from these accreditation bodies based on Internal Control System (ICS). These groups include farmers cooperatives, contract procedures, small scale processing units etc. In case farmers cannot run ICS, the accredited certification body will provide a contract external service provider. There will be an ICS manager to organize inspection, coordinate field staff etc. and also for imposing sanctions on default members. In addition, there shall be internal inspectors, approval manager, field officers, purchase officers, warehouse manager, processing manager in each group. Individual farmers in this group cannot market their produce individually as certified organic.

Participatory Guarantee System (PGS):

Department of Agriculture and cooperation along with NPOF has launched "PGS-India" program under National Mission for Sustainable Agriculture during the year 2011. It is an alternative farmer group centric low-cost alternative certification system that also provides quality assurance which is in between producers and consumers. It will work outside the frame of third-party certification and without any expensive paperwork for the domestic consumers. Minimum number of farmers should be 5. A consumer /buyer can visit the farm directly.

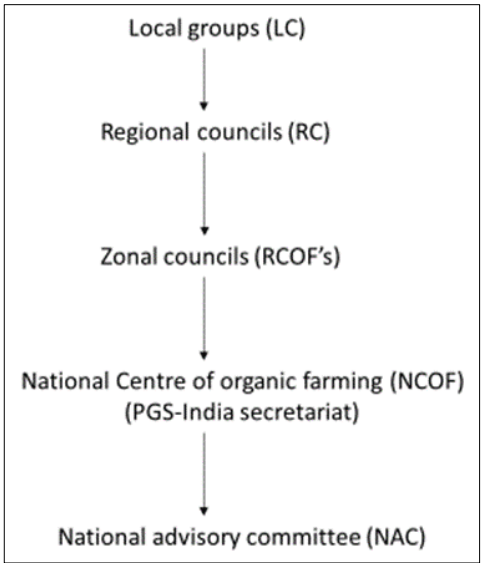

Fig 3: Operational structure of PGS

After getting certified from regional councils, the local groups can print "PGS-Organic" logo on their products. This certificate should be renewed after every 12 months. The logo for fields under conversion is "PGS-Green". Jaivik Kheti Portal is dedicated for organic farming act as both a knowledge platform as well as marketing platform. Details of farmers involved in Organic farming, input supplier, certification agency (PGS), and marketing agencies will be available for smooth implementation from production to marketing. PKVY/PGS groups can take the advantage of this portal for capacity building, technical know-how, communicating with marketing channels/ other groups and direct marketing of their produce to prospective buyers and consumers (PGS-India, 2020) [14].

Fig 4: Logo of PGS- India

Different promotional schemes in India

- NPOF as already mentioned, implemented with an outlay of INR 57.04 crore during 10th FYP and expanded during 11th FYP with an outlay of INR 101 crore. Under NPOF, incentives are available for establishment of production facility for organic inputs. 33% of project cost or INR 60 lakhs subsidy is provided for a compost unit, whereas for biofertilizers and biopesticides it will be subsidy of 25% of unit cost or INR 40 lakhs.
- National Mission for Sustainable Agriculture (NSMA) is one of the eight missions under National Action Plan on Climate Change (NAPCC) which provides total assistance from state government for setting up of fruit and vegetable waste plants, quality control laboratory for testing biofertilizers (up to INR 85 lakhs).
- Paramparagat Krishi Vikas Yojana, launched in 2015 a subcomponent of soil health management (SHM) scheme under National Mission of Sustainable Agriculture (NMSA). Farmer Producer Organisations (FPO's) with minimum 50 farmers are encouraged and clusters are formed with continuous patches up to 1000 ha under organic farming. Total financial assistance of 487 lakhs INR per cluster of 10,000 ha each, can be possible. Each farmer enrolled will be provided 20,000 INR per acre spread over 3 years time (PGS-India, 2020) [14].
- Mission Organic Value Chain Development in North East region (MOVCDNER), launched during 2015-16 in Manipur. This helps in grooming individuals and grouping them to form Farmer Interest Group (FIG) for production of certified organic products (MOVCDNER, 2020) [11].
- National Project on Management of Soil Health and Fertility (NPMSP) came into implementation during 11th FYP with an outlay of INR 429.85 crore. Under this scheme INR 500/ha will be provided to support the use of organic manures.

According to a study by de Ponti *et al.*, 2012 [7], rice, soybean, corn and clover grass when grown organically yield 6 to 11 per cent less than conventional farms. This case is even worse in case of fruits and wheat, which yield 28 and 27 per cent less respectively. But under extreme conditions which has been frequent due to climate change phenomenon, the organic systems produce higher yields than conventional systems (Lotter *et al.*, 2013) [10]. Most of the scientific studies and reviews stated that organic food is more nutritious (Baranski *et al.*, 2014; Worthington 2001; Williams 2002) [5, 21, 20]. Moreover, the organic foods command higher prices which often range from 10 to 100% more than conventional ones (Narayanan, 2005) [13].

Organic agriculture- scenario world wide

In 2017, there was 69.8 million ha of organically farmed land. Of it, Oceania occupies 35.9 million ha, followed by Europe 14.9 million ha and Latin America with 8 million ha. Australia individually occupies 79% of worlds organic land with 35.6 million ha. About 1.4 per cent of worlds agricultural land is organic. Nearly 14 countries have more than 10 per cent of farm land as organic. Of them Liechtenstein (37.9%, Samoa (37.6%0) and Austria (24%) are among the top. All along the years from 1999, there was a 533% increase in organically farmed land worldwide. When compared to 2016, there was 1.7 million ha additional area converted to organic. 69 per cent of the worlds organic land is grassland. Only 7 per cent is classified as a permanent crop land, used to grow coffee, olives, nuts, coconuts and grapes. The countries with largest market for organic produce are United States (worth 40 billion €), followed by Germany (worth 10 billion €) (Anonymous 2019b) [3].

1. India- its future

A total of 1.2 million ha (0.7% of total area) of agricultural land is organic in India. India ranks 9th in terms of worlds organic land. But stands in 1st position when coming to number of organic producers with 8,35,000, *ie*., 30 per cent of organic producers in the world (Anonymous, 2019b) [3].

Present area under NPOP is 3.56 million ha (2017-18) out of which 1.78 m ha is cultivated area and 1.78 m ha of wild collection. Highest land under the organic certification is in Madhya Pradesh, followed by Rajasthan. Including edible and non-edible certified products, Indian organic agriculture produced 1.7 million MT (2017-18). Again, Madhya Pradesh stands first in case of production. Oil seeds are the single largest commodity produced organically in India. A total of 4.58 Lakh MT of certified produce is exported during 2017-18 which worth around INR 3453.48 crore *ie*., 515.44 million USD. Oilseeds alone constitute 47.6% of these exports.

In India, Sikkim's organic plan began as early as 1995 with a programme "Harit Kranti – Greening Sikkim". Year after year new schemes started to implement like ban of non-biodegradable materials (1997), Green fund for schools and colleges (2000), Ten minutes to earth programme (2009) and Sikkim Organic Mission (2010). Finally, by 2016 became fully organic state with more than 76,000 ha of organic lands.

Andhra Pradesh and Himachal Pradesh has been trusting on ZBNF developed by Subhash Palekar in mid1990's. The original pioneer was Karnataka, where the ZBNF was adopted by Karnataka Rajya Raitha Sangha, a state farmers association. In June 2018, A.P rolled out a plan to achieve 100% natural farming by 2014.

ICAR is studying ZBNF methods practiced by Basmathi and wheat farmers in Modipuram, Ludhiana, Pantnagar and Kurukshetra. If found successful, an enabling institution could be set up to promote the technology **(**Jebraj, 2019**)**

The demand for organic produce is also ever increasing in India. According to Ragavan and Magesh (2013) [16], a survey in Chennai showed the strongest perception of residents towards organic produce and organic farming in a very positive way. Also, in a study by Radhika *et al.* (2012) [15] it was indicated that about 53% of the surveyed people wanted to by organic produce, but did not because, it is expensive.

Conclusion

The best criticism is with the lower yields of organic agriculture compared with conventional one, which may become a huge task of feeding ever growing world population without any further land brought into agriculture. But the environmental advantages overthrow the criticisms. Development of research, breeding of crops and resources which sustain organic systems will definitely reduce the yield lag (Badgley *et al.*, 2007, De Ponti *et al.*, 2012 [7], Murphy *et al.*, 2007, Reganold *et al.*, 2011) [4, 12, 17]. Multilocation trails with scientific validity are needed to scale it up country wide. A lot of extension works along with transparency in farmer-buyer relationship, organic farming can give more than the farmer expects. Organic farming does not fit where there is a little unused cultivatable land, as in China, or where there is a huge demand for food, as in India. But it can be successfully utilized in such pockets where the use of fertilizers and

pesticides is not viable. The identification of such pockets is a huge task infront. If the yield lag is reduced to some extent the price of commodities will come down and will be preferred by most of the middle-income groups, which constitute a major part of Indian population. On the other hand, the export market ever exists.

References

1. Anonymous 2018. https://apeda.gov.in/apedawebsite/organic/NPOP_certification_bodies.pdf, 2020.
2. Anonymous. 2019a. https://en.wikipedia.org/wiki/Organic_farming, 2020.
3. Anonymous. 2019b. https://www.organicwithoutboundaries.bio/2019/02/28/organic-agriculture-statistics-book-2019/, 2019.
4. Badgley C, Moghtader J, Quintero E, Zakem E, Chappell MJ, Avile´s-Va´zquez K *et al*. Organic agriculture and the global food supply. Renewable Agriculture and Food Systems. 2007; 22(2):86-108.
5. Baran´ski M, Rednicka-Tober DS, Volakakis N, Seal C, Sanderson R, Stewart GB *et al*. Higher antioxidant and lower cadmium concentrations and lower incidence of pesticide residues in organically grown crops: a systematic literature review and meta-analyses. British Journal of Nutrition. 2014; 112:794-811.
6. Booklet on Indigenous Technical knowledge (ITKS). 2018. Crop wise with reference to promotion of organic farming by Dr. Ajay Singh Rajput, Regional Director www. jaivikkheti.in, 2020.
7. De Ponti T, Rijik B, Van Ittersum MK. The crop yield gap between organic and conventional agriculture. Nature. 2012; 485:229-232.
8. IFOAM. https://www.ifoam.bio/why-organic/organic-landmarks/definition-organic, 2005.
9. Jebraj P. What is zero-budget natural farming? July 28, 2019. The Hindu, 2019.
10. Lotter D, Seidal R, Liebhart W. The performance of organic and conventional cropping systems in an extreme climate year. Am J Alternative Agr. 2003; 18:146-154.
11. Movcdner, 2020. https://momamanipur.com/movcdner/, 2020.
12. Murphy KM, Campbell KG, Lyon SR, Jones SS. Evidence of varietal adaptation to organic farming systems. Field crop Res. 2007; 102:172-177.
13. Narayanan S. Organic farming in India: Relevance, problems and constraints. Occasional paper-38, Dept of Economic analysis and research, NABARD, Mumbai, 2005.
14. PGS-India. 2020. https://pgsindia-ncof.gov.in/pgs_india.aspx, 2020.
15. Radhika P, Ammani P, Seema. Eating healthy- consumer perception of organic foods in twin cities. Int J Marketing, Finan Services Manag Res. 2012; 1(2):62-72.
16. Ragavan N, Magesh R. A study on consumers' purchase intensions towards organic products. PARIPEX- Indian J Res. 2013; 2(1):111-14.
17. Reganold JP, Jackson-Smith D, Batie SS, Harwood RR, Kornegay JL, Bucks D *et al*. Transforming U.S. Agriculture. Science. 2011; 332:670-671.
18. Shukla AK, Tabassum S, Singh R, Kumar VP. Organic Agriculture (Concept, Scenario, Principals and Practices). NCOP, 2017.
19. Stockdale EA *et al*. Agronomic and environmental implications of organic farming systems. Adv. Agron. 2001; 70:261-327.
20. Williams CM. Nutritional quality of organic food: Shades of grey or shades of green: Proc Nutr Soc. 2002; 61:19-24.
21. Worthington V. Nutritional quality of organic versus conventional fruits, vegetables and grains. J Alter Complem Med. 2001; 7:161-173
22. Yadav AK. Organic Agriculture. National Project on Organic Farming, 2010.
23. Khan MS, Shil NC, Noor S. Integrated Nutrient Management for Sustainable Yield of Major Vegetable Crops in Bangladesh. Bangladesh Journal of Agriculture and Environment. 2008; 4:81-94.
24. Kiran J, Vyakarana BS, Raikar SD, Ravikumar GH, Deshpande VK. Seed yield and quality of brinjal as influenced by crop nutrition. Indian Journal of Agricultural Research. 2010; 44(1):1-7.
25. Yousefi AA, Khavazi K, Moezi AA, Rejali F, Nadian HA. Phosphate solubilizing bacteria and Arbuscularmycorrhizal fungi impacts on inorganic phosphorus fractions and wheat growth. World Applied Sciences Journal. 2011; 15(9):1310-1318.
26. Singh S, Hansra BS. Knowledge and adoption level of improved vegetable farming practices of SHG members and non-members in Himachal Pradesh, India. Indian Res J Ext Edu.2018; 18(4):61-64.
27. Choudhary MK, Patel PC, Sharma PK, Patel JB. (Extent of knowledge and adoption of tomato growers about tomato production technology. Inter. Journal of Agriculture Sciences. 2016; 8(25):1521-1523.
28. Sushil Kumar Verma, DP Rai, Lekh Ram Verma. Knowledge and adoption of recommended chilli production technology by the farmers of Raipur district. Agric Update. 2015; 10(2):120-125.
29. Mahesh Choudhary BL, Asiwal RK Dular. Knowledge Level of Farmers about Improved Production Technology of Onion Crops in Sikar District of Rajasthan. J Krishi Vigyan. 2018; 8(1):191-196.