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Analyzing the impact of intelligence and technological factors on farmers' sustainable purchasing behavior

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A R T I C L E I N F O

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A B S T R A C T

With the increased environmental awareness and health consciousness in recent eras, a positive shift has occurred towards building a sustainable green culture. Therefore, agriculture as the primary pillar of our ecosystem needs to change to be sustainable. Farmers are the critical pillar of the agriculture system, so they need to be sustainable in their decision-making and behavior. The primary purpose of this research is to explore the farmers' intentions about purchasing sustainable products by applying the extension model of the Theory of Planned Behavior while integrating the effect of the Triarchic Theory of Intelligence. Data is collected through 183 usable surveys in rural areas, explicitly covering agriculture-dominated India's eastern, northern, and central zones. The empirical findings show that a farmer's intelligence, which integrates analytical, creative, and practical intelligence, positively affects attitude, subjective norms, and perceived behavioral control. Further, the farmers' attitudes, social norms, and perceived behavioral control positively influence their intention, continually developing their sustainable purchasing behavior and providing a positive directional change for purchasing sustainable products for farming. The study also includes the effect of technology and trust as controlling variables that positively affect sustainable procurement practices. Finally, this research analysis provided managerial insights to promote a green and sustainable culture at the ground level by transforming farmers' purchasing behavior. On a concluding note, this research would help analyze the factors influencing farmers' behavior in undertaking sustainable procurement practices.

1. Introduction

Worldwide, food production systems are vital for sustaining the global population by efficiently utilizing resources. Over the past few decades, agriculture has transformed significantly due to rapid urbanization, overpopulation, and scarcity of resources, leading to an increased adoption of intensified cultivation methods (Kastner et al., 2012). However, agricultural intensification practices have brought several challenges that threaten the long-term sustainability of our food production systems. These practices increase water demand and have led to the depletion of soil fertility, affecting nearly 40 % of cropland worldwide (Montgomery, 2007a,b; Pimentel et al., 1995; Reynolds et al., 2007; Wood et al., 2000). Intensified agricultural practices can lead to soil erosion, reducing agricultural capacity by approximately 16 %, which particularly affects croplands in the Global South (Wood et al., 2000). The accelerated rates of soil erosion also have a significant impact on crop productivity, affecting essential biogeochemical cycles, including carbon, nitrogen, and phosphorus (Quinton et al., 2010; Vitousek et al., 2009). Poorly executed intensive agricultural practices pose a twofold threat to soil ecology. These practices accelerate the oxidation and depletion of soil organic matter (SOM) and increase soil vulnerability to erosion, leading to excessive use of nitrogen fertilizers (Allison, 1973; Lal, 2004; Matson et al., 1997; Montgomery, 2007a,b; NRC, 2010; Pimentel et al., 1995; Rasmussen et al., 1998). Because of previous arguments, there is an urgent need to assess sustainable farming methods as current agricultural practices put soil, biodiversity, and the environment at risk (Gomiero et al., 2011a,b).

Population forecast estimates that over nine billion people will inhabit the Earth by 2050, posing a significant challenge for food production, which must increase by 70–100 % of its capacity (Gyawali

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et al., 2023; van der Laan et al., 2017). The main challenge is to meet the demand for agricultural raw materials while preserving Earth's resources and improving the livelihoods of communities and farmers. This approach, known as sustainable procurement, involves acquiring sustainable agricultural raw materials while considering environmental, social, and economic well-being (Ywema, 2013). Sustainable Agriculture Initiative (SAI, 2023) Platform members have defined sustainable agriculture as the efficient production of safe, high-quality agricultural products. This approach aims to protect and improve the natural environment, as well as the social and economic conditions of farmers, their employees, and local communities. It also focuses on safeguarding the health and welfare of all farmed species (sai.org).

The concept of sustainability emerged in response to the current ecological crisis, emphasizing the need to address humanity's environmental problems (Brundtland Commission Report, 1987). Sustainability involves learning about ecological challenges and integrating ecological and societal knowledge through changes in policy, institutions, and behavior (Pretty, 1995). The United Nations defines sustainability as ensuring a decent standard of living for everyone, without compromising the needs of future generations (van der Laan et al., 2017). There have been efforts from companies/organizations to support farmers to improve sustainability. For instance, SAI, a leading global platform, brings together over 170 member companies and organizations guiding sustainable agriculture. Sustainable Agriculture Initiative (SAI, 2023) delineated a sustainable agriculture approach as the efficient production of safe, high-quality agricul tural products by protecting and improving the natural environment and safeguarding the social, economic, health, and welfare conditions of farmers, their employees, and local communities (sai.org). Some SAI members, such as Forex and Unilever, have established a sustainability partnership fund. This fund aims to invest approximately 1 million eu ros in knowledge development and equipment to promote sustainable agriculture practices. Friesland Campina, a dairy manufacturer, has adopted a cooperative sustainability approach, which aims to set a reputable benchmark for responsible dairy farming practices, ensuring that such practices are followed both at the farm level and within the company's processing operations (Ywema, 2013). Despite the existence of sustainable agricultural practices like Integrated Pest Management (IPM), farmers frequently encounter challenges when trying to implement these methods. Behavioral factors such as attitudes, knowledge, motivation, and risk perceptions significantly impede farmers from transitioning to sustainable procurement (Meijer et al., 2015). Further economic barriers, such as increased economic risk, cost of materials and equipment, profitability uncertainties, and potential yield reductions, prevent famers to adopt sustainable practices (Grover and Gruver, 2017; Hanson et al., 2022; Rodriguez et al., 2009).

In conclusion, farmers' resistance to adopting sustainable procurement practices poses a significant challenge. Overcoming these obstacles is crucial for achieving a more sustainable and resilient agricultural system. Understanding the factors that hinder farmers from embracing sustainable practices will help to develop targeted strategies to support and encourage their transition. This is essential for ensuring the long-term viability of our food production systems and the well-being of both farmers and the environment. Therefore, the present research study aims to answer the following research questions:

RQ 1. How does a farmer's intelligence play a role in shaping a farmer's behaviour towards sustainable procurement?

RQ 2. What is the effect of technology adoption and level of trust on farmer's behaviour towards sustainable procurement?

To answer these questions, we have built a model using the Theory of Planned Behavior and the Triarchic Theory of Intelligence trying to explore how social norm mediates the relationship between different type of intelligence and farmers intentions and actions towards sustainable procurement. For the analysis, we used PLS-SEM software to analyze the data collected from a sample of 183 respondents in three agriculture-dominated zones in India: North, East, and Central.

2. Literature review

Environmental conservation awareness has steered farmers to address environmental challenges and protect natural resources in recent years. This movement began in the 1960s, after Rachel Carson's pioneered work identified humans and environmental harm as a result of the incremental use of pesticides in agriculture (Carson, 2002). Her work motivated various scholars to study sustainable agriculture practices and also inspired farmers to embrace sustainable agricultural procurement practices (Contreras Cruz et al., 2023; Moisander, 2007; Nugroho et al., 2023; Wang et al., 2020; Xie et al., 2022). Further rapid population growth, increasing food demand, and overdevelopment of urban areas led the United Nations in 1988 to coin the term "*sustainable agriculture*" as "the type of agriculture that manages and protects the natural resource base" (Pan et al., 2021). In recent years, there has been a growing emphasis on acquiring sustainable products to achieve sustainability principles and secure access to food (Dropuli'c and Krupka, 2020; Behnam et al., 2021; Mota et al., 2023). In such a stride, adopting emerging cleaner agricultural and technological practices can positively contribute to achieving the objectives of sustainable agriculture and the environment because of the several challenges to securing the incremental demand for food such as soil, water, energy, rain-fed production, climate change, and food availability (Lachaud and Bravo-Ureta, 2022; Naranjo et al., 2023; Omotoso et al., 2023; Song et al., 2022; Xie et al., 2022; Zhang et al., 2023). European countries that were early adopters of sustainable approaches have advanced their agricultural practices and improved environmental performance. Now, these countries can guide others to adopt such strategies (Streimikis et al., 2022). For instance, developing countries can adopt sustainable agricultural biotechnologies to secure food while combating poverty among local populations (Adenle et al., 2012). Another effective strategy to mitigate climate change is to reduce animal product consumption by adopting a plant-based diet, which helps to decrease the emissions associated with traditional agricultural practices (McInnes et al., 2023). African countries, such as Ghana, Tanzania, and countries in the Saharan region, have also adopted smart, sustainable, and technological agricultural practices to prevent the effects of climate change (Martey et al., 2021; Mgendi et al., 2022; Zakaria et al., 2020).

The term trolley dilemma describes any choice that has a trade-off between what is good and what sacrifices are "acceptable," if at all. The use of agricultural technologies poses a trolley dilemma: ensuring food availability despite the costs, risks, and environmental negative impacts and consequences, especially with small-scale farmers (Addison et al., 2022; Lioutas et al., 2021; Xian et al., 2023). Sustainable agricultural practices can meet the needs of present and future generations for produce while balancing the land and the environment, however, negative consequences can jeopardize the entire food supply chain since the land to cultivate food is limited (Cai et al., 2023; Pan et al., 2021). Thus, increasing the productivity and conservation of soils is needed to achieve sustainable and innovative agriculture ecosystems (Mashi et al., 2022). Moreover, policymakers and decision-makers must integrate these innovative approaches when updating or designing policies. On one hand, it is highly recommended to educate farmers so they can comprehend the significance and benefits of adopting emerging agricultural technologies and implementing sustainable purchasing and procurement practices (Damba et al., 2020).

2.1. Emergence of sustainable product and procurement behavior

Scholars predict a one-third increase in the global population over the next few decades, posing a risk to the food production system (Mota et al., 2023). As a result, the awareness of environmental conservation and natural resource protection have led to addressing these concerns, prompting governments and stakeholders to embrace sustainable agricultural procurement practices to meet production goals and stabilize access to food (Behnam et al., 2021; Contreras Cruz et al., 2023; Dropuli`c and Krupka, 2020; Moisander, 2007; Mota et al., 2023; Nugroho et al., 2023; Wang et al., 2020; Xie et al., 2022). Environmental conservation efforts also aim to create effective solutions for farmers to problems that affect crops, plants, and animal welfare (Goulet, 2021). Despite economic challenges, there are farmers willing to engaged in sustainable environmentally friendly products, reflecting their commitment to reducing environmental harm, contributing to the future healthy development and sustainable growth of the agriculture sector (Bhatt and John, 2023; Lin and Niu, 2018; Mottaleb, 2018).

Farmers engaged in sustainable procurement behavior (SPB) are characterized as conscious individuals of the environmental implications of their procurement decisions and are willing to minimize their ecological footprint (Moisander, 2007; Wang et al., 2020). However, to accomplish this, there is a need to develop or improve the waste management of both industrial and agricultural settings and understand the psychological factors influencing individuals' behaviors towards the environment (Kilbourne and Beckmann, 1998; Talbi et al., 2020; Varela-Candamio et al., 2018; Wang et al., 2023). SPB actions by farmers can help overcome the point of no return, as suggested by the United Nations (Costa et al. (2023). This involves reducing the impact of agriculture on the environment and seeking to eliminate goods identified as detrimental to the environment (Costa et al., 2023; Liobikienė et al., 2016; Liobikienė and Bernatonienė, 2017). Scholars have conducted research on the adoption of farmers' behavioral adoption and the use of green technologies to address agricultural challenges, land degradation, and sustainable practices (Guo et al., 2022). They have also explored the psychological factors influencing consumer reminiscence marketing of agricultural products (Tang et al., 2023). However, further research is necessary to understand the varied perspectives of individuals, such as transient or enduring, and how these perspectives affect both individuals and the environment, especially considering their impact on the preservation or degradation of ecosystems and the implications for future generations.

2.2. Triarchic Theory of Human Intelligence

The Triarchic Theory of Intelligence (TTI) provides a more comprehensive perspective on intelligence than conventional definitions. TTI suggests that intelligence involves achieving personal success according to individual standards and societal norms. The success of this theory centers on utilizing strengths, addressing weaknesses effectively, and navigating and influencing the environment using a blend of analytical, creative, and practical abilities. TTI underscores the adaptive nature of intelligence, emphasizing the capacity to adapt to, shape, and choose environments in pursuit of success. According to Robert Sternberg (1984), who proposed the Theory of Human Intelligence (THI), intelligence is characterized by a set of universal mental processes that underlie its various aspects. While the specific solutions deemed intelligent may differ across cultures, the cognitive processes involved in reaching those solutions remain consistent. THI identifies responsible meta-components, also known as executive processes, for tasks such as planning, monitoring, and evaluating. These meta-components enable individuals to strategically determine what actions to take, oversee their execution, and assess outcomes. Performance components complement the meta-components, which execute the instructions generated by the meta-components. Finally, knowledge acquisition elements assist in learning, acquiring new information, and developing problem-solving techniques (Sternberg, 1984, 1985, 1986, 1998). In order to gain a deeper understanding of human intelligence, this theory emphasizes the interaction between meta-components, performance components, and knowledge-acquisition components in cognitive activities (Sternberg, 1985). Memory-analytic, creative-synthetic, and practical-contextual are the three different aptitudes covered by the Triarchic Theory of Intelligence.

2.2.1. Analytical intelligence

Memory-analytic abilities involve tasks related to learning, comparing, analyzing, evaluating, and judging information. These abilities are often assessed through standardized tests that measure intelligence and scholastic aptitude, such as tasks involving synonyms, antonyms, verbal analogies, number series, and close procedures. While these abilities are commonly evaluated for the identification, instruction, and assessment of gifted individuals, it is worth noting that the extent to which educational opportunities influence performance on these tests is a subject of debate (Sternberg, 1985).

2.2.2. Creative intelligence

Creative-synthetic abilities pertain to the generation of novel and high-quality ideas across various domains, including art, writing, science, and history. These abilities also involve interpreting ordinary situations innovatively and effectively adapting to new and unfamiliar circumstances. Ongoing discussions exist about whether tests assessing creative abilities, such as the Torrance test, capture the specific forms of creativity within different domains (Amabile, 1982; Getzels and Csikszentmihalyi, 1976; Sternberg, 1998; Torrance, 1974).

2.2.3. Practical intelligence

Lastly, practical-contextual abilities come into play when individuals apply cognitive processes to highly contextualized everyday problems. These abilities include applying knowledge, utilizing skills, implementing strategies, and contextualizing information. Examples of practical-contextual thinking include considering the relevance of past lessons to present situations or applying mathematical techniques to real-world scenarios (Sternberg, 1984, 1985).

2.3. Theory of Planned Behavior: attitude, subjective norms, perceived behavioral control, and intention

The concept of intention holds significant importance within the framework of the Theory of Planned Behavior (TPB) (Ajzen, 1991). Several elucidated models and theories suggest that intention is crucial, serving as a primary determinant of human behavior. TPB postulates three key factors that influence intention: attitude); subjective norms; and perceived behavioral control. In general, the results of meta-analytical studies provide empirical support for the efficacy of TPB in elucidating both individuals' intentions and subsequent behaviors (Hamilton et al., 2020; McEachan et al., 2011). For instance, digitalizing traditional media in agriculture for consumers and stakeholders can generate positive and negative behaviors affecting the adoption of technological, institutional, and organizational changes (Mohr and Höhler, 2023; Spielman et al., 2009). The strategies to adopt agricultural technologies often fail due to the need to identify the fundamental and social motivations of intended users (Afful-Dadzie et al., 2022; Barragán-Ocaña and del-Valle-Rivera, 2016). However, the likelihood of adopting emerging technology in the agricultural sector is associated with the factors affecting the adoption of stakeholders, such as social, cultural, political, economic, and health (Ebrahimi Sarcheshmeh et al., 2018; Taheri et al., 2022). Overall, the above findings can be used to accelerate the behavioral adoption of such technologies.

TPB has effectively explained various actions affecting human behavior concerning sustainable procurement and the environment, such as using sustainable products, purchasing environmentally friendly products for consumption, and buying organic produce (Chen and Tung, 2014; Ha and Janda, 2012). Additionally, the adaptability of TPB has been observed across diverse cultures, in the context of sustainable procurement, including adolescent pro-environmental behaviors. As a result, the proposed model incorporates TPB's motivational factors, namely attitude, subjective norms, perceived behavioral control, and intention, to better understand the sustainable procurement behavior of farmers (R.Y.K. Chan and Lau, 2000; R. Chan and Lau, 2000; De Leeuw et al., 2015; Yadav and Pathak, 2016).

2.4. Theoretical underpinning

Sternberg (1985) defined intelligence as one's ability to adapt, shape and choose an environment to achieve personal, social, and aligned cultural goals. His theory of human intelligence (THI) defines three types of intelligence: analytical, creative, and practical intelligence. As the name indicates, one uses analytical intelligence to analyze information and solve problems. This process of analyzing information involves three components of intelligence, namely knowledge acquisition, meta, and performance evaluation. Creative intelligence is indicative of exploring past experiences and quickly finding out which information is necessary in the given situation (Amabile, 1982; Getzels and Csikszentmihalyi, 1976; Sternberg, 1998; Sternberg, 2005; Torrance, 1974). Finally, practical intelligence can be understood as one's ability to manage day-to-day situations by adapting to or modifying existing situations (Sternberg, 1985). Given a scenario, this intelligence assessment could be used to assess how farmers explore this different intelligence in deciding their intentions and actions towards sustainable behavior. Further, as we have been exploring the role of different intelligence in understanding farmers' intentions and actions towards sustainable behavior, this process could be useful in understanding those beliefs that shape their intentions and actions. Theory of Planned Behavior (TBP) explains three such beliefs that could influence intentions and actions, viz. behavioral beliefs, normative beliefs, and control beliefs (Ajzen, 1991; R.Y.K. Chan and Lau, 2000; R. Chan and Lau, 2000; De Leeuw et al., 2015; Yadav and Pathak, 2016). Behavioral beliefs render support in transitioning attitudes to actions. Normative beliefs explain how existing social norms within peer communities may influence farmers' intentions and actions, and control beliefs may project farmers perceived ability to translate their intentions into actions, e.g., farmers' behavioral attitude could be understood by their positive (Mohr and Höhler, 2023; Spielman et al., 2009) and negative (Afful-Dadzie et al., 2022; Barragán-Ocaña and del-Valle-Rivera, 2016) attitude towards adopting digitalized media or normative attitude could be influenced by existing peers and community beliefs towards such adoption (Ebrahimi Sarcheshmeh et al., 2018; Taheri et al., 2022), and control beliefs depict their control on perceived abilities in adapting sustainable procurement and the environment, such as using sustainable products, purchasing environmentally friendly products for consumption, and buying organic produce (Chen and Tung, 2014; Ha and Janda, 2012). The results of meta-analytical studies provide empirical support for the efficacy of TPB in elucidating both individuals' intentions and subsequent behaviors (Hamilton et al., 2020; McEachan et al., 2011).

2.5. Research gaps

After conducting a thorough literature review, we found significantly less research on farmers' sustainable procurement behavior. Table 1 shows the key themes related to this study followed by labelling the themes as pros and cons practices for farmers to adopt sustainable procurement behavior practices.

It is to be noted that we found several studies on the Theory of Planned Behavior in areas of green procurement. However, after conducting a gap analysis, we felt the need to integrate the Triarchic Theory of Intelligence with the Theory of Planned Behavior, to explore potential connections between these theories through this study, to analyze how intelligence could be associated with the behavioral factors affecting the farmer's sustainable procurement behavior. Despite our study not being directly inspired by the existing literature, our expected contribution is to identify potential points of intersection and application. This study aims to bridge the research gaps of the design model that pools psychological principles along with economic principles (Austin et al., 2001). Further, we also spotted the controlling effect of trust and technology on the sustainable procurement behavior of farmers.

Table 1
Key themes identified in the literature review.

Theme	Description	Effects	Reference
Level of Trust	European farmers began to inspire African farmers to adopt sustainable strategies	Positive	(Martey et al., 2021; Mgendi et al., 2022; Streimikis et al., 2022)
Technology Adoption	Despite the improvement in technologies, there has been no change in working hours, well-being, and revenue for farmers	Negative	(Addison et al., 2022)
Sustainable Procurement Behavior	Adoption of climate-smart agricultural practices and increased environmental sensitivities	Positive	(Kilbourne and Beckmann, 1998; Talbi et al., 2020; Varela-Candamio et al., 2018; Zakaria et al., 2020)
Level of Trust	Domestic and vulnerable small farmers continue to experience environmental consequences	Negative	(Addison et al., 2022; Xian et al., 2023)
Sustainable Procurement Behaviour	Controlling emissions related to traditional agricultural practices by reducing animal product consumption and adopting a plant-based diet	Positive	(McInnes et al., 2023)
Perceived Behaviour Control	Trolley dilemma, i.e., ensuring food availability despite the costs, risks, and environmental impacts	Negative	(Lioutas et al., 2021)
Social Norms	Combating poverty among local populations	Positive	(Adenle et al., 2012)
Sustainable Procurement Behaviour	Incremental demand for food (led the questions related to improving the quality of soil, water, energy, rain-fed production, climate change, and food availability)	Negative	(Lachaud and Bravo-Ureta, 2022; Mashi et al., 2022; Mota et al., 2023; Naranjo et al., 2023; Omotoso et al., 2023; Pan et al., 2021; Song et al., 2022; Zhang et al., 2023)

3. Methodology

3.1. Research background

In India, its agricultural sector is a significant part of the economy, although its contribution to the Gross Domestic Product (GDP) has been declining over the years. From a peak of 40 % in the 1960s, agriculture has settled at a range of 16 % to 18 % contribution to India's GDP in the past two decades (The World Bank, 2024). Despite the economic decline, India still stands out worldwide in the production of rice and wheat (Mottaleb, 2018; Xian et al., 2023) supported by its extensive agricultural workforce, employing up to 40 % of the population in the sector (Adenle et al., 2019) but far from the top compared with other developing countries concerning agricultural competitiveness (Nugroho et al., 2023). The unique challenges of Indian farming, such as small and fragmented agricultural land, hinder the adoption of mechanized farming practices and achieving economies of scale (Bhatt and John, 2023). A significant portion of Indian agriculture constitutes subsistence farming, with farmers primarily producing for household consumption. This group faces the burden of climate change, such as experiencing extended periods of heat and drought (Song et al., 2022). Therefore, larger farms are more likely to afford emerging technologies, intensive agriculture practices, access to fertilizers and pesticides.

Technology adoption, in Indian agriculture, is influenced by several factors such as education level, farm size, profit, and prior adoption by neighbor farmers (Gyawali et al., 2023; Mashi et al., 2022). Some regions, like Punjab and Haryana, have embraced intensive agricultural practices and advanced technologies such as fertilizers, pesticides, and irrigation systems generating large amounts of agro-waste (Sarangi et al., 2023). However, these agricultural practices have also raised concerns about environmental degradation, soil health, and excessive generation of carbon emission (Bhatt and John, 2023; S.M. Green et al., 2018; R.F. Green et al., 2018; Yu et al., 2023).

In response, the Indian government is actively promoting sustainable agriculture practices that benefit both the environment and the agricultural workforce (Bhatt and John, 2023). A key area of interest is the potential for technological advancements to address these challenges and stimulate the economy in India. In addition to the environmental benefits, agricultural growth is an effective tool for alleviating poverty and scaling the economy in developing countries (Mottaleb, 2018). Including cooperatives and new modalities of agricultural practices can stimulate the agricultural industry in India (Spielman et al., 2009).

3.2. Triarchic Theory of Intelligence on farmer's intelligence, attitude, and perceived behavioral control

The Triarchic Theory of Intelligence (TTI) and the Theory of Planned Behavior (TPB)have been applied in the current investigation. According to TPB, intention is critical in shaping people's behavior (Arafat et al., 2018; Passarelli et al., 2023), which is influenced by attitude (a person's evaluation of the target behavior), subjective norms (a person's impression of social pressure), and perceived behavioral control (a person's opinion of their capacity to carry out the behavior). TPB is part of the behavior theories, and it is useful for the adoption of technological innovations and technology adoption (Taheri et al., 2022; Zou et al., 2023). Numerous research (Ajzen, 1991; Hamilton et al., 2020; McEachan et al., 2011) have demonstrated TPB's effectiveness in describing intentions and subsequent behaviors adoption in different settings, such as technology in rural innovation (Passarelli et al., 2023), the use of low-carbon agricultural technologies (Yang et al., 2022), and the use of nuclear technology in agricultural practices (Ebrahimi Sarcheshmeh et al., 2018). TPB extensive research have also investigated people's perception, intention, and change of behavior towards new technology or the acceptance of technology (Omulo and Kumeh, 2020; Thomas et al., 2023), and understanding sustainable consumption, procurement behaviors, eco-friendly purchasing, and consuming sustainable goods (Chen and Tung, 2014; Ha and Janda, 2012). The motivating elements identified by TPB to understand farmers' sustainable procurement behavior are incorporated into the proposed model in this work (R.Y.K. Chan and Lau, 2000; R. Chan and Lau, 2000; De Leeuw et al., 2015; Yadav and Pathak, 2016).

TTI offers a more expansive view of intelligence than traditional definitions. It implies that intelligence entails attaining one's goals by following one's and society's standards by successfully using one's abilities and overcoming one's flaws. This theory strongly emphasizes the adaptability of intelligence and the necessity of a well-balanced set of practical, analytical, and creative skills to successfully traverse and shape one's environment (Sternberg, 1985, 1986; Sternberg, 1998). According to the theory, tasks are planned, monitored, and evaluated by meta-components (executive processes); they are then carried out by performance components, which carry out orders, and knowledge-acquisition components, which aid learning and problem-solving. Understanding human intelligence is aided by the interaction of its analytical, creative, and practical elements (Sternberg, 1985). TTI has also been used to assess different abilities among several demographics. For instance, a group of researchers explored the level of familiarity of traditional medicine between young populations in the US and Kenya. While Kenyans are familiar with traditional medicine, this does not define their level of intelligence (Sternberg, 1999). If we apply the same concept to agriculture, farmers in one region may be knowledgeable about certain techniques, while those in another region may be unaware. Learning, analyzing, and evaluating information are tasks associated with analytical intelligence, one of the abilities described in the Triarchic Theory. While practical intelligence applies cognitive processes to contextualized everyday situations, creative intelligence develops novel, high-quality ideas (Sternberg, 1985).

To sum up, the study uses the Theory of Planned Behavior to comprehend the driving forces behind farmers' sustainable purchasing decisions. The Triarchic Theory of Intelligence also offers a framework for understanding intelligence's broader facets, such as analytical, creative, and practical abilities. The theories are supported by relevant studies (Ajzen, 1991; R.Y.K. Chan and Lau, 2000; R. Chan and Lau, 2000; Chen and Tung, 2014; Ha and Janda, 2012; Hamilton et al., 2020; De Leeuw et al., 2015; McEachan et al., 2011; and Yadav and Pathak, 2016).

To better understand how intelligence influences several elements, such as social norms, the farmers' attitudes towards sustainable procurement, and perceived behavior control, our study integrates the Theory of Planned Behavior and the Triarchic Theory of Intelligence. These factors, in turn, would influence the farmers' intentions towards sustainable procurement and digital technologies, which leads towards sustainable procurement behavior of farmers (Li et al., 2023). New agricultural practices combined with new regulations increase the likelihood that farmers' intentions will improve current their practices (Annosi et al., 2022). We also measured intelligence across three dimensions: analytical intelligence, creative intelligence, and practical intelligence.

3.2.1. Farmer's intelligence

When applying the Triarchic Theory of Intelligence to the context of sustainable procurement behavior, the three components of intelligence—analytical intelligence, creative intelligence, and practical intelligence—manifest themselves in different ways. First, analytical intelligence assists farmers in evaluating the environmental impact of their farming practices, assessing the sustainability of various procurement options, and making informed decisions that are in line with ecological principles. Then, creative intelligence enables farmers to explore innovative and sustainable farming techniques, adapt to changing environmental conditions, and find novel solutions to sustainability challenges. Finally, practical intelligence is crucial for implementing sustainable procurement practices on the farm, translating theoretical knowledge into practical actions, and effectively managing resources for long-term sustainability (Sternberg, 1985, 1986).

3.2.2. Interplay between farmer's intelligence, attitude, and perceived behavioral control

Many customers lack the awareness necessary to make responsible decisions towards the environment. In the Indian context, awareness or intelligence refers to the level of understanding that customers have regarding the environmental implications and concerns associated with using specific products in the long term. This includes their understanding of values, reality, and the manufacturing processes, which in turn leads to heightened awareness of societal environmental problems (Lavuri, 2021; Lim et al., 2014; Wang et al., 2017). Consumers' cognitive awareness and concern for environmental issues influences their inclination to purchase sustainable products, applications, and vehicles (Rusyani et al., 2021a,b; Sangroya and Nayak, 2017). This constructive action includes a strong commitment to environmental issues and awareness of sustainable marketing and sustainable products (Kautish and Sharma, 2019). Previous studies have demonstrated that enhanced intelligence improves environmental intelligence and significantly influences the prediction of consumers' purchasing intentions (Asif et al., 2018; Kautish and Sharma, 2019; Rusyani et al., 2021a,b). Intelligence has also been found to be significantly associated with perceived behavioral control (PBC) and sustainable attitude for making a movement towards sustainable purchase (Heo and Muralidharan, 2019; Rusyani et al., 2021a,b). The availability of adequate environmental information has facilitated the ability to monitor individuals' reported behaviors (Asif et al., 2018; Lavuri, 2021). Therefore, intelligent farmers have the potential to positively affect sustainable procurement behavior through a positive attitude and perceived behavioral control towards sustainable procurement.

The interplay between the different components of intelligence, analytical, creative, and practical, influences farmers' perceived behavioral control and attitudes towards sustainable procurement. Farmers with higher levels of intelligence are more likely to have a greater sense of control over their ability to engage in sustainable procurement behavior, as their intelligence equips them with the cognitive skills and knowledge needed to understand the importance of sustainability, to evaluate environmental implications, and to make informed choices (Rusyani et al., 2021a,b). This in turn significantly contributes to farmers' perceived behavioral control by providing them with the necessary confidence to adopt technology (Heo and Muralidharan, 2019; Rusyani et al., 2021a,b). Additionally, intelligence influences their attitude towards sustainable procurement by fostering innovative thinking, openness to new ideas, and practical application of sustainable practices. Therefore, we can hypothesize that:

H1. Farmer's intelligence positively influences the farmer's attitude towards sustainable procurement.

H2. Farmer's intelligence positively influences the farmer's perceived behavior control.

3.2.3. Interplay between farmers' intelligence and social norms

People with high intelligence are self-aware about their activities in that they keep an eye on their emotional outbursts and are wise to comments from others regarding the social acceptability of those outbursts. Emotionally and cognitively intelligent people can control the strength of their emotional outbursts to stay within the parameters established by team norms. Therefore, intelligence has a direct effect on controlling social norms positively (Prati et al., 2003).

The capacity of the human intellect to comprehend and influence the thoughts and feelings of others is continually developing. It suggests that people are involved in competing to obtain an advantage by developing their capacity to understand and affect the thoughts and intentions of others around them. This representation places a strong emphasis on the value of having a tactical advantage by comprehending the thoughts of others. People who have more potential intellect power can positively influence the social norms around them (Cummins, 1998).

Therefore, knowledgeable farmers who actively practice sustainable procurement practices can be role models. They can encourage and persuade their contemporaries and the larger farming community to adopt comparable sustainable practices by demonstrating the positive effects of their decisions and sharing their knowledge and experiences with others. This may help the industry's social standards evolve in new directions. Therefore, we can hypothesize that:

H3. Farmers' intelligence positively influences social norms.

3.3. Effect of social norms on intention

Subjective norm refers to the perception of societal pressure to either engage or refrain from specific behaviors (Ajzen and Fishbein, 1980). It is an individual's viewpoint and significantly influences their decision-making and actions (Lavuri, 2021). Subjective norms are shaped by various social influences, including family members, peer groups, friends, and co-workers. These norms have a significant impact on individuals' and consumers' intentions, attitudes, and choices regarding sustainable purchasing, such as buying sustainable products (Eriksen et al., 2018), organic goods (Rusyani et al., 2021a), and revisiting sustainable hotels (Chen and Tung, 2014).

According to studies by Lavuri (2021) and Sun and Wang (2020), subjective norms have been discovered to impact customer purchase intentions for sustainable products in the Indian setting. However, Khare (2015) found no relationship between subjective norms and sustainable purchasing behavior, while Paul et al. (2016) concluded that there was no significant association between subjective norms and sustainable purchase intention. Despite these mixed findings, subjective norms have been identified as essential in promoting intentions to engage in sustainable procurement practices. Therefore, we can hypothesize that:

H4. Social norms positively influence the farmers' intention towards sustainable procurement.

3.4. Effect of attitudes on sustainable procurement intention

According to Scalco et al. (2017) and Ajzen (1991), attitudes towards behavior are defined as the degree to which an individual holds a positive or negative appraisal of a particular behavior. This assessment is impacted by the individual's beliefs about specific objects or acts. Additionally, attitudes incorporate the evaluation of a certain behavior's favorability or unfavourability and the individual's motivation or desire to engage in that behavior (Leonard et al., 2004). It is underlined that attitude includes how one perceives the outcomes of a particular behavior (Ramayah et al., 2010). According to Kotchen and Reiling (2000), attitude is a key indicator of behavioral intention. A favorable attitude produces more positive behavioral intentions (Chen and Tung, 2014). Attitude is the psychological response triggered by consumers' assessments that pilot a positive behavioral intention. It is widely acknowledged that consumers with a positive attitude towards environmentally friendly products prefer consuming such products. In contrast, those with a negative attitude tend to avoid them. Consequently, individuals with positive attitudes are more conscientious in product selection (Acevedo-Duque et al., 2020).

Earlier research indicates a positive association between attitude and purchase intention (Bredahl, 2001; Passafaro, 2020; Paul et al., 2016). Attitude has been recognized as the primary predictor of purchase intention. Consequently, environmental attitudes serve as a predictor of green purchase behavior, acting as a precursor to engaging in environmentally friendly actions (Lin and Niu, 2018). Put simply, consumers who hold positive attitudes towards green products are more likely to have a strong intention to purchase such products. Based on our comprehensive literature review, it is anticipated that a change in attitude towards purchasing sustainable products will positively influence the intention to purchase such products. Therefore, we can hypothesize that:

H5. Farmers' attitude towards sustainable procurement positively influences Farmers' intentions towards sustainable procurement.

3.5. Perceived behavioral control towards the intention of sustainable procurement

According to the Theory of Planned Behavior (TPB), when individuals have a strong belief in their capabilities to perform a particular behavior, they are more inclined to have the intention to perform that behavior and subsequently follow through with it (Ajzen, 1991). Yang-Wallentin et al. (2003) suggest that an individual's willingness to perform a behavior is influenced by their perceived control to execute it. The interaction between intention and perceived behavioral control can be both psychological and non-psychological. Psychologically, higher perceived behavioral control increases intention to perform a behavior. On the other hand, in non-psychological cases, individuals may fail to perform a behavior if their actual behavioral control is lower (Poncin et al., 2020).

Past empirical research provides evidence supporting the association between perceived behavioral control and intention. For instance, (Simsekoglu and Nayum, 2019) found that perceived behavioral control was the most influential factor in determining the intention to purchase electric battery vehicles among drivers of conventional vehicles in Norway. Furthermore, examples include recycling (Taylor and Todd, 1995a), conservation (Albayrak et al., 2013), green hotels (Chang et al., 2014; Chen and Tung, 2014; Han et al., 2010; Teng et al., 2014), organic foods (Tarkiainen and Sundqvist, 2005; Thøgersen, 2007), and green products in general (Moser, 2015).

In their research, (Paul et al., 2016) identified perceived behavioral control as a significant predictor of Indian consumers' intentions to purchase green products, suggesting that reducing the perceived difficulty through effective communication about the availability, modes of purchase, and variety of sustainable products in the market could positively influence purchase intentions. Similarly, Caso et al. (2017) conducted a study utilizing the theory of planned behavior and controlling for past purchases to predict the purchase intention of environmentally friendly products finding that perceived behavioral control played a decisive role in driving pro-environmental intentions, with a strong emphasis on its impact compared to other predictors in the model. Henceforth, we can hypothesize that:

H6. Farmers' perceived behavioral control positively influences farmer's intention towards sustainable procurement.

3.6. Intention towards sustainable procurement behavior

The concept of purchase intention refers to the likelihood or inclination of a consumer to acquire a product or service later. It reflects the probability of a consumer's future purchase plans or their willingness to make a purchase (Paul et al., 2016; Wu et al., 2011). Furthermore, the decision of consumers to purchase products from a particular category is primarily influenced by their personal preference and inclination (Becerra and Badrinarayanan, 2013). The willingness of individuals to purchase sustainable products reflects their intention to choose environmentally friendly alternatives over conventional products that pose harm to the environment which successfully guided their sustainable procurement behavior (Rashid, 2009). Thus, with the help of the above empirical and theoretical support, we can hypothesize that:

H7. Farmers' intention towards sustainable procurement positively influences farmers' sustainable procurement behavior.

3.7. The mediation effect of attitude, social norms, and perceived behavioral control

Kotchen and Reiling (2000) claim that attitude is the most significant indicator of behavioral intention. Psychological emotion underlies attitudes in customer assessments. Behavioral intentions are more likely to be favorable if they are favorable (Chen and Tung, 2014). More specifically, it has been found that attitudes and behavioral intentions are positively correlated across different cultures when it comes to sustainable products (Mostafa, 2007). According to van Birgelen et al. (2007), customers favor beverage packaging that is environmentally friendly if they have a favorable attitude towards protecting the environment. Additionally, every area of life benefits from having a high level of intelligence. Since everyone needs to learn new things and figure out problems occasionally, especially when there is too much social and technological development, people with higher intelligence are better at planning and learning since they tend to profit more than those with lower intelligence. It has a favorable impact on how students feel about learning and solving problems, therefore intelligence affects their attitude towards problem solving positively (Gondal and Husain, 2013). There are no direct studies on the mediation relationship of attitude between intelligence and intention. In this model, we prosed attitude will moderate the relationship between farmers' intelligence and farmers' intention towards sustainable procurement.

The TPB model was used by Hsu et al. (2017) to examine people's behavioral intentions to stay in green hotels. They discovered that behavioral intentions are positively influenced by perceived behavioral control. PBC has a favorable impact on consumers' intention, according to Chen and Tung, 2014, who extended the idea of planned behavior. Numerous studies have shown that PBC is a critical human predictor, and has a favorable relationship with intention, particularly in organic products/foods and sustainable hotels (Asif et al., 2018; Lavuri, 2021). Also, as per the research by Heo and Muralidharan (2019) and Rusyani et al. in 2021, intelligence has been found to be significantly correlated to perceived behavioral control (PBC) and for a positive shift towards sustainable purchases. Therefore, in our study we proposed that farmers' perceived behavioral control mediates the relationship between farmers' intelligence and farmers' intention towards sustainable procurement.

People utilize these social norms as a set of guiding principles to carry out behaviors that are deemed appropriate, which enables individuals to judge not only between morally right and wrong but also if a particular behavior is simple to carry out or helpful (Bamberg and Moser, 2007). Most researchers agreed that behavioral intention is positively impacted by subjective norms when examining the relationship between people's subjective norms and their behavioral intentions (Han et al., 2010; Taylor and Todd, 1995a,b; Tonglet et al., 2004). As a result, the more positive a person's subjective standard is, the more strongly that person intends to act. Also, the ability of the human intellect to understand and shape others' ideas and feelings constantly expands. This implies that individuals compete to gain an advantage by improving their capacity to comprehend and influence the thoughts and intentions of those around them. This illustration emphasizes the importance of gaining a tactical advantage by being aware of other people's thinking. People are more capable of favorably influencing the social norms around them through their intelligence (Cummins, 1998). Therefore, in our study we proposed that social norms mediate the relationship between farmer's intelligence and farmer's intention towards sustainable procurement.

Therefore, we can hypothesize that:

H8. Farmers' attitudes towards sustainable procurement mediates the relationship between farmers' intelligence and farmers' intention towards sustainable procurement.

H9. Farmers perceived behavior control mediates the relationship between farmers' intelligence and farmers' intension towards sustainable procurement.

H10. Social norms mediate the relationship between farmers' intelligence and farmers' intension towards sustainable procurement.

3.8. Trust with a controlling effect on sustainable procurement behavior

Trust plays a crucial role in shaping long-term customer sentiments, and is fundamentally connected to perceived value, leading to customer loyalty. It reflects an individual's willingness to place reliance on an entity, such as a person, business, brand, or product, based on their expectations regarding its competence, dependability, and overall quality (Hart and Saunders, 1997). According to (Chen and Chang, 2013), sustainable trust pertains to a consumer's preparedness to rely on a product, driven by beliefs or expectations concerning its trustworthiness, quality, and commitment to sustainability practices. Trust involves being open to vulnerability in exchange for positive anticipations regarding the integrity and capabilities of others (Lin and Wu, 2011).

Customers' belief in businesses that make sustainable claims about their products significantly influences their behavior towards procuring sustainable goods (Paul et al., 2016). In other words, customers' behavior towards sustainable goods becomes negative when they lack confidence in the authenticity of those products. Some companies' exaggerated claims regarding the environmental effectiveness of their products create hesitancy and distrust among consumers (Lavuri, 2021). Experimental evidence from Chen and Chang (2013) demonstrates that customers' trust in sustainability positively influences the behavior towards purchasing sustainable goods. Therefore, in our research trust is controlling variable positively affecting farmers' behavior towards sustainable procurement practices.

3.9. Technology adoption as controlling variable affecting sustainable procurement behavior

Technology encompasses the knowledge and information necessary to facilitate tasks, provide services, or create products with greater ease and efficiency (Lavison, 2013). Its primary objective is to enhance existing conditions or transform the current state into a more desirable state. By enabling users to perform tasks more efficiently, technology reduces the time and effort required compared to manual or non-technological methods, resulting in time and labor savings (Bonabana-Wabbi, 2002).

Governments design agricultural technology adoption policies to achieve several goals, such as increasing innovation and competitiveness, and production of goods following sustainability recommendations (Doss, 2006). Defining agricultural technology adoption is complex since this concept encompasses many different practices. However, the technology adoption process promotes the approval of new sustainability practices to reduce the impact of current practices (Riandita, 2022). Frequently, there is always a change-resistance level to adopt new regulatory push-and-pull policies, which tend to concentrate on prevention or mitigation measures while organizations and adopters can see them as new threats (Ghisetti, 2017; Kalyuzhnova et al., 2022). Implementing sustainable procurement involves the development of new products and radical innovation in addition to considerable financial investment by private enterprises or farmers (Ghisetti, 2017). Technology adoption leads to achieving sustainable metrics, but nowadays, the number of technologies is too broad for adopters, making the adoption decision process challenging (Sieg et al., 2023). Moreover, sustainability procurement promotes social, environmental, and economic value through technology adoption by improving production and consumption processes (Mastrocinque et al., 2022; Riandita, 2022). Extensive research has been conducted on the factors that influence the adoption of agricultural technology. According to Loevinsohn et al. (2012), farmers' decisions to adopt new technology are shaped by the dynamic interplay between the characteristics of the technology itself and the specific conditions and circumstances in which they operate. The diffusion of technology occurs through a series of individual decisions to adopt the new technology, often driven by a comparison of the uncertain benefits it offers against the uncertain costs of adoption (Hall and Khan, 2003). A distinct theory, proposed by Phoebe Koundouri et al., 2006, provides insights into the farmers' process of technology adoption based on acceptance criteria. According to this approach (Serebrennikov et al., 2020), farmers' acceptance of technology is influenced by three key factors: the subject of acceptance, the object of acceptance, and the surrounding context or framing conditions. The subject of acceptance pertains to the personal characteristics, attitudes, and preferences of farmers concerning the technology in question. The object of acceptance encompasses the attributes of the technology itself, including implementation costs, anticipated benefits, time requirements, and associated risks. Lastly, framing conditions encompass the diverse circumstances surrounding technology adoption, such as the financial state of the farm, the political environment, and relevant governmental policies and regulations. It is essential to reiterate that these factors collectively shape farmers' technology adoption decisions in a meaningful and original manner.

Technology adoption can play a pivotal role in transforming farmers' behavior towards sustainable procurement. By providing technology-driven solutions, farmers can gain valuable insights and experiences that challenge their negative perceptions. This can lead to a positive shift in his behavior, increasing their intention to adopt sustainable procurement practices. Technology adoption acts as a controlling variable, strengthening farmers' behavior towards sustainable procurement (OECD, 2008; Serebrennikov et al., 2020).

4. Methodology

4.1. Target population

For this study, the sample consists of adults aged 18 years or older who are farmers residing in rural areas. The sustainable or green context being investigated is known for its complexity, making it challenging for minors to understand and comprehend (Chan, 2001). Due to the conceptual intricacies involved, adults were considered better equipped to compare and evaluate the available choices and make informed decisions.

To ensure a representative sample, we employed a quota sampling technique to select farmers aged 18 years and above who resided in various regions of India. Our data collection involved a combination of personal interviews and online surveys. Personal interview surveys were chosen as our primary instrument due to their perceived accuracy and the advantage they offer in allowing respondents sufficient time for thoughtful responses (Sekaran, 2000). This approach aimed to minimize the likelihood of non-response and improve the overall quality of the data collected (Kinnear and Taylor, 1996).

Given the wide geographical coverage required for this study, we also utilized online surveys to efficiently reach a maximum number of farmer respondents across different regions of India in a cost-effective manner (Zikmund, 1997). Considering the rural telephone subscriber net addition in June 2022 as 523.87 million, and the monthly growth rate as 0.18%, the overall teledensity was 85.13%, in which the share of rural subscribers was 44.66% (Telecom Regulatory Authority of India, 2022). This reliable data shows the smartphone's rapid penetration in rural parts of India. Therefore, most progressive farmers have smartphones in our country nowadays. Online surveys offered the advantage of broader reach and reduced logistical constraints, facilitating the participation of farmers from diverse areas in the study. By employing a combination of personal interviews and online surveys, we aimed to ensure the representation of farmers, enhancing the robustness and generalizability of our findings.

Also, the data for this study were gathered through a questionnaire survey approach, employing the convenience sampling method. To ensure the questionnaire's understandability and validity, a pilot study was conducted prior to data collection. Valuable feedback from the pilot survey was considered, resulting in refinements to the questionnaire's wording to enhance its clarity and align it with the perspective of rural farmers. Regarding the questions in the survey, we used a back translation technique i.e., the questionnaire was initially translated into the local language and then the translated questionnaire was independently translated back into the source language by a qualified translator (Brislin and Freimanis, 2001). This process helped in removing the discrepancies and ambiguities in the understanding of the concepts. Using an iterative process, the questionnaires were compared and revised to remove mistranslations, ambiguities, and discrepancies (Bansal et al., 2016).

4.2. Sample size and composition

The determination of the sample size for this study followed the recommendation by Hair et al. (1998), which suggests having 15–20 observations per variable under investigation. In our study, we propose a model consisting of two controlling variables that examine six first-order constructs and three second-order constructs (see Fig. 1). The first order construct is **farmers' intelligence** (comprising thirty items); **farmer's attitude towards sustainable procurement** (five items); **subjective norm** (four items); **farmer's perceived behavioral control** (four items); **farmer's intention towards sustainable procurement** (four items); and **farmer's sustainable procurement behavior** (four

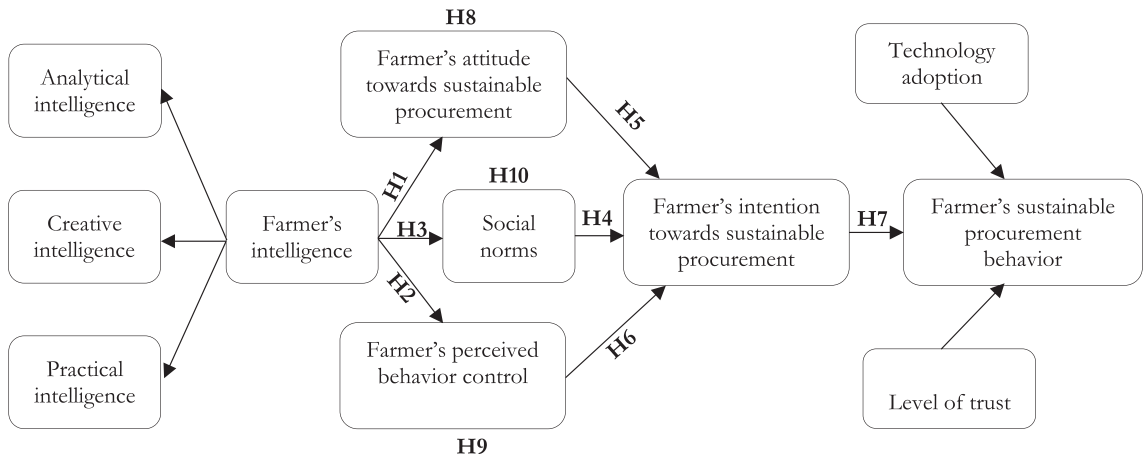

Fig. 1. Proposed theoretical framework.

items). The second order construct is level of trust (five items) and technology adoption (five items) act as **controlling variables** having a direct effect on farmers' sustainable procurement behavior. As per the Triarchic Theory of Intelligence (Sternberg, 1985), we divided farmers' intelligence into second order constructs analytical intelligence (ten items), creative intelligence (ten items), and practical intelligence (ten items). This resulted in a total of 61 items across the constructs.

Based on the desired level of 15–20 observations per variable, the ideal sample size for our study was calculated to be 160 respondents (8 * 20 = 160). As highlighted by Gunawan et al. (2021) *"The recommended sample size for factor analyses varies from 50 to more than 1000 samples, while the recommended item-to-response ratio is from 1:3 to 1:20"*, we have used the 1:3 ratio for collecting the samples in the present study. Studies in the past (Boateng et al., 2018; Clark and Watson, 1995) have also highlighted the sample size adequacy on similar lines. This sample size was deemed sufficient to capture an appropriate representation of the population and ensure statistical reliability. By adhering to the recommended sample size calculation, we aimed to obtain robust and reliable results in our study, considering the number of items and constructs in our questionnaire.

Thus 202 valid responses were collected with full answers. However, for the analysis of our study, we considered a sample size of 183 responses, which exceeded the minimum recommended threshold of 160, by maintaining a 1:3 relationship between items and responses to be analyzed. While the initial recommendation was to have at least 15–20 observations per variable, resulting in an ideal sample size of 96–160, we were able to gather a substantial number of responses beyond the minimum requirement. By surpassing the minimum recommended sample size, our study aimed to further enhance the statistical power and reliability of the findings. With a sample size of 183 (1:3), we still had a significant number of respondents to provide meaningful insights and draw reliable conclusions based on the collected data.

According to the descriptive statistics in Table 3, the majority of respondents in the sample are farmers with over 12 years of education, less than ten years of experience, and an average annual income of <200,000 rupees. Most respondents are in the age groups under 30 and 30–35, which aligns with the average age of the Indian population (Worldometer, 2023).

4.3. Measures

The study incorporated measurement scales that had undergone validation in previous studies, ensuring their reliability and accuracy. We measured farmers' attitude towards sustainable procurement (FATSP) on 5 items, 5-point Likert type scale which was adopted from (Chan and Lau, 2000a). The scale used for farmers' perceived behavioral control (FPBC) is validated 4 -item, 5-point Likert type scale (Pakpour et al., 2021; Shin and Hancer, 2016). The validated 4-item, 5-point Likert type scale was used for social norms (SN) (Liobikienė et al., 2016; Saleh et al., 2020). The validated 4-item, 5-point Likert type scale was used to measure farmers' intention towards sustainable procurement (FITSP) taken from these studies (Awuni et al., n.d.; Pakpour et al., 2021; Shin and Hancer, 2016). Farmers' sustainable procurement behavior (FSPB) was measured on a 4-item, 5-point Likert type scale adopted from Urbanski and Haque, 2020. The study employed a level of trust (LOT) measurement scale consisting of 5 items, rated on a 5-point Likert scale (Yamagishi and Yamagishi, 1994), which had been previously validated in relevant research. Moreover, a 5-item, 5-point Likert-type scale was used for technology adoption (TA) for sustainable products from online survey questionnaires. We measured farmers' intelligence by using triarchic theory of intelligence in which farmers' intelligence (FI) is a combination of analytical intelligence (AI) (10-item, 5-point Likert type scale), creative intelligence (CI) (10-item, 5-point Likert type scale), and practical intelligence (PI) (10-item, 5-point Likert type scale) (Sternberg, 1985). The measuring items for the study are mentioned in Table 2. The five items with 5 points on Likert's scale (strongly disagree (1)/strongly agree (5)) is used to measure all variables used in the analysis.

4.4. Scale reliability

To determine the reliability of the scale, we calculated Cronbach's α using Smart PLS (PLS-SEM) software. As depicted in Table 4, all our items Cronbach α values are outperformed by crossing the limit of 0.7 (Kline, 2005; Nunnally and Bernstein, 1994) for basic research (Nunnally, 1967). In our analysis, we dropped some of the items that had loading <0.7, the threshold value (Hair et al., 2019) which is shown in Table 3. The model reliability was also measured through various measures using composite reliability (CR) and average variance expected (AVE), which is discussed in the part result and analysis.

5. Results

Partial Least Squares Structural Equation Modelling (PLS-SEM), a well-liked variance-based SEM method, was adopted in our investigation (Hair et al., 2019). PLS-SEM is one of the most adherent ways to deal with small sample sizes and non-normal data distribution because of its capacity and adherence for exploratory investigations (Fosso Wamba and Akter, 2019; Hair et al., 2017; Queiroz et al., 2020). The main benefit of PLS-SEM is that it helps to free from applying distributional assumptions to the data and allows estimating of complex models with numerous constructs, indicator variables, and structural paths. When there are large number of items, PLS-SEM can produce results

Table 2
Measurement items & their reliability.

Construct	Items	Factor loadings	Adopted from
Analytical Intelligence (AI)	1. I can analyze different situations by listening to or discussing with different farmers	Dropped (≤0.7)	(Triarchic Theory of Intelligences -Robert Sternberg)
	2. I am able to compare and contrast the points of view of farmers	0.895	
	3. I criticize my own and other farmers' work	Dropped (≤0.7)	
	4. I can think clearly and analytically	0.791	
	5. I can solve logical problems	0.791	
	6. I tend to evaluate my own and other's point of view	0.807	
	7. I am able to explain difficult ideas or problems to others	0.778	
	8. I am able to make inferences and drive conclusions out of different situations	0.777	
	9. I am good at sorting and classifying things	0.761	
	10. I use images to systematically analyze farming related things	Dropped (≤0.7)	
Creative Intelligence (CI)	1. I am good at designing new methods for farming	Dropped (≤0.7)	(Triarchic Theory of Intelligences -Robert Sternberg)
	2. I am good at coming up with new ideas to improve farming	0.74	
	3. I use my imagination to improve productivity in farming	0.768	
	4. I am good at thinking of alternative solutions	0.795	
	5. I often notice things which others often ignore	Dropped (≤0.7)	
	6. I am good at visualizing things	0.809	
	7. I believe things would have been better, if done differently	0.71	
	8. I am good at coming up with different scenarios	0.797	
	9. I am good at inventing new approaches	0.8	
	10. I am good at composing innovative farming techniques, developing more efficient crop management strategies, to increase my farm's profitability	Dropped (≤0.7)	
Practical Intelligence (PI)	1. I like fixing things	0.775	(Triarchic Theory of Intelligences -Robert Sternberg)
	2. I am good at learning through hands-on activities	0.765	
	3. I am good at putting into practice the things I have learned	0.801	
	4. I am good at working with people in teams or groups	0.74	
	5. I am good at resolving conflicts	0.774	
	6. I am good at advising friends on their problems	0.769	
	7. I am good at convincing someone to do something	0.736	
	8. I am good at learning by interacting with others	Dropped (≤0.7)	
	9. I am good at applying my knowledge to work	0.746	
	10. I am good at adapting to new situations as per need	0.776	
Farmer's attitude towards sustainable procurement (FATSP)	1. Purchasing sustainable products can alleviate environmental problems (alleviating eco-problems)	0.759	(Chan and Lau, 2000a)
	2. Purchasing sustainable products can save natural resources (saving resources)	0.78	
	3. Purchasing sustainable products costs more (higher price)	0.763	
	4. Purchasing sustainable products is socially responsible (social responsibility)	0.75	
	5. Purchasing sustainable products is risky (high risk)	Dropped (≤0.7)	
Social/Subjective norms (SN)	1. Most people whose opinions I value think that, "it is important to do sustainable procurement	0.847	(Saleh et al., 2020, Liobikienė et al., 2016)
	2. Most people whom I respect and admire engage in environmentally friendly behaviors	0.835	
	3. It is expected of me to be environmentally friendly	0.863	
	4. I do agree that procuring sustainable products sets a good example	0.834	
Farmers' perceived behavior control (FPBC)	1. I am confident that I could purchase sustainable products if I want to	0.836	(Shin and Hancer, 2016, Chan and Lau, 2000a, Pakpour et al., 2021)
	2. The decision to purchase sustainable products is not beyond my control	0.747	
	3. Whether I purchase sustainable product is entirely up to me	0.847	
	4. There are resources, time, and opportunities for me to purchase sustainable products	0.875	
Farmers' intention towards sustainable procurement (FITSP)	1. I am willing to procure sustainable products	0.876	(Joseph Agebase Awuni et al., n.d., Shin and Hancer, 2016, Pakpour et al., 2021)

(continued on next page)

Table 2 (*continued*)

Construct	Items	Factor loadings	Adopted from
	2. I am planning to buy sustainable products for ecological reasons	0.865	
	3. I intend to do sustainable procurement within one year	0.862	
	4. I will choose products that avoid using chemical materials (harmful fertilizers)	0.746	
Farmers' sustainable procurement behavior (FSPB)	1. I think procuring sustainable products is relevant to my farming needs	0.849	(Urbanski and Haque, 2020)
	2. I am aware of sustainable products	0.803	
	3. I think sustainable products have premium quality	0.862	
	4. I think sustainable products are value for money	0.874	
Level of trust (LOT)	1. Most people are trustworthy	0.828	(Yamagishi and Yamagishi, 1994)
	2. Most people are basically good and kind	0.9	
	3. Most people are trustful of others	0.879	
	4. I am trustful	0.761	
	5. Most people will respond in kind when others trust them	0.781	
Technology adoption (TA)	1. To what extent do you agree that using digital infrastructure/ technology poses a challenge for adopting sustainable procurement practices?	0.732	(–)
	2. Are you familiar with digital platforms that facilitate the purchase of sustainable products?	0.839	
	3. Do you frequently use your smartphone to buy sustainable products or compare them with non-sustainable products?	0.885	
	4. Do you often watch educational programs such as Krishi Darshan & avail services from Krishi Vigyan Kendra to increase your knowledge about the benefits of sustainable products?	0.847	
	5. Do you frequently use social media platforms like Instagram, YouTube, and Facebook to learn about sustainable products?	0.829	

with small sample sizes (Fornell and Larcker, 1981; Willaby et al., 2015; Hair et al., 2017). PLS-SEM exhibits greater robustness when the size of the dataset is constrained (Sarstedt et al., 2016).

5.1. Measurement model

We adhered to the four procedures advised in the literature (Hair et al., 2019) because we employed a reflecting model. The key reliability metrics values are reported in Table 4. Initially, we assessed the items' dependability using the loadings' values. The proposed cut-off, according to Hair et al. (2019), is loadings higher than 0.708, which shows that the construct accounts for at least 50 % of the variation of the indicator. This ensures the dependability of the item. In our model, all the loadings were outperformed, having a safer loading value of >0.708. Confirmatory factor analysis (CFA) was used to verify the model. The standardized factor loadings of the CFA model are shown in the right column of Table 4, and all of them are statistically significant (p-value 0.001), demonstrating that the items accurately reflect the underlying latent construct. This supports the measurement model's convergent validity (Anderson and Gerbing, 1988). In the second stage, an internal consistency reliability assessment is done, utilizing composite reliability Joreskog's (1971) most frequently. By using Cronbach's alpha and composite reliability, in turn, we assessed the consistency reliability. We performed better than the 0.70 composite reliability or Cronbach's alpha literature cut-off values (Hair et al., 2019; Nunnally, 1978). Table 4 shows each factor's composite reliability (CR) and Cronbach's alpha (Cronbach, 1951). All factors have Cronbach's Alpha and CR values that are higher than the indicated cutoff point of 0.70, according to Hair et al. (2010). As a result, the measurement model's dependability is established. The average variance extracted (AVE) metrics were then used to assess the constructs' convergent validity. Our results were more significant than the cut-off value of 0.50 (Hair et al., 2019), indicating that the construct explains more variance in the items than 50 %. All the AVE values in our analysis in Table 5 are larger than required 0.50, which means that it has good convergent validity.

Divergent or discriminant validity (DV) establishes whether constructs that ought to be unrelated to one another actually are unrelated. This can be verified by comparing the average variance extracted (AVE) with the squared correlations of all latent variables in a matrix, as shown in Table 4. We assessed the discriminant validity to ensure that each construct in the model was distinct from the others, and the findings are shown in Table 5. We used the Fornell-Larcker criterion (Fornell and Larcker, 1981), which compares each construct's AVE to the inter-construct squared correlation. According to the Fornell-Larcker Criterion, no discriminant problems exist if the square root of each variable's AVE is greater than its association with other variables (Fornell and Larcker, 1981; Hilkenmeier et al., 2020). With the exception of the variables AI, CI, and PI, they did well in all correlations from one

Table 3
Profile of the respondents' demographics.

Variable	Categories	Frequency	Percentage
Age	<30 years	103	56.28 %
	From 30 to 45 years	39	21.31 %
	From 45 to 60 years	27	14.75 %
	>60 years	14	7.65 %
Education level	No formal education (illiterate)	6	3.28 %
	From 1 to 5 years of schooling (elementary education)	9	4.92 %
	From 6 to 12 years of schooling (secondary education)	30	16.39 %
	Above 12 years of schooling (some college)	138	75.41 %
Experience in farming	<10 years	103	56.28 %
	From 10 to 20 years	38	20.77 %
	From 20 to 30 years	17	9.29 %
	>30 years	25	13.66 %
Average annual income	<100,000	67	36.61 %
	In between 100,000–200,000	41	22.40 %
	In between 200,000–300,000	26	14.21 %
	>300,000	49	26.78 %
Smartphone	Yes	153	83.61 %
	No	30	16.39 %
T.V.	Yes	148	80.87 %
	No	35	19.13 %
Newspaper subscription	Yes	69	37.70 %
	No	114	62.30 %

Table 4
Internal consistency, reliability, and convergent validity metrics.

Construct	Items	Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
AI	AI2	0.781	0.895	0.918	0.614
	AI4	0.791			
	AI5	0.791			
	AI6	0.807			
	AI7	0.778			
	AI8	0.777			
	AI9	0.761			
CI	CI2	0.74	0.888	0.913	0.6
	CI3	0.768			
	CI4	0.795			
	CI6	0.809			
	CI7	0.71			
	CI8	0.797			
	CI9	0.8			
PI	PI1	0.775	0.911	0.927	0.585
	PI2	0.765			
	PI3	0.801			
	PI4	0.74			
	PI5	0.774			
	PI6	0.769			
	PI7	0.736			
	PI9	0.746			
	PI10	0.776			
FI	AI2	0.746	0.964	0.967	0.56
	AI4	0.793			
	AI5	0.759			
	AI6	0.775			
	AI7	0.746			
	AI8	0.745			
	AI9	0.731			
	CI2	0.705			
	CI3	0.704			
	CI4	0.78			
	CI6	0.784			
	CI7	0.71			
	CI8	0.762			
	CI9	0.747			
	PI1	0.753			
	PI2	0.73			
	PI3	0.769			
	PI4	0.713			
	PI5	0.768			
	PI6	0.779			
	PI7	0.732			
	PI9	0.71			
	PI10	0.75			
FATSP	FATSP1	0.759	0.761	0.848	0.582
	FATSP2	0.78			
	FATSP3	0.763			
	FATSP4	0.75			
SN	SN1	0.847	0.866	0.909	0.713
	SN2	0.835			
	SN3	0.863			
	SN4	0.834			
FPBC	FPBC1	0.836	0.846	0.897	0.685
	FPBC2	0.747			
	FPBC3	0.847			
	FPBC4	0.875			
FITSP	FITSP1	0.876	0.858	0.904	0.704
	FITSP2	0.865			
	FITSP3	0.862			
	FITSP4	0.746			
FSPB	FSPB1	0.849	0.869	0.91	0.718
	FSPB2	0.803			
	FSPB3	0.862			
	FSPB4	0.874			
LOT	LOT1	0.828	0.887	0.918	0.692
	LOT2	0.9			
	LOT3	0.879			
	LOT4	0.761			
	LOT5	0.781			
TA	TA1	0.732	0.884	0.916	0.686
	TA2	0.839			
	TA3	0.885			
	TA4	0.847			
	TA5	0.829			

individual construct to another, as indicated by the diagonal values. Since each of these factors represents a subset of the variable intelligence, there is only a strong correlation between them.

We used an alternative metric to assess the discriminant validity in light of the Fornell-Larcker criterion's limitations. Table 6 presents the data for the Heterotrait-Monotrait Ratio (HTMT). The HTMT presents the mean of the correlations of the items over the constructs in relation to the average correlation's mean and takes into account the items that evaluate the same construct (Hair et al., 2019; Henseler et al., 2015). The HTMT cutoff is 0.90 or less. With the exception of AI, CI, and PI, every value in Table 6 of our research demonstrates that the constructs are distinct from one another and confirms the guidance offered in the literature (Hair et al., 2019; Henseler et al., 2015). This is so because, according to the Triarchic Theory of Intelligence, intelligence unites the three aspects of AI, CI, and PI under it. As they are part of the intelligence umbrella, there is a fair amount of correlation between the items listed under these three variables.

5.2. *Structural model*

The traditional Stone-Geisser's Q^2 test was used to assess our model's predictive relevance (power) (Mitrega et al., 2017; Stone, 1974). A blindfolding algorithm calculates this test and then runs a predetermined number of resamples (Kock, 2020). Values over zero adequately demonstrate the model's predictive ability (Hair et al., 2019; Kock, 2020). To reflect the prediction accuracy of the structural model for a given endogenous construct, Q^2 values for that construct should, as a general rule, be greater than zero. Q^2 values >0, 0.25, and 0.5 represent the PLS-path model's small, medium, and significant predictive importance (Hair et al., 2019). As a result, the overall model's Q^2 value 0.66 in Table 7 is consistent with previously published research (Hair et al., 2019; Kock, 2020), where the greater the value, the better the model's predictive ability. Besides, the variance explained by the endogenous variables (first order construct) are FATSP (0.51), FPBC (0.41), SN (0.457) FITSP (0.443), and FSPB (0.663). These large values of Q^2 for all our latent variables show the predictive relevance of the PLS-path model. Further, the high Q^2 value of the second-order construct (PI, CI, and AI) explains their high predictability.

The value of R^2 for our model is 0.703, which was almost 70 %, and indicated that the endogenous variable of farmers' sustainable procurement behavior was influenced by predictor variables of research-based techniques and relationship factors. According to Rigdon (2012), the R^2 is also known as in-sample predictive power. Greater explanatory power is shown by higher values of the R^2, which range from 0 to 1. According to Henseler et al., 2015, the R^2 values of 0.75, 0.50, and 0.25 are substantial, moderate, and weak, respectively. In our model both significant Q^2 and R^2 signifies the present of strong model predictability.

5.2.1. *Hypothesized structural equation model (SEM) by PLS-Bootstrapping*

A nonparametric technique called bootstrapping can be used to evaluate the statistical validity of PLS-SEM results, such as path coefficients (Hair et al.,2017). The following section examined the structural model to obtain the statistical analysis results utilizing Smart PLS

Table 5
Discriminant validity using AVE.

Construct	AI	CI	PI	FI	FATSP	SN	FPBC	FITSP	FSPB	LOT	TA
AI	0.78										
CI	0.89	0.78									
PI	0.91	0.9	0.77								
FI	0.97	0.96	0.98	0.75							
FATSP	0.68	0.65	0.71	0.71	0.76						
SN	0.63	0.65	0.68	0.68	0.59	0.85					
FPBC	0.59	0.62	0.64	0.64	0.46	0.58	0.83				
FITSP	0.63	0.64	0.65	0.66	0.59	0.82	0.63	0.84			
FSPB	0.7	0.75	0.73	0.75	0.63	0.76	0.62	0.75	0.85		
LOT	0.66	0.68	0.66	0.69	0.59	0.74	0.56	0.65	0.76	0.83	
TA	0.6	0.69	0.61	0.65	0.52	0.59	0.52	0.55	0.68	0.69	0.83

Table 6
Discriminant validity using Heterotrait-Monotrait Ratio (HTMT).

Construct	AI	CI	PI	FI	FATSP	SN	FPBC	FITSP	FSPB	TA	LOT
AI											
CI	1										
PI	1.01	1									
FI	1.04	1.04	1.04								
FATSP	0.82	0.79	0.85	0.82							
SN	0.72	0.74	0.76	0.74	0.73						
FPBC	0.68	0.71	0.73	0.71	0.57	0.66					
FITSP	0.71	0.73	0.73	0.72	0.72	0.95	0.72				
FSPB	0.8	0.86	0.83	0.83	0.77	0.88	0.72	0.86			
TA	0.68	0.78	0.68	0.71	0.63	0.67	0.6	0.63	0.77		
LOT	0.73	0.76	0.72	0.74	0.71	0.84	0.64	0.74	0.86	0.78	

Table 7
Values for Stone-Geisser's Q-square and adjusted R-squared value.

Construct	Q-square	R-square adjusted
AI	0.932	0.932
CI	0.919	0.919
PI	0.95	0.95
FATSP	0.494	0.496
SN	0.457	0.459
FPBC	0.405	0.408
FITSP	0.432	0.711
FSPB	0.662	0.703

and PLS-Bootstrapping (see Fig. 2). In Table 8, we provided the standardized path coefficients, t-stats, and the p values for our hypotheses (H1–H7). The finding shows positive effect of FI on FATSP ($\beta = 0.707$, $p < 0.001$), FI on FPBC ($\beta = 0.642$, $p < 0.001$), FI on SN ($\beta = 0.68$, $p < 0.001$), SN on FITSP ($\beta = 0.628$, $p < 0.001$), FATSP on FITSP ($\beta = 0.116$, $p < 0.001$), FPBC on FITSP ($\beta = 0.215$, $p = 0.002$) and FITSP on FSBP ($\beta = 0.403$, $p < 0.001$). So, the model is supporting all our direct hypotheses.

On the other hand, the second order construct FI -> AI, FI -> CI, FI -> PI have $\beta = 0.996$ and $p = 0.000$, $\beta = 0.959$, $p = 0.000$ and $\beta = 0.975$, $p = 0.000$ respectively, shown in Table 10, proving all of them as significant but having a large correlation between them, which identified the path relation as impressive.

5.2.2. *Mediating effect analysis*

The mediation effect must be evaluated in two steps. The mediator and the dependent variable should both be strongly impacted by the independent variable in the first phase. In the second phase, a full mediation effect can be obtained if the dependent variable is strongly impacted by the mediator but not significantly by the independent variable. A partial mediation effect can be obtained if the mediator and the independent variable impact the dependent variable. It is important to note that if the independent variable does not impact the mediator or dependent variable, there is no mediation effect. Table 8 below displays the findings of the mediating influence analysis (Xiaoping, 2019).

Table 9 shows the three mediation effects of farmers' attitude towards sustainable procurement (FATSP) between farmers' intelligence (FI) and farmers' intention towards sustainable procurement (FITSP); farmers' perceived behavioral control (FPBC) mediates between farmers' intelligence (FI) and farmers' intention towards sustainable procurement (FITSP); and social norms (SN) mediates between farmers' intelligence (FI) and farmers' intention towards sustainable procurement (FITSP) based on combined Theory of Planned Behavior (TPB) and Triarchic Theory of Intelligence.

In Table 9, we provided the standardized path coefficients, t-stats, and the p values for our hypotheses (H7–H9). The findings in our case of 3 hypotheses (H7–H9) show that the mediator and the independent variable impact the dependent variable from Table 9, β and p values. Therefore, there is a partial mediation between FI -> FATSP -> FITSP, FI -> FPBC -> FITSP & FI -> SN -> FITSP.

5.2.3. *Control variable*

We considered technology adoption and level of trust as controlling variables that significantly affect sustainable procurement behavior shown in Table 11. The findings show that TA on FSPB ($\beta = 0.219$, $p = 0.003$) and LOT on FSPB ($\beta = 0.344$, $p < 0.001$) controlling sustainable procurement behavior positively.

6. Discussion

Our first hypothesis H1 was that the farmers' intelligence positively affects the farmers' attitudes towards sustainable procurement. The path FI -> FATSP with $\beta = 0.707$ and a p-value of 0 shows that this hypothesis is accepted, and that the farmers' intelligence has a strong relationship with the farmers' attitude towards sustainable procurement. The result of this hypothesis is in line with the literature (Heo and Muralidharan, 2019; Rusyani et al., 2021a,b), which suggests intelligence has a significant positive relationship with a sustainable attitude for making a move towards sustainable procurement and the stakeholders' attitudes, such as farmers, positively influence the engagement of sustainable

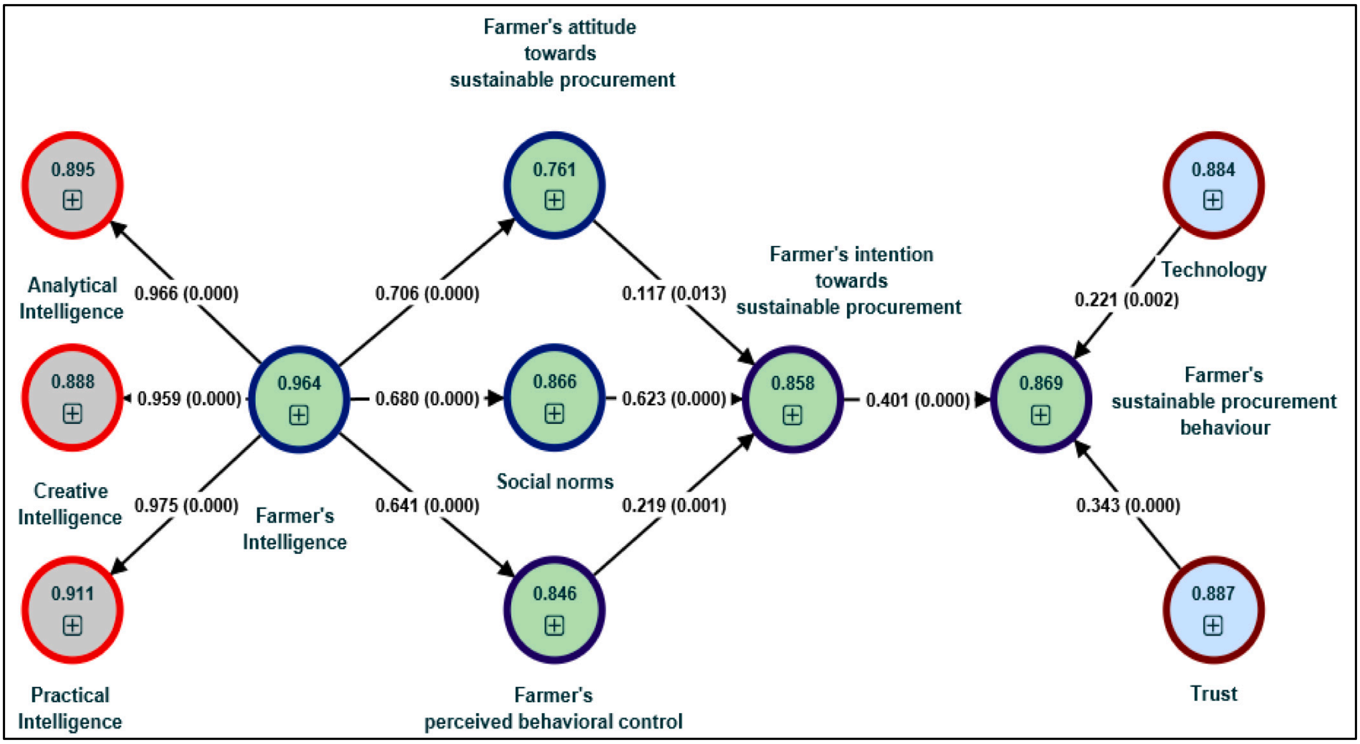

Fig. 2. The estimated structural equation model.

Table 8
Hypotheses and path coefficients.

Hypotheses	Path	Beta	Standard errors	t-statistics	p-values	Decision
H1	FI -> FATSP	0.707	0.049	14.486	0	Accepted
H2	FI -> FPBC	0.642	0.043	14.81	0	Accepted
H3	FI -> SN	0.68	0.052	13.168	0	Accepted
H4	SN -> FITSP	0.628	0.068	9.147	0	Accepted
H5	FATSP -> FITSP	0.116	0.052	2.224	0.013	Accepted
H6	FPBC -> FITSP	0.215	0.075	2.897	0.002	Accepted
H7	FITSP -> FSPB	0.403	0.06	6.669	0	Accepted

Table 9
Results for the mediation.

Hypotheses	Path	Beta	Standard errors	t-statistics	p-values	Decision
H7	FI -> FATSP -> FITSP	0.082	0.037	2.199	0.014	Partially Mediated
H8	FI -> SN -> FITSP	0.427	0.056	7.534	0	Partially Mediated
H9	FI -> FPBC -> FITSP	0.138	0.048	2.868	0.002	Partially Mediated

Table 10
Results for the second-order constructs.

Hypotheses	Path	Beta	Standard errors	t-statistics	p-values	Decision
Second-order constructs	FI -> AI	0.966	0.007	131.081	0	Accepted
	FI -> CI	0.959	0.009	105.019	0	Accepted
	FI -> PI	0.975	0.006	170.649	0	Accepted

Table 11
Results for the control variable constructs.

Hypotheses	Path	Beta	Standard errors	t-statistics	p-values	Decision
Control variable constructs	TA -> FSPB	0.219	0.079	2.782	0.003	Accepted
	LOT -> FSPB	0.344	0.064	5.335	0	Accepted

practices (Nunkoo and Ramkissoon, 2011).

In hypothesis H2, we proposed that the farmers' intelligence positively affects the farmers' perceived behavior control. The path FI -> FPBC with β = 0.642 and a p-value of 0 strongly supports this relationship. This result is one of the critical findings in line with the related literature. Farmers' intelligence equips them with the cognitive skills and knowledge needed to understand the importance of sustainability, evaluate environmental implications, and make informed choices that significantly impact perceived behavioral control by providing them with the necessary confidence. (Heo and Muralidharan, 2019; Rusyani et al., 2021a,b).

In hypothesis H3, we argued that social norms are positively affected by the farmers' intelligence. The result evidenced by the path FI -> SN with $\beta = 0.68$ and a p-value of 0 confirms this hypothesis. This new finding suggests that farmers possessing higher intelligence are more likely to shape the social norms in their community as they evaluate information critically, have deep knowledge of the field, and therefore have better decision-making. This finding is in line with the Prati et al. (2003), which suggests that people who have intelligence are aware of their activities and social acceptance of them. They can control their emotional outbursts to be within the parameters established by social norms.

In hypothesis H4, we considered that the farmers' intention towards sustainable procurement is positively affected by social norms. It is validated by the path SN -> FITSP with $\beta = 0.628$ and a p-value of 0. This hypothesis is in line with the literature (Lavuri, 2021; Sun and Wang, 2020), which suggests that in the Indian scenario, social/subjective norms significantly affect customers' intention towards sustainable procurement. Moreover, low- and high-effort social norms positively influence stakeholders' intention to adopt environmental behavior (Ramkissoon, 2023). However, this hypothesis contrasts with the literature (Paul et al., 2016), which suggests no significant effect of social/subjective norms on sustainable purchase intention.

In hypothesis H5, we examined whether the farmers' attitude towards sustainable procurement positively affects the farmers' intention towards sustainable procurement. The path FATSP -> FITSP with $\beta = 0.116$ and a p-value of 0.013 supports this hypothesis. The finding of this hypothesis is in line with the related literature (Kotchen and Reiling, 2000), which dictates that attitude is a crucial predictor of behavioral intention. (Chen and Tung, 2014) Found that attitude represents the psychological response driven by consumers' evaluations, and if the attitude is positive, it leads to more positive behavioral intentions.

In hypothesis H6, we proposed that the farmers' intentions towards sustainable procurement is positively affected by the farmers' perceived behavior control. The path FPBC -> FITSP with $\beta = 0.215$ and a p-value of 0.002 supports this hypothesis. The result of this hypothesis is in line with the findings of Paul et al. (2016). (Yang-Wallentin et al. (2003) explain that there can be psychological and non-psychological interactions between intention and perceived behavioral control. Social relations between farmers can positively influence the adoption of sustainable procurement since addressing environmental concerns is urgent (Ramkissoon, 2021). In psychological cases, higher perceived behavioral control enhances the intention to perform a behavior. Whereas, in non-psychological cases, individuals might fail to perform a behavior if their actual control over behavior is low.

In hypothesis H7, we theorized that the farmers' sustainable procurement behavior is positively affected by the farmers' intention towards sustainable procurement. It is justified by the path FITSP -> FSPB with $\beta = 0.403$ and a p-value of 0. This finding aligns with (Paul and Rana, 2012; Wu and Chen, 2014), which suggests that customers' intention refers to their probability of future purchases or willingness to purchase.

Finally, after carrying out a mediation analysis, we found that social norms partially mediate the relationship between the farmers' intelligence and the farmers' intention towards sustainable procurement. Previous literature explored mainly that intelligence directly affects social norms (Prati et al., 2003), and social norms directly affect the farmers' intention towards sustainable procurement (Lavuri, 2021; Sun and Wang, 2020). This outcome emphasizes the role of social norms in facilitating the impact of the farmers' intelligence on the farmers' intentions towards sustainable procurement.

Similarly, previous works of literature have highlighted that the farmers' intelligence positively influences the farmers' attitude towards sustainable procurement, (Heo and Muralidharan, 2019; Rusyani et al., 2021a,b) and the farmers' attitude positively impacts the farmers' intention towards sustainable procurement (Kotchen and Reiling, 2000). Our study shows that the farmers' attitudes towards sustainable procurement partially mediates the relations between the farmers' intelligence and the farmers' intentions towards sustainable procurement. In addition, previous studies have identified that the farmers' intelligence positively affects the farmers' perceived behavior control (Heo and Muralidharan, 2019; Rusyani et al., 2021a,b), and the farmers' perceived behavior control positively influences the farmers' intentions towards sustainable procurement (Paul et al., 2016).

The analytical intelligence capability plays a significant impact on the sustainability related outcomes in procurement. The research highlights that farmers exhibiting strong analytical intelligence capability can effectively analyze and disseminate information related to sustainable products and practices. This can be attributed to the evaluation of environmental and social impacts of various products by farmers by assessing long term economic benefits and understanding the technical aspects of sustainable procurement practices. With higher levels of analytical intelligence, farmers are able to evaluate and assess the initial costs vis-à-vis long-term savings thereby making informed decisions based on long-term financial viability.

The creative intelligence capability equips the farmers with finding alternate ways for adopting sustainable procurement practices such as developing their own tailored solutions for meeting their specific needs (examples include utilization of renewable resources, switching to alternative farming methods to name a few). Another aspect of creative intelligence by farmers is the ingenious method of brainstorming with their fellow peers during casual meetings about topics such as adopting and implementing new technologies, adapting to changing farming conditions, and navigating potential market fluctuations.

The practical intelligence capability allows farmers to effectively translate the acquired knowledge and analysis into action by putting sustainable practices into operation. With practical intelligence, they can overcome the potential hurdles and thereby adapt to unforeseen circumstances. For optimizing resource usage while implementing sustainable solutions, practical intelligence capability is crucial.

The result from our study shows that the farmers' perceived behavior control partially mediates the relationship between the farmers' intelligence and the farmers' intentions towards sustainable procurement. These three mediating relationships are new outcomes of our research. It shows how the farmers' attitude towards sustainable procurement, social norms, and the farmers' perceived behavior control facilitates the relationship between the farmers' intelligence and the farmers' intentions towards sustainable procurement.

In our study, we considered technology adoption and the level of trust as controlling variables affecting the sustainable procurement behavior of the farmer. Adopting emerging technologies can successfully help achieve sustainable food production systems (Samkange et al., 2023). Our findings justify it with $\beta = 0.219$, $p = 0.001$ for the relationship of technology adoption with the farmers' sustainable procurement behavior and $\beta = 0.344$, $p < 0.001$ for the relationship of the level of trust with the farmers' sustainable procurement behavior.

7. Conclusions

This is a unique study of the factors that keep farmers from adopting sustainable procurement practices. The results of this study demonstrate important management implications to bridge the research gaps identified in the literature review. First, our study contributes to increasing the research on farmers' sustainable procurement behavior with a lens on integrating the Triarchic Theory of Intelligence with the Theory of Planned Behavior. Also, we analyzed how farmers' intelligence is associated with the behavioral factors influencing sustainable procurement behavior. One crucial factor identified is the intelligence of farmers, which positively influences their perceived behavior control, attitude towards sustainable procurement, and social norms. This, in turn, enhances their intentions to engage in sustainable procurement practices. This leads to the desired outcome of farmers adopting sustainable procurement behaviors. Therefore, agribusiness managers should focus on improving the farmers' intelligence, which could be done by developing and conducting training/capacity development programs, and educational initiatives in collaboration with government agencies such as the Krishi Vigyan Kendras. This further strengthens the fact that the experience of prolonged education impacts intelligence (Strenze, 2007), and intelligence is created by learning (*the more one learns, the more intelligent one becomes*). Further, personal field visits and live demonstrations can be done to educate the farmers. A recent example can be of the Drone Didi initiative by the Government of India which focuses on empowering women farmers and self-help groups.

Second, social norms have a positive effect on the farmers' intentions towards sustainable procurement, leading to the farmers' sustainable procurement behavior. Therefore, managers should promote social norms. Community conversations are a crucial technique for changing social norms because they allow group members to recognize detrimental behaviors and norms that are responsible for upholding the status quo and, eventually, adjust norms for their own empowerment and well-being (Linos et al., 2022).

Our study can help identify factors/barriers that keep farmers from sustainable procurement. Our proposed and validated model could be significant for future practitioners to have comprehensive knowledge of how the Theory of Planned Behavior and the Triarchic Theory of Intelligence could be employed from a sustainable agriculture perspective. The model resulted that a farmers' intelligence has a positive effect on the farmers' attitudes towards sustainable procurement, social norms, and farmer's perceived behavior control, which in turn positively affects the farmers' intentions towards sustainable procurement, which results in sustainable procurement behavior of the farmers. As far as sustainability related outcomes are concerned, sustainable procurement practices have three-fold benefits on the economic, environmental, and social aspects. On the economic front, sustainable procurement practices can lead to considerable cost savings by improving resource efficiency and minimizing wastage. It also leads to reductions in operational costs in the long run. Agribusiness organizations prioritizing sustainable procurement practices tend to gain a long-term competitive advantage as more and more farmers are now opting for sustainable procurement practices. A few notable examples include the initiatives by StarAgri Warehousing Limited in Rajasthan and ITC in Madhya Pradesh. On the environmental front, sustainable procurement practices lead to reduced environmental footprint by optimizing energy usage, water consumption, and reliance on resources during processing, packaging, and disposal. Sustainable procurement practices promote a healthier environment through responsible management of natural resources thereby reducing the detrimental effects on the environment. On the social front, sustainable procurement practices lead to improved working conditions as they source from suppliers adhering to fair labor practices and safe working conditions. Sustainable procurement practices attribute to local community development through job creation and fostering a sense of ownership within the farming community.

Overall, sustainable procurement practices can lead to resilient agribusiness supply chains as they mitigate the risks associated with environmental degradation, social unrest, and resource scarcity.

Referring to our results, we can say that a farmers' intelligence plays a crucial part in shaping the farmers' sustainable procurement behavior. Thus, awareness programs, training programs etc., should be initiated to improve the farmers' intelligence. In addition, our findings suggest that technology adoption and level of trust as controlling variables significantly affect the farmers' sustainable procurement behavior. Furthermore, sustainable agricultural procurement practices help address Sustainable Development Goals and climate change issues (Samkange et al., 2021; Samkange et al., 2023).

8. Limitations & future research directions

This study has some limitations, which can be categorized into four points. First, this study considers sustainable procurement, i.e., it is not for any specific product. Therefore, if specific products are considered, results may differ. Future studies should examine the suggested model for different products, i.e., procurement of different types of seeds, procurement of fertilizers etc. Second, we acknowledge the limitations of our sample during the study design and analysis. While we understand the significance of generalizability, data limits further the analysis. We collected data only from farmers in three Indian zones: the north, east, and central zones. However, our findings offer valuable insights into sustainable procurement and establish a groundwork for future research with more extensive and diverse samples that could explore zones not included in this study. Having a diversified data set will be helpful to compare findings between different cities. Third, we have analyzed a robust sample of 183 respondents, but having other participants' opinions might provide a different viewpoint. Future researchers may test it over a large sample size and a more diversified data set, as around 56 % of our respondents were <30 years of age, which might be biasing the data. Fourth, we have not measured actual behavior. Instead, we have measured self-perceived behavior through a survey as it can be easily gathered, and it is helpful for researchers for further analysis. Future research might include actual behavior instead of self-perceived behavior for the study.

CRediT authorship contribution statement

Nikhil Kewal Krishna Mehta: Writing – original draft, Data curation, Conceptualization. **Rohit Sharma:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Investigation. **Angel Contreras Cruz:** Writing – review & editing, Writing – original draft, Methodology, Data curation. **Tugrul U. Daim:** Writing – review & editing, Writing – original draft, Supervision, Project administration.

Declaration of competing interest

We have no conflicts of interest.

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Appendix A. Mean, standard deviation, T-stat & p-values for items

Items	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	p values
A1 <- FATSP	0.755	0.042	18.036	0
A2 <- FATSP	0.779	0.048	16.364	0
A3 <- FATSP	0.76	0.045	17	0
A4 <- FATSP	0.75	0.045	16.787	0
AI2 <- FI	0.745	0.045	16.528	0
AI2 <- AI	0.78	0.04	19.767	0
AI4 <- FI	0.793	0.037	21.607	0
AI4 <- AI	0.791	0.04	19.772	0
AI5 <- FI	0.756	0.043	17.576	0
AI5 <- AI	0.788	0.044	18.112	0
AI6 <- AI	0.805	0.034	23.759	0
AI6 <- FI	0.773	0.04	19.291	0
AI7 <- FI	0.746	0.043	17.539	0
AI7 <- AI	0.778	0.036	21.575	0
AI8 <- AI	0.775	0.038	20.709	0
AI8 <- FI	0.743	0.043	17.133	0
AI9 <- FI	0.728	0.048	15.377	0
AI9 <- AI	0.759	0.042	18.267	0
CI2 <- CI	0.74	0.044	16.674	0
CI2 <- FI	0.705	0.045	15.579	0
CI3 <- FI	0.703	0.053	13.341	0
CI3 <- CI	0.767	0.042	18.357	0
CI4 <- CI	0.792	0.04	19.819	0
CI4 <- FI	0.778	0.041	19.218	0
CI6 <- CI	0.808	0.034	23.6	0
CI6 <- FI	0.782	0.04	19.361	0
CI7 <- FI	0.709	0.05	14.18	0
CI7 <- CI	0.709	0.054	13.08	0
CI8 <- FI	0.759	0.046	16.415	0
CI8 <- CI	0.794	0.041	19.27	0
CI9 <- CI	0.799	0.03	27.029	0
CI9 <- FI	0.747	0.035	21.479	0
I1 <- FITSP	0.873	0.022	39.084	0
I2 <- FITSP	0.862	0.022	40.172	0
I3 <- FITSP	0.861	0.02	42.084	0
I4 <- FITSP	0.749	0.043	17.261	0
PBC1 <- FPBC	0.836	0.028	29.935	0
PBC2 <- FPBC	0.742	0.06	12.498	0
PBC3 <- FPBC	0.845	0.027	30.864	0
PBC4 <- FPBC	0.874	0.018	49.774	0
PI1 <- PI	0.773	0.041	18.887	0
PI1 <- FI	0.752	0.04	18.904	0
PI10 <- FI	0.747	0.041	18.461	0
PI10 <- PI	0.773	0.04	19.344	0
PI2 <- FI	0.729	0.05	14.551	0
PI2 <- PI	0.765	0.051	14.98	0
PI3 <- PI	0.799	0.037	21.57	0
PI3 <- FI	0.767	0.043	17.979	0
PI4 <- FI	0.71	0.046	15.413	0
PI4 <- PI	0.738	0.046	16.125	0
PI5 <- PI	0.774	0.048	16.058	0
PI5 <- FI	0.768	0.043	17.764	0
PI6 <- FI	0.779	0.034	22.853	0
PI6 <- PI	0.768	0.037	20.558	0
PI7 <- FI	0.73	0.046	15.82	0
PI7 <- PI	0.733	0.05	14.641	0
PI9 <- PI	0.744	0.044	16.997	0
PI9 <- FI	0.708	0.05	14.272	0
SN1 <- Social norms	0.845	0.028	30.502	0
SN2 <- Social norms	0.833	0.03	27.522	0
SN3 <- Social norms	0.862	0.024	35.875	0
SN4 <- Social norms	0.832	0.033	25.433	0
SPB1 <- FSPB	0.848	0.03	28.718	0
SPB2 <- FSPB	0.803	0.031	25.967	0
SPB3 <- FSPB	0.859	0.027	31.977	0
SPB4 <- FSPB	0.872	0.021	41.81	0
T1 <- Level of_ trust	0.828	0.032	26.263	0
T2 <- Level of_ trust	0.9	0.019	48.513	0
T3 <- Level of_ trust	0.879	0.021	42.231	0
T4 <- Level of_ trust	0.757	0.037	20.29	0
T5 <- Level of_ trust	0.779	0.044	17.601	0
TA1 <- Technology	0.73	0.047	15.648	0
TA2 <- Technology	0.838	0.031	27.502	0
TA3 <- Technology	0.884	0.018	48.72	0
TA4 <- Technology	0.847	0.023	36.381	0
TA5 <- Technology	0.829	0.029	28.276	0

Appendix B. List of abbreviations

Abbreviation	Definition
AI	Analytical Intelligence
CI	Creative Intelligence
PI	Practical Intelligence
FI	Farmer's Intelligence
FATSP	Farmer's Attitude Towards Sustainable Procurement
SN	Social/Subjective Norms
FPBC	Farmer's Perceived Behavior Control
FITSP	Farmer's Intention Towards Sustainable Procurement
FSPB	Farmer's Sustainable Procurement Behavior
LOT	Level of Trust
TA	Technology Adoption

Data availability

Data will be made available on request.

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