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Influence of Psychological Behavior on Agricultural Technology Adoption Among Ghanaian Smallholder Farmers

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Abstract:

This study examined the influence of psychological behavior of smallholder farmers on agricultural technology adoption. The understanding of behavioral element is necessary determinant of technology adoption pattern for effective response strategy to mitigate influencing behavioral element that undermine positive relationship for increased rate of adoption and based on perceived usefulness and ease of use. The study employed the quantitative research method. Data was collected from 285 randomly selected smallholder rice farmers in the Volta Region of Ghana through a cross-sectional survey. Analysis of the data was done using the Structural Equation Modelling technique to examine the relationship between variables. Findings revealed a significant positive influence of the psychological behavior of smallholder farmers on agricultural technology adoption. There were significant positive relationships between perceived usefulness and agricultural technology adoption, likewise perceived ease of use and adoption. However, perceived ease of use exerts more influence on adoption as compared to perceived usefulness. The study has its implications for governments, and producers of agricultural technologies, emphasizing that perceived utility and simplicity of use must be carefully considered when introducing new technologies to smallholder farmers. The psychological concepts examined in the study provide a limited understanding of how Ghanaian farmers' psychological conduct is influenced.

Keywords:

Agricultural Technology Adoption (ATA), Smallholder Farmers, Perceived Usefulness, Perceived Ease of Use, Ghana.

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Introduction

Agriculture accounts for 5% of Ghana's GDP, employs nearly half of the labor force, and serves as the primary source of income for the vast majority of the nation's poorest citizens (Ghana Agriculture Sector Policy Note, 2017). Notwithstanding the farming industry's apparent importance, low yields for both cash and staple crops persist in the sector. As a result, rice, poultry, sugar, and vegetable oils are among the fundamental foods Ghana imports on a net basis. The Ghanaian government over the years therefore created a framework for implementing several policies such as the Food and Agriculture Development Policy to modernise Ghana's agricultural industry (FASDEP). Despite efforts by the government and policymakers, the agricultural sector continues to face challenges such as food insecurity, insufficient research or utilisation of improved planting materials, lack of access to agricultural automation and labour, and poor infrastructure (Banson, Nguyen & Bosch, 2015) etc. In this study, adopting agricultural technology refers to adopting yield enhancing agricultural technologies that include fertilizer application, improved seeds, irrigation, integrated pest management and mechanization.

More than 80% of Ghana's total food production comes from smallholder farmers, which continues to be the dominant source of food production (Kansanga et al., 2019). Agriculture is essential for providing the population's food and nutritional needs as well as work for the throngs of young people. However, a number of obstacles have made smallholder agriculture more difficult, such as poor transportation infrastructure, poor marketing, limited storage capacity, restricted access to better technologies, and finance to support the adoption of new technologies (Kuivanen et al., 2016). As a result, the majority of smallholder farmers frequently use antiquated techniques that are less efficient and less profitable (Kansanga et al., 2019).

The reliance on traditional method of production will not address the problem of low yield. It is hoped that the challenge of low agricultural yield can be addressed with an improved agricultural technology adoption by the small holder farmers in Ghana (Adams & Jumpah, 2021; Atsriku, 2020). Increasing agricultural yield and productivity, combating poverty among farmers and improving the livelihood of smallholder farmers can be achieved through adopting agricultural technology (Doss, 2006; Arslan, Wollni, Oduol & Hughes, 2022). Nonetheless, Ghana's smallholder farmers have a poor rate of agricultural technology adoption (Ahmed & Anang, 2019; Teye & Quarshie, 2022).

This study, however, focuses on the psychological behavioral components that affect the adoption of agricultural technology. Particularly with regard to Ghanaian smallholder farmers, this has not gotten sufficient coverage in the literature. The main question is: which psychological consumer behavior elements are appropriate for agricultural technology adoption strategy? The element of consumer behavior presented by marketing experts is evaluated to understand and answer the above question appropriately. This knowledge helps to understand the power of the psychological component of the

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technology adoption strategy and the appropriate application of this element in developing the technology adoption strategy. There are two goals that this study hopes to achieve. First, to investigate the relationship between farmers' perceived utility and their desire to embrace agricultural technology; second, to determine the relationship between farmers' perceived ease of use and their willingness to adopt agricultural technology.

Literature Review

Theoretical Framework

The theoretical foundation of this study is the Technology Acceptance Model (TAM). Davis (1989) proposed the theory of TAM. Several academics have employed this model throughout the years to explain the variables that affect a person's decision to adopt technological improvements (Lee, Hsieh, & Hsu, 2011). The Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) are the two psychological theories that gave rise to this theory (Legris, Ingham, & Collerette, 2003; King & He, 2006; Venkatesh & Bala, 2008). TAM is now considered one of the major theories that can explain the adoption of technology and the elements influencing the consumer’s decision to accept or reject a new technology (Marangunić & Granić, 2015).

Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) are two important criteria that impact an individual's decision to embrace and employ an innovation or new technology, according to TAM (Davis, 1989). Some academics argue that by emphasizing the significance of PEOU and PU in persuading consumers to accept new technologies, it has, in large part, simplified the theoretical landscape for technology adoption (Giovanis, Binioris, & Polychronopoulos, 2012). "The degree to which a person believes using a particular system would enhance his or her job performance" (Davis, 1989, p. 320) is the definition of PU according to the theory. However, "the degree to which a person believes that using a particular system would be free of effort" is also the definition of PEOU.

The purpose of the TAM is to encourage and support efforts aimed at increasing technology adoption for more productive and sustainable farming. The hypothesis explains how people who are open to embracing new technologies are sometimes hindered by psychological factors that influence their behavior. According to Kamal, Shafiq, and Kakria, (2020), the components are PU and PEOU and how they integrate into the individual's life. While technological acceptance and adoption among farmers can be better understood through the use of TAM, increasing agricultural production is essential for both sustainable farming practices and food security. Agricultural technology adoption is made easier when it is straightforward and user-friendly, and when smallholder farmers possess the necessary knowledge and abilities to use it. The present investigation employs the technology acceptance model to elucidate

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the correlation between farmers' desire to adopt agricultural technology and the perceived utility of technology.

Psychological Behaviour Elements

The collection of variables that affect consumers' attitudes and behaviors is referred to as psychological factors (Roberts et al., 2021; Gerli et al., 2022). Two (2) psychological characteristics are operationalized in this study as adoption behavioral aspects that predict Ghanaian rural farmers' adoption of agricultural technology. They include Perceived Usefulness (PU) and Perceived ease of use (PEOU). These factors are based on an individual's assessment of technology in relation to its benefits and degree of complexity or simplicity (McDonald, Heanue, Pierce & Horan, 2016; Verma & Sinha, 2018).

Scholars have found that the extent to which people consider an innovation to be significant to their needs impacts adoption behaviour (Bagheri et al., 2021; Ulhaq et al., 2022). Hence, PU is conceptualised in this study as an element of the adoption behavioural dimension that positively affects agricultural technology adoption. In a similar vein, PEOU functions as a component of adoption behavioral variables that forecast smallholder farmers' adoption of agricultural technology. Smallholder farmers' decisions to use technology in their farming operations are influenced by these two psychological aspects (Kamrath et al., 2018; Khoza et al., 2021).

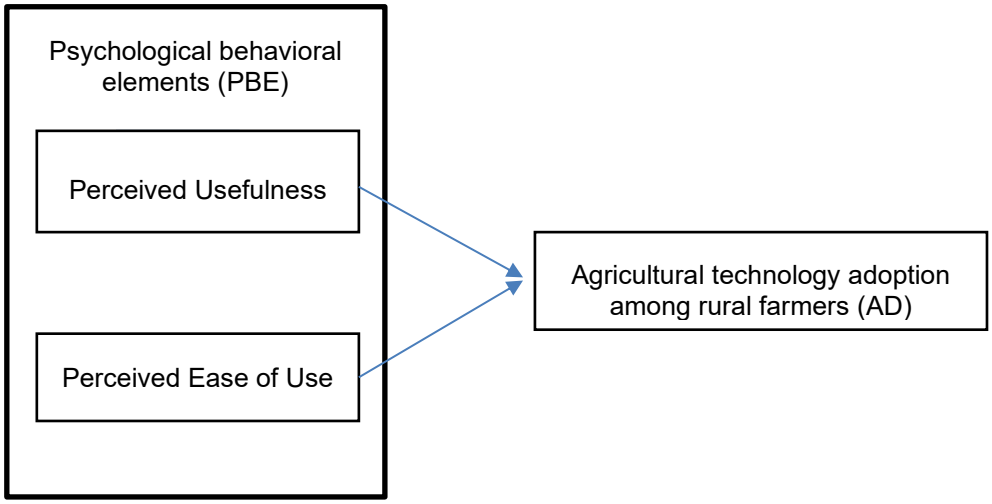

Figure 1: Theoretical Framework

Figure 1 represents the framework adopted for the study, linking the variables deduced from the theoretical discussions. It proposes that, from the TAM model, psychological behaviour elements take two dimensions namely PU and PEOU. Rural farmers' acceptance of agricultural technology would be

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based on these two behaviors. Thus, a hypothetical connection between the variable in the model is given in the following sections of the literature.

Perceived Usefulness (PU) and ATA

The extant literature hints at various studies which have supported the notion that perceived usefulness results in technology adoption (Caffaro, Cremasco, Roccato, & Cavallo, 2020; Tavitiyaman, Zhang, & Tsang, 2022). Some studies (e.g., Chen & Aklikokou, 2020) reveal that perceived usefulness is a requisite factor that facilitates the adoption of new technology. When individuals perceive technology to be useful to their work tasks and roles, it encourages them to be willing to learn and adapt the technology in the working environment. Taufik and Hanafiah (2019) state that in order to ascertain whether adopting a technology will benefit or be useful to a person, it is necessary for that person to assess the technology psychologically. PU was discovered by Caffaro et al. (2020) to have a favorable impact on the uptake of Smart Farming Technologies (SFTs). According to Venkatesh et al. (2003), consumers' behavioral intentions toward the adoption of technology are significantly influenced by perceived usefulness.

Additionally, a study by Wang and Wood (2021) found that farmers were open to using new procedures and technologies if they thought doing so would increase their productivity. Farmers are astute people who thoroughly weigh the pros and downsides of new procedures before implementing them (Anang et al., 2020). Because of this, one of the things that may motivate them to adopt new technology is whether or not they find the features and technology to be beneficial and useful (Weyori et al., 2018). According to a recent study by Issahaku and Abdulai (2020), the perceived utility of these technologies was influencing many Ghanaian farmers to embrace climate-smart practices. Thus, PU serves as a significant predictor of the adoption of agricultural technologies. In light of the discussions above, the study puts out the following theory:

H1: PU positively influences agricultural technology adoption amongst smallholder farmers

Perceived Ease of Use (PEOU) and Agricultural Technology Adoption

Brosnan (1999) claims that PEOU is a psychological construct influencing how an individual responds to a new technology. The ease or difficulty with which smallholder farmers perceive a new technology to be employed may have an impact on the technology's rate of adoption (Takahashi et al., 2020). PEOU directly pertains to the degree of complexity of innovation and how users perceive they can adapt to the technology (Hörner et al., 2022). According to Asare-Nuamah and Mandaza (2020), PEOU is a powerful predictor of technology adoption in general and in the agricultural sector. The link between PEOU and technology adoption can be characterized as positive, according to Acheampong et al. (2020). It is argued that when people believe a technology is straightforward and easy to use, they become aware of the fact that using and adopting the technology might actually benefit them more and reduce their

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stress levels. In the agricultural sector, the adoption of technology is already perceived as a difficult activity due to many personal, social and contextual factors (Kebebe, 2019). Therefore, in diffusing new technology in the agricultural sector, one feature that scholars have advocated for is PEOU (Hung-Chou et al., 2018; Verma & Sinha, 2018).

This study provides compelling evidence for the beneficial association between PEOU and the uptake of agricultural technology. It can be claimed from this study that there is a strong and positive correlation between smallholder farmers' use of agricultural technology and PEOU. This relationship is predicated on the degree of complexity with respect to usage of agricultural technology, the less complex the usage of technology, the more ease to adopt. (Verma & Sinha, 2018; Kanuna & Ngari, 2021). The impact of PEOU on individual technology uptake in the agriculture industry gives rise to the following theory:

H2: PEOU has a positive and significant effect on smallholder farmer adoption of agricultural technology

Research Methodology

For the purpose of conducting a hypothetical test in this study, quantitative research was used. Utilizing a quantitative approach, the relationship between farmers' psychological behaviors and the uptake of agricultural technology was examined using analytical methods and quantitative data. In order to achieve its goals, the study also employed a cross-sectional survey research design to gather data from farmers.

Sampling and Procedure

A list of rice farmers in the Volta Region, one of the primary agricultural zones in the country, who are part of the Ghana Irrigation Development Authority's (GIDA) Weta Irrigation Scheme served as the study's sample frame. After a phone call to the GIDA Office at Avalavi asking for the farmers' list, a trip to Weta was undertaken in order to retrieve the sample frame from the District Engineer. It was stated explicitly that the list included every farmer in the Weta Irrigation Scheme. There were 1,095 farmers representing the total population of farmers in the Weta Irrigation Scheme. Data could not be collected from the entire population as this would be expensive to undertake. The study followed bin Ahmad and binti Halim (2017) sample size determination procedure and 285 farmers were selected for the study. The study involved the random selection of the 285 participants out of the 1,095 using a simple random sampling technique. With the aid of agricultural extension officers, data was collected from 285 farmers using questionnaires. The extension staff worked with all the farmers, making multiple calls to them at home and on the farm, until 100% retrieval was accomplished.

The questionnaire recorded farmers' psychological traits, sociodemographic traits, and readiness to use agricultural technology in their farming operations. The PU and PEOU components of the farmer's

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psychological behavior were assessed. Construct items that were modified from Tubaishat's (2017) technology adoption constructs were used to test both dimensions (PU and PEOU). The Technology Acceptance Model (TAM) served as the basis for the items. The adoption of agricultural technology by farmers was measured using six items that were modified from Buabeng-Andoh (2018). Structural Equation Modelling (SEM) was used in Amos to analyse the data. The dependent variable in the analysis was technology adoption, and the independent variable was psychological behavior (PU, PEOU). Results about the sociodemographic traits of the participants were presented using descriptive statistical measures like frequency and percentages.

Measures

Path analysis was employed in the data analysis to measure the structural model and verify the proposed relationships. The association between the constructs and their indicators as well as between the latent variables was determined using the SEM analysis. Several tools for analyzing variables and determining how they relate to research goals are included in the SEM suite.

Validity and Reliability

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
AD	0.954	0.974	0.972	0.853
PBE	0.903	0.963	0.937	0.701

Table 1: Construct Reliability and Validity

AD = Adoption, PBE = Psychological Behavioral Elements

	AD	PBE
AD	**0.924**	
PBE	0.761	**0.837**

Table 2: Discriminant Validity – Fornell-Lacker Criterion

The study measures both the convergent and the discriminant validity which are the requirement for establishing construct validity (Campbell and Fiske, 1959). Convergent validity measurement using Fornell-Lacker criterion requires the Average Variance Extracted (AVE) greater than 0.5 (Cheung and Wang, 2017). The AVE of the items of the constructs were assessed and were; Psychological Behavioural Elements = 0.701 with Composite Reliability of 0.963, and the dependent variable Adoption = 0.853 with Composite Reliability value = 0.974. The constructs convergent validity was considered

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substantial as the AVE values were greater than 0.5 and the composite reliability values were greater than 0.70 (Table 1).

The discriminant validity is established to ascertain the distinctiveness of the constructs in the study (Henseler, Ringle and Sarstedt, 2015). The discriminant validity of the study was tested with Fornell-Lacker criterion and results are presented in Table 2. The Fornell-Lacker criterion requires that the square root of AVE of a particular construct shall be greater than the correlation of that construct with other constructs in the study. In this study, the square root of the AVE for the construct AD = Adoption is greater than the correlation between the construct and the other construct PBE, i.e, AD = 0.924 > its correlation with PBE = 0.761. Also, the square root of AVE for PBE = 0.837 > its correlation with AD = 0.761. The discriminant validity as per Fornell-Lacker criterion is established. The constructs of the study are therefore valid tools in measuring Ghanaian farmers agricultural technology adoption behaviour.

The study instrument's reliability was evaluated using Cronbach's alpha to measure internal consistency. The domains' Cronbach's alpha values were AD = 0.954 and PBE = 0.903. Given that all items and the domain as a whole had an alpha of ≥0.70, which is deemed desirable by Snoek, Skovlund, and Pouwer (2007), the item internal consistency was deemed substantial. As a result, the questionnaire provides a valid means of assessing the psychological behavior of farmers in the adoption of agricultural technology in the Ghanaian context (Table 1).

Another way to measure internal consistency is the Composite Reliability. Reliability measurement using Fornell-Lacker criterion requires a composite reliability not less than 0.70 (Cheung and Wang, 2017). The composite reliability value for the various domains were; AD = 0.974 and PBE = 0.963. The internal consistency of the items for the study was established as the Composite Reliability values > 0.70 (Table 1).

Research Findings

The study presents the socio-demographic profile of farmers covered in the study. The results are depicted in Table 3.

Variable	Frequency	Percent
Age		
18 to 24	16	5.61
25 to 34	82	28.77
35 to 54	85	29.82

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55 and above	86	30.18
Prefer not to answer	16	5.61
Gender		
Male	158	55.44
Female	123	43.16
Prefer not to say	4	1.40
Level of education		
No Education	47	16.49
Basic Education (Primary and Junior Secondary Education)	123	43.16
Secondary Education (Senior Secondary Education)	72	25.26
Tertiary Education (University, Polytechnic, etc.)	42	14.74
Prefer not to say	1	0.35
Number of years farming rice		
1 to 2 years	21	7.37
3 to 5 years	115	40.35
6 to 10 years	63	22.11
11 to 15 years	38	13.33
More than 15 years	33	11.58
Prefer not to say	15	5.26

Table 3: Socio-Demography Characteristics of Participants (n=285)

In all, 285 people were engaged to take part in the study. Those within the age range 55 and above had the highest proportion of 30.18% (86), followed by those within the age range 35-54 years, 29.82% (85) and 25-34 at 28.77% (82). The least were those 18 - 24 years, 5.61% (16). It shows that the age distribution of small-scale farmers in the research area is evenly distributed between those who are 25–34 years old, 35–54 years old, and older than 54. Both young and ageing smallholder farmers constitute the participants in the study. In terms of educational attainment, 123 participants (43.16%) reported having completed their basic education. About 25.26% attained secondary education, whiles a little above 14% have qualifications as tertiary (university, polytechnics etc.) graduates. This shows that most

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smallholder commercial farmers operating in the region have low levels of education. Most farmers were engaged in rice farming for about 3 - 5 years (40.35%). At large, the farmers have been engaged in rice farming for some time, roughly 3 years and more.

Psychological Behavior and Adoption of Agricultural Technology

The study determined how farmers' psychological behaviors, which were based on consumer behavior theory, related to their inclination to use agricultural technology. PU and PEOU, two aspects of psychological behavior, were utilized in this context as independent variables, with adoption serving as the dependent variable. The analysis in this section seeks to test hypotheses one (H1) and two (H2) of the study.

Variables	**Coefficients**		**Standard Error**	**p-value**
	Unstandardised	***Standardised***		
ATA <--- PU	0.203	0.104	0.074	0.006
ATA <--- PEOU	1.034	0.792	0.049	0.000
Measures of fit: NFI= 1.00, TLI=1.00, CFI=1.00, RMSEA=0.756, R^2=0.733				

Table 4: Relationship between psychological behaviour elements and adoption

ATA=Agricultural Technology Adoption; PU=Perceived Usefulness; PEOU=Perceived ease of use

The results in Table 4 illustrate how farmers' psychological behavioral traits relate to their willingness to adopt agricultural technology that increases yield in their farming operations. The readiness to accept agricultural technology is found to have a substantial positive association with psychological behavior factors. This is supported by the correlation coefficient of 0.85 ($\sqrt{0.733}$). Approximately 75% of the variations in farmers' readiness to accept agricultural technology may be attributed to changes in their psychological behavior (coefficient of determination R^2=0.733). The study demonstrates PU and PEOU account for about 75% of the adoption of agricultural technology. Specifically, PU of agricultural technology positively influences the willingness to adopt among rice farmers (β=0.104, p=0.006). This explains that with any change in the PU of agricultural technology among farmers, their willingness to adopt it will either increase or decrease by 0.104.

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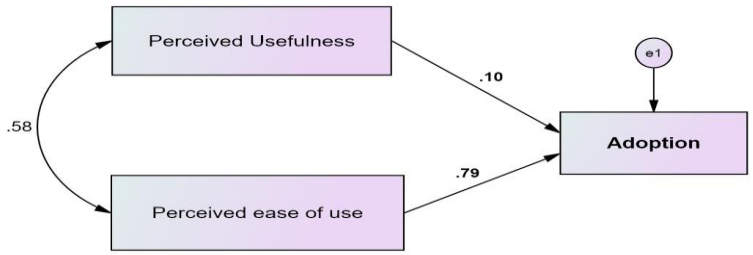

Figure 2: SEM between psychological elements and adoption

As seen in Figure 1, PU and PEOU are considered as psychological factors that affect farmers' adoption of agricultural technology. The degree to which farmers find the technology easy to use and how useful they think it is are positively correlated. This correlation is moderately strong. Figure 1 also indicates a positive but relatively weak correlation between PU and adoption. Nonetheless, there is a significant positive relationship between adoption and the PEOU.

Discussion of Findings

According to the study, farmers' adoption of agricultural technology is significantly influenced by the psychological variables PU and PEOU. In particular, PEOU has a higher association with adoption than PU, indicating that farmers are more inclined to accept technology if they deem it user-friendly. Moreover, PU and PEOU have a favorable association.

The positive correlation between PU and farmers' readiness to use agricultural technology concurs with empirical researches that show positive association between PU and adoption of agricultural technology (Obiero, et al., 2019; Kamble, et al., 2019; Tavitiyaman et al., 2022). In a study conducted by Caffaro et al. (2020), the adoption of Smart Farming Technologies (SFT) is affected positively by PU. Based on these results, the study argues that technological adoption is impossible if smallholder commercial farmers are not informed about the potential benefits that adopting agricultural technology might bring to their operations, especially with regard to output and harvest. According to Wang et al. (2021), farmers were also open to implementing new procedures and technologies if they thought they would increase their productivity. It is worth mentioning that the positive relationship between the variables does not only induce an increase in adoption when perceived usefulness is high. It also cautions that if technological innovations in agriculture are perceived as useless and unable to meet the functional needs of the farmer, the likelihood of adoption reduces.

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Furthermore, the positive effects of PEOU point to farmers' perceptions that agricultural technology adoption is more likely if it is simple to use. Nonetheless, farmers will be less likely to accept the technology if it is difficult to use. According to Clohessy et al. (2019) and Kapoor et al. (2014), adoption intentions are intensified when perceived ease of use is high. Farmers become aware of the fact that adopting and using a technology might result in greater benefits and less stress when they believe it to be easy to use. A favourable attitude and positive intentions to adopt agricultural technology emerge from the notion that the farmer sees the technology as easy to use.

The study's results (PU and PEOU) align with the findings of researchers in the field of technology adoption (Kamble et al., 2019; Tavitiyaman et al., 2022; Caffaro et al., 2020). Obiero et al. (2019), for instance, discovered a strong positive correlation between smallholder fish farmers' readiness to embrace aquacultural technologies in Kenya and their perception of the technologies' usefulness and simplicity of use. Similarly, Caffaro et al. (2020), who investigated how farmers' intentions to adopt technical advancements in Italy were influenced by perceived usefulness and simplicity of use, came to the same conclusion. Similar to this research, several studies concentrated on the agriculture sector (Obiero et al., 2019; Caffaro et al., 2020). Nonetheless, the results in this study show that farmers' adoption of agricultural technology is more influenced by PEOU, with a greater impact (β=0.792 and β=0.104 for PU). According to the current study, agricultural technologies that are easy to use will be favored over those that are useful by Ghanaian farmers. The bulk of the farmers in this investigation only had a basic education, suggesting that their educational background may have contributed to this outcome. This conclusion can be drawn from the findings of previous researchers who discovered a high rate of adoption among well-educated individuals (Caffaro et al., 2020; Tavitiyaman et al., 2022).

With regard to H1, the study specifically finds that it should be rejected and deduces, with a 95% degree of confidence, that there is a strong positive correlation between the psychological component of perceived usefulness and the desire of smallholder farmers to accept agricultural technology. The perceived usefulness of agricultural technologies improves adoption among smallholder farmers. The likelihood of agricultural technology used being deemed less useful is only 5%. Here, it is evident that the need for strategic intervention that allows a smallholder farmer to be both user and co-innovator of agricultural technology becomes increasingly important. Farmer’s need has become a strategic anchor on which agricultural technology should be developed, promoted and adopted for sustained food production. The importance and functional needs of any new innovative technology made available to farmers must be well tailored to these psychological dimensions of smallholder farmers as consumers of agricultural technologies.

Conclusively, the study also contradicts H2, demonstrating that smallholder farmers' adoption of agricultural technology is positively impacted by their perception of the equipment's ease of use.

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Smallholder farmers are stimulated to adopt technology that is user-friendly. It is the view of farmers that when agricultural technology is user-friendly, it is perceived to be useful with high motivation to adopt. The perceived utility and simplicity are important determinants of agricultural technology adoption that akin to both farming for and investment benefit to would-be potential investors. On the one hand, technology that is not user-friendly may not attract farmers' interest to adopt.

Conclusions

The primary goal of this study was to investigate how smallholder farmers' psychological behavior affects their adoption of agricultural technology. In this sense, the consumer behavior model was applied to measure the farmer's psychological behavior. It is concluded that psychological behaviour of smallholder farmers is very instrumental in getting smallholder farmers to accept and adopt agricultural technology.

This study is focussed on consumer behaviour in respect of agricultural technology adoption. The theoretical framework is derived from aspects of product marketing based on usage with emphasis on perceived usefulness and ease of use. These behavioural elements are important for marketing of technical goods to consumers with limited education and technical background. In light of the study's findings, it is important that regular consumer feedback is collected and used for product improvement to enhance agricultural yield and increased farmers appetite to adopt new and modern agricultural technology. Also, the interest of stakeholders in the agricultural sector should be incorporated to the overall marketing and adoption ecosystem for the benefit of sustainability in development of agricultural technology adoption by Ghanaian smallholder farmers in rural areas.

While smallholder farmers' adoption of agricultural technology is directly influenced by their perception of its usefulness, this influence is not very strong. The Ministry of Food and Agriculture (MoFA) therefore should establish a learning environment where smallholder farmers can be trained on the usage of agricultural technology to increase adoption rate. MoFA should improve the technical training provided to agricultural extension officers and provide peer mentoring to farmers. New inventions and innovations should also be made simple to entice farmers to use them.

This study's sample size was sufficient to be representative of smallholder commercial rice growers, however it was restricted to Ghana, West Africa, which presents a limitation. The use of Ghana restricts the ability to generalize the findings because the infrastructure for agricultural technologies that smallholder commercial rice producers have access to differs depending on the location. Only the adoption patterns of Ghanaian smallholder farmers are represented in the study's findings.

The psychological traits of rice farmers in Ghana's Volta Region are the main subject of this study. More research might look at the cultural, social, and personal consumer behavioral components of farmers in

various agricultural sectors in order to conclusively determine the characteristics of farmers' consumer behavior and their inclination to accept agricultural technology.

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