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Socio-Cultural Determinants of On-Farm Policies and Innovation Adoption in Ghana

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Abstract

This study investigates the influence of socio-cultural factors such as social network ties, traditional knowledge and farmer incentives on-farm policies and innovation adoption in Upper West Region of Ghana. Using a cross-sectional design, we collected data from 568 farmers who cultivate cereals and legumes such as maize, millet, sorghum, soybeans and groundnuts. The results show that while formal rituals are rare, farmers widely incorporate traditional knowledge into their decision-making process, suggesting the value of practical traditional wisdom. The findings also suggest that investment in both demonstration programs and longitudinal research could significantly increase innovation adoption rates, particularly when results are communicated in ways that build trust among more skeptical agricultural stakeholders. The hierarchical regression analysis results show that the adoption of on-farm policies and innovations is primarily shaped by farmers' attitudes and beliefs, supported by the strength of their social networks, and reinforced by incentives and risk-buffering mechanisms. Attitudes and beliefs emerged as the strongest predictor, highlighting the centrality of farmers' personal convictions in adoption decisions. This study contributes by highlighting the need for policy and program design to prioritize interventions that build farmers' confidence in innovations while leveraging community-based networks to enhance dissemination. This calls that scaling adoption requires long-term demonstration and communication strategies that build trust across diverse farming contexts. Awareness campaigns, participatory demonstrations, and farmer-to-farmer exchanges are particularly effective in shifting attitudes. By prioritizing confidence-building measures, policies can strengthen positive attitudes, which then allow incentives and social networks to more effectively enhance adoption.

Keywords: Socio-cultural, On-farm policies, Innovation adoption, Traditional knowledge, Social network

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1. Introduction

Agricultural transformation in the Global South, particularly in sub-Saharan Africa, increasingly hinges not only on the diffusion of new technologies but also on the policies and social structures that underpin the adoption of these technologies (FAO & Alliance Bioversity-CIAT, 2021). On-farm policies that are rule, incentives, support programs that target decision-making at the farm level including farm-specific practices and compliance measures are central to this transformation. Despite widespread policy reforms and innovation rollouts, little is known about how these interventions reshape social networks, traditional knowledge, and incentive structures that ultimately determine adoption (FAO, 2021; World Bank, 2023). Existing research highlights that adoption is rarely a purely technical or economic decision. Rural farming communities are embedded in complex social systems where relationships and trust networks shape access to resources, knowledge, and support (Jakku et al, 2019). On-farm policies, such as subsidies, extension programs, or input credit schemes, can either reinforce or disrupt these networks. For instance, evidence from Ghana suggests that the implementation of planting for food and jobs (PFJ) policy and targeted fertilizer subsidies influenced not only crop choice and yield outcomes but also reshaped farmer-to-farmer information sharing by introducing more dependence on formal extension channels (Tsiboe, Egyir & Anaman, 2021; Pauw, 2022). Similarly, innovation adoption - such as improved seed varieties, digital advisory tools, or mechanization services - often bypasses traditional knowledge brokers, reconfiguring who is seen as credible or authoritative within the community (Rizzo et al, 2024).

Knowledge systems in rural contexts are traditionally oral, experiential, and community-based (Ruiz-Mallén & Corbera, 2013). However, policy-driven innovation rollouts often prioritize standardized, top-down approaches to knowledge dissemination. This shift can marginalize indigenous agricultural wisdom and reduce local adaptability. A study by Karubanga et al. (2017) found that while video-based extension significantly increased adoption rates of conservation practices (enhanced awareness, and knowledge acquisition) among rice farmers in East Africa, it also narrowed the space for local experimentation and farmer-led innovation. Therefore, understanding how new policies and tools interact with existing knowledge systems is essential for ensuring that technological gains do not come at the cost of social resilience (Ofosu-Ampong et al, 2025). Moreover, incentives for farmers are shaped by more than just prices and subsidies—they are also influenced by norms, peer behaviour, and expectations. When on-farm policies are designed without considering these socio-cultural incentives, adoption can be shallow or unsustainable (Klebl, Feindt & Piorr, 2024). For example, the success of farmer field schools in East Africa has been partly attributed to their ability to leverage group learning and peer validation, rather than relying solely on financial rewards (Davis et al., 2012). Likewise, innovations such as mobile-based market information systems may alter farmers' motivations by expanding their options and bargaining power, but they also change the social dynamics of marketing and collective action.

On-farm policies and innovations (OFPI) do not operate in isolation; their success depends on how they interact with the social systems in which farmers are embedded (Ofosu-Ampong et al, 2024). Policies that alter networks of trust, marginalize traditional knowledge, or overlook culturally embedded incentives risk undermining long-term adoption. Yet, despite increasing investment in agricultural modernization, there remains limited empirical understanding of how OFPI reshape the social dynamics of farming communities in West Africa. This study addresses that gap by analyzing how social networks, traditional knowledge, and incentive structures mediate the adoption of on-farm policies and innovations among 568 farmers in Ghana's Upper West Region. By integrating hierarchical modeling with socio-cultural analysis, we provide new insights into how attitudes, beliefs, and community ties shape adoption, with direct implications for the design of farmer-centered policies and programs.

2. Theoretical Framework underlying the Adoption of On-Farm Policies and Innovation

The theoretical understanding of on-farm policy implementation and agricultural technology adoption has evolved to encompass multiple interconnected socio-cultural dimensions (Lee, 2005). This study synthesizes current literature that examines how traditional knowledge systems, incentive structures, risk perceptions, social networks, and farmer attitudes collectively influence agricultural decision-making processes of on-farm policies and innovation. The theories underlying this study include Social Capital Theory, Technology Acceptance Model (TAM), and Theory of Planned Behavior (TPB) to explain farmer decision-making regarding OFPI (Tama et al, 2021; Zhang et al, 2025). Prior studies show that integrating TAM-TPB models offers comprehensive insights into the adoption of ecological agricultural technologies, while dimensions of social capital — trust, norms, and connectedness — play a crucial role in shaping adoption choices and farmers' productivity decisions (Zhang et al, 2025). Traditional knowledge serves as both a complement and potential barrier to formal agricultural policies. The study recognizes that farmers operate within dual knowledge systems where indigenous practices interact dynamically with modern agricultural technologies (Apraku et al, 2021). Consequently, knowledge access emerges as a critical driver of adoption, suggesting that effective on-farm policies should bridge traditional wisdom with contemporary scientific knowledge (Ray, 2023). Such integration requires acknowledging the contextual relevance of traditional practices while addressing their limitations through evidence-based improvements (Kimmerer, 2002). However, few studies have explicitly examined this intersection, highlighting the need for deeper research to unpack how knowledge systems can be harmonized to enhance adoption and sustainability. (Kumar et al, 2025). Furthermore, the economic dimension of agricultural decision-making operates through complex incentive structures that must account for both immediate and long-term benefits. Sustainable agricultural practices require incentives that benefit farms, the environment, or both, yet farmers adopt green control technologies only when net benefits exceed those of traditional chemical inputs (Bopp et al, 2019). Risk perception fundamentally shapes these calculations, with agricultural socialized services influencing organic fertilizer application behaviour through risk mitigation (Wang et al, 2022). The framework emphasizes that successful incentive design must address multiple risk categories: production risks, market volatility, climate uncertainty, and regulatory changes.

Social capital theory provides crucial insights into how agricultural innovations diffuse through farming communities. Social networks significantly influence technology adoption, particularly for soil testing and conservation tillage practices (Maertens & Barrett, 2013). This study identifies social networks as conduits for information, trust-building mechanisms, and sources of normative pressure. Farmers' social capital affects agricultural decision-making through key mechanisms that align with existing management practices. Network diversity, and tie strength emerge as critical factors determining information quality and adoption rates. Farmer attitudes toward agricultural innovations reflect complex interactions between personal beliefs, perceived efficacy, and social norms (Wang et al, 2020). Technology acceptance among small rural farmers requires understanding unified theories of acceptance and use of technology framework, which examines determinants of OFPI adoption. Behavioural factors influencing sustainable farming practice adoption encompass cognitive, social, and economic dimensions that vary across geographical contexts and practice types. The theoretical framework highlights that effective adoption of on-farm policies and innovation must address several interconnected dimensions at once. While knowledge access, social networks, and farmers' attitudes are recognized as key drivers of adoption, there is limited understanding of how these factors interact in practice (Martey et al, 2025; (Ofosu-Ampong et al, 2024). In particular, little is known about how information flows within trusted and diverse networks, and how prevailing social norms shape farmers' decision-making. This gap underscores the need for research that integrates these dimensions to design policies that are both context-specific and sustainable.

3. Methodology

The human capital model suggests that the level and distribution of schooling across the population determines the distribution of earnings (Becker &Chiswick 1966; Mincer 1974). Hence, the model predicts that the supply and demand of educated people influence the earnings inequality in society. While the model predicts an unambiguously positive association between educational inequality, as measured by the variance of schooling, and income inequality, the effect of the average years of schooling on income inequality may be either positive or negative, depending on the evolution of the rates of return on education. Consider the following human capital earnings function (De Gregorio and Lee, 2002):

3.1 Study setting

Ghana is a lower-middle-income country with an estimated population of 30.9 million at a population growth rate of 2.1% (GSS, 2021). It has a total area of 238,533 sq. km (land area – 227,533 sq. km, water area of 11,000 sq. km) and shares borders with Burkina Faso (602 km) to the North, Cote d'Ivoire (720 km) to the West, and Togo (1098 km) to the East, and Gulf of Guinee to the South. Ghana's climate is tropical, with warm and comparatively dry along the Southeast Coast, hot and humid in Southwest and hot and dry in the North (MoFA, 2022). As of 2022, Ghana's agricultural produce was maize, rice, cassava, yam, rubber, cocoa, citrus, plantain, cocoyam, oil palm, and pineapple. Ghana has 16 administrative regions with each region having an average land area of 14,445 square kilometre (Fig. 1). Interestingly, the northern part of Ghana which comprises Northern region, North East region, Savannah region, Upper East and Upper West region occupies 41.6% (96,227 sq. km) proving to be a hub of agricultural produce, hereby our study area, specifically Upper West. The southern region experiences two rainy seasons—from March to July and from September to October—characteristic of a bimodal rainfall system. In contrast, the northern part of the country has a unimodal rainfall pattern, with a single rainy season extending from May to October.

3.2 Study design

This add-on survey is a cross-sectional study conducted among farmers in Upper West Region of Ghana who cultivate cereals and legumes such as maize, millet, sorghum, soybeans and groundnuts. The Upper West Region of Ghana is primarily an agrarian area, with most people engaged in subsistence farming. Data was randomly collected from 4 April to 10 April 2024 using ODK data collection tool. Leveraging of Degas farmers association, a snowball sampling technique was used to reach more farmers within the catchment areas. The farmers were recruited from the following communities: Daffiama-Bussie-Issa, Sissala East, Sissala West, Wa East, Jirapa, Lambussie-Karnu and Wa municipal. Participation of the farmers in the study was voluntary, and anonymity was ensured. All ethical guidelines in relation to the data collection from human subjects were observed in the study.

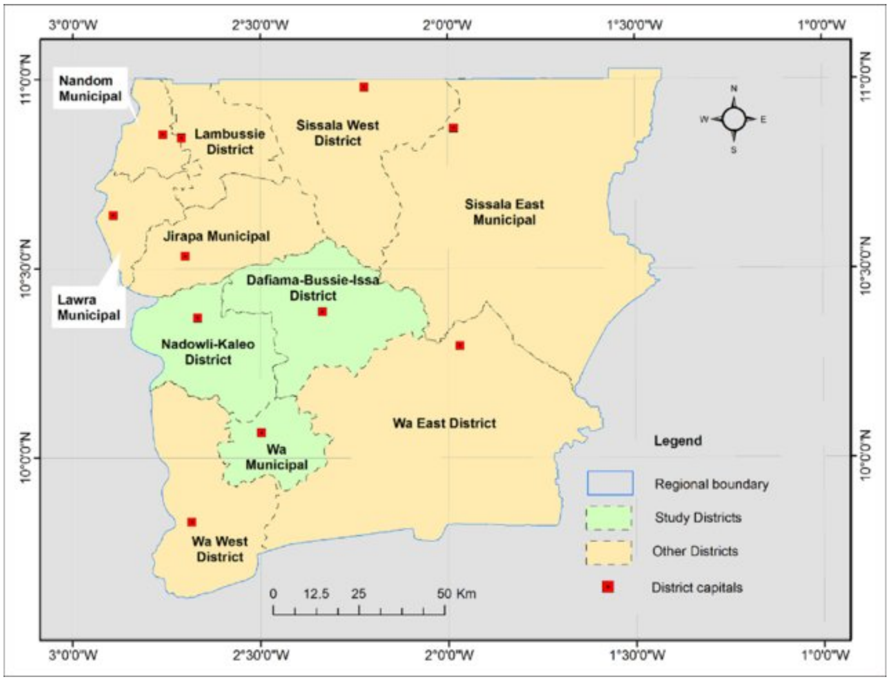

Fig. 1 Map of upper West Region of Ghana

3.3 Measurement and variables

Adoption in this study was defined as the actual implementation or use of OFPI by the farmer towards sustainable agricultural practices. This was the dependent variable, and it was assessed using the question: "If on-farm policies, and innovations were proven to improve agricultural productivity, would you adopt them" and the response was 'Yes', 'No' and 'Not sure' - *moderate*. The questionnaire developed covered four sections: a) sociodemographic characteristics, b) traditional knowledge, c) social networks and d) incentive structures. The sociodemographic characteristics include measures such as age, gender, education and crop cultivated. The insurance variables were adapted from Marr et al. (2016), while the traditional knowledge questions were adapted in previous studies (Geng et al, 2017; Sabar & Midya, 2024). In addition, the questions on social networks ties have been validated in previous studies (Albizua et al, 2021; Izadi et al, 2024), however, some of the questions were adapted to better reflect our local context. To assess the validity and reliability of the scales, a confirmatory factor analysis was conducted. Thus, a Cronbach's alpha coefficient was calculated for the traditional knowledge, social network ties, and incentive structure scale. The resulting Cronbach's alpha ranges from 0.8517 to 0.893, all indicating a high level of reliability. Generally, a Cronbach's alpha value above 0.60 indicate a high reliability – reflecting strong internal consistency (Hair et al, 2020).

3.4 Statistical analysis

Data was analysed using R software (version 4.2.3), with descriptive statistics employed to summarise the sociodemographic characteristics of the farmers. In addition, Pearson's chi-square test was conducted to examine the associations between the adoption of OFPI and key variables, including the demographics, social network ties, traditional knowledge and incentives. Statistical significance was determined at 95% confidence interval with a p-value threshold of <0.05. Furthermore, hierarchical regression analysis was conducted using Jamovi software to assess the unique contribution of predictor variables toward OFPI.

4. Results and Discussion

4.1 Adoption of on-farm policies and innovation: Out of the 596 farmers who participated in the study, about four-fifths (n=525, 88.1%) of them indicated adoption of OFPI for sustainable agriculture, while 34 (5.7%) indicated non-adoption of OFPI. In addition, 37 (6.2%) farmers indicated not sure of adopting OFPI.

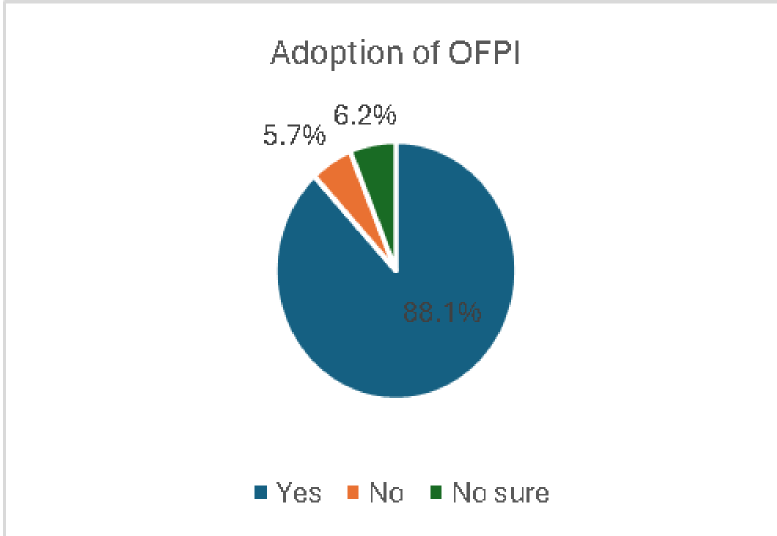

Fig 3. Adoption of On-farm policy and innovation

4.1.1 Socio-demographic characteristics_ Sample characteristics: There was a total of 596 farmers who participated in the survey. Of the 596 farmers, 87.4% (n=521) were males whiles 12.6% (n=75) were females. The chi-square analysis (Table 1) shows that among the socio-demographic factors examined, only age was significantly associated with adoption of on-farm policies and innovations ($\chi^2 = 14.88$, $p = 0.021$). Younger and middle-aged farmers (20–40 years) reported higher adoption rates compared to older farmers, suggesting that age influences willingness to engage with new practices. By contrast, gender, education level, and crop type were not significantly related to adoption ($p > 0.05$). This indicates that adoption patterns cut across male- and female-headed households, educational backgrounds, and crop systems. Interestingly, even farmers with no formal schooling adopted innovations at rates comparable to those with higher levels of education, indicating the importance of experiential and community-based knowledge in shaping adoption decisions.

Also, the findings reveal a non-significant relationship, which suggest that gender, by itself, may not be a determining factor in whether farmers adopt new policies or innovations on their farms (Table 1). Also, more than half (52.3%, n=312) of the participants had ‘no school’ while 21% had secondary education. From the analysis we found that educational level had a non-significant relationship with farmers adoption of OFPI. The absence of a significant relationship between education level and adoption of on-farm innovations challenges traditional assumptions in agricultural development. Rather than formal education driving innovation, knowledge transfer might occur through informal channels such as peer networks and extension services. This suggests that innovations may be designed with sufficient accessibility to transcend educational barriers, while farmers' practical experience may effectively substitute for formal education. Other factors like farm size, resources, and risk tolerance likely exert stronger influence on adoption behaviours.

Furthermore, over one-third (36%) of the participants were aged 31–40, while 26.2% were aged 41–50, and 18.1% were above 51 years. The finding of a significant relationship between farmers' age and the adoption of OFPIs suggests that age plays an important role in shaping farmers’ decisions and behaviours regarding new agricultural practices or policies. Farmers in the middle age bracket (e.g., 31–50 years) were found to strike a balance between experience and openness to innovation. Lastly, most of the farmers cultivated maize and soybean (39.3%, n=234) while about 30.5% cultivated only maize. Other intercropping crops cultivated include maize, soybean and groundnut (12.9%, n=77), maize and groundnut (7.3%, n=44), millet, rice and cowpea (6.4%, n=38), and sorghum, yam and soybean (4.2%, n=24). The analysis indicates a non-significant relationship, implying that the type of crop a farmer cultivates is not strongly predictive of whether they will adopt new farming policies or innovations. Thus, agricultural extension services and innovation diffusion programs may not need to be highly tailored by crop type but rather address universal adoption factors.

Table 1. Socio-demographics

		Adoption of on-farm policies and innovations				Chi2	p_ value
		n (%)	Yes (%)	No (%)	Not sure		
Gender	Female	75 (12.6)	11.6	0.5	0.5	1.26	0.5326
	Male	521 (87.4)	76.5	5.2	5.7		
Age _group	20-30	112 (18.8)	16.7	0.5	1.6	14.88	0.0212*
	31-40	220 (36.9)	32.8	1.2	2.9		
	41-50	156 (26.2)	24.1	0	2.1		
	51_ above	108 (18.1)	16.5	1.1	0.5		
Education level	Adult education	13 (2.1)	1.8	0.3	0	9.76	0.2821
	No_school	312 (52.3)	45.8	2.5	4		
	Post secondary	57 (9.6)	8.6	0.5	0.5		
	Primary	88 (14.8)	12.8	1.5	0.5		
	Secondary	126 (21.1)	19.1	0.8	1.2		
Farmers_ Crops	Maize/soybean	234 (39.3)	32.1	2.7	4.5	11.24	0.318
	Maize	182 (30.5)	28.3	0.2	2		
	Maize/soybean/ groundnut	77 (12.9)	10.5	1.2	1.2		
	Maize /groundnut	44 (7.3)	6.2	0	1.1		
	Millet/ rice/cowpea	38 (6.4)	5	0.2	1.2		
	Sorghum/yam/ soybean	25 (4.2)	3.2	0	1		

$p < 1^{*}$, $p < 0.05^{**}$, $p < 0.01^{***}$.

4.2. The association of socio-cultural and economic variables and adoption of on-farm policies and innovations (OFPI)

4.2.1. Traditional knowledge and adoption of on-farm policies and innovation

About 12.6% of respondents (n=75) perform specific rituals or ceremonies for key farming moments while the vast majority (86.2%, n=514) of farmers do not practice farming-related rituals (Table 2). Out of this vast majority, 75.8% of the respondents indicated adoption of OFPIs. The non-significant relationship indicates that the presence or absence of farming rituals/ceremonies doesn't reliably predict whether a farmer will adopt new policies or innovations. Practically, traditional values don't necessarily inhibit innovation: contrary to what some might assume, holding traditional farming ceremonies doesn't appear to make farmers resistant to new technologies or practices (Assefa, E., & Hans-Rudolf, 2016). Furthermore, 62.1% of respondents (n=370) incorporate traditional knowledge passed down through generations while 22.1% (n=132) do not use traditional knowledge in their decision-making. 5.8% (n=94) remained neutral in the use of traditional knowledge to inform farm decisions. Of the 22.1% of the farmers who do not incorporate traditional knowledge, 18.6% indicated the adoption of OFPIs ($p<0.05$). Also, 57.2% of those that incorporate traditional knowledge indicated the adoption of OFPI for farm improvement. This relationship suggests that farmers who incorporate traditional knowledge (like lunar cycles or weather signs) are more likely to adopt OFPIs. Consequently, farmers who value traditional knowledge might be more holistic in their approach to farming, integrating both traditional wisdom and modern innovations rather than seeing them as opposing approaches (Aksoy & Öz, 2020). The analysis implies that while formal rituals are rare, farmers widely incorporate traditional knowledge into their decision-making process, suggesting they value practical traditional wisdom.

Table 2. Traditional knowledge and adoption of on-farm policies and innovation

		Adoption of on-farm policies and innovation				
Variable	**Response**	**Yes (%)**	**No (%)**	**Not sure (%)**	**Chi^2**	**p_value**
TK: Are there any specific rituals or ceremonies you perform for planting, harvesting, or other key moments in the farming cycle?	Yes (n=75, 12.6%)	11.1	0.7	0.8	1.01	0.9087
	No (n=514, 86.2%)	75.8	5	5.4		
	Not sure (n=7, 1.2%)	1.2	0	0		
TK: Do you incorporate traditional knowledge passed down through generations into your decision-making, such as using lunar cycles or weather signs?	Agree (n=370, 62.1%)	57.2	1.7	3.2	57.30	< 0.001***
	Disagree (n=132, 22.1%)	18.6	3.4	0.2		
	Neutral (n=94, 15.8)	12.2	0.7	2.9		
TK: Have you found ways to combine traditional practices with modern techniques to create a more sustainable or productive farm?	Agree (n=422, 70.8%)	65.5	2.3	2.9	56.92	< 0.001***
	Disagree (n=92,15.4%)	12.1	2.7	0.7		
	Neutral (n=82, 13.8%)	10.4	0.7	2.7		
TK:Do you feel pressure from your community to follow traditional farming practices, even if they are not sustainable?	Yes (n=31, 5.2%)	4.9	0.3	0	2.32	0.678
	No (n=564, 94.6)	83.1	5.4	6.2		
	Not sure (n=1, 0.2%)	0.2	0	0		

p<1*, p<0.05**, p<0.01***

A strong majority (70.8%, n=422) of farmers have found ways to combine traditional and modern farming approaches. Only 15.4% (n=92) have not combined these approaches. 13.8% (n=82) were neutral in their approach. 65% of the farmers who agree to have found ways to combined traditional practice with modern techniques indicated that they have adopted OFPIs. The high percentage of farmers combining traditional and modern approaches indicates a pragmatic rather than ideological approach to farming methods (Adefila et al, 2024). Thus, the significant relationship (p<0.05) suggests that farmers who are finding ways to integrate traditional farming practices with modern techniques are more likely to adopt OFPIs that promote sustainability or productivity. Also, only 5.2% (n=31) feel community pressure to follow traditional farming practices. An overwhelming 94.6% (n=564) do not feel such pressure. This insignificant finding (p=0.678) indicates that community pressure to follow traditional farming practices doesn't significantly influence farmers' adoption of OFPIs. Thus, farmers' decisions to adopt new farming policies and innovations don't appear to be strongly influenced by perceived community pressure about traditional practices.

4.2.2. Social network ties and adoption of on-farm policies and innovation

The results in this section show strong and statistically significant support (p < 0.05) across all four questions related to social network ties and knowledge exchange among farmers. The data reveals that 83.1% of respondents agree that broader social and organizational change is necessary for behavioural change to occur in agriculture and 79% indicated adoption of OFPI. This significant relationship (p<0.05) finding suggests a meaningful connection between farmers' belief in the necessity of broader social and organizational change and their willingness to adopt new OFPIs.

Furthermore, 79.4% of respondents are open to involving family and advisors in knowledge exchange activities, and 73.8% have adopted OFPI while 3.2% are not sure if they have adopted it. 14.8% of respondents are moderately open to involving family and advisors in knowledge exchange activities. This finding suggests (p<0.05) that farmers who are more open to involving family and advisors in knowledge exchange activities are significantly more likely to adopt OFPI. The peer-to-peer learning environment created through family and advisor involvement appears to be a critical catalyst for agricultural innovation adoption and policy implementation at the farm level (Sutherland & Marchand, 2021). The results further showed that 87.6% of respondents agree that existing farmer participation networks can facilitate group knowledge exchange, and 80.5% indicated that they have adopted OFPI (Table 3). The significant findings ($p<0.05$) highlight the importance of farmer participation networks as drivers of agricultural innovation. When farmers actively engage in knowledge-sharing groups, they're significantly more likely to adopt new OFPI. This relationship suggests that strengthening these existing networks could be a cost-effective strategy for promoting sustainable agricultural practices and accelerating the diffusion of beneficial innovations across farming communities.

Also, 64.1% of respondents agree that peer testimonies in advice booklets would positively influence their decision-making while 15.45 disagree. In addition, 20.5% were neutral that peer testimonies in advice booklets would positively influence their decision-making and about half (59.7%) of those that agreed have adopted OFPIs. This finding suggests ($p<0.05$) that farmers who believe peer testimonies would positively influence their decision-making are more likely to adopt new OFPIs. Peer influence appears to be a significant factor in agricultural innovation diffusion (Jizorkuwie et al, 2024). For effective policy implementation, government institutions should consider incorporating farmer testimonials in advisory materials to leverage social proof as a driver of agricultural advancement.

Table 3. Results on Social Networks and adoption of on-farm policies and innovation

		Adoption of on-farm policies and innovation				
Variable	**Response**	**Yes (%)**	**No (%)**	**Not sure (%)**	**Chi²**	**p_value**
SN: To what extent do you agree that wider social and organizational change is necessary to facilitate behavioural change in agriculture?	To a great extent (n=495, 83.1%)	79	2.2	1.8	255.21	< 0.001***
	To a small extent (n=32, 5.4%)	2.2	2.9	0.3		
	To some extent (n=69, 11.6%)	6.9	0.7	4		
SN: How open are you to involving your family and advisors in knowledge exchange activities to stimulate peer-to-peer learning?	Very open (n=473, 79.4%)	73.8	2.3	3.2	162.48	< 0.001***
	Not open (n=35, 5.9%)	3	2.9	0		
	Moderate (n=88, 14.8%)	11.2	0.5	3		
SN: To what extent do you agree that existing networks of farmer participation can facilitate group knowledge exchange?	To a great extent (n=522, 87.6%)	80.5	2.5	4.5	124.80	< 0.001***
	To a small extent (n=29, 4.9%)	2.3	2.3	0.2		
	To some extent (n=45, 7.6%)	5.2	0.8	1.5		
SN: How much do you agree that including testimonies of peer groups in advice booklets would positively influence your decision-making?	Agree (n=382, 64.1%)	59.7	2	2.3	81.19	< 0.001***
	Disagree (n=92, 15.4%)	12.1	3.2	0.2		
	Neutral (n=122, 20.5%)	16.3	0.5	3.7		

p<1*, p<0.05**, p<0.01***

4.2.3 Incentive structure and attitudes towards adoption of on-farm policies and innovation

The survey results reveal strong patterns in farmers' attitudes toward agricultural innovation, behaviour change, and risk management. There was an overwhelming consensus (88.1%) that OFPIs are crucial in agriculture, with only 5.7% disagreeing. Also, 65.1% of respondents find it difficult to try new farming recommendations or practices while 76.8% emphasize the importance of perceiving value before adopting new behaviours (Table 4). Also, 82.6% believe that long-term studies can prove the value of new tools and practices while 79.2% indicate that sustained rewards are important for long-term behaviour change, implying that a one-time incentive may not drive lasting behavioural change (Bopp et al, 2019). Interestingly, there was a very low insurance penetration with only 2% having any form of agricultural insurance. Lastly, 56.9% agree that reduced insurance premiums would motivate investments in preventative measures, though there's more diversity in responses to this question. The extremely low insurance penetration (2%) combined with moderate interest in premium-based incentives (56.9%) points to an underdeveloped agricultural insurance market with potential for growth in Upper West region. The strong responses to perceiving value (76.8%) and the value of adopting new tools, and policies and practice (82.6%) indicate farmers are evidence-based decision-makers who require clear demonstration of value before changing practices. Our study found a significant relationship (p<0.05) between '*To what extent do you believe active demonstrations and evidence from long-term studies can prove the value of adopting new tools, policies, and practices?' and 'adoption of OFPI'*. This finding indicates an important psychological component in agricultural innovation adoption. Thus, farmers who believe that demonstrations and long-term studies can effectively prove value are more likely to adopt new OFPIs (Masoud et al, 2024). This suggests that investment in both demonstration programs and longitudinal research could significantly increase innovation adoption rates, particularly when results are communicated in ways that build trust among more skeptical agricultural stakeholders (Adamsone-Fiskovica & Grivins, 2022). On the contrary, the non-significant relationship (p=0.8779) between agricultural insurance coverage and adoption of OFPI is an important finding that warrants careful explanation for agricultural financing. This result suggests that having agricultural insurance does not significantly predict whether farmers will adopt innovative practices or new policies on their farms (Hazell & Varangis, 2020).

Table 4. Incentive structure and attitudes towards adoption of on-farm policies and innovation

		Adoption of on-farm policies and innovation				
Attitude and belief variables	**Response**	**Yes (%)**	**No (%)**	**Not sure (%)**	**Chi²**	**p_value**
IN: How hard is it for you to try new farming recommendations or practices	Easy (n=388, 65.1%)	61.9	1.7	1.5	131.67	< 0.001***
	Hard (n=83, 13.9%)	10.2	3.5	0.2		
	Moderate (n=125, 21%)	15.9	0.5	4.5		
IN: How important is it for you to perceive value in adopting new behaviours before considering a change	Very important (n=458, 76.8%)	72.7	1.8	2.3	185.74	< 0.001***
	Not important (n=45, 7.6%)	4.4	3.2	0		
	Somewhat important (n=93, 15.6%)	11.1	0.7	3.9		
IN: To what extent do you believe active demonstrations and evidence from long-term studies can prove the value of adopting new tools, policies, and practices?	To a great extent (n=492, 82.6%)	77	1.8	3.7	155.06	< 0.001***
	To a small extent (n=47, 7.9%)	4	3.4	0.5		
	To some extent (n=57, 9.6%)	7	0.5	2		
Incentive structures and risk variables	**Response**	**Yes (%)**	**No (%)**	**Not sure (%)**	**Chi²**	**p_value**
IN: How important is it for rewards to be sustained for long-term behaviour change?	Very important (n=472, 79.2%)	75.2	2.2	1.8	186.42	< 0.001***
	Not important (n=41, 6.9%)	4.4	2.5	0		
	Somewhat important (n=83, 13.9%)	8.6	1	4.4		
IN: Do you currently have any form of agricultural insurance for your crops or livestock?	Yes (n=12, 2%)	1.8	0.2	0	1.20	0.8779
	No (n=582, 97.7%)	85.9	5.5	6.2		
	Not sure (n=2, 0.3%)	0.3	0	0		
IN: Would reduced insurance premiums motivate you to invest in preventative measures	Very motivating (n=339, 56.9%)	53.4	2.2	1.3	43.83	< 0.001***
	Not motivating (n=114, 19.1%)	14.3	2.9	2		
	Somewhat motivating (n=143, 24%)	20.5	0.7	2.9		

4.3. Attribution of stepwise adoption rate using hierarchical regression analysis

Table 6 details the hierarchical regression analysis of how the four different socio-cultural constructs shape the adoption of on-farm policies and innovations (OFPI). The HRM shows *how much* the socio-cultural influences matter after considering other factors. In the first step, Model 1, which included *attitudes and beliefs toward adoption of OFPI*, explained 16.5% of the variance in the outcome ($R^2 = 0.167$, Adjusted $R^2 = 0.165$), $F(1, 594) = 119.0$, $p < .001$. This result shows that farmers' personal outlook and belief systems form an important foundation for adoption decisions, accounting for a significant share of the variance.

When *social network ties* were introduced in Model 2, explanatory power increased substantially to 23.3% ($R^2 = 0.236$, Adjusted $R^2 = 0.233$), yielding a significant ΔR^2 of 0.069 over Model 1. Fit indices also improved markedly (AIC dropped from 1610 to 1561, BIC from 1623 to 1578, RMSE from 0.929 to 0.890), $F(2, 593) = 91.5$, $p < .001$. This suggests that beyond individual beliefs, the role of peer influence, information sharing, and community connections has a strong and statistically significant effect on the likelihood of adopting OFPI.

Table 6. Model Fit Measures (M1 is based on just attitudes and beliefs, M2 is based on M1 + social network, M3 is based on M2 + incentive structure and risk consideration, M4 is based on M3 + traditional knowledge)

							Overall Model Test			
Model	R	R^2	Adjusted R^2	AIC	BIC	RMSE	F	df1	df2	p
M1	0.408	0.167	0.165	1610	1623	0.929	119.0	1	594	<.001
M2	0.486	0.236	0.233	1561	1578	0.890	91.5	2	593	<.001
M3	0.507	0.257	0.253	1546	1568	0.878	68.3	3	592	<.001
M4	0.508	0.258	0.253	1547	1574	0.877	51.4	4	591	<.001

Note. Models estimated using sample size of N=596

The introduction of *incentive structures and risk considerations* in Model 3 pushed the explained variance further to 25.3% ($R^2 = 0.257$, Adjusted $R^2 = 0.253$), with a ΔR^2 of 0.021 compared to Model 2. This improvement, while smaller than the leap from Model 1 to Model 2, was still significant, $F(3, 592) = 68.3$, $p < .001$, and fit statistics again improved (AIC = 1546, BIC = 1568, RMSE = 0.878). These findings imply that financial rewards, insurance mechanisms, and other risk-buffering strategies matter in sustaining adoption, though their effect is incremental compared to attitudes and social networks. By contrast, the addition of *traditional knowledge* in Model 4 contributed virtually nothing to the model. The explained variance rose only slightly to 25.8% ($R^2 = 0.258$, Adjusted $R^2 = 0.253$), with a negligible ΔR^2 of 0.0009, and the overall fit even worsened slightly (AIC increased to 1547 and BIC to 1574), $F(4, 591) = 51.4$, $p < .001$. This suggests that while traditional knowledge remains culturally important, it does not statistically add to explaining OFPI adoption once attitudes, social networks, and incentives are accounted for. Taken together, these results highlight a layered structure in socio-cultural influences. *Attitudes and beliefs* provide the base upon which adoption decisions are formed. *Social networks* amplify this effect by facilitating trust, demonstration, and reinforcement of new practices. *Incentives and risk considerations* further consolidate adoption but to a smaller extent, ensuring sustainability over time. Meanwhile, *traditional knowledge*—though socially and historically valued—does not significantly influence adoption in this statistical model. Thus, Model 3 emerges as the most robust and parsimonious explanation, accounting for about a quarter of the variance in OFPI adoption while balancing explanatory power and efficiency.

Furthermore, the regression results show that three socio-cultural constructs—attitudes and beliefs, social network ties, and incentive structures related to risk—significantly predict the adoption of on-farm policies and innovations (OFPI) (Table 7). Attitudes and beliefs had the strongest effect ($\beta = 0.256$, $p < .001$), suggesting that farmers' personal conviction and perceived value of innovation are central drivers of adoption. Social network ties also played a key role ($\beta = 0.218$, $p < .001$), indicating that peer influence, community interactions, and information sharing enhance the likelihood of adopting new practices.

Table 7. Model Coefficients - OFPI

			95% Confidence Interval				
Predictor	**Estimate**	**SE**	**Lower**	**Upper**	**t**	**p**	**Stand. Estimate**
Intercept	2.0865	0.1848	1.7235	2.4496	11.288	<.001	
Attitude and belief	0.2161	0.0341	0.1491	0.2832	6.332	<.001	0.2560
Social network ties	0.1990	0.0364	0.1275	0.2704	5.472	<.001	0.2184
Incentive structure and risk	0.1461	0.0383	0.0708	0.2213	3.814	<.001	0.1667
Traditional knowledge	0.0196	0.0230	-0.0257	0.0649	0.851	0.395	0.0318

Incentive structures and risk considerations, while comparatively smaller in effect ($\beta = 0.167$, $p < .001$), were still significant, highlighting the importance of rewards, insurance, and financial security in sustaining adoption decisions. By contrast, traditional knowledge ($\beta = 0.032$, $p = 0.395$) was not a significant predictor, with its coefficient close to zero and a wide confidence interval. This reinforces the earlier model comparisons, suggesting that reliance on traditional knowledge does not independently explain adoption once other socio-cultural factors are considered.

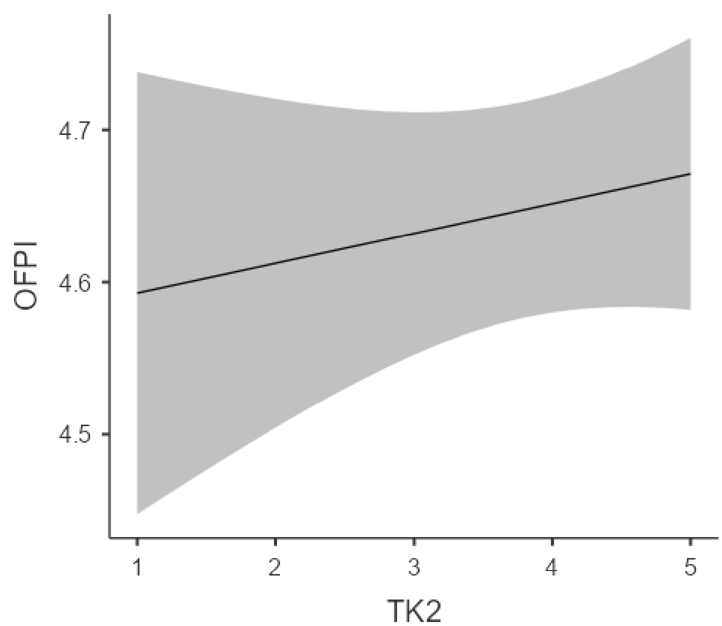

Fig 4. Traditional knowledge pattern and OFPI

To further examine the insignificant predictor of traditional knowledge, we conducted the estimated marginal means of the constructs (Table 8). We found that the traditional knowledge pattern as shown in Fig 4 is flat: indicating that whether farmers score low, average, or high on *Traditional Knowledge (TK2)*, the predicted outcome remains almost the same—around 4.6 to 4.7.

Table 8. Estimated Marginal Means – Traditional Knowledge (TK)

			95% Confidence Interval	
TK2	**Marginal Mean**	**SE**	**Lower**	**Upper**
2.14⁻	4.62	0.0525	4.51	4.72
3.80$^{\mu}$	4.65	0.0361	4.58	4.72
5.45^{+}	4.68	0.0525	4.58	4.78

Note. $^{-}$ *mean - 1SD,* $^{\mu}$ *mean,* $^{+}$ *mean + 1SD*

The differences across levels are very small (only 0.06 between low and high TK), and the overlapping confidence intervals show that these differences are not statistically meaningful (Table 8). This reinforces the regression finding that *traditional knowledge* does not significantly improve model fit for predicting OFPI adoption. Farmers' reliance on traditional knowledge—whether weak, average, or strong—does not substantially shift the predicted adoption outcomes. In other words, while traditional knowledge may be valued culturally, its statistical effect on actual adoption behaviour appears negligible once other factors like attitudes, social networks, and incentives are taken into account.

4.4 Reasons for non-adoption of on-farm policies and innovation practices

In an open-ended question, we asked the farmers reasons that would prevent them in the future adoption of OFPI towards sustainability. The majority (41.8%) of farmers were unwilling to adopt OFPI due to financial barriers especially, due to high cost of inputs, expensive insurance policies and lack of incentives. Also, 20.9% and 14.6% of them were unwilling to adopt OFPI due concerns of knowledge and training (demonstrations) gap, and access issues. Other concerns were market-related challenges (8.1%), policy and institutional issues (6.1%), technology constraints (5%) and motivation and support factors (3.5%) (Table 9).

Table 9. Reasons for non-adopting on-farm policies and innovation practices or challenges

Reasons for non-adopting on-farm policies and innovation practices or challenges	**N (%)**
Financial barriers High cost of inputs (seeds, fertilizers, equipment) - most frequently mentioned Expensive insurance policies with limited access to credit/loans Need for subsidies on agricultural inputs Lack of incentives for early adopters	249 (41.8)
Knowledge and training gaps Need for more demonstrations and field days Insufficient training on new technologies and innovations Limited education on sustainable agronomic practices Need for home visits by extension officers Lack of awareness about insurance policies	125 (20.9)
Access issues Limited availability of quality inputs and seeds Poor road networks affecting delivery Inputs not available at doorstep/community level Need for timely delivery of inputs and information	87 (14.6)
Market-related challenges Lack of ready markets for produce Poor pricing for agricultural products	48 (8.1)
Policy and Institutional Issues Poor implementation of agricultural policies Need for more reliable policymakers Farmers' opinions not considered in decision-making	36 (6.1)

Technology and Innovation Constraints Limited access to new farming technologies and practices Need for drought and pest-resistant varieties Limited promotion of alternatives like organic farming/biochar	30 (5.0)
Motivation and Support Factors Lack of recognition and awards for farmers Limited support for women in agriculture Need for alternative livelihood training	21 (3.5)

5. Conclusion

This study demonstrates that the adoption of on-farm policies and innovations (OFPI) is primarily shaped by farmers' attitudes and beliefs, supported by the strength of their social networks, and reinforced by incentives and risk-buffering mechanisms. Attitudes and beliefs emerged as the strongest predictor, highlighting the centrality of farmers' personal convictions in adoption decisions. Social networks amplified these effects, showing the importance of peer influence and information flows. Incentive structures contributed further, though modestly, underscoring the role of financial and risk considerations in sustaining adoption. By contrast, traditional knowledge, while culturally valued, showed no significant explanatory power once other socio-cultural constructs were accounted for.

Implications – These findings suggest that policy and program design should prioritize interventions that strengthen farmers' confidence in innovations and leverage community-based networks for dissemination. Building trust, reinforcing positive attitudes, and mobilizing social ties may be more impactful than relying solely on traditional knowledge channels. Incentive and insurance mechanisms remain valuable for sustaining adoption over time, but they cannot replace the foundational role of beliefs and social interaction. For extension systems and agricultural development programs, this means focusing on behavioural change communication, peer learning platforms, and targeted incentive schemes to maximize uptake and long-term use of innovations.

Future studies should explore how these socio-cultural constructs interact dynamically over time, rather than in static models. Longitudinal research could reveal how attitudes, social networks, and incentives evolve as farmers gain more experience with innovations. Additionally, qualitative and mixed-method approaches could unpack why traditional knowledge, though socially significant, does not translate into measurable adoption behaviour in statistical terms. Finally, examining these dynamics across different farming systems, policy contexts, and digital advisory tools could refine the generalizability of the findings and inform more context-specific interventions.

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