

## Factors influencing the adoption of sustainable agricultural practices in rural regions of developing countries: a review

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### Article history:

Received: 30 July 2022

Received in revised form: 3 October 2022

Accepted: 24 November

Available Online: 12 July 2024

### Keywords:

Sustainable agricultural practices, Sustainable food production, Behavioural factors, Organic farming, Adoption,

### DOI:

[https://doi.org/10.26656/fr.2017.8\(4\).400](https://doi.org/10.26656/fr.2017.8(4).400)

### Abstract

Farmers in developing countries show low adoption rates of sustainable agricultural practices. Therefore, this review examines influential factors contributing to sustainable agricultural practices adoption among rural farmers in developing countries in Asia, Latin America, Europe, and Africa, thereby highlighting challenges and constraints. The research indicated that behavioural factors influence the participation in and adoption of sustainable agricultural practices. Farmers are often unaware of environmental issues such as climate change and need support through knowledge, technology, and training. The behavioural insights of farmers need to be incorporated for better policymaking. Therefore, urgent attention is needed to address the social, agronomic, structural, political, and technical barriers before taking up new roles in adopting sustainable agricultural practices in their agricultural systems. From a policy perspective, this review explained how current policies should be implemented and periodically amended to achieve long-term goals.

## 1. Introduction

Until recently, the pressure on agricultural systems has been to achieve food security within the context of increasing demand. Moreover, the technologies available to farmers have been primarily determined by the need to increase production, productivity, and profits. In such a scenario, it is necessary to rethink current agricultural production systems toward sustainable models. Sustainability in agriculture is characterised as being good stewards of the land. Sustainable agriculture does not deplete the planet's resources or pollute the environment. Sustainable agriculture practices are being implemented to enhance agricultural and livestock standards without degrading the environment. Farmers are embracing many sustainable agricultural practices (SAPs), such as organic farming, rotating crops, planting cover crops, adopting agroforestry practices, integrating crops and livestock, and precision farming (Piñeiro *et al.*, 2020). Sustainable agricultural policies ensure environmental sustainability alongside enhancing or maintaining farm productivity (Earles and Williams, 2005).

Adopting SAPs protects the ecosystem by using natural resources and strengthening the capacity to adapt to climate variability and change. Therefore, adopting SAPs is significant for building resilient food systems

and enabling sustainable food production to fulfil food security and reduce poverty, thereby contributing to the United Nations Sustainable Development Goals (SDGs) by 2030 (Serebrennikov *et al.*, 2020). Currently, the adoption of SAPs in developing countries, such as India, is low. It is essential to state that less than 4% of the farmers in India have adopted SAPs and related systems, according to a study conducted by the Council on Energy, Environment, and Water (CEEW) in 2021 (Gupta *et al.*, 2021). This low adoption could be because of complex behavioural factors that depend on agroecological, socioeconomic, and psychological factors, informational and institutional factors, and perceived attributes (Tey *et al.*, 2017).

Developing nations should adopt policies for specific regions differently because the constraints and challenges are unique. Thus, the present review examined the influence of behavioural factors that contribute to enhancing the adoption of SAPs by farmers in the rural regions of developing countries during the transition from conventional to SAPs. It was necessary to highlight the adoption of SAPs in rural regions of developing countries as most of the rural population depends on agriculture for their livelihood. The growing food demands in these nations, along with a rising population and the looming threat of climate change

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scenarios across the globe, make the adoption of SAPs a necessity among rural farmers. Until now, policies in developing nations have not given their farmers much confidence in sustainable farming and production. Thus, this research bridges the gap between farmers and policymakers by highlighting the necessity for effective policies to fit local demands.

## 2. Literature review

### 2.1 Aspects of sustainable agricultural practices in developing countries

The SAPs promote economic stability in agricultural farms and help farmers meet society's food demands without compromising future generations' ability to meet their needs. SAP is based on understanding the ecosystem and contributes to environmental conservation and sustainability. Hence, sustainable agriculture development and adoption are paramount, especially in developing countries (Lichtfouse *et al.*, 2009).

Developing countries are implementing many initiatives to enhance smallholder production and productivity, as most of their rural populations rely on agriculture as a primary source of livelihood (Schindler *et al.*, 2015). There is an urgent need to investigate the economics of SAPs in developing nations and the necessity for meeting farmers' output and production expectations. Smallholder farmers in developing nations have many unique challenges that must be addressed, even if they are difficult to fathom. In Zambia, agricultural productivity has dropped, posing a threat to national food security due to a lack of adoption of sustainable agriculture practices, instability in land tenure, and uncertainty in property rights over agricultural land (Uziak and Lorentowicz, 2017).

Farmers are adopting crop diversification, intercropping, agroforestry, and planting basins to enhance the adoption of sustainable agricultural practices. When farmers in Malawi, Tanzania, Kenya, and Ethiopia obtained exclusive property rights from their respective governments, it encouraged them to implement sustainable agricultural practices. Without sustainable farming practices, there is an increase in average temperature and a reduction in water levels that directly impact human life and well-being (Nkomoki *et al.*, 2018).

Ecological concerns may not exist or be talked about less frequently, but farming-related issues are significant in developing economies. Regarding farming and food processing, many farmers in developing nations still rely on human and animal power. However, farmers in developing countries are more concerned with increasing

crop yields, increasing the variety of products they can grow, and increasing their income rather than environmental issues. SAPs focus on environmental sustainability, economic viability, and social equality as the three main pillars. Cooperation and involvement are two additional characteristics that play a role in developing countries regarding these aspects (Biggelaar and Suvedi, 2000).

According to numerous research, farmers in developing nations are more likely to employ sustainable practices if they have a higher education level. Generally, the more educated a farmer is, the more knowledgeable they are about farming. Education is critical because trained farmers are required to participate in SAPs and make their farms more sustainable by employing contemporary pest control and irrigation systems, reducing the use of chemical fertilisers, and transitioning to sustainable farming. Adoption involves using cutting-edge pest control technology, irrigation systems, and less chemical and more organic fertiliser. All of these elements necessitate a more profound comprehension of achievement. Consequently, an extensive support network is required to demonstrate the virtues of sustainability in agriculture and help farmers become more resourceful and productive, which can contribute to a better quality of life for the farmers (Saifi and Drake, 2008).

### 2.2 Factors contributing toward integration of sustainable agricultural practices.

The adoption of SAPs in developing countries is relatively low despite farmers' successful adoption of conservation agriculture. Techniques that are essential to make agriculture sustainable require a level of knowledge and education. The level of knowledge and education enhances the adoption and promotion of SAPs in agricultural practices. In this context, knowledge can be defined as awareness, understanding, consciousness, and responsiveness, along with applying and comprehending sustainable agricultural solutions (Mutyasira *et al.*, 2018).

However, farmer engagement in training is a significant social component influencing the successful promotion and acceptance of SAPs. The amount of knowledge is strongly tied to farmer participation in training, where local farmers may learn how to use technology and about SAPs (Adnan *et al.*, 2018). This involvement can also be linked to cooperation between social partnerships and farmer groups. Such collaboration might be propagated locally and globally, increasing the adoption of SAPs among farmers in rural villages of developing countries. Activities aimed at empowering people and sharing knowledge about new

farming techniques, developing new capacities, and making rural farmers in developing countries more capable of grasping the practical aspects of SAPs and increasing their understanding all play an essential role in increasing SAP adoption among farmers (Adenle et al., 2017).

Any system's contribution to improving economic conditions is one of the most concrete and tangible indications of farmers' benefit. The fundamental concern of smallholder farmers in rural parts of any developing country is income from land. Their primary purpose is to meet their family's needs and sell the surplus to the markets. A lack of access to information, education, technology, opportunities, and inputs influences smallholder farmers' low adoption of SAPs. Economic motivations can be essential in promoting sustainable farming and adopting innovative technologies (Tey, 2013).

Furthermore, expecting smallholder farmers to have a broad understanding and awareness of long-term environmental concerns and how these would influence rural people in developing nations is impractical. As a result, economic stability could be one of the primary influencing variables for increasing SAP adoption among rural farmers in emerging nations. Adopting sustainable agricultural practices helps to increase crop output, improve soil fertility, reduce erosion, and promote economic growth. It also aids in developing agroecosystem resilience and preserving biodiversity, ensuring that individuals' nutritional demands are met in a balanced manner.

Various factors, including attitude, technology adoption, normative concerns, perceived control, and perceived utility, influence smallholder farmers' adoption of sustainable agriculture methods. Farmers in Asia and Latin America might adopt crop rotation and soil conservation with the help of improved technologies. This adoption would conserve both water and soil. It improved output while simultaneously lowering poverty and food insecurity risk. The adoption of more sustainable agricultural practices by farmers, such as row planting and reduced tilling, contributed to the growth of sustainable agriculture (Zeweld et al., 2018).

Multiple behavioural factors influence the sustainability of agricultural practices. Agricultural adoption decisions are impacted by psychosocial factors such as stewardship, farmers' mindset, and norms. Using Ajzen's theory of planned behaviour, smallholder farmers in Ethiopia were assessed. The ability of smallholder farmers to adopt sustainable farming practices is determined by their knowledge, skills, access

to agricultural loans, availability of labour, and farm equipment (Mutyasira et al., 2018).

Farm Adopting sustainable agricultural methods helps farmers increase food grain production, which feeds the world's growing population. Social capital, perceived usefulness, self-efficacy, conducive conditions, perceived compatibility, and extension services influence farmers' adoption of sustainable agricultural techniques. The opportunity cost is reduced if the farmer comes from a large family with many members, encouraging sustainable farming techniques (Syan et al., 2019).

Self-efficacy refers to a person's capability to employ a technique. Application and deployment benefits are what determine the perceived value of something. Smallholder farmers would be likelier to do so if they could see the value in adopting sustainable agriculture practices. The same would not be implemented if found ineffective. Smallholder farmers with access to current technology, such as integrated pest management (IPM), crop rotation, biodynamic farming, hydroponics, and aquaponics, can adopt SAPs more readily. These practices can potentially assist smallholder farmers in improving their economic viability, the health of the environment, and social justice. Without financial incentives or guarantees of social fairness, smallholder farmers will not adopt environmentally sustainable agricultural practices (Wauters and Mathijs, 2014).

Tenure security is crucial for adopting sustainable farming, highlighting that public policies that strengthen land ownership rights also act as incentives for farmers to make long-term investments in the sustainability of their land. Numerous studies have shown that farmer productivity increases when they have a greater sense of security in their land holdings. Farmers have a better chance of keeping their hard-earned profits with more stable land ownership (Kassie et al., 2009).

Farms with stable land ownership were likelier to try various sustainable agriculture practices than those without stable ownership. In terms of property rights, the farms were classified as either "secure" (those with a title deed) or "insecure" (those without one). Smallholder farmers who cultivate land under customary land tenure have less reliable access to SAP than those who cultivate land under legal land ownership (Nkomoki et al., 2018).

Facilitating conditions influence the inclination of farmers to adopt sustainable farming practices. The equipment necessary for sustainable agriculture is in farming-friendly circumstances. A sustainable agricultural system requires self-driving tractors, Fit Bits

for cows, CPS technology, and moisture sensors. When farmers have easy-to-use agricultural technologies, they are more likely to adopt environmentally sustainable agricultural practices. Its applicability is limited when high-tech farming equipment is scarce and smallholder farmers lack technological knowledge. Sustainable farming will be harder to do if farmers do not have access to and cannot figure out how to use high-tech farming equipment (Samsudin *et al.*, 2017).

Extension services are vital in persuading smallholder farmers to adopt sustainable farming techniques. Extension services supplement the core service. Smallholder farmers are more likely to adopt sustainable farming methods if their efforts boost their livelihood options, living standards, and social standing. Farmers will not adopt sustainable practices without additional facilities or rewards. Extension services in sustainable farming include training farmers about subsistence farming, upgrading their skills, and using technology in farming. These practices incentivise farmers to practise sustainable agriculture by improving their skills and earning potential (Bobulescu *et al.*, 2018).

Determining the factors influencing smallholder farmers' adoption of sustainable agricultural practice is a complex process involving accepting technology, concerns about norms, perceived control and perceived reward. The adaptation of technology to current systems or user experiences determines its compatibility. Sustainable agriculture is more accepted in areas where farmers use row planters, augers, strip tills, grain carts, and conveyors. When farmers discover that both old and new tools are equally effective, they can save costs. Inconsistent tools for sustainable agriculture will increase the cost of new products and diminish the cash accessible to farmers. It discourages farmers from embracing environmentally friendly farming practices and encourages them to continue with more conventional ones (Zeweld *et al.*, 2018). Table 1 shows the factors affecting SAP adoption in developing countries.

### 2.3 Analysis of influential factors impacting sustainable agricultural practices

Agricultural practices and food production are linked with other aspects of society, including but not limited to technology, land management, retailing, agricultural and environmental regulations, and consumer habits. The socio-technical regimes develop from changes in sustainable practices following the requirements and needs of the evolving environmental system. The SAP systems used worldwide are undergoing a period of innovation and transition to meet the rising demand for food and provide dynamic and interactive processes. These processes involve various members from the public and private sectors, including smallholder farmers (Nguyen and Drakou, 2021).

Agriculture should be responsive to food demand and resilient against climate change. There is an immediate need for sustainable agricultural production and climate-smart agriculture. The successful adoption of sustainable productivity among farmers depends on their capacity to make informed choices depending on the availability of knowledge sources. Technical support, training through appropriate incentives, and extension services are various means to promote adoption. At the local level, it is imperative to facilitate the uptake of sustainable production practices by empowering the disadvantaged groups in rural areas and utilising their traditional knowledge and local experiences (Adenle *et al.*, 2017).

Before any net economic benefits can be realised due to new techniques, the transition to more sustainable farming and agriculture must be completed, which is time-consuming and expensive. At this juncture, it is vital to aid farmers in their transition to SAP by providing them with valuable information and knowledge. During this transition period, the agronomic, structural, social, and technical restrictions are the most important aspects to consider (Teklewold *et al.*, 2013).

The authorities need to understand better the obstacles that stand in the way of changing cropping practices. Not only should the lack of knowledge or technical problems be taken into account, but so should

Table 1. Factors affecting SAP adoption in developing countries.

No.	Factors	Authors
1	Agronomic, structural, social, and technical factors backed by knowledge and valuable data.	Teklewold <i>et al.</i> (2013)
2	Local variability encompassing cultural, social, geographic, and economic factors.	Piñeiro <i>et al.</i> (2020)
3	Diversity of farmers unique to each local setting.	Rust <i>et al.</i> (2021)
4	Level of knowledge and education that enhances the adoption and promotion of SAP.	Mutyasira <i>et al.</i> (2018)
5	Participation of farmers.	Adnan <i>et al.</i> (2018)
6	Regional social activities, cooperation and collaboration.	Adenle <i>et al.</i> (2017)
7	Economic motivations.	Tey (2013)

the complex realities of smallholder farmers and their local differences, which include cultural, social, geographic, and economic factors that cause farmers in developing countries to use SAPs (Piñeiro *et al.*, 2020). It is necessary to recognise how farmers manage farming processes with spatial and temporal variability and what suits their abilities, personalities, values, traditions, and motivations, among other factors. To understand the conditional and influencing factors required for the transition to SAPs.

In addition, the farms' diversity and regional differences influence the transition to SAPs. It is essential to provide stakeholders with a general solution, assistance in developing local agriculture systems, and the opportunity to strengthen their adaptability during the SAP transition process (Rust *et al.*, 2021). To accomplish this goal, interdisciplinary approaches and essential research abilities, which are typically undervalued in the agricultural sciences, are required. Human capital and structural and institutional factors influence the adoption intentions of farmers for sustainable agriculture practices. Human capital characteristics include the age and level of education of farmers. Age impedes transformation, technology adoption, and change. As a person ages, adapting to new technologies and work practices becomes more challenging. Young farmers favour sustainable agricultural methods, whereas older farmers do not (Czyżewski *et al.*, 2021).

Institutional factors such as policies and regulations encourage sustainable agriculture. Policies on sustainable agriculture are well-received if they benefit farmers and do not harm their earnings and profitability. Suppose policies for sustainable agriculture prioritise the environment and soil conservation over farmers. In that case, they will be less likely to be adopted. Farmers' adoption of sustainable agriculture practices is influenced by climate, soil type, water quality, and weather factors. Farmers must use conventional methods if the climate and groundwater are not conducive to sustainable agriculture (Hyland *et al.*, 2018).

Moral obligation influences farmers' attitudes toward farming. Farmers are more likely to accept sustainable farming if they know the various benefits, such as reduced cropping costs, increased food production, and environmental conservation. On the other hand, if farmers are unaware of the benefits of sustainable farming, it will not motivate them to switch from traditional farming to sustainable farming.

The Theory of Planned Behavior (TPB) could better understand the factors influencing farmers' intentions to adopt sustainable farming practices. The theory assesses

the determinants' attitudinal intent to forecast environmental protection action among farmers. The model can predict the likelihood of a particular attitude among individuals by determining the motivational factors. The perceived social pressure on the farmer can predict whether or not the farmer will use sustainable farming practices in the future (Menozzi *et al.*, 2015).

Additionally, chemical storage and a sense of behavioural control urge farmers to choose sustainable agriculture. The storage of chemicals impacts the environment and the soil. If farmers are personally motivated to preserve a pollution-free environment, they will adopt sustainable agriculture. Farmers who grow to make money and improve profits will not alter traditional practices. Farmers' transition from conventional to sustainable agriculture will be expensive and time-consuming. According to the evidence, human capital, structural, institutional, motivation, policy, and regulations influence farmers' intentions to adopt sustainable agriculture techniques (Terano *et al.*, 2015).

#### 2.4 Challenges in adopting sustainable agricultural practices in developing countries.

Transitioning to a new way of farming requires a new perspective toward new possibilities and challenges and the ability of farmers to adopt new practices in sustainable agriculture that demand continuous learning. The authors have identified many constraints in adopting SAPs by farmers in developing countries. The reason for these challenges is the need to fulfil the increasing demand for food in developing countries and the absence of required conditions that enable the transition toward SAPs. First, SAPs must improve food production to satisfy smallholder farmers' consumption needs and create the possibility of selling excess produce to customers (Oyetunde-Usman *et al.*, 2021).

Many authors have studied various constraints in SAPs and their adoption in developing countries, grouping them as external and internal factors, with a few classifying them as socioeconomic and biophysical factors (Murendo *et al.*, 2016). The significant challenges to adopting and implementing SAPs by rural farmers in developing countries are related to the lack of agriculture policy addressing sustainability. The current practices do not lead to sufficient production, and the long-term degradation of the environment is not a valid argument for a farmer struggling to feed his family. Thus, there is a need for economic incentives to help farmers during this transition period.

Another challenge Šūmane *et al.* (2018) highlighted is the dramatic need for knowledge and education creation and farmers' willingness and awareness to

participate in sustainable agriculture. The availability of community training and extension services is entirely lacking in developing countries, which is considered a second major constraint in adopting SAPs by

Table 2. Challenges in adopting SAPs in developing countries.

1. Low production yield
2. No incentives for farmers
3. Lack of knowledge
4. Lack of awareness among farmers
5. Non-availability of training and extension services
6. Lack of governmental support systems
7. Social and political instability

smallholder farmers (Muzari *et al.*, 2012). Social and political instability is another major factor identified as a constraint in developing countries. Table 2. Shows challenges in adopting SAPs in developing countries.

### 3. Research gap

The literature review identifies three overarching directions as the research gap in the behavioural factors affecting farmers' decisions to adopt SAPs. The 'farmers' decision-making requires investigating the distal and proximal factors required to bridge the knowledge gap. Proximal factors include the perceived benefits and costs, and distal factors such as environmental concerns may affect the decision-making of rural farmers in adopting SAPs in their farming methods. A research gap has also been seen in the decision-making phases of smallholder farmers in adopting SAPs. For a farmer to adopt a new method in their farming, the first step is to understand the problem and become aware of the environmental issues.

Secondly, the farmer should understand the severity of the problem and search for sustainable alternatives. Finally, analysis, choice, and implementation are required. The problems need analysis with many adoption alternatives that need a local understanding. The farmer needs to have choices on adoption and support for adopting SAPs. Implementing SAPs is vital and should be encouraged through institutional and policy support. The existing literature mainly focuses on the analysis and choice phases rather than the fact that many farmers are not prepared to make significant changes in their farming methods. However, farmers in rural regions in developing nations are more concerned with feeding their families. They cannot suddenly change to SAPs without support from the government and financial institutions. It is unrealistic to think they can change their farming methods with just awareness.

SAP adoption would be only possible through policy support and collaborative efforts from public, private,

governmental, and developmental agencies, along with active advocacy programs. Existing literature considers farmers as individual decision-makers, but it is essential to look beyond each farmer's behaviour and tackle the adoption of SAPs through group decision-making. Research focusing on one location may not adequately explain the challenges and non-adoption of SAPs in another location, as the factors are unique.

Therefore, the literature suggests that past research does not analyse geographic diversity, and studies on behavioural factors must be conducted at the regional or national level. The literature suggests that there are policy-oriented research gaps. The needs of each geographic region are different; therefore, policies should be tailored to meet these varied needs. The existing research suggests that shortcomings in the behavioural factors that influence 'farmers' decision-making in adopting SAPs must be addressed locally.

### 4. Findings and discussion

Various social, political, economic, and individual factors prevent the widespread adoption of SAPs in developing nations. This study identified the behavioural factors influencing rural farmers' willingness and participation in SAP adoption. Research indicates that small-scale farmers are not concerned about climate change. Many rural farmers in developing nations rely exclusively on their land to support their families. Their behaviour influences the adoption of SAP by farmers. The propensity of farmers to act in various ways is a dispositional factor. There are two possibilities: either they will be motivated to adopt SAPs due to environmental and moral concerns and a willingness to experiment with new things, or they will resist implementation due to economic factors.

In order to promote conservation as a farming objective and increase consumers' willingness to pay more for food produced in an environmentally responsible manner, it is necessary to examine farmer adoption from a broader environmental perspective. From a policy standpoint, it is necessary to consider the diversity of farmers in terms of geographic and sociodemographic characteristics. Possible policy options include educating farmers on environmental concerns and the benefits of SAPs and providing financial support through incentives in regions with low adoption rates.

A crucial cognitive factor is equipping farmers with the knowledge, technology, and training they need to consider the advantages of sustainable practices and increase their propensity to adopt them. According to the findings of this study, rural farmers in developing

nations are more likely to adopt SAPs if the behavioural issues they face are considered and addressed during the policy formulation process. There is a need for more research to fill the research gaps identified in this study and address the challenges. In addition, it sought to raise

Table 3. Key findings.

1.	The adoption of SAP is low in developing countries.
2.	Behavioural factors influence participation and adoption.
3.	Farmers are unaware of environmental effects such as climate change.
4.	Farming is the only source of income for many rural farmers in developing countries.
5.	Dispositional factors influence adoption.
6.	The heterogeneity of the farmers needs to be addressed as per geographic and sociodemographic characteristics from the policy perspective.
7.	Incentives are needed to boost sustainable agriculture in developing countries.
8.	Farmers need support through knowledge, technology, and training.
9.	For more effective policymaking, farmers' behavioural insights must be incorporated.

awareness of the importance of giving priority to smallholder farmers in rural areas of developing countries when it comes to adopting new technologies. Table 3. shows Key findings.

## 5. Conclusion

In conclusion, this study delved into the intricate web of social, political, economic, and individual factors that hinder the widespread adoption of Sustainable Agricultural Practices (SAPs) in developing nations. The focal point of our investigation was the behavioural dynamics influencing the willingness and participation of rural farmers in embracing SAPs.

Notably, our findings underscored a critical observation – the prevalent lack of concern among small-scale farmers in developing nations regarding climate change. Many of these farmers' connections to the land are not just agricultural. However, it forms the bedrock of their familial sustenance. Their behavioural disposition emerged as a pivotal determinant influencing the adoption or resistance to SAPs, driven by environmental and moral considerations, a willingness to experiment, or economic factors leading to resistance.

To catalyse SAP adoption, our study advocates for a holistic approach transcending the narrow confines of immediate economic considerations. Shifting the focus to broader environmental perspectives is imperative, emphasising promoting conservation as a fundamental farming objective. Aligning consumers' willingness to pay more for environmentally responsible food

production can drive this paradigm shift.

From a policy standpoint, recognizing the diversity among farmers in terms of geography and sociodemographic characteristics is paramount. Tailoring policies to educate farmers about environmental concerns, extolling the benefits of SAPs, and providing financial incentives in regions with low adoption rates emerges as a strategic pathway.

Crucially, cognitive factors play a pivotal role. Equipping farmers with the requisite knowledge, technology, and training is a linchpin in fostering an appreciation for the advantages of sustainable practices. Policy formulation processes must meticulously consider and address rural farmers' behavioural challenges in developing nations, enhancing the likelihood of SAP adoption.

This study advocates for continued research to bridge identified gaps and confront the challenges head-on. It serves as a clarion call to prioritize smallholder farmers in the rural landscapes of developing countries when introducing new technologies. By doing so, we pave the way for a sustainable agricultural landscape that addresses immediate economic concerns and contributes to a global ethos of responsible and conscientious farming practices.

## Conflict of interest

The authors reported that there are no competing interests to declare.

## Acknowledgements

We want to thank our research colleagues for their valuable suggestions.

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