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Insights from organic farmers in Punjab: A survey on practices, challenges and market access

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ABSTRACT

The present study was carried out during 2020–21 to 2023–24 at Punjab Agricultural University, Ludhiana, Punjab under the All-India Network Programme on Organic Farming (AI-NPOF) to conduct a geo-tagged characterization of organic and natural farmers among 98 farmers in Punjab (Faridkot, Ludhiana, Malerkotla and Barnala). The survey was based on the questionnaire provided by the AI-NPOF lead centre, ICAR-Indian Institute of Farming Systems Research (IIFSR), Modipuram, Meerut, Uttar Pradesh, to elucidate the management practices, yield, profit and soil-health benefits of organic farming. Fifty percent of the farmers were small and marginal and rest 50% were semi-medium and medium and the 80% of the farms were organic certified. Major crops grown organically were wheat, basmati rice and vegetables (garlic, onion, peas, okra, bottle guard, pumpkin, palak, carrot, radish etc.), gobhi sarson, gram, turmeric, maize and fodder crops. Organic farmers utilized farmyard manure, green manuring, vermicompost, and liquid organic manures like vermiwash, *beejamrit*, *jeevamrit* and *ghanjeevamrit* for soil health. Botanicals such as neem biopesticides, *agniastra*, *brahmastra*, sour buttermilk and tricho-cards were employed for pest and disease management. Farm waste was recycled by composting and vermicomposting for nutrient management. The major constraint faced by farmers in adoption of organic farming was labour intensive operations (36%) and lack of marketing facilities (31.5%). Other constraints included were weed control (14.3%) and reduced yield (9%). These findings highlight the need for labour-saving technologies, better market infrastructure and targeted research on weed management and soil fertility to enhance organic farming adoption and sustainability, ensuring long-term economic and environmental benefits for farmers.

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

The green revolution not only brought significant changes to India's food production but also introduced new challenges such as overuse of synthetic agrochemicals, stagnating productivity, nutrient imbalances, low water and nutrient use efficiency and rising input costs. These issues, coupled with growing awareness of health and environmental concerns related to agrochemical use, have driven interest in sustainable agriculture alternatives like organic farming (Gamage *et al.* 2023). The overuse of chemical inputs has caused second-generation problems, highlighting the need for resource-efficient, resilient farming to ensure food security (Aulakh *et al.* 2022a). Organic farming focuses on sustainable production and conservation of natural resources, aiming to produce safe food while avoiding the negative impacts of modern agricultural practices. Similarly, natural farming (NF), an even more stringent form of organic farming, eliminates all external inputs and reduces cultivation cost. NF involves four core practices, using microbial formulations (*beejamrit, jeevamrit* and *ghanjeevamrit*); crop residue mulching; intercropping; and promoting soil aeration (*whapasa*) (Sharma *et al.* 2023). Organic systems improve soil health, conserve biodiversity (Lin *et al*. 2019) and offer resilience against crop failure while reducing environmental impacts. They rely on organic matter management to sustain fertility and productivity. Enhanced productivity and profitability can be achieved by meeting nutritional needs through organic sources and optimizing agronomic practices for efficient resource utilization (Kumar *et al*. 2024).

Organic and natural farming is a sustainable farming model recognized globally. India ranks 1st in terms of total number of organic producers (2.5 million) worldwide, was more than 50% of the total number of organic food producers in the world and ranks 2th in terms of the total area (4.7 Mha) under organic farming, which increased by 74%, from 2021–22 (Willer *et al.* 2024). In Punjab, organic farming has grown due to health concerns, environmental awareness, and increased demand driven by rising purchasing power. Farmers are shifting to organic practices to meet demand and address these issues. The present study examines organic

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farming practices, adoption trends, productivity perceptions and barriers, focusing on socio-economic, policy and farm-specific factors like landholding, cropping preferences and sustainable management. It explores yield gaps, market access, certification and premium pricing challenges. By understanding farmers' motivations and challenges, it aims to suggest practical solutions to help more farmers adopt organic practices. The findings will guide policies, improve support systems and promote sustainable farming that benefits both farmers and the environment.

MATERIALS AND METHODS

The present study was carried out during 2020–21 to 2023–24 at Punjab Agricultural University, Ludhiana, Punjab (29.30°–32.32°N and 73.55°–76.50°E) under the All-India Network Programme on Organic Farming (AI-NPOF) led by the ICAR-Indian Institute of Farming Systems Research (IIFSR), Modipuram, Meerut, Uttar Pradesh to conduct a geo-tagged characterization of organic and natural farmers in Punjab (Faridkot, Ludhiana, Malerkotla and Barnala) (Fig. 1A). It was executed as a Geographical Information System (GIS)-based survey in which Global Positioning System (GPS) and a questionnaire related to farming situations provided by the AI-NPOF lead centre, ICAR-Indian Institute of Farming Systems Research (IIFSR), Modipuram were used as the major tools for the study. A total of 98 organic farms were characterized by treating each farm as a single operational unit and the owner farmer was interviewed as per the questionnaire to collect information about area under organic and natural farming, crops being grown, organic manures and biopesticides being used, productivity level of the crops, perception of organic farmers, availability of price premium and constraints in its adoption. The proportion of land under organic farming was calculated on the basis of total land holding of organic farmers. Statistical analyses involved frequency, cumulative frequency and percentages to extract the information from data. The percentage of farmers adopting organic farming, the ratio between number of farmers adopting organic farming and total number of farmers surveyed or in the region were calculated according to Aslam and Hong (2018). The yield gap analysis was computed as per the method suggested by Ittersum *et al*. (2013):

$$\text{Yield gap (\%)} = \frac{\text{On station yield - Farmer's field yield}}{\text{On station yield}} \times 100$$

RESULTS AND DISCUSSION

Farm size and distribution: The farmers, who adopted organic farming in the current era of chemical farming, may be considered as innovators or early adopters. A review of various adoption studies concluded that early adopters had a larger farm size than late adopters (Aulakh *et al.* 2022b). Therefore, farm size plays an important role in the adoption decision. Half of the organic farmers (52%) had semi-medium (2–4 ha), medium (4–10 ha) or large (>10 ha) farm size and the rest 48% of the farmers belonged to small and marginal group with land-holding size <2 ha. The proportion of area under organic farming out of total land holding of surveyed farmers was 29.3, 28.2, 28.8 and 21.5% in Faridkot, Ludhiana, Malerkotla and Barnala, respectively. Among characterized farmers, 100% were doing organic farming and no farmer was practicing complete natural farming. Twenty-five per cent farmers were using concoctions of natural farming along with organic farming.

Adoption trend of organic farming: The adoption of organic farming increased gradually until 2005, then accelerated due to initiatives by the Indian government and development agencies (Aulakh *et al.* 2022b). India's diverse agro-climatic conditions and traditional organic farming practices offer significant potential for organic production. Post-COVID-19, heightened environmental and health awareness has driven global demand for organic foods (Smiglak and Wojciechowska 2021), boosting farmer interest. The study indicates a gradual increase in organic farming adoption, with variations over time (Fig. 1B). By 2023, around 21% of farmers had adopted organic farming practices, reflecting the highest recorded rate of adoption.

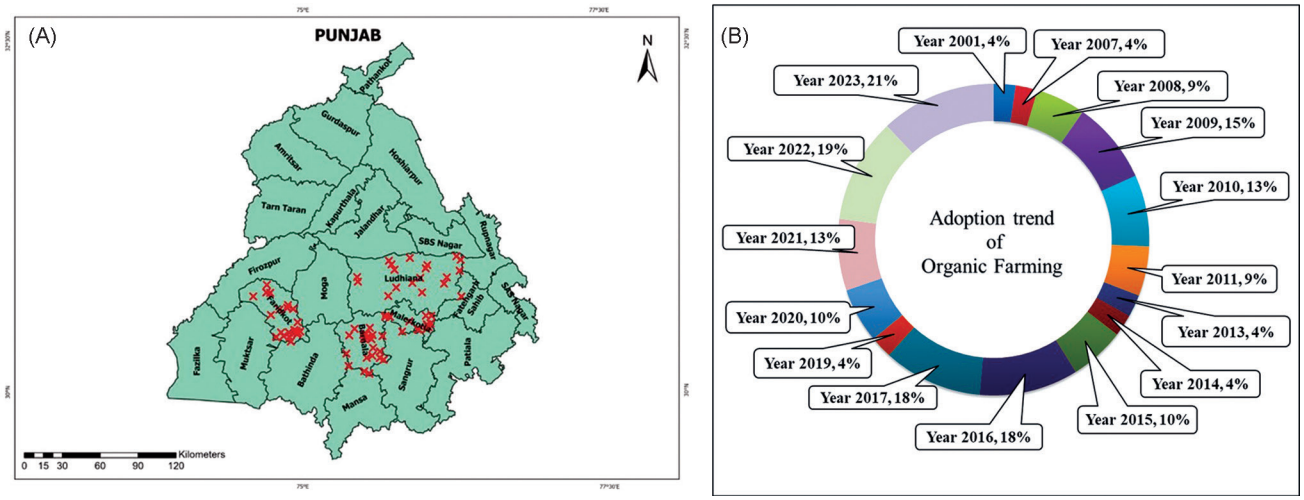

Fig. 1 (A) GPS coordinates of surveyed farms, (B) Adoption trend of organic farmers

This was followed by 19% adoption in 2022, indicating sustained growth in recent years. In 2016 and 2017, the adoption rate was recorded at 18%, demonstrating moderate but consistent uptake during that period. Earlier, in 2009, the proportion of farmers practicing organic farming was 15%, signifying a progressive interest in organic systems during the late 2000s. In 2015 and 2020, the adoption rate stood at 13%, indicating a slight dip compared to 2009, but still showing steady commitment to organic practices over time. Lower adoption rates were observed in earlier years, such as 2008 and 2011, where only 9% of farmers practiced organic farming. The lowest adoption rates, at 4%, were recorded in 2001, 2007, 2013, 2014 and 2019, reflecting the initial slow pace of organic farming adoption during the early 2000s.

Crops grown under organic farming: The crops with low nutrient requirement and manageable insect pest problems are compatible to grow under organic farming. While Punjab's conventional farming rely on rice-wheat systems, organic farms diversify but often retain the basmati rice-wheat system for its productivity and premium pricing. Pulses and oilseeds are added based on market demand and price premiums. During rainy (*kharif)*, majority of the farmers (72.2%) had grown basmati rice followed by vegetables (35.7%), *kharif* moong (21.3%), sugarcane (18.5%), maize (16.3%), turmeric (12.5%), oilseeds (5%) and fodder crops (36.9%). 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. During winter (*rabi)*, wheat was the most commonly grown crop (88.4%) because of local demand, ease of storage and availability of premium price. Other crops included, mustard (*gobhi sarson*) (37%), gram (36.5%), vegetables (33%), fodder crops (34.5%) and maize (5%). Vegetables (garlic, onion, peas, okra, bottle guard, pumpkin, palak, carrot, radish etc) was the second most commonly grown crop under organic farming in surveyed area of Punjab due to local demand near big cities like Ludhiana and premium price even in the local market. Pulses, sugarcane and turmeric also grown in these areas near cities, where there was local demand.

Nutrient management: Application of organic inputs like farmyard manure (FYM), green manure, vermicompost, biofertilizers and crop residue recycling improve nutrient cycling and soil properties. Among these, FYM is a widely used, enriches crops with nutrients, enhance soil organic matter and serves as a cost-effective alternative to mineral fertilizers (Lazcano *et al.* 2008, Silva *et al.* 2017). In Punjab, FYM was used by 84.3 and 87% of organic farmers in *kharif* as well as *rabi* season, respectively (Table 1). With livestock being integral part of farming families, FYM is easily accessible, but its availability is insufficient to convert entire farms to organic systems (Aulakh and Gill 2013). Farmers applied 12–15 t/ha of FYM, supplying 0.5% nitrogen, 0.2% phosphorus and 0.5% potassium (Majumdar *et al*. 2014). Green manuring is the second most common practice, used by 56.8% of farmers during *kharif* season.

Table 1 Methods used by farmers for nutrient, weed, disease and insect-pest management under organic farming

Management	Method	Farmers (%)	
		Kharif	*Rabi*
Nutrient management	FYM	84.3	87.0
	Green manuring	56.8	-
	Vermicompost	24.5	28.3
	Jeevamrit	21.8	23.3
	Bacteria culture	8.0	20.0
Weed management	Hand weeding	87.5	88.3
	Mulching	44.5	27.0
	Ponding water	24.3	-
	Mechanical weeding	23.0	26.3
	Cutting	6.5	5.0
Disease and insect-pest management	Sour butter milk	59.3	71.3
	Neem based pesticides	80.0	63.0
	Agniastra and *brahmastra*	40.5	35.8
	Tricho-cards	26.0	-

Farmers generally prefer both sunhemp and dhaincha as per availability of seed due to higher dry matter production, less infestation of insect-pests and easy seed production.

Vermicompost (VC) was used by 24.5 and 28.3% of organic farmers in *kharif* as well as *rabi* season, respectively, with some farmers producing their own VC to ensure a consistent supply. Despite its higher nitrogen content, VC usage is limited due to high costs and insufficient supply. Organic liquid formulations, particularly *jeevamrit*, were applied by 21.8% of farmers in *kharif* and 23.3% in *rabi* season. Farmers apply it @500 litres/ha 3–4 times during crop cycle, more frequently in *rabi* crops due to longer duration and favourable conditions for microbes. It is also used as a foliar spray for pest management (Aulakh *et al.* 2013, Gulati *et al*. 2024). Crop duration and variety influence *jeevamrit* application, with longer-growing and pest-prone crops needing more frequent use to sustain microbial activity and pest management. Bacterial culture was used by 8 and 20 per cent of farmers during *kharif* and *rabi,* respectively, primarily *Rhizobium* for pulses and consortium for cereals. Seed inoculation improved pulses seed yields by 12–16% (Anonymous 2024).

Weed management: Farmers adopt an integrated approach of weed management, using crop rotation, intercropping, mulching, manual weeding and the use of cover crops to suppress weed growth (Table 1). Hand weeding is the most commonly used method by majority of the organic farmers (87.5 and 88.3% in *kharif* and *rabi* crops, respectively), despite its time consuming, labour-intensive and costly operation, due to its effectiveness. In *kharif*, 24.3% of farmers manage weeds by ponding water in basmati rice fields during the early stages, as recommended for reducing weed infestation (Anonymous 2024). Mulching, which improves economic yield by modifying the crop microclimate, is another popular method, used by 44.5%

of farmers in *kharif* and 27% in *rabi*. Mulching directly suppresses weeds and promotes crop growth by improving soil conditions (Mishra 2023). Most farmers use paddy straw for mulching, though some also use mustard straw and sugarcane trash, primarily in crops like vegetables, sugarcane and maize. Farmers report high satisfaction with mulching for its positive impact on organic farming. Mulching is particularly effective in crops like soybean, turmeric and mentha (Anonymous 2024). The quantity of mulch used ranges from 3–5 t/ha. Cutting of weeds with sickle for fodder from wider row crops was practiced by 6.5 and 5% farmers in *kharif* and *rabi*, respectively.

Disease and insect-pest management: Organic farming emphasizes creating a bio-diverse farm ecosystem to naturally manage pests and diseases. The study highlights the use of on-farm preparations, including neem-based homemade biopesticides, sour buttermilk, fermented plant extracts and cow urine formulations, as cost-effective and sustainable pest management strategies. Among these, neem-based biopesticides were the most widely adopted, with usage rates of 80% during the *kharif* season and 63% during the *rabi* season. Sour buttermilk (*Khatti lassi*) was the second most commonly used biopesticide, by 59.3 and 71.3% farmers during *kharif* and *rabi*, respectively (Table 1). Additionally, 40.5% of farmers in *kharif* and 35.8% in *rabi* used natural farming biopesticides like *agniastra* and *brahmastra* to manage insect pests and diseases. These were applied at 3.75–5 litres/ha (Bishnoi and Bhati 2017). Farmers reported that these preparations were effective in controlling various pests and diseases. Furthermore, biological control using Tricho-cards was practiced by 26% of farmers during *kharif*, particularly in basmati rice, sugarcane and maize. Bio-control agents such as *T. chilonis* and *T. japonicum* were used for managing stem borers and leaf folders in organic basmati rice. In cases of severe infestation, neem-based biopesticides were applied for effective management.

Yield: The economic yields of almost all the crops were lower under organic cultivation as compared to conventional cultivation. Additionally, the mean yields at farmer's fields were lower as compared to on-station yield in major crops like basmati rice and wheat. The on-station grain yield for wheat was 41.3 q/ha, while the farmer's field yield was 32.7 q/ha, indicating a 20.8% reduction. Similarly, basmati rice showed an on-station yield of 38.2 q/ha and a farmer's field yield of 35.9 q/ha, reflecting a 5.8% reduction. This may be due to the use of local varieties by the farmers and insect pest and disease infection. Poor control of insect-pests and diseases also contributes to lower grain yields under organic production. Similarly, the reason behind this might be use of lower dose of FYM. While traditional farming practices have sometimes been reported to achieve relatively high crop yields, organic farming often experiences lower yields compared to conventional farming, particularly in the initial years. This yield reduction is primarily attributed to the slower nutrient release from organic sources, which limits the immediate nutrient availability to crops (Patel *et al.* 2020).

Availability of price premium on organic produce: The availability of price premiums for organic produce is higher near large cities compared to rural areas. This is because urban residents are more aware of the health and environmental consequences of chemically produced goods and recognize the value of organic products. The price premium availability in Ludhiana and Malerkotla is higher (75% of farmers agree) compared to Faridkot (65%) and Barnala (72%), as Ludhiana is a major city and Malerkotla is located nearby. In these districts, organic farmers received price premiums for crops such as wheat, mustard oil, turmeric powder, sugarcane products, pulses, maize flour and millets. However, no premium was reported for basmati rice, maize grains and certain vegetables.

Reasons to adopt organic farming: The dominant agricultural system in Punjab is based on agrochemical farming, with rice and wheat being marketed at assured prices. However, it was interesting to note that farmers who adopted organic farming were not primarily motivated by profits. The main reason for switching to organic practices, cited by 68.8% of farmers, was concern for human health and the environment (Fig. 2). In addition to environmental and health concerns, 20.5% of farmers saw organic farming as a business opportunity and approached it with a commercial mind-set. Others were drawn to organic farming due to their passion for it (7.5%) or the peace of mind it provides (4.3%). Overall, while the shift to organic farming is not primarily driven by financial gain, it reflects a growing awareness among farmers about the importance of sustainable practices for the long-term health of the land, people and communities. Many farmers are hopeful that organic farming will not only improve the quality of their products but also contribute to a healthier environment for future generations.

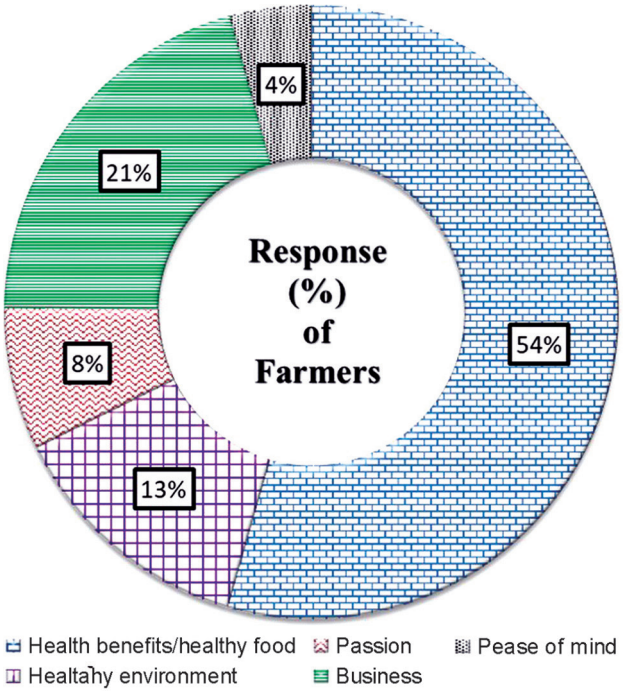

Fig. 2 Reasons to adopt organic farming

Constraints in adoption of organic farming: While organic farming offers many advantages, it faces several practical constraints (Patel *et al*. 2020). Labour-intensive tasks like weed and pest management are difficult in regions with labour shortages or high costs. Despite growing demand, organic farmers struggle with market access, price volatility, distribution issues, and competition from large-scale producers (Orsini *et al.* 2018, Gamage *et al.* 2023). Labour-intensive operations and lack of marketing facilities are major challenges for organic farming adoption, noted by 67.5% of farmers in the survey (Fig. 3). Tasks like manure application, weeding and harvesting require significant labour, highlighting the need for mechanization. Farmers also struggle with marketing, as there are no separate markets for organic produce and large-scale marketing is difficult. A similar survey by Sivaraj *et al.* (2017) in Tamil Nadu found marketing channels as the major constraint which was confirmed by 43.3% of farmers. Another problem faced by farmers was weed infestation (14.3%) because herbicides are prohibited in organic farming. The reduced yield of the crops in organic farming added to their problems. This is another constraint that was confirmed by 9% of the farmers. Other constraints included lack of premium price availability on organic food products (5.5%), non-availability of subsidy on organic inputs (3.8%), difficulty in pest and disease management, limited availability of organic manures and lack of technical knowledge for organic farming etc. were also the constraints in adoption of organic farming in Punjab.

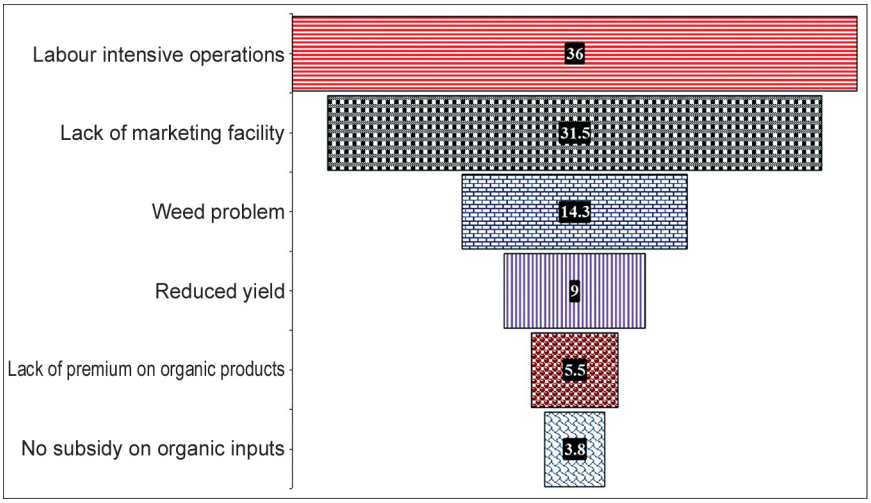

Fig. 3 Constraints in adoption of organic farming

In conclusion, organic farming in Punjab offers a sustainable alternative to conventional farming, driven by government initiatives, consumer demand and environmental awareness. Larger farms lead adoption, but small farmers actively participate as well. Despite challenges like lower yields, high labour costs and market access issues, organic farming benefits soil health, environmental restoration, and human well-being. Key crops include basmati rice and wheat, supported by organic inputs such as farmyard manure and vermicompost, along with the advantage of premium pricing. To sustain growth, efforts must focus on enhancing input availability, refining organic farming technologies to boost yields, improving insect pest management and strengthening market infrastructure for premium pricing. Additionally, systems should be established to provide certified, safe food to the general public at affordable prices.

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