TIGR²ESS
Transforming India's Green Revolution by Research and Empowerment for Sustainable food Supplies

2022

Evaluation of Knowledge, Attitude and Practices of Farmers in Sustainable Farming

UNIVERSITY OF CAMBRIDGE
GLOBAL FOOD SECURITY
GCRF Global Challenges Research Fund

Life of an Organic Farmer

Though mosquitoes suck my blood without my permission,
They rely after all on our blood donation.
The sharp sugar cane leaves do cut my flesh while weeding,
No pain no gain, plants will grow well, thanks to my bleeding.
Horse flies do harass me too, thinking I'm a donkey,
Or because I'm white , they assume I am a Yankee .
Ants hiding behind the leaves bite me mercilessly,
They save themselves, nothing against me personally.
While sweating like a horse, I think life is beautiful,
I don't have to go to the Turkish bath, and that's cool.
Like a soldier, a farmer has to shed sweat and blood.
He may harvest his crop after facing drought or flood .
The monsoon can bring hope, but also devastation,
He prays for it, rains guarantee food for the nation.
A farmer can sow seeds, work hard and hope for the best,
For it is through God's Grace, if one day he can harvest.
In Punjab, wheat and rice are the main cultivation,
The only crops favoured by the green revolution.
Punjabis don't relish rice , it's not their cup of tea,
To grow food we don't eat is a great absurdity.
Organic farmers don't believe in using pesticide ,
To work against nature is like committing suicide .
To pollute soil and water is not sustainable,
And produce pure and safe food, is only sensible.
Multi cropping combined with a wise crop rotation,
Can protect the soil from any deterioration.
Such farming does not rely on petrochemistry,
It provides healthy food for home and the country.
Such farmers who produce their food are self-reliant,
They won't make a fortune, but they are self-sufficient.
Hard work and organic food keep the farmer healthy,
If one stays in poor health, what's the point of being wealthy.
Farmers who feed the world are looked upon with contempt,
But when there is a lockdown, they are self-sufficient.
Do boost your immune system in time of pandemic,
Organic food will help you along with turmeric.

Darshan Singh Rudel
(Raza Farm, Nurpur Bedi)

Transforming India's Green Revolution by Research and Empowerment for Sustainable food Supplies

Evaluation of Knowledge, Attitude and Practices of Farmers in Sustainable Farming

About TIGR^{2}ESS

Objectives and Outcomes Jointly Framed by the Consortium Partners

India's Green Revolution produced significant benefits. The greatest positive impact was felt in regions and on farmers who were able to harness benefits from the combination of new technologies, increased inputs and research-led innovation that have characterised agrarian transformation over the last fifty years. Despite these positive outcomes, there is widespread agreement that the 21st century demands new thinking to address new and emergent challenges, driven by changes in migration and settlement patterns, new forms of economic activity, changes in global commodity markets, and significant environmental challenges.

Objectives

1. To define the requirements and set the policy agenda for a second Green Revolution in India, framed by demographic changes affecting rural communities and feminisation of smallholder farming systems.
2. To develop and strengthen alliances across a carefully selected network of UK and Indian experts, to build a collaborative, long-term research partnership in sustainable agriculture that will set India on the path to a second Green Revolution.

Flagship Projects

Objectives were attained through fundamental research, structured into six Flagship Projects.

- **FP1** Sustainable and Transformative Agrarian and Rural Trajectories (START);
- **FP2** Crop Sciences: Water Use and Photosynthesis;
    - Improving Water Use and Yield Stability in Millet and Sorghum;
    - Crop Sciences: Enhancing Photosynthesis;
- **FP3** Heat and Drought Resilience in Wheat;
- **FP4** Water Use and Management in a Changing Monsoon Climate;
- **FP5** Supply Chains: Modelling Water Use for Sustainable Livelihoods;
- **FP6** Impacting Wellbeing in Rural and Urban Communities: Education, Empowerment and Entrepreneurship Leading to Improved Human Nutrition;
    - Education Food, Nutrition and Empowerment (EFNE);
    - Education, Employment, Empowerment and Entrepreneurship (4E);
    - Cross-Cutting FP6 Projects are the Mobile Teaching Kitchens and the Innovation Farm Model.

About the Research Team

Lead

Professor Howard Griffiths
Department of Plant Sciences
Cambridge University
United Kingdom

Research Team

Maitri Sharma (Project JRF)
Malika Kukreja (Project Intern)
Sheena Chadha (Project Intern)

Principal Investigator

Professor Ramanjit Kaur Johal
Department of Public Administration
Panjab University
India

Co-Investigators

Professor Suveera Gill
University Business School
Panjab University
India

Cover Credits: Raza Farm, Nurpur Bedi captured by Prof. Suveera Gill (September 2021)

Contents

BOX

FIGURES

TABLES

Executive Summary

Over the years, attempts have been made to explicate ways of practising sustainable agriculture. Studies related to knowledge, attitudes and/or practices (KAP) provide a research typology that provides a basis to explore the potential sources of success or failure of initiatives that promote sustainability. The present research explores the KAP of select farmers in Punjab. In particular, the case study approach to analysing the KAP studies on sustainability is adopted since it combines individual perception with conceptual criteria to decode farmers' transitions to solve environmental challenges. The study framework was conceptually based on behaviour change models, specifically the theory of planned behaviour as proposed by Ajzen (1985).

Most farmers interviewed follow the organic farming system, with 78 per cent having their organic products certified. They primarily cultivate grain and vegetables and have small to medium size landholdings. The farmers have good knowledge of the local ecological region and its dynamism. They are sensitive to conserving land, water, and biological resources. Using organic or natural farm inputs, especially home-grown seeds, bio-fertilisers and pesticides, is a common practice. Workshops and other extension activities are effective sources for gaining information. Many consider healthy and nutritious food as an outcome of the sustainable approach to agriculture. However, they are wary of the additional associated costs, particularly regarding labour and access to knowledge.

Various reasons have been put forth for adopting sustainable farming, from health fallouts of the green revolution to personal awakening and, ultimately, societal well-being. The farmers realise the challenges of practising organic, or even sustainable, farming in the present socio-economic setup with the break-up of family farming and youth migrating abroad. Further, many of their concerns relate to the economic viability of their cultivation practices as they face escalating costs, a squeeze on the availability of farm hands, and a debt spiral. Nevertheless, they are ready and willing to learn and have built their relationship with farmer producer organisations, trusts, co-operatives or collectives.

Farmers realise that moving towards sustainable agriculture will evolve slowly. Therefore, it is imperative to prioritise sustainable practices through more robust support from within the government and civil society. Greater impetus must be given to knowledge-building at a fledgling stage, financial support during the transition phase and marketing support at the production stage. Engaging with farmers and cultivating healthy food at affordable prices with environmental protection is the way forward.

Acknowledgements

The research presented in this report has been made possible by the Global Challenges Research Fund award by the UK-India Research Councils. Our thanks to the University of Cambridge, U.K., for its engagement and extending their network of partner institutions in the U.K. and India. We acknowledge the support of our parent institution, Panjab University, for this project and the pursuit of a multi-faceted understanding of sustainable farming practices and systems in Punjab. We are thankful for the assistance extended by the School of Organic Farming and the Department of Soil Sciences, Panjab Agricultural University, Ludhiana. We express our appreciation for the work and help provided by Krishi Vigyan Kendras at S.A.S. Nagar and Patiala, Nabha Foundation at Nabha, Kheti Virasat Mission at Faridkot, Punjab Agri Export Corporation Limited (PAGREXCO) at Chandigarh, and Mahatma Gandhi State Institute of Public Administration at Chandigarh.

We would like to acknowledge the unstinting guidance and expertise provided by Siva Muthuprakash K.M. (VikasAnvesh Foundation) in the development of quantitative-cum-qualitative Farm Assessment Index to better capture economic, social, and ecological dimensions of alternate agricultural systems. We are indebted to our colleagues at Panjab University, especially the Department of Public Administration, School of Communication Studies, University Institute of Applied Management Sciences, University Institute of Hotel and Tourism Management, and University Business School, in our pursuit of research across inter-disciplinary issues. Our sincere thanks to Prof. Shailaja Fennell (University of Cambridge), Prof. Sumantra (Shumone) Ray (NNEdPro Global Institute for Food, Nutrition and Health), Prof. Srijit Mishra (IGIDR), Prof. R. Padmaja (ICRISAT) and Dr. Vandana Shiva (Navdanya) for their expert insights and direction.

We have depended on support and advice from numerous stakeholders in each district and village, especially in the field. We are beholden to the wife-husband duo of Khaalis for unravelling the nuances of organics and ethos behind the farmers' collective. We are grateful to our technocrat farmer, Mr. C.S. Grewal (Grewal Farms) and engineer farmer, Mr. Tarjinder Singh (member of the organic grower's group of PAGREXCO), who provided us with a deep insight into farming practices and processes. Their knowledge of organic farming systems and clarity helped in the cost computations. A special thanks goes to our poet farmer, Mr. Darshan Singh Rudel (Raza Farm), who shared his precious and illuminating work titled 'Punjab Bachao (Save Punjab)' and 'Life of an Organic Farmer.' Our deepest thanks to all the farmers who came forth to respond and put forth their perspectives under challenging times of the pandemic and farmers' stir at Delhi borders.

Our young talented research team's consistent perseverance and efforts are highly appreciated. Their multitasking skills contributed to every aspect of research, from field surveys and data collection to analysis

support. It has been a great pleasure to work with them. Co-investigators and the team had the privilege of presenting and discussing their research findings with all our stakeholders at the Final Policy Dissemination Workshop, especially with Mr. Suresh Kumar (TIGR²ESS Policy Fellow). We are most grateful for their well-meaning engagement and thought-provoking suggestions for the way ahead. The creative help of Abhishek Kralia (Department of Geology, Panjab University) in producing maps is acknowledged. We also put on record the administrative support provided to us by the Department of Public Administration, Panjab University.

It is a pleasure to acknowledge our resilient and steadfast Principal Investigator, Prof. Ramanjit Kaur Johal. Her mentorship skills, unstinting spirit, constant nudge, and upfront observations made it possible to work on myriad themes and connect with our roots. I am glad we made such a good team and took our work to another level.

Suveera Gill
29th July 2022

Abbreviations

CFAI	Comprehensive Farm Assessment Index
FPO	Farmer Producer Organisation
FSSAI	Food Safety and Standards Authority of India
ICAR	Indian Council of Agricultural Research
IIT	Indian Institute of Technology
KAP	Knowledge, Attitude and/or Practice
KVK	Krishi Vigyan Kendra
KVM	Kheti Virasat Mission
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Scheme
NABARD	National Bank for Agriculture and Rural Development
NADEP	Narayan Deorao Pandharipande Method
NAFED	National Agricultural Cooperative Marketing Federation of India Ltd
NHM	National Horticulture Mission
NMSA	National Mission on Sustainable Agriculture
PAGREXCO	Punjab Agri-Export Corporation
PAU	Punjab Agricultural University
PGS	Participatory Guarantee System

Conversion Table

Length

1 kilometre (km) = 1000 metres (m)
1 km = 0.6214 miles
1 m = 1.0936 yards
1 m = 3.2808 feet
1 mile = 1760 yards
1 mile = 1.609 km
1 yard = 0.9144 m
1 foot = 0.3048 m

Area

1 km^2 = 100 hectare (ha)
1 km^2 = 0.3861 square mile
1 km^2 = 247.105 acre
1 m^2 = 10.7639 square feet
1 ha = 10.000 m^2
1 ha = 2.4711 acres
1 square mile = 2.59 1 km^2
1 acre = 0.4047 ha
1 acre = 4046.86 m^2
1 acre = 4840 square yard
1 square yard = 9 square feet
1 square yard = 0.8361 m^2
1 square foot = 0.0929 m^2

Weight

1 tonne = 1000kg
1 tonne = 1.1023 US ton
1 US ton = 0.9072 tonnes
1 hg = 100 gram
1 kg = 2.2046 pounds (lb)
1 kg = 35.274 ounce (oz)
1 lb = 0.4536 kg
1 oz = 28.3495 gram

Units

1 crore = 10 million
1 million = 10 lakh
1 lakh = 100000
1 billion = 1000 million

1 Knowledge and Attitudes for Scaling Up Sustainable Farming Practices

The transition towards sustainability calls for radical changes at the macro- and micro-level. Delivering an ambitious economy-wide framework for changes in values and beliefs requires profound commitment (Westley et al., 2011). All successful transitions are defined by people and how the state prioritises the development of a clear and pertinent 'people agenda'. Thus, to discern and foster the changeover of people or a community would necessitate examining at least three critical facets – knowledge or beliefs, attitude or behaviour, and actions or practice that ought to be consistent with such belief and attitude. After all, the implementation of developing evidence-based interventions and informed policies to achieve a sustainable future hinges on the effective discernment of catalysts.

Agriculture is a fundamental human activity. The food system is global, interdependent, and affected by natural and climate vagaries. However, this food system is also a key contributor to biodiversity loss, negatively affecting the fertility of soil and water quality and climate change (Jia et al., 2019). This occurs through a change in land use and the adverse impact of unsustainable agricultural practices. Therefore, there is an urgent need for commitment to reduce the use and risk of pesticides and fertilisers in agriculture while enhancing the share of sustainable farming and natural landscapes. Conventional agriculture negatively impacts the environment and creates conditions under which it is difficult for farmers to compete. Thus, sustainability has emerged as an imperative in agricultural practice and policy.

Over the years, attempts have been made to explicate ways of practising sustainable agriculture. As a result, there are several approaches to sustainable agriculture addressing the same core issues, i.e., restoring soil health, reducing resource consumption, minimising vulnerability to pests in environmentally-friendly ways, reducing pollution and greenhouse gas emissions, and protecting and restoring biodiversity at multiple levels. These approaches include organic farming, nature-inclusive agriculture, permaculture, agroecology, biodynamic agriculture, conservation agriculture, regenerative agriculture, carbon farming, climate-smart agriculture, high nature value farming, low external input agriculture, circular agriculture, ecological intensification, and sustainable intensification (Oberč and Schnell, 2020). Further, many ancillary activities, such as mixed farming systems, integrated farming tools, and precision farming, as well as socio-economic activities, for instance, community-supported agriculture and agri-tourism, support sustainable agriculture. These approaches strive for a better state of the environment keeping the socio-economic impact in focus.

The factors that influence the adoption of environmentally sustainable practices by farmers have been a subject of interest for researchers (e.g., Kabii and Horwitz, 2006; Knowler and Bradshaw, 2007; Prokopy et al., 2008; Baumgart-Getz et al., 2012; Herath and Wijekoon 2013; Altenbuchner et al., 2014; Bravo-Monroy et al., 2016; Karalliyadda1 and Kazunari, 2019; Fatemi and Rezaei-Moghaddam, 2020). Studies related to knowledge, attitudes and/or practices (KAP) provide a research typology that provides a basis to explore the potential sources of success or failure of initiatives that promote sustainability. Knowledge refers to cognitive foundations associated with mental actions such as perception, memory, learning and prediction during information processing. Attitudes are affective responses to an object, which hinge on beliefs, values (Bohner and Wanke, 2002), individual experiences, interactions (Kerin et al., 2009), the socialisation processes and realistic situations (Donahue and Miller, 2006). Practices mean specific actions that relate to cognitive and affective processes to the degree that individual response is consistent with their values, beliefs, perception, culture and other socialisation processes (Heimlich and Ardoin, 2008). Conclusively, literature substantiates that sustainable environmental knowledge, attitudes and behaviour, and individual-specific attributes holistically influence farmers to undertake practices geared towards a sustainable environment.

Implementation of sustainable agriculture depends greatly on national contexts and specific priorities. Although the government recognises the importance of promoting sustainable agriculture in India,[1] the emphasis has remained heavily skewed towards a green revolution-led farming system; the agenda of greening agriculture seemed to lag in all budget allocations. There is a net reduction of around 17 per cent compared to the previous year's estimates in the funding for the Management of Natural Resources, which includes Natural Resource Management Institutes, including Agro-Forestry Research and Climate Resilient Agriculture Initiative, in the budget for 2022-2023.[2] Most small-level initiatives have been promoted through civil society actions, especially in promoting organic farming, natural farming, zero-based budget farming, and integrated farming systems. These groups facilitate awareness and capacity building and provide inputs and technology transfer. According to Gupta et al. (2021), civil society groups have actively lent support in the states of Maharashtra,

[1] Since 2014-2015, the National Mission for Sustainable Agriculture (NMSA) promotes sustainable agriculture by way of several programmes focusing on agroforestry, rainfed areas, water and soil health management, climate impacts, and adaptation. Further, micro-irrigation and rainwater harvesting is being promoted by the Pradhan Mantri Krishi Sinchai Yojana and the Integrated Watershed Management Programme, respectively.

[2] https://timesofindia.indiatimes.com/blogs/voices/green-investment-for-sustainable-agriculture-a-missed-opportunity/

Rajasthan, Madhya Pradesh, and Odisha. However, they have lagged in states like Punjab and Haryana.

In Punjab, the green revolution has completed an entire cycle – from high growth and stagnation to the current crisis. The structural change in agriculture has led to fewer, larger and generally more intensive farms suggesting a reduction in natural resources, biodiversity, and agricultural sustainability. Since the appropriate support from the state government is missing, it is imperative to explore the mindsets of early adopters of ecologically sustainable farming systems. Thus, this research explores the KAP of select farmers who practice farming sustainably. In particular, the case study approach to analysing the KAP studies on sustainability is a valuable research alternative since it combines individual perception with conceptual criteria to decode farmers' transitions to solve environmental challenges. Further, it provides insight into their socio-economic status, participatory engagement, and perceived barriers to practising sustainability.

2 Materials and Methods

The concept of sustainability has diverse connotations, which depend on the context of the term. This variability of definitions and applications hinders its operationalisation (Mebratu, 1998; Glavic, 2007; Bolis et al., 2014; Vogt and Weber, 2019). Similarly, as discussed, several explicit and implicit processes and practices exist for sustainable agriculture. According to Salas-Zapata et al. (2017), sustainability can be concurrently assumed to be a set of goals of organisations, the behaviour of discrete systems and the assimilation of economic, social and environmental criteria into specific activities. Therefore, it is reasonable to expect heterogeneity when exploring knowledge, attitudes and practices related to agricultural sustainability. Qualitative data facilitates unravelling context-specific factors (Sutton and Austin, 2015), influencing the adoption of alternate practices and processes. Therefore, a qualitative approach was invoked to gain a deeper understanding of the knowledge, attitude or behaviour and practices of farmers cultivating sustainably.

2.1 Study location and selection of farmer interviewees

As part of a broader study on the assessment of sustainable farming, a total of 125 farmers were interviewed across 68 villages from six districts of Punjab. The study was conducted from September to December 2021 and covered two cropping seasons. During the survey, farmers adopting exemplary sustainable agriculture practices or systems were identified through the Kheti Virasat Mission, a non-profit registered trust and Nabha Foundation, a charitable trust.

Further, the interviewees proposed references of other farmers adopting sustainable agricultural practices for the interview and who would consent to participate.

Ten self-identified farmers (male and female) practising sustainable agriculture (e.g., organic, natural, and conservation) agreed to participate in a detailed interview. The number of sample interviewees conforms within the range (6-25) archetypally suggested for qualitative approaches in literature (Morse, 1994; Patton, 2001). Seven of the ten farmers also participated in the Comprehensive Farm Assessment Index (CFAI) survey. The shortlisting of these farmers was based on three criteria. First, the farmers are sensitised to the biotic and abiotic stresses of conventional farming. Accordingly, all the interviewees are engaged in organic, natural, conservative or alternative sustainable agriculture systems. Second, farmers have varied experience, nature and scope of operation, as well as marketing channels. Last, farmers belong to different districts for better geographic representation within Punjab.

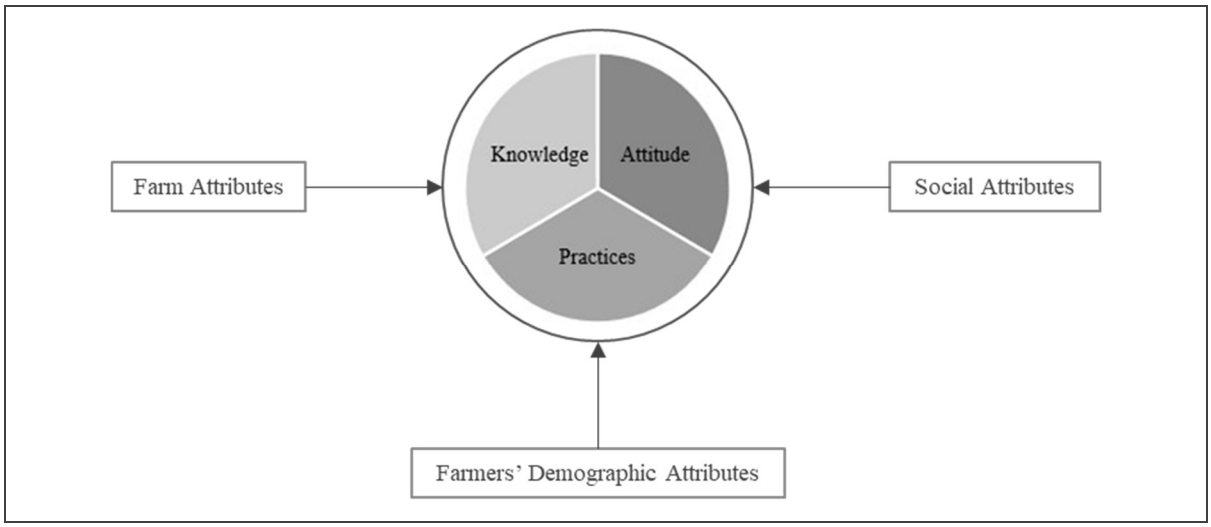
2.2 Interview process

According to Creswell (2007a), specific steps need to be followed for conducting an interview. The first step is to ensure the research questions are framed in an open-ended manner. The second step involves identifying interviewees and determining the type of interview. The third step sought an adequate recording process for conducting face-to-face interviews. The use of a suitable interview protocol is the fourth and last step. The study used semi-structured, open-ended interviews to collect the data. Open-ended semi-structured interviews were designed to ensure open discussions with the farmers. The interview questions were based on the premeditated objectives of the study and were audio-recorded after seeking consent from the interviewees. Apropos Creswell (2007b), all the recorded interviews were fully transcribed and lasted between two and three hours to capture the farmers' knowledge and attitude as well as farm practices followed. At the start of each interview, the objective underlying the conduct of the study was elucidated. Consistent with the recommendations of Brown (1992), the interviews employed neutral, conversational prompts and a laddering technique.

Interviews were scheduled after seeking farmers' convenience as to time and location. All the farmers preferred interviews to be conducted on the farm site. As shown in Figure 1, information was collected to reflect the farmers' demographic attributes (e.g., age, gender, marital status, household size, farming experience practising sustainable farming, education, professional training, familiarity with media/technology/other information sources, farm and off-farm income), farm attributes (e.g., farm size, cropping pattern, peripheral plants and trees, farm yield, labour, and livestock ownership), and social attributes (e.g., membership of co-

operative/farmer producer organisation, extension services available including technical advice/mediation and training). The study framework was conceptually based on behaviour change models, specifically the theory of planned behaviour (Ajzen, 1985). The model enables analysing of farmers' intention to change an established behaviour reinforced by their attitudes and subjective norms attached to the behaviour. Attitude deals with an individual's beliefs associated with the outcomes of behaviour. Subjective norms take into account an individual's beliefs about societal expectations. Further, if individuals are confident about their abilities to perform a behaviour, they are more inclined to accomplish it. Evidence exists that farmers' positive attitudes and perceived behavioural control toward the conversion to organic production positively influence the behavioural intention to convert (e.g., Toma and Mathijs, 2007; Kaufmann et al., 2009; Herath and Wijekoon, 2013; Rezai et al., 2016; Issa and Hamm, 2017; Nguyen et al., 2020).

Figure 1 Conceptual Model of the Study



Source: Depiction by Gill.

2.3 Data analyses and verification

The data analysis process followed the basic principles of content analysis (Neuendorf, 2017). The data were stored, categorised, and labelled with an open code to pre-defined constructs. As suggested by Morse and Richards (2002), descriptive and topic coding methods were invoked for assigning the data. Descriptive coding was used to index attributes known about the data, such as the respondent's age, gender, marital status, household size, and farming experience practising sustainable farming. Topic coding enabled indexing data related to a particular issue, such as knowledge about sustainable practices and inputs. Issues that emerged post- coding were summarised, and follow-ups, if any, were made for any further clarification.

Learning outcomes from each case were compared and contrasted with others to identify similarities and explore differences. Data tables were developed using the transcribed interviews to unravel the underlying themes. Finally, two peer reviewers analysed the coding tables for accuracy and consistency.

The case study method is effective at verifying the quality of the study (Dooley, 2002). Miles and Huberman (1994) argue that the influence of values on the research process can be controlled by the design quality, data quality, and interpretive rigour and by explicitly stating sources of bias that may exist. Design quality or reliability refers to whether the research method is appropriate for answering the research issues and questions (Tashakkori and Teddlie, 2003). By comprehensively covering the research procedures, such as case selection and coding procedures, methodological rigour has been achieved. Further, a case study database was created, wherein all data collected through questionnaire administration and interview transcripts were coded, analysed, and electronically stored.

Often referred to as construct validity (Healy and Perry, 2000), data quality refers to whether data meets the minimum criteria to be acceptable and adequately represents the theoretical phenomena under study (Tashakkori and Teddlie, 2003). Data triangulation is critical to achieving high data quality (Eisenhardt, 1989; Yin, 2003). This study utilised interviews, document review, member checking and a peer review process in the coding process to enhance the reliability of the data. In addition, the degree to which the conclusions presented are consistent with existing knowledge and theory influences their transferability to other contexts or external validity (Creswell, 2007b).

Interpretive rigour, also termed internal validity, refers to standards used to evaluate the accuracy, credibility or authenticity of the findings (Tashakkori and Teddlie, 2003). Common standards used to evaluate the interpretive rigour of a study include theoretical consistency, which is the degree to which the findings are consistent with the current state of knowledge and theory (Eisenhardt, 1989). The results arrived at were compared with the theoretical foundations and literature review. The similarities and dissimilarities between the findings and existing literature provided an opportunity for deeper insight. In addition, the interpretive agreement and distinctiveness to other possible interpretations of the results (Miles and Huberman, 1994) put the findings to conditional analyses. Finally, comparing and contrasting the findings from alternate research methods enhanced the interpretive rigour of the case studies.

3 Results and Discussion

3.1 Profile of the farmer interviewees

Interview participating farmers' demographics (gender, years of farming experience, alternate source of income) and farm attributes (farm size, primary crops of production, and farming approach) are summarised in Table 1. The sample includes eight male and two female farmers, with 60 per cent having an alternate source of income other than agriculture. As apparent, most farmers follow the organic farming system, with 78 per cent having their organic produce certified by Punjab Agri Export Corporation Limited (PAGREXCO), which is mandated to promote and market organic farming in Punjab. Farmers report a history of following sustainable agricultural practices ranging from 3 to 23 years. The farmers' minimum and maximum operational holdings are 2 acres and 16 acres, respectively. Thus, the farmers have small to medium size landholdings. Cultivation of primarily food grains and vegetables is being done with sugarcane and fruits grown by two farmers each.

Table 1 Select Farmers' Demographics and Farm Attributes

Farmer ID	Farmers' Demographics			Farm Attributes		
	Gender	Experience (in years)	Alternate Income	Farming Approach	Farm Size (in acres)	Primary Crops
1	Male	22	No	Organic	7	Sugarcane and fruits
2	Male	5	No	Conservation with low external input	3	Vegetables
3	Male	3	Yes	Organic	2	Vegetables
4	Male	23	No	Organic	12	Sugarcane and pulses
5	Female	10	Yes	Organic	7	Pulses and grains
6	Female	12	Yes	Organic	16	Grains and fruits
7	Male	8	No	Organic	2.5	Vegetables and fruits
8	Male	8	Yes	Organic	8	Grains and vegetables
9	Male	11	Yes	Organic	10	Grains and oilseeds
10	Male	10	Yes	Organic	7	Vegetables and fruits

Source: Compilation by Gill and Sharma.

3.2 Knowledge of Sustainable Farming

A person's familiarity with facts, dexterity or effects leading to improved understanding is referred to as knowledge. Knowledge enables identifying a respondent's predisposition to appreciate sustainability as an environmental issue with ramifications on the ecosystem. The

knowledge of sustainable farming relates to specific ecological regions, processes, practices, policies, conservation, or environmental problems. Accordingly, five key categories of knowledge of sustainable agriculture were identified through interviews with farmers, as shown in Table 2.

Table 2 Categories for Knowledge of Sustainable Farming

Knowledge of the local ecological region
Knowledge of sustainable practices
Knowledge of sustainable farm inputs
Knowledge of extension services and policy-supported schemes
Perception of the relative benefits, costs, and risks linked to sustainable farming

The farmers have fairly good knowledge of the local ecological region and its dynamism (Box 1). At an individual level, farmers realise that the agro-climatic profile (i.e., sets of climatic parameters and natural resource characteristics, such as rainfall, solar radiation, soil types and soil qualities, which correspond to a level of agricultural potential) of their farmland should determine their choice of crops. Further, they realise that the unsustainable water-guzzling paddy is traditionally not a native crop of the state and has been cultivated because of its high subsidised yields. Due to the limited practice of organic farming in Punjab,

Box 1 Summary of Generalised Statements about Knowledge of Local Ecological Region

- *Choice of crops is based on the agro-climatic suitability, like:*
  ... rice is not the crop of this region because our land is not rainfed where natural water remains standing for a long.
  ... these are low-lying areas; therefore, gram is not suitable, while peas are.
  ... pulses like gram and lentils grow because of our sandy-loam soil.
  ... the land was wild, lying uncultivated for several years, and we eventually realised that it is better to plant fruit trees than crops.
  ... we, as a collective, divide the crops for production as per the expertise of farmers, varied soil types, and environmental factors.
- *Irrigating crops will be a challenge since:*
  ... due to the over-extraction of underground water, our area is in the red zone.
  ... the water table in this area is below 600 metres. However, I had a fair idea of my farmland's contour (very mild from north to south). Our area has a rainfall of 600 mm (approximately 2 feet of water depth).

Source: Interviews with farmers and focus group discussions (Compilation by Gill).

the farmers' collective strategically decides on crop types based on farmers' expertise and farmland location. This is primarily done so that they can offer a potpourri of food items, from dry cereals, perishable vegetables, and seasonal fruits, to processed food items, to their customers. Due to the over-exploitation of underground water and climatic vagaries, a few farmers are proactively looking for water recharging and conservation methods.

The organic farmers are sensitised to conserving land, water, plant and animal resources, as summarised in Box 2. Accordingly, they are aware of practices appropriate to adaptation, management of natural resources, and climate change. To reduce erosion, enrich

Box 2 Summary of Generalised Statements about Knowledge of Sustainable Practices

- *To retain the soil's moisture and fertility, conserve water, and activate the micro-organisms requires the use of:*
  ... conservation tillage
  ... crop diversification
  ... multi-cropping
  ... cover cropping
  ... border cropping
  ... canopy plantations
  ... straw mulching
  ... clover (Berseem) planting
  ... spiny sesbania (Jantar) as green manure
- *There are different ways of composting, like:*
  ... NADEP
  ... decayed fruits and vegetables
  ... vermicomposting
- *Biomass is beneficial for soil building and biodiversity. It is also associated with carbon sequestration by plants*
- *Weeds are also part of nature and biodiversity, so we should remove only the harmful ones. In addition, some weeds have a life cycle, and if they do not germinate during that cycle, they are no threat. Same is the case for some insects.*
- *I realised that birds are also a part of pest management and pollination.*
- *I read that termites can't digest chlorophyll. I used my knowledge about termite foraging activity and thus avoided using pesticides.*
- *I read about traceability systems that contribute to food safety because they provide information about how and where the food is produced.*

Source: Interviews with farmers and focus group discussions (Compilation by Gill).

the soil with nutrients, and enhance biological control of pests, practices like minimum tillage, cover crops, and mulching are very beneficial. The farmers know the use of sustainable crop straws as mulch over plastic. Practices like crop diversification and multi-cropping enhance crop yield due to nutrient uptake and input efficiency. Canopy management of fruit trees enables the growth of diverse types of trees with improved quality, yield, and water use efficiency. Border cropping provides a natural shield or breaks from chemical sprays used in the adjoining fields. The use of nitrogen-fixing crops and composting results in integrated nutrient management. Some farmers prefer NADEP to vermicompost due to its lower costs. Interrupting the life cycle of weeds, birds in pest management and termites foraging activities are distinct agroecological practices. Further, they are also aware of technology and techniques that focus on food safety through traceability.

The use of organic or natural farm inputs, especially home-grown seeds, bio-fertilisers and pesticides, is a common practice that farmers know (cf. Box 3). However, all inputs used in practising sustainably require considerable time and effort in preparation if prepared at home. Further, there is associated cost entailed even if using home-sourced materials. Certain

Box 3 Summary of Generalised Statements about Knowledge of Sustainable Farm Inputs

- *Saving the best seeds from the current cropping season for the future and aiming at improving the seed quality over time.*
- *Plant growth boosters include:*
  ... farmyard manure
  ... mixture of cow urine ('Gau Mutra') and jaggery
  ... mix of cow dung and urine with gram flour, jaggery, and soil ('Jeev Amrit')
  ... fruit and vegetable waste
  ... Azolla cultivation
  ... Vermiwash
- *Poultry manure releases its nutrients within 24 hours (especially during the warm season) and affects its efficacy as a plant growth promoter.*
- *Home-made bio-pesticides include:*
  ... neem and cow urine blend
  ... sour buttermilk spray
- *Maximising the water use efficiency, through:*
  ... drip irrigation
  ... raised-bed cultivation

Source: Interviews with farmers and focus group discussions (Compilation by Gill).

methods, like, the mixture of cow urine and jaggery, and sour buttermilk spray, are indigenous, and their preparation has been passed over from one generation to another. Inputs like Azolla cultivation and preparation of vermiwash (a liquid extract produced from vermicompost) are newer low-input farming practices. Flooding the fields removes the supply of oxygen to the roots causing damage to the plants. On the other hand, raised-bed cultivation allows the soil to drain better and maximises water use efficiency.

A summary of farmers' knowledge about the extension services and policy-supported sustainable schemes is captured in Box 4. Organic farmers are aware of the certification process and certification agencies. The transition period of three years and the importance of adherence to organic practices and processes are well known to such farmers. Further, the progressive farmers are also aware of the increasing demand for organic produce in the global market and the process of obtaining an export licence. However, they are also well versed in the challenges of getting a laboratory certificate every time an export order has to be executed. The government scheme to promote farm stays is a novel proposition, though it applies only to those who naturally have or can recreate an ecological environment. Farmers are aware of the environmental ramifications of paddy straw burning and the government incentives to discourage this practice. Since the state had no budget for the provision of this financial incentive, farmers considered it a failure as the benefit could not percolate to many small and marginal farmers. An initiative of the state government to provide a market outlet for locally grown organic produce in Chandigarh alone is considered a non-starter.

The Punjab Agricultural University's (PAU) Organic Farmers Club is a good networking platform for direct face-to-face interactions with other organic producers. Together with the workshops tailored for the members, the initiative is perceived as an effective source for gaining information. In addition, several governmental (e.g., MNREGA, Horticulture Department, NAFED, KVKs) and non-governmental organisations (e.g., KVM, Pingalwara Charitable Society, Nabha Foundation) sponsor various conferences, workshops, and demonstrations to increase the farmers' awareness. Trainers and experts dwell upon a range of practices – the cultivation of pulses, bio fertilisers and composting, planning and plantation of fruit plants, integrated farming, food processing and preserving, branding and marketing of organic products, the scope of natural farming, and soil and water conservation technologies. The farmers appreciated the outreach activities as they were relatively easy to access and on relevant themes.

Box 4 Summary of Generalised Statements about Knowledge of Extension Services and Policy-Supported Sustainable Schemes

- *Obtaining organic certification:*
  ... is a three-year process
  ... is conducted in two modes – the third-party certification and the Participatory Guarantee Scheme (PGS).
- *I got a certificate from the Food Safety and Standards Authority of India (FSSAI). Mere certification is insufficient since it requires a laboratory test each time an export order is processed.*
- *Punjab Farm Tourism Scheme provides licence to operate farm stays to boost ecological tourism in the state.*
- *Availing of the NABARD subsidy for rural warehouse/godown can solve marketing problems*
- *Through the Krishi Vigyan Kendras (KVKs), the Punjab government gave an incentive of Rs. 2,500 per acre to small and marginal farmers who did not burn paddy stubble.*
- *PAGREXCO markets farmers' produce through 'Organic Hut'.*
- *The PAU Organic Farming Club conducts quarterly interactive meetings for progressive and organic farmers.*
- *Participation in the technical training programme related to sustainable farm processes, practices, and processing under the aegis of:*
  ... the Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGA)
  ... the Indian Agricultural Research Institute, Delhi
  ... ICAR-Central Potato Research Institute, Shimla
  ... ICAR-Directorate of Mushroom Research, Solan
  ... the Horticulture Department, Punjab
  ... the National Agricultural Cooperative Marketing Federation of India Ltd (NAFED), through the National Horticulture Mission (NHM)
  ... the KVKs
  ... the PAU
  ... the Kheti Virasat Mission (KVM)
  ... the Pingalwara Charitable Society (Amritsar)
  ... the Nabha Foundation

Source: Interviews with farmers and focus group discussions (Compilation by Gill).

Since the sample farmers have been cultivating sustainably for some time, they are mindful of its positive impacts on the environment, biodiversity, and society (Box 5). They perceive that the quantity and quality of output depend on the quantity and quality of inputs; therefore, they choose environmental-friendly resources. Together, they apply organic farming

techniques and practices that improve soil and water health. Farmers take pride in not opting for crops and methods that are unsustainable and in catering to local demand. By providing chemical-free food, they believe they are doing a great service by providing customers with healthy and nutritious food. Their goodwill has percolated in the market, and their produce is in great demand, particularly among health-conscious consumers. For example, they state that the percentage of curcumin and allicin is high in organically grown turmeric and garlic, respectively. These products have medicinal properties and are immunity boosters; realising which customers prefer purchasing from them, especially during post-Covid times. These products sell at a good margin, mainly if they are processed.

Box 5 Summary of Generalised Statements about Perception of the Relative Benefits, Costs, and Risks Linked to Sustainable Farming

- *Perceived benefits:*

  ... organic farmers go the extra mile to use the right inputs in the right quantity

  ... products of our farm are in demand due to their nutrient density

  ... eating fresh and local food will provide health benefits

  ... people are becoming more conscious about what they eat and are aware of the goodness of organic food

  ... processing of organic produce fetches a high premium

  ... organic exports have a good scope and offer good job opportunities to the youth

  ... I am not only conserving natural resources but am also saving the exchequer

- *Perceived costs and risks:*

  ... practising sustainably is laborious and expensive

  ... lack of knowledge and necessary skills

  ... lack of marketing support and platforms

  ... government failure to align incentives towards resource conservation from increasing yields

  ... political leaders give the 'Swadeshi' slogan but do not provide any solution to the challenges

  ... land fragmentation and corporatisation of agriculture

  ... agri-scientists do not guide as to the sustainable way ahead.

  ... consumers seek cheap food and do not value quality and nutrition

  ... conventional farmers are monopolising the market

Source: Interviews with farmers and focus group discussions (Compilation by Gill).

The statements about the perceived risks and costs associated with opting for sustainable farming relate to applying organic practices in the face of political and institutional apathy. Organic farming is labour-intensive and requires adequate knowledge and skills to

practice. Farmers believe that government policies are contradictory to organic principles. There is an emphasis on an increase in yield and subsidies for purchasing chemicals and electricity, primarily used in industrial farming. The farmers believe that the chemical manufacturing companies are hand in glove with the government. Further, the government's lackadaisical attitude to promoting markets and marketing platforms discourages many from adopting organics since practising sustainably entails high operations costs. The ones who do practice sustainably are given no incentive or recognition. Agri-scientists, too, have failed to provide them with a sustainable way ahead, even when they know the unfavourable/negative fallout of the green revolution way of farming. The small farmers continue to sell their lands, leading to the corporatisation of agriculture. Finally, the farmers are disappointed with the general attitude of the consumers, to whom what matters is the food price.

3.3 Attitude towards Sustainable Farming

Attitudes characterise a person and are a realised state resulting from nurturing or experiential conditions. It encompasses cognition about the subject, eliciting affective reactions, and influencing behaviour. The issue of interest can be an object, event, person or group. The interactions demonstrate that, in general, respondents have a positive attitude toward sustainability and are willingly practising conforming to their attitude. The six categories of attitude toward sustainable farming show that participants share the reasons for adoption, feelings, and economics about practising, attitude to learn and seek information, as well as individual and social values to the conservation and protection of the environment and ecosystems (Table 3).

Table 3 Categories for Attitude towards Sustainable Farming

Reasons behind adopting/continuing with sustainable farming
Feelings and concerns about practising sustainable farming
Attitude about the economics of sustainable farming
Attitude anchored in group-norm/values
Attitude towards learning and seeking information about sustainable farming
Attitude to life seeking fulfilment with one's own actions

There are various reasons for adopting sustainable farming, from health fallouts of the green revolution to personal awakening and, ultimately, societal well-being, as put forth in Box 6. The Punjabis are aware of the increasing health fallouts of the excessive use of chemical fertilisers and pesticides in fields. Malignant diseases, like cancer, in the family and among

acquaintances have resulted in them voluntarily giving up conventional farming. Some farmers have drawn inspiration from family and friends practising organics. Many others have decisively elected to farm sustainably out of the conviction that this is in the interest of the state and agroecology. Moving from individual to shared values, a few farmers are oriented to do social good by providing healthy and chemical-free food for all.

Box 6 Summary of Generalised Statements about Reasons behind Adoption of Sustainable Farming

- *Concern about the health fallouts of the green revolution:*
  ... my cousin died of blood cancer. After this incident, we decided to give up chemical farming.
  ... my uncle suffers from cancer. The doctors advised having only home-grown pesticide-free food. So, we took the lesson and decided to practice sustainably
- *Inspiration from:*
  ... an acquaintance who practised organic farming
  ... my wife, when we relocated to India in 2008, tried to explain to our children what we used to eat traditionally.
- *Sustainable awakening:*
  ... we will have barren land and heavily contaminated food if we don't change our ways, so I decided to practice organic farming, maintaining the natural ecosystem
  ... I began with chemical farming but soon discontinued it since my conscience did not allow me
  ... I opted for a sustainable way of farming because I love nature
- *Societal well-being:*
  ... as I wanted to provide good quality nutritious food to people
  ... as I desired to improve community health
  ... as I believe that our consumers should eat the same as us, i.e., healthy organic food

Source: Interviews with farmers and focus group discussions (Compilation by Gill).

The farmers realise the challenges of practising farming in the present socio-economic setup (Box 7). Increasingly families are breaking-up with the youth looking for greener pastures in India and abroad. The break-up of family farming makes labour-intensive sustainable agriculture an economic drain on resources. Further, the social and gender norms in rural setup restrict women to stereotypic chores, resulting in depriving them of participating in (male-dominated) farming decisions. Some farmers feel that social stigma and discrimination faced at the hands of friends and neighbours at times has a demotivating effect on them. Acquaintances even cite the case of a sudden switch to sustainable farming by Sri

Lanka, resulting in its failure. The respondents believe that moving towards sustainability cannot happen overnight and must evolve slowly.

Box 7 Summary of Generalised Statements about Feelings and Concerns in Practising Sustainable Farming

- *Feelings about practising sustainability:*
  ... the size of the family has gone down, so there are fewer working hands
  ... women's representation is low as they are less inclined to join a farmer producer organisation
  ... social stigmatisation by friends and neighbours
  ... move toward increasing the land under sustainable farming has to be slow
  ... the nutritional value does not determine the pricing of the food consumables
  ... consumers are enticed by aesthetic packaging and display
  ... some farmers mis-sell conventional as organics
  ... no follow-up inspection post organic certification by authorities
  ... apathy and lack of commitment of the local administration to provide a suitable marketing platform
  ... the choice of crops restricted to cereals due to lack of infrastructural facilities
  ... companies producing agricultural chemicals lobby with the government
  ... government needs to support and provide an enabling environment
- *Concerns about practising sustainably include:*
  ... low yields and high labour cost
  ... poor profits
  ... meagre government subsidies
  ... three years of transition to organics is a long to sustain economically
  ... premium on organics is unrealisable
  ... consumers lack awareness about sustainable production and consumption
  ... consumers are price-focused and unwilling to pay
  ... lack of suitable marketing channels
  ... lack storing, warehousing and refrigeration facilities
  ... politicisation of the organic farmer's market

Source: Interviews with farmers and focus group discussions (Compilation by Gill).

One common reason for farmers' perturbation is consumers' attraction towards aesthetically packed and displayed products. They feel that the nutritional value should determine the pricing of the food consumables. Further, they are wary of the unethical practices of some farmers who pass chemical-laden food as organic. The farmers also point out the administrative lapses and laxity in the certification process with no follow-up inspection post

organic certification. The government needs to support and provide an enabling environment; they consider it opportunistic and uncommitted to the cause.

The concerns aired by farmers are in line with how they feel about carrying out sustainable farming. The economic viability is low due to poor productivity and higher costs. Farmers indeed face losses when they opt for the organic way. In the face of no handholding from the government, many small and marginal farmers, facing economic hardships, give up on practising organically. Further, inadequate policy support in product development and marketing, developing infrastructure, promoting key market channels, processing, and encouraging product diversification are hampering the adoption of this system. With all the incentives stacked against organic and other alternative sustainable cultivation systems, the local market's politicisation further impinges its growth. The much-talked-about premium on organics is available in the presence of knowledgeable consumers, which are present only in cities. For farmers to whom such markets are not accessible have to make distress sales every so often.

Many concerns raised by the participating farmers relate to the economic viability of environmentally-friendly cultivation practices (Box 8). Many of these concerns are interlinked as the costs are inevitably linked to profitability, productivity, and scalability. Farmers account for not only the actual costs but also the opportunity costs, i.e., gross revenue calculated under organic vis-a-vis conventional farming system. Some farmers adopt shadow pricing to factor in the price of home-grown ingredients used in processed food. In the final analysis, they are bogged down by escalating costs, squeeze on the availability of farm hands, and debt spiral. As a result, many of them have gone back to their old ways of conventional or unsustainable farming.

Farmers adopting mixed and multi-cropping have not only been able to reduce the environmental consequences linked with crop production but also successfully diversified their risks. A cost-effective way of protecting vegetables, like net houses, also conserve water as rainwater irrigates the fields naturally. Further, farmers realise they fetch a far greater premium on their produce if they undertake to process. A little value addition, like drying chillies and selling them whole or in a powder form, gives more returns. The farmers take the initiative in making the consumers aware of the benefit of consuming organic food. Since chemical-free produce is pure, the quantity consumed or used while cooking is reduced, making it cost-effective.

Box 8 Summary of Generalised Statements about the Economics of Sustainable Farming

- *Costs of practising sustainably:*
  ... the loss of efficiency and opportunity are also costs associated with agriculture production, but monetising it isn't easy
  ... to determine the cost of home-grown ingredients used in food processing, we do shadow pricing and refer to the average market price. I charge costs plus a markup of 15%.
  ... the cost of production has drastically increased due to scarcity of farm workforce (especially during Covid times) and escalating diesel prices
  ... the construction costs have gone up post-Covid, and the rising fuel prices are adversely affecting my plans to promote agri-tourism
  ... the interest rate on agricultural loans is very high, and if the crop fails, what matters is economics and not sustainability
- *Benefits of practising sustainably:*
  ... since I practice mixed- and multi-cropping, if I don't earn sufficient from one crop, I can make good from selling the other
  ... protected farming using net houses is far economical than spending Rs. 25-35 lakhs on a poly house
  ... most of our products are processed as it fetches more money vis-à-vis if sold raw
  ... due to purity and non-adulteration, the consumption of our products is reduced to half

Source: Interviews with farmers and focus group discussions (Compilation by Gill).

Most farmers are ready and willing to learn. Several factors foster and strengthen this predisposition and ensure their capacity to continue with sustainable farming. Without developing these attitudes and skills, cultivators will not be well prepared to acquire the knowledge and skills necessary for successful adaptation, especially in the face of sustainability challenges. Farmers draw concurrently on a range of resources, with some analogous to their knowledge and awareness, while others are extrinsic and motivational, contributing to their receptiveness. Amongst intrinsic factors, positive disposition to agriculture and learning, such as '*I have gained knowledge through practice'*, '*I had to relearn'*, and *'I always say that my farm is a laboratory',* agriculture and learning (Box 9) was seen. Interest in and satisfaction with practising holistically affects the continuity of engagement in a specific farming system.

Instrumental or external motivation plays an essential role in generating interest and upskilling. For instance, dissemination sessions and training workshops are significant predictors for selecting farming processes, practices, and performance outcomes. It has been observed that organic farmers are sufficiently aware of the benefits of value additions to their

produce. Therefore, they are interested in workshops imparting knowledge about processing, preservation, packaging and labelling. Others are savvy enough to access social media for resources on traditional and progressive agricultural inputs and practices. Further, they experiment with innovative farming technologies, like aquaponics and hydroponics. On the whole, in their collective wisdom, they try to make a difference in their network and society.

Box 9 Summary of Generalised Statements about Attitude towards Learning and Seeking Information regarding Sustainable Farming

- *Intrinsic motivation to learn and seek information:*

  ... I have gained knowledge through practice, as I have no degree in agriculture science. Today, I hold online and offline training sessions. The PAU has invited me to deliver lectures on multiple cropping and small-scale marketing strategies

  ... over the years, I have visited Greece, Switzerland, New Zealand and Australia, where I have tried to pick up new farming practices. I also learnt landscape gardening while I was in Japan. However, the agricultural nuances in the context of India are different, so I had to relearn, and it took me some time to establish myself

  ... I always say that my farm is a laboratory where I conduct agricultural experiments and invite others to join me. While farming, I have followed the principle of 'minimum water and maximum output.'
- *Extrinsic motivation to learn and seek information:*

  ... I never miss the opportunity to learn more through farmers' training sessions. The PAU provided hands-on training in the latest technologies, such as food processing, preservation, and packaging.

  ... I look forward to learning a new skill and regularly attending training programmes and dissemination workshops on sustainable farming methods and processing. I have even done a course on making handmade natural soaps.

  ... I want to try innovative farming methods and took part in experimenting with aquaponics and hydroponics under the guidance of a professor at IIT Ropar

  ... I am active on social media, and there are several WhatsApp groups and free communities where information about traditional and innovative agricultural inputs and practices are regularly exchanged.

  ... we are a group of seven members and believe in doing good through practice. We have a WhatsApp group named 'Mai Punjabi'. We recently held a seminar on a nearby landfill to sensitise people about the problems caused by unsustainable waste management

Source: Interviews with farmers and focus group discussions (Compilation by Gill).

For most farmers, farming is central to their daily life. Experiencing the meaning in life is an important contributor to a person's well-being and health (Box 10). For some, attitude to life describes how the world appears to them. So, farmers believe they are the '*caretakers of land'* or *'agriculture is a lifestyle'* and *'farming is livelihood differently'*. For others, life's purpose refers to the direction and future-oriented goals. Farmers consider that their main aim is not to make money but to provide nutritious and high-quality food to satisfy customers, create awareness about the health benefits of eating chemical-free organic food, and emphasise their cultivation's social and environmental consequences. Still, others perceive the world that might arise from pursuing their purpose, which focuses on value and a life worth living. The farmers interviewed trust that they must practice and produce ethically as one cannot put a value on the goodness of nutrition and health.

Box 10 Summary of Generalised Statements about Attitude to Life Seeking Fulfilment with One's Actions

- *Making sense of one's experiences in life (understanding):*

  ... as caretakers, we are responsible for leaving the land in good condition for the next generation. Sri Guru Nanak Devji said, 'Kudrati-Kheti' (natural farming) is 'Uttam Kheti' (superior farming)

  ... I am doing my work with passion and differently from others. I'm not embarrassed about my work; I lead a happy life. I advised my children to join the family farm, just as I opted to in my youth.

  ... agriculture cannot be slotted as a commercial activity. It is a lifestyle and a way of living rather than earning. So, it is livelihood in a different way, more like happiness
- *Future-oriented aims and goals that give direction to life (motivation):*

  ... our main aim is to provide pure and nutritious food to satisfy our customers. We also attempt to create awareness about the health benefits of eating chemical-free organic food

  ... my motive is not to make money but to provide good quality food to the community of families

  ... farming is not related to growing crops alone. It should also emphasise social, environmental and nutritional aspects
- *Making sense of life's inherent value (evaluation):*

  ... people ask me how can sustainable be profitable! I question whether they can calculate the goodness of nutrition and health

  ... people ridicule us that we are pursuing farming even after being highly qualified. However, we believe we must practice and produce ethically since we are educated

Source: Interviews and focus group discussions with farmers (Compilation by Gill).

The elicitation of the group and social values goes beyond the prescriptive view of the self to incorporate common notions of social goods and cultural importance (Box 11). The transcendental values include things characterised as desirable end states, such as the aspiration to see the youth of Punjab engaged in family farming. It also involves emotional rhetoric to engage youth in agriculture, offering them decent returns. Cultural and societal values are shared virtues grounded in a specific context. As pronounced by the Sikh Gurus, farmers believe one is following a righteous way of life by working hard and in everybody's well-being. Further, you respect not only people of all religions, languages, and cultures but also your soil, air, water, and biodiversity. Within the society, farmers undertake community-supported initiatives to engage with their stakeholders, especially consumers. Some also demonstrate their sustainable practices and viability to allay their fears and misconceptions in the mind of conventional farmers. Further, they also care for their collectives by providing each other with inputs and undertaking support activities, including a common marketing platform.

3.4 Practices in Sustainable Farming

Practices represent explicit actions that are directly related to processes that require the application of knowledge and affective responses. The reported practices of the farmers interviewed relate to sustainability, such as practising agroforestry, ecological intensification and environmentally-friendly activities, such as crop rotation, cover cropping, mixed and intercropping, crop diversification, mixing farming, bio-pesticide and bio-fertiliser use, minimal or no tillage, and nutrient balancing. The practices are consistent with their attitude towards sustainability. The three categories of sustainable farming practices show farmers' activities, activities linked to others, and activities advocated collaboratively, as in Table 4.

Table 4 Categories for Practices in Sustainable Farming

Sustainable farming practised by self
Sustainable farming practices propagated by others
Sustainable farming is practised and advocated collaboratively

The respondents follow a range of holistic approaches to address sustainability issues through their practices, such as restoring soil health, conserving water, reducing resource consumption, and minimising vulnerability to pests in environmentally-friendly ways, thus protecting and restoring biodiversity (Box 12). There is a widely shared understanding of the local challenges and the same set of solutions adopted. From practising agroforestry to using ecosystem and biodiversity integrates food production with natural capital. It aims at securing the natural or semi-natural habitat together with productivity. Farmers practising eco-

Box 11 Summary of Generalised Statements about Attitude anchored in Social/Group Norms and Values

- *Transcendental values:*

  ... I feel that the youth of Punjab should join family farming as a career choice and not as a last resort. Therefore, if my initiatives are successful, I would like to involve young villagers by offering them decent returns.

- *Cultural and societal values:*

  ... we are hard-working and doing our best to cater to the good health of our people, as pronounced by the teachings of Guru Nanak Devji.

  ... we need to remember the teachings of Guru Nanak Devji and do our work (Kirat) with patience (Sabar), thanksgiving (Shukar), and contentment (Santokh). In our lives, we need to imbibe the Slok in Jap Ji Sahib, "Pavan Guru, Pani Pita, Mata Dharat Mahat."

  ... when we are associated with the soil, our attitude toward life changes. Hence, I am attached to the local people, language, and culture. As a result, so many people reach out to me for help on how to start organic farming.

  ... I maintain an excellent relationship with the panchayat and villagers. There is 'Peer Baba Di Mazaar' on my farm, which I have preserved as a mark of my respect for him.

- *Communal values:*

  ... this community-supported initiative encourages families to visit and see how farming is carried out for themselves.

  ... the primary purpose of farming is to grow food crops for the local community and make a person's mind and body healthy

- *Group values:*

  ... I began organic farming so that other farmers could observe my practices and come out of the misconceptions related to practising sustainability. Then I started processing so that they get an idea that operations are economically viable.

  ... we are trying to support the farmers by sharing our experience so that they can grow and sustain themselves in the future.

  ... the organic farmers' market is a common platform where we connect a community of farmers with customers.

- *Value to society:*

  ... we are in the process of building a big kitchen, where we intend to impart training to local village girls and women in food processing and nutrition so that they are skilled and can earn their living.

Source: Interviews with farmers and focus group discussions (Compilation by Gill).

Box 12 Summary of Generalised Statements about Sustainable Farming Practised by Self

- *Practising agroforestry:*
  - *... canopy plantation*
  - *... cover cropping*
- *Using ecosystem and biodiversity:*
  - *... insects as natural pollinators*
  - *... biological management of pests and weeds*
  - *... trees as windbreaks*
  - *... natural ponds for Azolla cultivation*
- *Building healthy soil:*
  - *... no or minimum tillage*
  - *... fallowing*
  - *... crop rotation*
  - *... intercropping*
  - *... crop diversification*
  - *... relay cropping*
  - *... precision cropping*
  - *... straw mulching*
  - *... termite foraging activity*
- *Water management:*
  - *... shunning paddy cultivation*
  - *... drip irrigation and water sprinkler system*
  - *... natural water recharging and harvesting*
  - *... elevated horizontal mulch crop bed on a waterway*
- *Integrated nutrient management:*
  - *... cultivation of nitrogen-fixing plants and other green manure crops*
  - *... bio-fertilisers, farmyard manure*
  - *... composting using straw, vegetable and fruit waste, animal excreta, and earthworms*
- *Ergonomic interventions:*
  - *... on-farm zero-energy cool storage chamber*
  - *... multi-tier zero energy storage*
- *Supporting socio-economic activities:*
  - *... retail outlet with added services like cold-pressed juices*
  - *... agri-tourism with farm stays*
  - *... minimising drudgery by engaging labour in both cultivation and processing*
  - *... selecting and saving the best seeds for future cropping*
  - *... demonstrative and experimental farming using different crop varieties and techniques*

Source: Interviews with farmers and focus group discussions (Compilation by Gill).

agriculture have good biodiversity, with diverse species of birds, insects and animals on their farms. Some have retained natural ponds that fill up during the rainy season and thus helps in the water recharging and additionally engaging in Azolla cultivation. All work on building healthy soil by no-tilling and no use of chemical fertilisers or pesticides. Alternatively, soil and plant health can be enhanced through mulching, green manuring, composting, and crop diversification. Some progressive farmers have started using paddy straw for mulching as it favours the soil's physical, chemical, and biological properties and reduces the number of irrigations and retards weed growth. Indigenous methods, like applying cow dung to the jujube (ber) tree's bark, have prevented the fungus' spread and facilitated growth due to better absorption of microbiological nutrients.

Due to the depletion of water resources in Punjab, farmers are undertaking activities that increase water filtration and retention by opting for natural water recharging and rainwater harvesting. Practices like furrow irrigation are an inexpensive way that the facilitates the rotation of water and results in less water wastage. Others have opted for drip irrigation or sprinkler system for irrigating their farms. In addition, several ergonomic interventions have been opted to improve the on-farm storage process, such as an eco-efficient zero-energy cool storage chamber for short-term storage of vegetables and fruits on-field that retains shelf-life and nutritional value. Many farmers, taking on more of a socio-economic angle to boost economic sustainability, opt for agritourism in supporting and maintaining the land and its resources. Others engage the hired labour on the farm and in food processing so that the drudgery of work is minimal. This is how they generate employment for rural women who are paid at par with men, which is not the usual practice except under the MNREGA.

The respondent farmers are well networked and are aware of the practices of not only friends and acquaintances but others to whom references are made during training workshops and seminars. Most farmers have an all-inclusive view of nature and agricultural practices resulting in a keenness to learn from the experiences of other adopters, as cited in Box 13. Discussions range from sustainable agriculture systems like organic farming, natural farming and integrated farming system to practices like crop diversification and intercropping. Further, processing of food as a solution for avoiding waste and improving profits is appreciated by the farmers, to quote, *"processing enables the conservation of foods for prolonged periods, which can then be sold offseason at a premium"*. Specific adverse observations made by the farmers regarding the non-biodegradable mulches used in farming and hassles with marketing due to lack of organic certification are constraints to the practice. Such farmers have a problem

associating with any organic marketing platform because it is difficult for them to prove the genuineness of their produce

Box 13 Summary of Generalised Statements about Sustainable Farming Practised by Others

- *Positive encounters:*
  ... one organic farmer, from Ferozepur district, cultivates over fifty crops with diverse varieties of trees, animals and birds on his farmland. He has improvised farm machines to make them less strenuous for the operator
  ... an acquaintance integrated cultivation with five acres of poultry farming and is making handsome profits.
  ... a farmer from the SAS Nagar district grows a variety of turmeric with a very high curcumin level of 7% to 8%. As a result, there is a lot of demand for his dry turmeric powder, which sells for Rs. 500 per kg (how much over the normal market price? We can use this in our analysis).
  ... since bacteria are found in all produce that contains sugar, some organic farmers produce fruit vinegar through the fermentation process from apples, pomegranates, and Indian blackberry (Jamun), besides the traditional sugarcane.
  ... my friend has tried preparing fruit juice from ripened peaches, which is very tasty.
- *Negative encounters:*
  ... use of non-biodegradable mulches for agricultural purposes
  ... some farmers who practice organic have not had their produce certified. As a result, it becomes difficult for such farmers to sell through a common market platform

Source: Interviews with farmers and focus group discussions (Compilation by Gill).

Collaborating amongst farmers can take different forms, from setting up a farmer producer organisation (FPO), Company or Trust to informal collectives. Many others, including farmers' organic marketplace, provide a common platform to market their produce (Box 14). India's central and state government agencies promote and support FPOs under various programmes and schemes. Similarly, trusts are formed under the Indian Trusts Act, 1882. While in other forms, it is up to the collaborators to decide the level of involvement and set the guidelines for them, for example, the Chandigarh Holistic Agriculture Initiative assists in practices which are sustainable to give an entry to such/these farmers to sell their produce as organic.

Many benefits accrue to the farmers as a group through collaborative arrangements. Collaboration allows for resource sharing, processing high-value products, and marketing a diverse range of food and non-food items. It allows for better production plans, efficient

execution and effective delivery. When farmers from various locations and experience team up, they are in a better position to learn from each other and resolve common challenges. Continuous networking helps them to keep abreast with the latest agri-innovations and technologies. Over and above, collectivisation results in good health and nutrition for their families and communities.

Box 14 Summary of Generalised Statements about Sustainable Farming Practiced and Advocated Collaboratively

- *Nature of collaborative arrangement:*

  ... initially, only a few members were part of our FPO. Presently we are 214 members and strive to enrol new members to support our community.

  ... we have neither formed any FPO nor registered as a company but are working as a 'collective' for a good cause towards nutrition and health, selling only organic produce in our store. A majority of the members are small or marginal farmers from Punjab, but farmers from nearby states our getting to know about us by word of mouth

  ... we are a group of around twenty-five families contributing to the growth of vegetables through a trust as a community-supported family farming

  ... the farmers' organic mandi is not registered, it's our collective effort, and we happily carry out our work voluntarily. Together with Chandigarh Holistic Agriculture Initiative, we interview farmers and observe their practices before allowing them to sell their produce.
- *Benefits of collaboration:*

  ... share inputs and exchange seeds

  ... our FPO has a machinery bank, so we save on investing in agricultural equipment

  ... plan to cultivate diverse food and non-food items amongst the collective so that a range of products are available to the customer. It also helps farmers to do what they can do well.

  ... we provide raw materials to some of our members and then ask them to process them into ready-to-eat products, which sell at a higher price

  ... the distantly located farmers for whom marketing is a challenge are benefitted through our common city outlet

  ... we use social media (WhatsApp groups) for marketing purposes

  ... all member households receive their supply of fresh vegetables through common farmland

  ... we conduct meetings for problem-solving and hold talks on innovative farming practices so that we all are abreast with the latest

Source: Interviews with farmers and focus group discussions (Compilation by Gill).

4 Conclusion and Recommendations

The research adopted the case study approach to analyse the KAP of select farmers practising sustainable farming, including a better state of the environment, healthy food, and good quality of life for the producers and community. Most farmers interviewed follow the organic farming system, with 78 per cent having their organic products certified. The farmers primarily cultivate grain and vegetables and have small to medium size landholdings. The case studies focus on exploring knowledge of ecosystems, sustainable inputs and practices, extension services and policy-supported schemes, and perception of sustainable farming. Regarding attitudes, the importance and value that the farmers place on practising and economics of sustainable farming, individual and group norms, and seeking information have been delineated. A similar observation is made in the practices followed by self, others and collaboratively as they are associated with sustainability.

The farmers under study know reasonably well about the local ecological region and its dynamism. They are sensitive to conserving land, water, and biological resources, considering the environmental challenges faced in Punjab. Further, they are also aware of technology and techniques that focus on food safety through traceability. The use of organic or natural farm inputs is a common practice that farmers know about though they consider it a strenuous activity. Organic farmers are aware of the certification process and certification agencies. They are also mindful of the environmental ramifications of paddy straw burning and the government incentives to discourage this practice. Workshops and other extension activities are perceived as an effective source for gaining information, whether conducted by government agencies or self-help groups. Many consider healthy and nutritious food as an outcome of the sustainable approach to agriculture. However, they are wary of the additional associated costs, particularly regarding labour and access to knowledge. A challenge inextricably linked with costs is not only profitability but also productivity. Further, they perceive that most conventional agricultural practices are continuing to receive public subsidies. The government's lackadaisical attitude and consumers' price sensitiveness does not augur well for them.

There are various reasons for adopting sustainable farming, from health fallouts of the green revolution to personal awakening and, ultimately, societal well-being. The farmers realise the challenges of practising organic, or even sustainable, farming in the present socio-economic setup. The administrative laxity in the certification process with no follow-ups reflects their lackadaisical attitude, despite the acknowledgement that it is wrong for some farmers to pass chemical-laden food as organic. The much-talked-about premium on organics

is available only if consumers are knowledgeable, like in cities. For farmers to whom such markets are not accessible have to make distress sales many a time. Their belief to provide nutritious and high-quality food to satisfy customers, create awareness about the health benefits of eating chemical-free organic food, and emphasise their cultivation's social and environmental consequences has held them steadfast. They elicit group and social values beyond self to integrate common notions of social goods and cultural importance.

In line with their attitude, farmers are actively pursuing practices to reduce soil erosion and resource consumption, minimise vulnerability to pests, conserve water, and protect biodiversity. They are well networked and are aware of the practices of friends and acquaintances. Sustainable agriculture approaches like organic farming, natural farming and integrated farming system with practices like crop diversification, intercropping and similar environmentally-friendly methods are being adopted. Further, the processing of food as a solution for avoiding waste and improving profits is garnering much support. Farmers' collaboration through FPOs, trusts, or collectives has benefitted them by allowing for resource sharing, processing high-value products, and marketing a diverse range of items.

Overall, as stated by a farmer, moving towards sustainable agriculture cannot happen overnight and must evolve slowly. It is imperative to prioritise sustainable practices through more robust support from within the government and civil society. Greater impetus must be given to knowledge-building at a fledgling stage, financial support during the transition phase and marketing support at the production stage. Being labour-intensive perhaps is an opportunity to engage rural youth, promoting family farming and reducing unemployment. The challenge for policymaking is engaging with farmers to create the right environment to help define priorities according to local contexts. Cultivating healthy food at affordable prices with environmental protection is crucial.

References

Ajzen, I. (1985). From intentions to actions: a theory of planned behavior. In: Kuhl, J. & Beckmann, J. (eds) *Action-Control: From Cognition to Behavior* (pp. 11–39). Springer: Heidelberg.

Altenbuchner, C., Larcher, M. & Vogel, S. (2014). The impact of organic cotton cultivation on the livelihood of smallholder farmers in Meatu district, Tanzania. *Renewable Agriculture and Food Systems*, *31*(1), 22–36. http://doi.org/10.1017/S1742170514000416

Baumgart-Getz, A., Prokopy, L. S. & Floress, K. (2012). Why farmers adopt best management practice in the United States: a meta-analysis of the adoption literature. *Journal of Environmental Management*, 96(1): 17–25. http://doi.org/10.1016/j.jenvman.2011.10.006.

Bohner, G., & Wanke, M. (2002). *Attitudes and Attitude Change*. East Sussex, Psychology Press: United Kingdom.

Bolis, I., Morioka, S. N., & Sznelwar, L. I. (2014). When sustainable development risks losing its meaning. Delimiting the concept with a comprehensive literature review and a conceptual model. *Journal of Cleaner Production, 83*, 7–20. http://dx.doi.org/10.1016/j.jclepro.2014.06.041

Bravo-Monroy, L., Potts, S. G., & Tzanopoulos, J. (2016). Drivers influencing farmer decisions for adopting organic or conventional coffee management practices. *Food Policy*, *58*, 49–61. https://doi.org/10.1016/j.foodpol.2015.11.003

Brown, S. M. (1992). Cognitive mapping and repertory grids for qualitative survey research: some comparative observations. *Journal of Management Studies*, *29*(3), 287–307. https://doi.org/10.1111/j.1467-6486.1992.tb00666.x

Creswell, J. W. (2007a). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*. Prentice Hall: Upper Saddle River, NJ.

Creswell, J. W. (2007b). *Qualitative Inquiry and Research Design: Choosing among Five Traditions*. Sage: Thousand Oaks, CA.

Donahue, A. K., & Miller, J. M. (2006). Experience, attitudes, and willingness to pay for public safety. *The American Review of Public Administration, 36*(4), 395–418. https://doi.org/10.1177/0275074005285666

Dooley, L. M. (2002). Case study research and theory building. *Advances in Developing Human Resources*, *4*(3), 335–354. https://doi.org/10.1177%2F1523422302043007

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, *14*(4), 532–550. https://doi.org/10.2307/258557

Fatemi M., & Rezaei-Moghaddam, K. (2020). Sociological factors influencing the performance of organic activities in Iran. *Life Sciences, Society and Policy*, *16*(1), 3–16. https://doi.org/10.1186/s40504-020-00098-z

Glavic, P. L. R. (2007). Review of sustainability terms and their definitions. *Journal of Cleaner Production, 15*, 1875–1885. http://dx.doi.org/10.1016/j.jclepro.2006.12.006

Gupta, N., Pradhan, S., Jain, A., & Patel, N. (2021). *Sustainable Agriculture in India 2021 – What we know and how to scale up.* New Delhi: Council on Energy, Environment and Water. https://www.ceew.in/sites/default/files/CEEW-Sustainable-Agricultre-in-India-2021-May21.pdf

Healy, M. & Perry, C. (2000). Comprehensive criteria to judge validity and reliability of qualitative research within the realism paradigm. *Qualitative Market Research: An International Journal*, *3*(3), 118–126. https://doi.org/10.1108/13522750010333861

Heimlich, J. E., & Ardoin, N. M. (2008). Understanding behavior to understand behavior change: a literature review. *Environmental Education Research, 14*(3), 215–237. https://doi.org/10.1080/13504620802148881

Herath, C. S., & Wijekoon, R. (2013). Study on attitudes and perceptions of organic and non-organic coconut growers towards organic coconut farming. *Idesia (Arica)*, *31*(2), 5–14. https://dx.doi.org/10.4067/S0718-34292013000200002

Issa, I., & Hamm, U. (2017). Adoption of organic farming as an opportunity for Syrian farmers of fresh fruit and vegetables: an application of the theory of planned behaviour and structural equation modelling. *Sustainability (Switzerland), 9*(11). https://doi.org/10.3390/su9112024

Jia, G., Shevliakova, E., Artaxo, P., De-Docoudré, N., Houghton, R., House, J., Kitajima, K., Lennard, C., Popp, A., Sirin, A., Sukumar, R., Verchot, L., & Sporre, M. (2019). Land–Climate interactions. In *Special Report on Climate Change and Land: An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* (133–206). IPCC. https://www.ipcc.ch/srccl/chapter/chapter-2/

Kabii, T., & Horwitz, P. (2006). A review of landholder motivations and determinants for participation in conservation covenanting programmes. *Environmental Conservation*, *33*(1), 11–20. http://doi.org/10.1017/S0376892906002761.

Karalliyadda, S., & Kazunari, T. (2018). Certified organic farming: awareness of export oriented small-scale farmers in Sri Lanka. *Journal of Sustainable Development, 11*(6), 259–268. https://doi.org/10.5539/jsd.v11n6p259

Kaufmann, P., Stagl, S. & Franks, D. W. (2009). Simulating the diffusion of organic farming practices in two new EU member states. *Ecological Economics*, *68*(10), 2580–2593. https://doi.org/10.1016/j.ecolecon.2009.04.001

Kerin, R. A., Hartley, S. W., & Rudelius, W. (2009). *Marketing* (8th ed.). McGraw-Hill: NY.

Knowler, D. & Bradshaw, B. (2007). Farmers' adoption of conservation agriculture: a review and synthesis of recent research. *Food Policy*, *32*(1), 25–48. http://dx.doi.org/ 10.1016/j.foodpol.2006.01.003.

Mebratu, D. (1998). Sustainability and sustainable development: historical and conceptual review. *Environmental Impact Assessment Review, 18*(6), 493–520. http://dx.doi.org/10.1016/S0195-9255(98)00019-5

Miles, M. B. & Huberman, A. M. (1994). *Qualitative Data Analysis.* Sage Publications: Newbury Park, CA.

Morse J. M. & Richards, L. (2002). *Readme First for a User's Guide to Qualitative Methods*. Sage Publications: Thousand Oaks, CA.

Morse, J. M. (1994). *Critical Issues in Qualitative Research Methods*. Sage Publications: Thousand Oaks, CA.

Neuendorf, K. A. (2017). *The Content Analysis Handbook*. Sage Publications Inc: Thousand Oaks, CA.

Nguyen, T. P., Nguyen, T. T., Doan, X. H., Tran, M. L., Tran, N. M., & Nguyen, T. D. (2020). A dataset of factors influencing intentions for organic farming in Vietnam. *Data in Brief*, *33*, 106605. https://doi.org/10.1016/j.dib.2020.106605

Oberč, B. P. & Arroyo Schnell, A. (2020). Approaches to sustainable agriculture. Exploring the pathways towards the future of farming. Brussels, Belgium: IUCN EURO. https://doi.org/10.2305/IUCN.CH.2020.07.en

Patton, M. Q. (2001). *Utilisation-Focused Evaluation: The New Century Text*. Sage Publications: Thousand Oaks, CA.

Prokopy, L. S., Floress, K., Klotthor-Weinkauf, D. & Baumgart-Getz, A. (2008). Determinants of agricultural best management practice adoption: evidence from the literature. *Journal of Soil and Water Conservation*, *63*(5), 300–311. http://doi.org/10.2489/jswc.63.5.300

Rezai, G., Shamsudin, M. N., Mohamed, Z. A., & Ling, T. J. (2016). Can contract marketing motivate farmers to go organic? measuring the moderation effect of contract marketing.

American Journal of Agricultural and Biological Sciences, *11*(1), 29–34. https://thescipub.com/pdf/ajabssp.2016.29.34.pdf

Salas-Zapata, W., Rios-Osorio, L., & Cardona-Arias, J. (2017). Methodological characteristics of sustainability science: a systematic review. *Environment, Development and Sustainability*, *19*(4), 1127–1140. http://10.1007/s10668-016-9801-z

Sutton, J. & Austin, Z. (2015). Qualitative research: data collection, analysis, and management. *The Canadian Journal of Hospital Pharmacy*, *68*(3), 226–231. https://doi.org/10.4212/cjhp.v68i3.1456

Tashakkori, A. & Teddlie, C. (2003). *Handbook of Mixed Methods in Social and Behavioral Research*. Sage Publications: Thousand Oaks, CA.

Toma, L., & Mathijs, E. (2007). Environmental risk perception, environmental concern and propensity to participate in organic farming programmes. *Journal of Environmental Management, 83*(2), 145–157. https://doi.org/10.1016/j.jenvman.2006.02.004

Vogt, M., & Weber, C. (2019). Current challenges to the concept of sustainability. *Global Sustainability, 2*, E4. http://doi.org/10.1017/sus.2019.1

Westley, F., Olsson, P., Folke, C., Homer-Dixon, T., Vredenburg, H., Loorbach, D., ... van der Leeuw, S. (2011). Tipping toward sustainability: emerging pathways of transformation. *AMBIO, 40*(7), 762–780. https://doi.org/10.1007/s13280-011-0186-9

Yin, R. K. (2003). *Case Study Research: Design and Methods*. Sage Publications: Thousand Oaks, CA.

Funding Call	Growing Research Capacity: UKRI GCRF
Country	India
Title	Transforming India's Green Revolution by Research and Empowerment for Sustainable food Supplies (TIGR^{2}ESS)
Grant Number	BB/P027970/1
Website	https://tigr2ess.globalfood.cam.ac.uk/