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ORGANIC AND NATURAL FARMING IN NORTH-WEST INDIA: FARMERS' PERSPECTIVE

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ABSTRACT

Despite the widely recognised environmental and human health benefits of organic and natural farming, its adoption in north-west India is quite low. Thus to know the status, cultural practices, inputs used, benefits, economic aspects and constraints of organic and natural farming, a geo-tagged survey of organic/natural farmers in five districts of Punjab in north-west India was conducted by Punjab Agricultural University, Ludhiana. Findings of the survey study revealed that adoption of organic/natural farming accelerated after the year 2005. Wheat (76.32%) and basmati rice (55.26%) were the major crops being grown by the farmers. Organic farmers were using farmyard manure, green manuring and vermicompost for soil health management besides liquid organic manures such as *jeevamrit* and vermiwash and buttermilk and botanicals viz. neem biopesticides, natural farming concoctions- *agniastra* and *brahmastra* for pest and disease management. Manual weeding was the predominant weed management practice adopted by more than 70 per cent of the farmers. It was found from the study that no farmer was practicing complete package of natural farming, but a few had integrated one or more practices of natural farming with organic farming practices. Farmers diverted their path towards organic/natural farming due to human health (32.89%) and environment concerns (39.47%). Lack of marketing facilities (60.53%) and labour-intensive nature of operations (59.21%) were found to be the major constraints in its adoption.

Keywords: Environment, Geo-tagged, Human health, Natural farming, Organic farming

Organic and natural farming largely avoid the use of chemical fertilizers, synthetic pesticides and growth regulators with the only difference that Organic Farming (OF) has a well-defined system of standards and certification and allows use of off-farm organic inputs; whereas, in Natural Farming (NF) there are no defined standards and certification system and is based on on-farm inputs only. OF is an agricultural production system that sustains the production of healthy and safe food, with no dependence on chemical fertilizers, using organic manures and bio-fertilizers, cultivating with reduced tillage, environmentally safe pest management and the adoption of integrated farming systems (Pimentel *et al.,* 2005). It has the potential to sustain crop productivity along with a good compromise between healthy food, farmer profit due to premium price offered on organic products (Yadav *et al.,* 2013) and the conservation of natural resources (Brzezina *et al.,* 2017; Tal, 2018). Though, it is not panacea to all the problems of agriculture in every farming situation yet it can be so in some. It not only has the potential to sustain food production but can also cater to concerns and demands of modern society regarding safe food and environmental footprints of agricultural systems. It can also encounter the mitigation measures enforced upon agriculture by climate change, through practices such as tillage, composting, soil carbon sequestration, and energy offsets (Scialabba and Muller-Lindenlauf, 2010, Lynch *et al.,* 2011) and also contribute to healthier and pollution free environment (Arthurson and Jaderlund, 2011; Diacono *et al.,* 2019).

The OF has been a way of life for Indian farmers until the food security issue along with technological advances encouraged them to shift towards agrochemicals-based input intensive agriculture. Of late, farm issues are making the headlines but the discourse is confined to issues like farm laws, minimum support price, debt relief, floods, famine and the availability of chemical fertilisers. In the context of Haryana and Punjab states of India, the crop monoculture is also being highlighted, but the underlying technology is rarely questioned (Anonymous, 2019). Environment and human health concerns are gradually bringing alternate forms of agriculture to the forefront. Among these, organic agriculture is the one, which can produce food in line with the principles of ecology. However, in the absence of agrochemicals' use and lack of availability of sufficient non-chemical options, the adoption of OF, especially in the input intensive agriculture regions, is a tough task. In the context of ecosystem services, OF has definitely edge over the conventional agriculture but those are not accounted for economic purposes.

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The soil management systems in OF have considerable and positive effects on the greenhouse gas (GHG) emissions (Diacono *et al.,* 2019) and play a key role in the conservation of fertility and biological biodiversity, beyond the productivity itself (Galazka *et al.,* 2019) as conservation tillage practices are integral part of OF.

Punjab, an input intensive agricultural region now, played a key role in green revolution in India. The agriculture here was traditionally organic until mid-60s and it shifted to modern input intensive system of agriculture with introduction of high yielding varieties (HYVs), agrochemicals, irrigation facilities and favourable government policies after mid-60s. Recently, the human health concerns and demand for organic produce have led the farmers to small scale shift to organic farming for domestic consumption and local market and stress is being laid on large scale promotion of Natural Farming (NF) in India with claims of eliminating external inputs, debt and dependency. However, there are contradictory reports on performance of natural farming inputs (Aulakh *et al.,* 2013).Thus, the current study was planned to assess the potential of OF and NF and their grassroot level problems in adoption.

MATERIALS AND METHODS

Study area

The study was conducted in Punjab, a north-western state of India (Fig. 1), extending from 29.30°-32.32° N latitude and 73.55°-76.50° E longitude. It is one of the most fertile regions on earth, comprises alluvial soils formed under the Indo-Gangetic river system. Agriculture is the predominant occupation for people in Punjab with 4.12 mha net sown area, out of which 4.08 mha area is irrigated (Anonymous, 2021a). Rice-wheat is the predominant cropping system in the state. Having only 1.53 per cent area of the total geographical area of the country, Punjab produces about 12 and 18 per cent of the country's rice and wheat, respectively, The farming in the state is highly intensified having a cropping intensity of 190 per cent (Anonymous, 2021a) with large dependency on agrochemicals and synthetic fertilizers.

Sampling

A purposive sampling technique was used to select the sample for the study due to the very small number of organic farms in the state. Farm survey was conducted during 2014-15 to 2019-20 in the five districts (Patiala, Ferozepur, Fatehgarh Sahib, Hoshiarpur, and Moga) of the state (Fig. 2), one district in each year. It was executed as a Geographical Information System (GIS) - based survey in which ha Global Positioning System (GPS) and a questionnaire related to farming situations provided by the All-India Network Programme on Organic Farming (AINPOF) lead centre, ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut, Uttar Pradesh was used as the major tools for the study. A total of 152 organic farms were characterized by treating each farm as a single operational unit and the owner farmer was interviewed as per the questionnaire to explore information about various parameters such as adoption trend, farm size, : reasons behind adoption of organic/natural farming, the crops being grown, soil and plant health management, weed management, pest and disease management, and major constraints in the adoption of organic farming. To extract the information from data, frequency, cumulative frequency and percentages were used.

RESULTS AND DISCUSSION

Adoption trend

According to the diffusion of innovation researchers, adoption of an innovation, when plotted using the cumulative number of adopters results in an S shape curve (Padel, 2001; Rogers, 2003).The rate of adoption of organic farming followed nearly S shaped pattern

Fig. 1. Location of the Punjab state in India

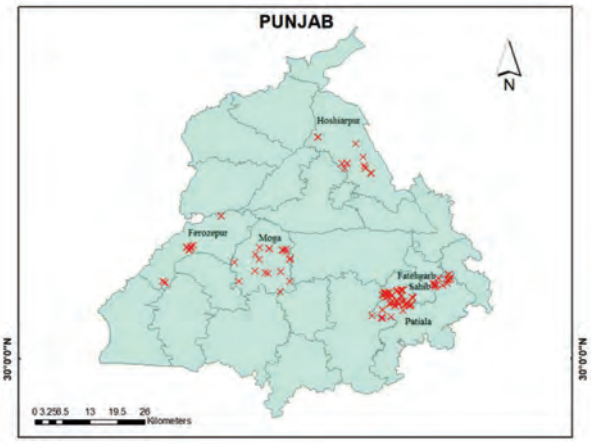

Fig. 2. GPS coordinates of surveyed farms

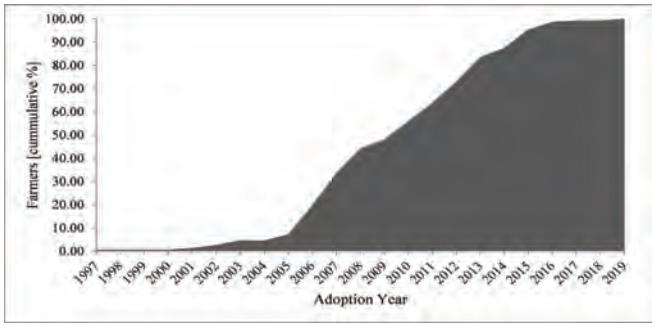

Fig. 3. Year wise adoption of organic farming

(Fig. 3). The S shaped distribution rises very slowly till 2005, and afterwards the rate of adoption accelerated. The reason behind this acceleration might be the various initiatives taken by the Indian government and other development agencies to promote organic farming in 2004 such as 'National Programme on Organic Production' (NPOP) by the Government of India and 'All India Network Programme on Organic Farming' by the Indian Council of Agricultural Research (Aulakh and Ravisankar, 2017). There had been consistent increase in number of farmers adopting organic agriculture after 2005. Another reason might be the awareness among consumers regarding the quality of food and concerns for environment. The re-survey in district Patiala during 2017-18 revealed that out of 50 farmers surveyed during 2014-15, 20 farmers had left OF and only 30 farmers continued with it.

Farm size

The farmers, who adopted organic farming in the current era of chemical farming, may be considered as innovators or early adopters. Rogers (2003) while reviewing various adoption studies concluded that early adopters had a larger farm size than late adopters. Therefore, farm size plays an important role in the adoption decision. More than half of the organic farmers

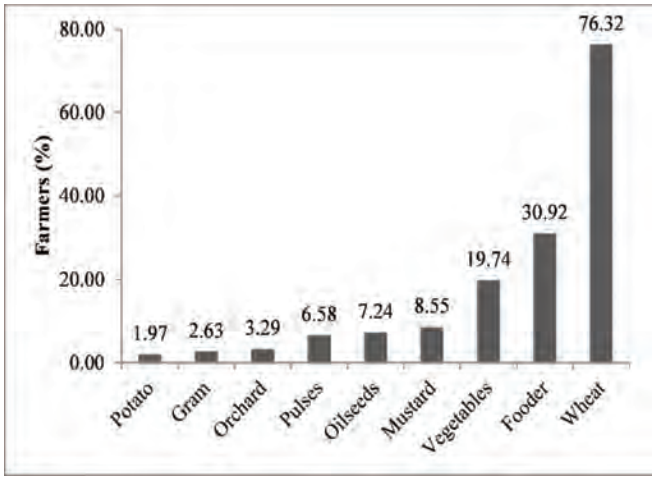

Fig. 5. Crops grown by farmers in *rabi* season

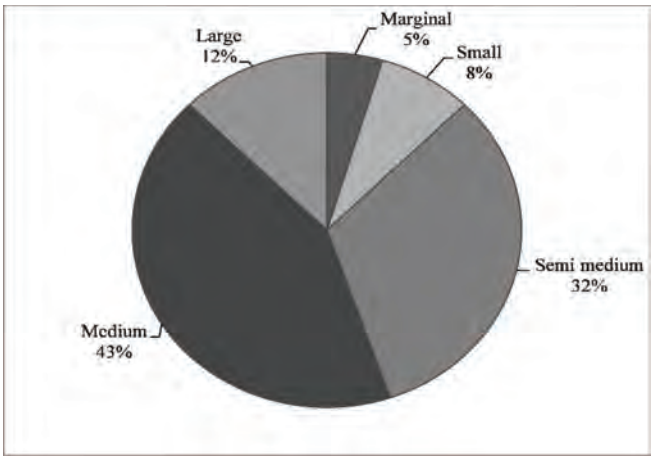

Fig. 4. Farm size distribution of organic farmers

(55%) had more than the average farm size in Punjab (3.62 ha) i.e. had medium (4-10 ha) or large (>10 ha) farm size (Fig. 4). During the initial years, OF involves some production and marketing uncertainties and large and semi-medium farmers have the better capacity to bear these risks and hence a greater number of farmers from these categories adopted OF.

Crops grown

Rice-wheat cropping system is the major cropping system of Punjab, but on organic farms, instead of this, diverse cropping systems were being followed. Though, various cropping systems have been recommended for organic cultivation in Punjab (Anonymous, 2021b), most of the farmers were practicing basmati rice-wheat cropping system due to comparable productivity of basmati rice, and availability of premium price of wheat.

During *rabi*, wheat was the most commonly grown crop (76.32%) because of local demand, ease of storage and availability of premium price (Fig. 5). Other crops included, fodder crops (30.92%), vegetables (19.74%), mustard & other oilseeds (15.79%). Though, pulses are an important component of OF, only about

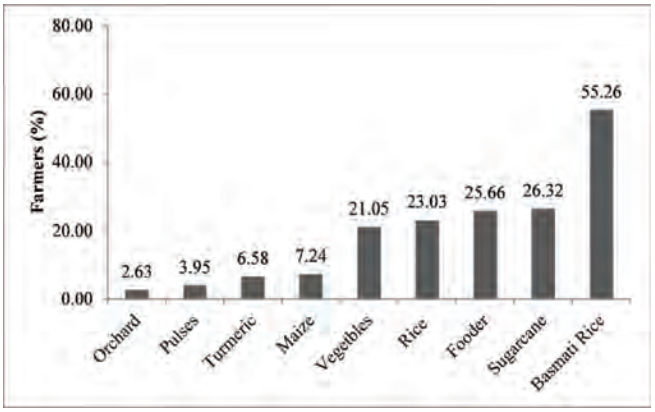

Fig. 6. Crops grown by farmers in *kharif* season

Table 1. Inputs used by farmers for soil health management

Rabi		Kharif	
Input	**Farmers (%)**	**Input**	**Farmers (%)**
FYM	61.84	FYM	63.82
Jeevamrit	23.68	Green manuring	44.74
Vermicompost	11.84	*Jeevamrit*	9.87
PSB* & N Fixers	7.89	Vermicompost	8.55
Others (Biofertilizers, FYM extract, Goat manure, *beejamrit*) etc	9.88	Others (Blue green algae, PSB, FYM extract, Goat manure, Bacterial cultures)	6.59

* Phosphate solublizing bacteria

seven percent of farmers had grown pulses. Farmers considered these crops risky due to more insect-pest incidence and inconsistent yields. A small fraction of some farmers (3.29%) had organic orchard followed by gram (2.63%) and potato (1.97%). A meager proportion of farmers had also grown *fenugreek*, lentil, barley, linseed, maize and medicinal plants.

During *kharif*, majority of the farmers (55.26%) had grown basmati rice (Fig. 6) followed by sugarcane (26.32%), fodder crops (25.66%), rice (23.03%), vegetables (21.05%) and maize (7.24%). The reason behind preference for basmati rice was its less nutrient requirement, which could be fulfilled by green manuring alone resulting in comparable yields with conventional crop. Sugarcane was the second most commonly grown crop under OF in Punjab due to its processing to jaggery which fetches premium price even in the local market. Vegetables were being grown in areas near cities, where there was local demand.

Inputs used in organic farming for soil and plant health management

In organic systems, it is important to improve soil fertility and at the same time to protect and improve soil physical conditions for its healthy functioning. Farmyard manure (FYM) was the major organic manure used by most of the farmers in both *rabi* (61.84%) and *kharif* (63.82%) seasons (Table 1). As livestock (specifically cattle) is an integral part of every farming family in Punjab, the FYM is easily available option for nutrition management in OF, but not in sufficient quantity to shift whole land area to OF. The quantity of FYM used by the farmers varied as per its availability on the farm which in turn depended on number of livestock and other uses of FYM (as dung cakes, etc). The average use of FYM varied from 12-15 tonne per hectare which supplies 0.5% nitrogen (N), 0.2% phosphorus (P) and 0.5% potassium (K).

Green manuring was the second most commonly used nutrition source. But its feasibility under Punjab conditions exists for *kharif* season, only 44.74 per cent farmers incorporated green manure in the field before sowing of *kharif* crops. Farmers generally prefer sunhemp over dhaincha due to higher dry matter production, less infestation of insect-pests and easy seed production. Due to difficulty in availability of cowpea seed, it is not being preferable among farmers. Farmers also use many types of organic/natural preparations. Among these, the most common was *Jeevamrit*, a microbial culture prepared from dung and urine of local cow, which was used by 23.68 and 9.87 per cent farmers during *rabi* and *kharif,* respectively. *Jeevamrit* is source of beneficial bacteria and is commonly prepared using cow dung and urine, jaggery, pulse flour and soil (Khadse and Rosset, 2019). Aulakh *et al.* (2013) reported that the application of *jeevamrit* increased the bacteria and fungi count in the soil, but was unable to influence the crop yields. Farmers used *jeevamrit* @ 500 liters/ha along with irrigation water 3-4 times during the crop duration usually at monthly

Table 2. Weed management strategies followed by farmers

Rabi		Kharif	
Method	**Farmers (%)**	**Method**	**Farmers (%)**
Hand Weeding	77.63	Hand weeding	72.37
Cutting	10.53	Mulching	12.5
Crop Rotation	7.89	Water ponding	9.87
Mulching	5.26	Cutting	7.24
Mechanical weeding	3.95	Mechanical Weeding	1.97
Turmeric spray	0.66	Hand Pulling	0.66

intervals. The frequency of application of *jeevamrit* was higher in *rabi* crops as compared to *kharif* crops, which might be due to the fact that higher soil and air temperatures during summer season promote the growth and multiplication of microbes and hence less quantity of inoculum (*jeevamrit*) was required. Farmers also used it as foliar spray with the same dose and frequency as it is also believed to have pesticidal effect.

During *kharif* season, 7.89 per cent farmers used Phosphate Solublizing Bacteria (PSB) & N fixers for supplementing nutrition of crops. Other homemade organic formulations/concoctions/manures used by organic farmers include blue-green algae (BGA), cow dung cake extract, goat manure, biogas slurry and *beejamrit* and all these were confirmed effective by interviewed farmers.Vermicompost (VC) is another source of nutrients that was used by 11.84 and 8.55 percent organic farmers during *rabi* and *kharif*, repectively. Although VC has higher nitrogen content than FYM but its use by less number of farmers is attributed to its non-availbility, higher price and reluctance of farmers to prepare on-farm VC.

Weed management

The restriction on herbicides use makes weed control more challenging in OF and necessitates a deeper understanding of weed and crop biology to carefully plan different agronomic strategies. Hand weeding was used by majority of the organic farmers (77.63 and 72.37% in *rabi* and *kharif* crops, respectively) for weed management (Table 3). Although hand weeding is time consuming, laborious and costly operation, it was preferred due to its effectiveness. In *kharif*, 9.87 percent farmers managed weeds by ponding water in the field during initial stages in rice and basmati rice. Ponding of water helps to reduce weed infestation in rice especially during early stages of crop (Samoy-Pascual *et al*., 2020). Mulching for weed control was done by 12.50 and 5.26 per cent farmers in *kharif* and *rabi*, respectively. Apart from other benefits, mulching also reduces weed pressure (Sharma and Bharadwaj, 2017). Majority of farmers used paddy straw as mulch although few also used mustard straw and sugarcane trash. The main crops in which mulch was used includes vegetables, maize, sugarcane, *gobhi sarson,* etc. The farmers using mulch were very satisfied with its results and confirmed that for successful organic farming, mulching is must. Mulching is effective for weed control in soybean, turmeric, sugarcane, mentha, maize (Anonymous, 2021b). The quantity of mulch used by farmers ranged from 3-5 t/ha. Cutting of weeds with sickle for fodder from wider row crops was employed by 10.53 and 7.24 per cent farmers in *rabi* and *kharif*, respectively.

Pest and disease management

Management of insect-pests and diseases in organic/natural farming is one of the most challenging tasks. In OF, the emphasis is given on the creation of a well-managed ecosystem at the farm for management of insect-pests and diseases. Though, commercial biopesticides are available in the market, the majority of the organic farmers use on-farm preparations for pest management (Aulakh *et al*., 2009).

Sour buttermilk (*Khatti lassi*) was the most commonly used biopesticide, by 34.21 and 33.55 per cent farmers during *rabi* and *kharif*, respectively (Table 3). Farmers perceived that the use of sour buttermilk helped to control the various fungus and bacterial diseases in crops. The antifungal activity of buttermilk is due to the lactic acid bacteria that produce antifungal metabolites such as proteinaceous compounds and fatty acids (Schniirer and Magnusson, 2005). Raw milk was used by 11.18 and 1.32 per cent of farmers in *rabi* and *kharif*, respectively. Kumar *et al*. (2004) also reported effectiveness of raw milk in reducing the severity of sorghum downy mildew.

Table 3. Insect-pest and disease management

Rabi		Kharif	
Method	**Farmers (%)**	**Method**	**Farmers (%)**
Sour butter milk	34.21	Sour butter milk	33.55
Natural farming concoctions	24.35	Biocontrol	29.61
Neem products (Commercial)	21.05	Neem products (Commercial)	29.60
Indigenous plant-based products	15.78	Natural farming concoctions	24.36
Raw milk	11.18	Neem products (Homemade)	14.47
Neem products (Homemade)	9.87	Mechanical (rope pulling)	3.95
Pheromone traps	5.26	Pheromone traps	1.97
Misc. Products	2.64	Raw milk	1.32
		Misc. products	1.98

Farmers (24.35% and 24.36% in *rabi* and *kharif*, respectively) used natural farming concoctions (*brahmaster*, *agniaster*, *jeevamrit* and *panchgavya*) to manage various insect-pests and diseases. *Brahmaster* was prepared by neem leaves, custard apple leaves, guava leaves, *Lantern camellia* leaves, pomegranate leaves, papaya leaves and white datura leaves crushed and boiled in urine and it was used @ 6.25-7.0 litres per ha. *Agniaster* is prepared by mixing 10 litres local cow urine, 1 kg tobacco, 500g of green chilli, 500g of local garlic and 5kg neem leaves pulp crushed in urine and was used @ 3.75-5.0 litres per ha (Bishnoi and Bhati, 2017). The farmers confirmed that these concoctions were effective in managing different insects and diseases.

Neem-based products, homemade and commercial, play very significant role in insect-pest management in organic and natural farming. During *rabi*, 21.05 per cent farmers used commercial neem products and 9.87 per cent used homemade. The corresponding values in *kharif* were 29.60 and 14.47 per cent. Homemade neem products were prepared and used by farmers in a number of ways as all the parts of neem tree (seed, flowers, bark and leaf) can be used. Neem products are used as insecticide, fumigant, fertilizer and soil conditioner (Lokanadhan *et al*., 2012). Biological control (Tricho-cards, fungi based biopesticides, etc) was employed by 29.61 per cent of farmers in *kharif* season. None of farmers used this method of insect-pest control in *rabi* season. Farmers purchased Tricho-cards from nearby KVKs and used in basmati rice, sugarcane and maize. Farmers also used fungi based biopesticides *Beauveria bassiana* and *Verticillium* spp.

Reasons for adoption of organic farming

The prevailing system of agrochemical-based farming in Punjab is led by marketing of rice and wheat at assured price. It was interesting to find that farmers who adopted organic farming were not influenced by the profit orientation. The major reason (72.36% farmers) behind the adoption of OF was the environment and human health concern (Fig. 7). Most of the farmers quoted that environmental and human health is degrading due to chemical farming:

"Our forefathers used to do farming without the use of agrochemicals, so environmental and human health was much better than today. Air and water were also very pure at those times, thus they used to live long and healthy life"

The benefits to the human health and environment; improvement in soil health and the price premium were the key highlights of OF given by the farmers. Regarding the soil quality, farmers revealed that:

"We consider soil as our mother. But in chemical farming, we are applying tons of synthetic fertilizers to soil and making it barren. So, it is the need of the hour to preserve soil by giving proper nutrition."

The improved food quality was one of the reasons (13.16% farmers) to adopt OF. Farmers were concerned with the food quality as said:

"Today we are eating food full with synthetic fertilizers and chemicals, which is causing many diseases to us and family. So, if we want a healthy life, we have to produce healthy food".

The nutritional value can be considered as the minimum content of food contaminants (pesticides residues, nitrates, heavy metals, etc.) at the optimum content of valuable ingredients (Vitamins, mineral elements, proteins, etc) (Rembialkowska *et al.,* 2012). There is ample evidence that organically grown grains and vegetables have better nutritional quality than conventionally produced products. Organic management improves quality (higher vitamins and nutrients) of fruit and vegetable crops and helps minimize the toxic chemical load (Lairon, 2010). Other reasons for opting organic farming included improved soil health (21.71%), environment friendly nature (12.50%), passion (3.95%), business (2.63%), peace of mind (1.93%) and sustainability (0.66%).

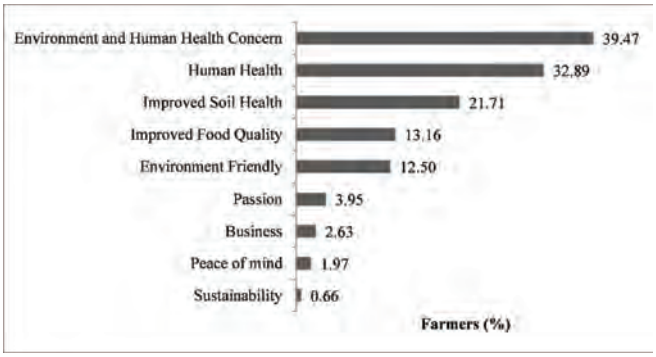

Fig. 7. Reasons for adoption of organic farming

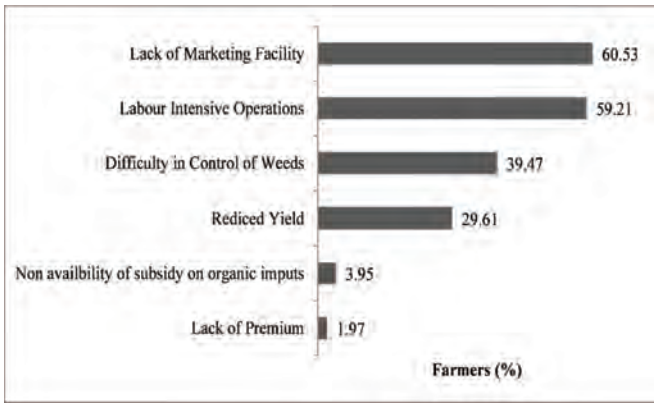

Fig. 8. Constraints in adoption of organic farming

Constraints in adoption

The advantages of OF outweigh its disadvantages, but at field level, there are many difficulties faced by farmers (Aulakh and Ravisankar, 2017). Marketing is the most important and crucial aspect of OF for its up-scaling and it was confirmed by 60.53 % of the interviewed farmers (Fig. 8). Farmers perceived that

"Marketing of organic produce is not easy as for chemical produce. There is no separate market setup for organic produce. On small scale, organic produce can be sold to local contacts, friends or another known person. But if a farmer wants marketing on large scale, then it turns out to be a big obstacle"

Survey conducted by Sivaraj *et al.* (2017) in western zone of Tamil Nadu also confirmed lack of sufficient marketing channels as the major constraint which was confirmed by 43.34 percent of farmers. Farmers opined that there should be separate markets/*mandis* for organic producers at district level, particularly for perishable food items such as vegetables and fruits. At present, farmers are marketing in groups especially through WhatsApp groups of consumers, but government intervention is lacking.

Another problem faced by farmers was the labor-intensive nature of operations (59.21%) and difficulty in hand weeding (39.47%) in OF. As, synthetically produced fertilizers, herbicides and pesticides are prohibited in organic farming, farmers must rely on the labour for various operations in the cultivation of crops. As farmers expressed that:

"We need a lot of labour in organic farming, because we do not use chemicals and most of the work has to be done manually."

All the operations in OF right from start viz; transportation and application of bulky organic manures, hand weeding and manual harvesting and threshing, etc. are labour intensive. There is a need for mechanization for mechanical weeding and for application of manures for reducing dependence on labour and cost cutting. Although, most of the farmers received premium prices up to 25-50% for their crops, especially for wheat, they sold their produce at the local level since organized market for organic produce is not available. The reduced yield of the crops in organic farming added to their problems. This is another constraint that was confirmed by 29.61 percent of the farmers. The yield gap analysis of crops at farmers field suggested that grain yield of basmati rice, moong, turmeric under organic management was 10.5, 20.8 and 24.5 per cent higher than conventional management, respectively. The productivity of wheat and sugarcane under organic management was 10.5 and 15.5 per cent lower than conventional management, respectively. Yield gap analysis for productivity of crops under organic management at farmers' field (on-farm) and at research farm (on-station) indicated that yield of different crops was lower at farmers' fields to the tune of 8 to 25 per cent. Other constraints included non-availability of subsidy on organic inputs (3.95%) and lack of premium on organic food products (1.97%).

The findings of the study have important research and policy implications. The up-scaling of organic farming would require strengthening of research efforts for development, validation and refinement of organic production and protection technologies, and development of market infrastructure with premium price on organic produce. With exception to elite organic consumer segment, the consumers in general need to be provided safe food free from any pesticide residues. Mechanisms should be developed to provide certified safe food to the consumers in general at affordable prices.

Authors' contribution

Conceptualization and designing of the research work (CSA, ASS); Data collection(CSA, ASS, SS); Analysis of data and interpretation (ASS, SS, DS); Preparation of manuscript (CSA, ASS, SS, DS).

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