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KEYWORDS	ABSTRACT
Rural Farmers, Agricultural Extension, Digital Agricultural Information, Institutional Trust, Adaptive Capacity, Livelihood Resilience	The rural farmers in Pakistan face climate variability, market uncertainty, production risk, uneven access to institutional and informational resources. This study examined that whether agricultural extension support, digital agricultural information access & institutional trust strengthen livelihood resilience directly & indirectly through adaptive capacity. A quantitative cross-sectional survey was conducted in 2026 with 360 active farmers from rural communities in Sargodha, Punjab, Pakistan. The multi-item measures were adapted from published agricultural extension, digital information, institutional trust, adaptive-capacity, and livelihood-resilience research. The partial least squares structural equation modelling was performed in SmartPLS-4. The digital agricultural information access was the strongest antecedent of adaptive capacity (beta = 0.331), followed by agricultural extension support (beta = 0.286) & trust (beta = 0.244). adaptive capacity strongly predicted livelihood resilience (beta = 0.442) and significantly mediated all three antecedent-resilience relationships. Therefore, model explained 56.0% of adaptive capacity and 63.0% of livelihood resilience. The findings show that rural support systems become resilience-enhancing when farmers can translate information, credibility & extension support into adaptive action.
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INTRODUCTION

The livelihoods in rural agriculture are now governed by multiple environmental, economic, and institutional factors. Climate uncertainty influences planting schedules, water, pests & production risks, while economic instability and growing input costs may reduce capability of farm-households to cope with shocks. The resilience here is more than just a recovery to pre-shock condition, but also

an opportunity to learn, to organize and reorganize resources and livelihood strategies for continued functionality in changing circumstances (Folke, 2006; Smit & Wandel, 2006). Likewise, the rural households in Pakistan have shown that their vulnerabilities to climate change & adaptation choices are heavily influenced by household resources, risks, and availability of enabling institutions (Abid, Schilling, Scheffran & Zulficar, 2016a; Abid, Schneider & Scheffran, 2016b). Livelihood resilience requires not only assets but ability of farmers to mobilize the relevant resources when circumstances become challenging (Quandt, 2018). There are three resources in particular that can facilitate the development of such adaptive capacity. First, there are agricultural extension services, which can interpret technical information and help farmers understand the risks involved in climate change, production and markets.

There is digital agriculture, which can overcome the problem of delay of information by making available information on weather conditions, prices, inputs, diseases and recommendations; research conducted in Punjab and rural areas of Pakistan demonstrates that mobile technology and other information sources have now become a part of the decision-making process of farmers (Khan, Qijie, Ali, Shahbaz & Shah, 2019; Yaseen, Xu, Yu & Hassan, 2016). Third, there is institutional trust, that determines how farmers perceive advice, programs and information as credible enough to be used. Information, being one of the crucial aspects of adaptive capacity, does not become of much value if it is unavailable, misunderstood or distrusted; adaptive capacity involves learning and adaptation processes. Agriculture is inherently sensitive to changes in rainfall, temperature, water availability, soil conditions, pest outbreaks, market prices, input costs, and government policies. Therefore, the proposed theory states that extension services, digital agriculture and institutional trust contribute to livelihoods resilience by developing adaptive capacity. Still, literature remains fragmented in three significant ways.

First, most studies on adaptation in agriculture consider either extension services, information access or institutional linkages separately making it hard to make any comparison amid them in the same farmer-level model. Second, there are numerous instances where adaptation through the adoption of climate-smart technology is taken as an end in itself. This is despite the fact that farmers need livelihood resilience from various climatic, production & marketing shocks. Third, there is very little mediation of the linkages amid variables where there is enough empirical evidence for all variables considered. It is established that institutions, information, resources & adaptation exist in agriculture but not so about behavioral process involved in converting externalities into resilient livelihoods. In such situations, capacity of farmers to anticipate risks, absorb shocks, reorganize their livelihood strategies, & recover from adverse events becomes central to sustainability of rural livelihoods. This research gap exists in case of Pakistan despite empirical evidence on climate openness, adaptations as well as agricultural information usage (Abid et al., 2016a; Abid et al., 2016b; Khan et al., 2019; Yaseen et al., 2016).

However, actual challenge is that even though these resources are available, they do not translate directly into adaptive action & hence livelihood resilience. An extension agent might be available but provide advice that is too generalized; person might be able to use digital sources of information but absence trust in the relevancy of that information for his own area; a public program might be

available but the provider might lack credibility in the eyes of the farmer. Adaptive capacity refers broadly to the ability of individuals, households, communities, and livelihood systems to adjust to changing circumstances, reduce vulnerability, take advantage of emerging opportunities, and cope with adverse conditions. In such a case, extension services and digital agriculture could yield very weak livelihood benefits. Adaptive capacity is therefore not simply the possession of physical assets or financial resources. This research focuses on solving this challenge amongst rural farmers in Sargodha Division, Punjab, Pakistan, where the concept of adaptive capacity serves as mechanism through which the external inputs, information, along with the institutional credibility translate into livelihood resilience.

Research Objectives

1. Examine effect of agricultural extension support on adaptive capacity & livelihood resilience among rural farmers
2. Assess the effect of digital agricultural information access upon the adaptive capacity and livelihood resilience
3. Determine the effect of institutional trust upon the adaptive capacity & livelihood resilience
4. Evaluate the effect of adaptive capacity upon livelihood resilience in particular context; and
5. Test whether adaptive capacity mediates the relationships amid three antecedent variables and livelihood resilience.

LITERATURE REVIEW

The present research is based on the resilience framework and adaptive capacity theory. Resilience is defined as the ability of the social-ecological system to withstand disturbances, maintaining core properties, and where necessary, reorganizing itself in light of changes. Learning, adaptation, and transformation are the key features of resilient systems according to [Folke \(2006\)](#). Adaptability of human systems is referred to by [Smit and Wandel \(2006\)](#) as the ability to cope with either actual or anticipated circumstances, reduce adverse impacts, as well as take advantage of opportunities. In application to rural households, the above theoretical framework suggests that resilience should be viewed as a result of capacities and resources of households to cope with shocks rather than as an inherent trait of people. In households, the Household Livelihood Resilience Approach created by [Quandt \(2018\)](#) builds on this argument in that resilience is linked to livelihood assets, agency, social relations, and capabilities. The indicator frameworks related to these approaches stress buffer the capacity, self-organization, and learning as essential components of livelihood resilience ([Speranza, Wiesmann & Rist, 2014](#)).

In farming, adaptive capacity becomes a link between the resources and outcomes, whereby access to resources, information, institutions, and assets generates potential, while the adaptive capacity defines transformation of potential into adaptation in timing, practices, resource use, diversification, and risk management. In addition, empirical research in relation to small-scale farmers has defined concept of adaptive capacity in terms of economic resources, awareness, technology, infrastructure, and institutions ([Abdul & Kruse, 2017](#)). Institutional trust adds to the resilience framework, in the sense that it explains why there may, may not use of formal resources. Trust in public organizations entails perception of competence, benevolence, and integrity ([Grimmelikhuijsen & Knies, 2017](#)). In

case of farmers, institutional trust decreases the level of uncertainty in terms of extension services, government schemes, online sources of information & adaptive strategies. The literature indicates that the level of institutional trust among information sources and institutions affect the perceptions of risk as well as response strategy of farmers (Arbuckle, Morton & Hobbs, 2015); on the other hand, lack of institutional trust is a barrier for sustainability-oriented adaptive strategy (Ahsan, Brandt & Faruque, 2021).

Agricultural Extension Support & Adaptive Capacity

The agricultural extension can enhance adaptive capacity by providing the technical information, locally-tailored advice, problem-solving and linkages to programs, markets or inputs. The evidence from northeastern Ghana suggests that extension services are more valuable in supporting climate adaptation if the information provided is timely, contextualized and conveyed through credible social relations (Antwi-Agyei & Stringer, 2021). There is also evidence from the Malawi that rural organizations and supply-side factors are significant determinants of the adaptive capacity among farmers (Arbuckle, Morton & Hobbs, 2015). As extension services have the potential to improve risk perception and increase the range of the coping strategies among farmers, they should enhance the capacity to adapt.

H1: The agricultural extension support has positive significant effect on farmers' adaptive capacity.

Digital Agricultural Information Access & Adaptive Capacity

The digital agricultural information can lead to decreased information lags and increased access for farmers to weather, pricing, inputs, disease, and advisory information. The potential of using mobile phones as well as several other sources of information for accessing the agricultural information has been found to be possible in Pakistan despite the constraints posed by digital literacy and digital awareness barriers (Khan et al., 2019; Yaseen et al., 2016). Information turns out to be a source of adaptation as long as it is accessed by farmers on time, analyzed for relevance and incorporated into decision-making.

H2: Digital agricultural information access has a positive effect on farmers' adaptive capacity.

Institutional Trust & Adaptive Capacity

The availability of information through use of digitized agricultural data could result in reduced information gaps & increased access to weather, prices, inputs, diseases, and advice information for farmers. It is feasible to use mobile phone technology along with various other types of information technology that could allow access to agricultural information despite challenges posed by issues of digital literacy & awareness barriers (Khan et al., 2019; Yaseen et al., 2016). Information becomes adaptive tool when farmers are able to access information timely, analyze its relevancy, and adopt it into decisions.

H3: The institutional trust has a positive and significant effect upon the farmers' adaptive capacity.

Adaptive Capacity & Livelihood Resilience

The difference between adaptive capacity and livelihood resilience lies in their respective focuses upon the ability to adapt before, during, and after stress and the overall ability to sustain livelihood functionality amid learning & reorganization. The concepts are related, although there exist certain

differences in terms of conceptual frameworks. Studies on household resilience stress importance of learning, self-organization & adaptation as drivers of household response to shocks (Quandt, 2018; Speranza et al., 2014). In addition, in the context of rural China, studies demonstrate a link between livelihood resilience and resource reorganization and restructuring of livelihood strategies (Liu et al., 2020). Hence, farmers with higher adaptive capacities should prevent emergence of livelihood losses in long term.

H4: The farmers' adaptive capacity has the positive significant effect upon the livelihood resilience.

Agricultural Extension Support & Livelihood Resilience

The role played by extension services can be extended further through the provision of livelihood resilience by linking farmers' households with resources needed during periods of stress. Extension can help to reduce uncertainty and make better production and risk management decisions even before adaptive capacity is established (Antwi & Stringer, 2021). As extension can offer decision-making support and capability building, there exists an expectation of positive association between the two variables.

H5: The agricultural extension support has positive significant direct effect on livelihood resilience.

Digital Agricultural Information Access & Livelihood Resilience

The information can actually protect livelihoods directly through its role in helping the farmers manage price risks, weather risks, disease risks, and resource risks. Research from Pakistan finds that farmers rely on cell phone as well as the interpersonal means to get market and farm management information, but the usefulness of these means is dependent upon their access to the same and their digital literacy (Khan et al., 2019; Yaseen et al., 2016). Relevant information reduces unnecessary risks in the production and markets, and therefore access to such information should protect farm livelihoods digitally.

H6: The digital agricultural information access has positive direct effect upon livelihood resilience.

Institutional Trust & Livelihood Resilience

Trust in institutions could enhance resilience apart from its impact on adaptive capacity due to the fact that the institutions which are trusted lead to greater levels of willingness to utilize the public programs, extension services, warnings, subsidies, and collective action. By decreasing uncertainty about the ability of the institutions to provide capable and fair assistance, trust could help enhance the level of involvement in activities to build resilience (Grimmelikhuijsen & Knies, 2017; Ahsan et al., 2021). In this drive, in case farm households trust certain institutions, they are likely to depend on the institutions.

H7: The institutional trust has a positive and significant direct effect upon the livelihood resilience.

Adaptive Capacity as Mediator of Extension Support & Livelihood Resilience

The value of extension as a source of resilience lies partially in the ability of farmers to translate the approvals, connections into action. Extension may enhance the capacities for learning, diagnosing production challenges, experimenting, and accessing response strategies; in turn, such capacities facilitate shock absorption. This channel is line with finding that effectiveness of extension services

is contingent on context-based learning and capacity building before just information transmission (Antwi & Stringer, 2021).

H8: Adaptive capacity mediates relationship between agricultural extension support & resilience.

Adaptive Capacity as Mediator of DIA & Livelihood Resilience

The use of digital information cannot create resilience in livelihoods on its own. The utility of the information lies in the farmers' ability to interpret, integrate, and use the information in order to be able to anticipate any problems, make the appropriate production decisions, and allocate resources accordingly. In Pakistan, there is ample proof of the increasing importance of mobile agricultural information & lack of adequate use by farmers of existing digital means (Khan, Qijie, Ali, Shahbaz & Shah, 2019).

H9: Adaptive capacity mediates link amid digital agricultural information access and resilience.

Adaptive Capacity as Mediator of Trust & Livelihood Resilience

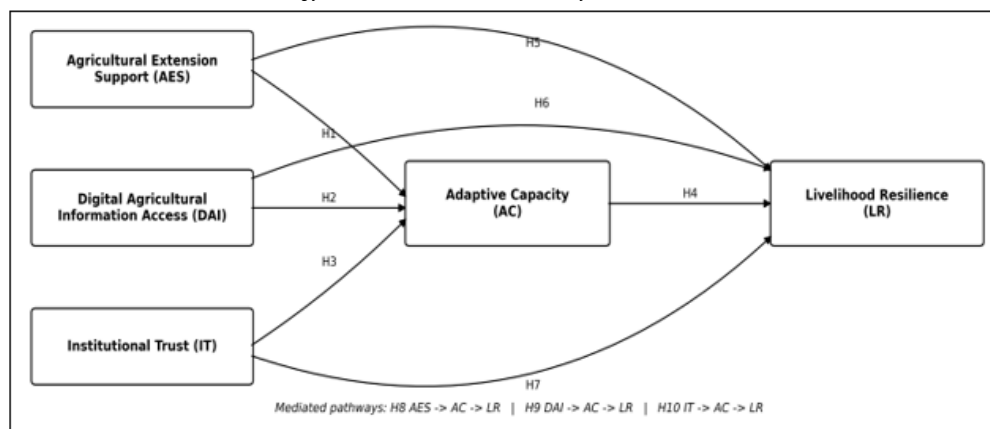
However, even as institutional trust enables farmers to heed the advice, engage in programs, and embrace novel approaches, resources will have to be converted into adaptive actions. Therefore, the institutional trust can contribute to improving the adaptive capacities of the individuals by making them more willing to access institutional services and adopt suggested changes. Using mediation logic, institutional trust is likely to make individuals more adaptive over enhancing their adaptive capacities, but the direct impact will persist because institutions provide tangible help in particular situations and context.

H10: Adaptive capacity mediates relationship between institutional trust and livelihood resilience.

Theoretical Model

Figure 1 brings together three antecedents, adaptive capacity, and livelihood resilience. The model includes direct impacts of agricultural extension services, access to digital agricultural information, and institutional trust on livelihood resilience so that analysis is able to separate complementarity of mediation from complete indirectness. Thus, H8-H10 are the three particular indirect effects via adaptive capacity.

Figure 1 Theoretical Model & Hypothesized Relationships



RESEARCH METHODOLOGY

The study made use of quantitative research design with cross-sectional strategy, and the positivist research philosophy (Jawad et al., 2022; Sabir et al., 2023; Khan et al., 2024). A positivist research philosophy was chosen as study operationalized theoretical constructs into observable indicators, formulated directional hypotheses based on the previous theories, and used statistical inference to evaluate any relationship between variables. The research design was deductive and explanatory, whereby the expectations of the theory were turned into structural model and then analyzed using survey data collected from rural farmers. Participants in the study included active crop/livestock farmers living in rural areas of Sargodha Division, Punjab, Pakistan. Sargodha Division includes Sargodha, Khushab, Mianwali, and Bhakkar districts. Inclusion criteria entailed adults who were engaged in farming for at least the past 12 months and made household decisions about farms. A sampling technique used to ensure the representation of rural areas in Sargodha Division included multistage stratified sampling. The initial geographic strata involved Sargodha District followed by rural areas in these districts and identification of eligible farmers from available lists of farmers in the rural areas.

Finally, a total of 360 completed questionnaires were analyzed and exceeded the minimum sample size of 300 identified at the design stage (Hair et al., 2019). The data collection was done using the structured questionnaire in 2026 (Sohail et al., 2022; Shafique et al., 2023; Mansoor et al., 2023; Hussain et al., 2025). The first part of questionnaire included respondent and farm characteristics like gender, age, education level, farm size, farming experience. The second part of questionnaire included multi-item scales for the agricultural extension support, digital agricultural information access, institutional trust, adaptive capacity, as well as livelihood resilience. For all these factors, the questionnaire relied on operationalization from literature and no single item measures developed from scratch. The agricultural extension support items included usefulness, responsiveness, problem-solving support, and relevance (Antwi-Agyei & Stringer, 2021). Agricultural information access items included access, timeliness, relevance, frequency, and usefulness based on the literature from Pakistan on the use of agricultural information (Khan et al., 2019; Yaseen et al., 2016). Thus, the operationalization of institutional trust included ability, benevolence & integrity (Grimmelikhuijsen & Knies, 2017).

The adaptive capacity items included learning, flexibility, resource mobilization, and adjustment (Abdul-Razak & Kruse, 2017; Smit & Wandel, 2006), while livelihood resilience items included maintaining, reorganizing, and recovering livelihoods under disturbance (Quandt, 2018; Speranza et al., 2014). All the attitudinal items were measured using a common Likert-type scale. Prior to conducting the fieldwork, the questionnaire wording was checked for contextual meaning, while the constructs used in original source were conceptually maintained in the process of adaptation. Missing values and other response errors were screened out from dataset prior to its analysis. Since the present research relies on self-reports, the cross-sectional design implies that data collection procedure is characterized by procedural consistency through use of standardized questionnaire order and neutral instructions. Data analysis in SmartPLS-4 was performed by means of partial least squares structural equation modeling (PLS-SEM) (Shafiya et al., 2022; Jawad et al., 2022; Sabir et

al., 2023; Khan et al., 2024; Adnan et al., 2026). The process of analyzing the model was divided into two stages.

In the first stage, the reflective measurement model was tested with respect to indicator loadings, Cronbach’s alpha, RHO_A, composite reliability (CR), and average variance extracted (AVE). The discriminant validity was tested with the help of heterotrait-monotrait ratio (HTMT) that is a much sensitive measure of discriminant validity compared to traditional cross-loading criteria (Henseler et al., 2015). In the second stage, structural model was assessed based on inner-model collinearity, standardized path coefficients, bootstrapped t-values as well as confidence intervals, coefficient of determination (R2), predictive relevance (Q2), specific indirect effects. Mediation was examined based on the size and significance of the bootstrapped indirect effects as well as on the significance of direct effects (Nitzl et al., 2016). Bootstrapping involved 5,000 resamples. The research adhered to established ethical standards for survey research. The participants took part voluntarily, they were informed about the aim of the research and the possibility of refusal from taking part or terminating participation, confidentiality of the answers was ensured. There were no personal identifiers in the analytical data set.

Table 1 Measurement Operationalization

Construct	Items	Published measurement basis
Agricultural Extension Support	5	Perceived usefulness, responsiveness, problem-solving support, timeliness & local relevance; adapted from published extension-service operationalization’s (Antwi & Stringer, 2021).
Digital Agricultural Information Access	5	The accessibility, timeliness, relevance, frequency, and practical usefulness of DFI; adapted from Pakistan agricultural-information studies (Khan et al., 2019; Yaseen et al., 2016).
Institutional Trust	9	Competence, benevolence, and integrity dimensions from the validated citizen-trust scale (Grimmelikhuijsen & Knies, 2017).
Adaptive Capacity	6	Learning, flexibility, mobilization, adjustment, response capability; adapted from smallholder adaptive-capacity research (Abdul & Kruse, 2017), adaptive-capacity theory (Smit & Wandel, 2006).
Livelihood Resilience	8	Perceived capacity to absorb, maintain, reorganize, learn & recover livelihood functioning; adapted from household livelihood-resilience frameworks (Quandt, 2018; Speranza et al., 2014).

RESULTS OF STUDY

Table 2 Demographic Profile of Respondents (n = 360).

Characteristic	Category	n	%
Gender	Male	252	70.0
	Female	108	30.0
Age	18-30	54	15.0
	31-40	104	28.9
	41-50	112	31.1
	51+	90	25.0

Education	No formal/primary	126	35.0
	Secondary	151	41.9
	College or above	83	23.1
Farm Size	<=5 acres	169	46.9
	6-15 acres	125	34.7
	>15 acres	66	18.3
Farming Experience	<10 years	88	24.4
	10-20 years	142	39.4
	>20 years	130	36.1

The results of study revealed that according to the characteristics of the respondents profiled, there was a higher number of males in the farming community (70.0%). The majority of the respondents aged between 41 and 50 years constituted the largest percentage (31.1%). In addition, most of the respondents did not have any formal education (combined 76.9%) and 46.9% farmed on five acres or below. In this linking, over three-quarters of respondents had more than ten years of experience in the farming.

Measurement Model

Measurement Model Evaluation was conducted prior to conducting the path analysis. The loading values for all retained indicators were greater than 0.70 and varied between 0.718 and 0.902. The Cronbach's alpha varied from 0.853 to 0.912, RHO_A from 0.859 to 0.918 and Composite reliability from 0.900 to 0.930. In this regard, all coefficients of reliability were therefore above 0.70 but less than 0.95. The average variance extracted varied between 0.599 and 0.707 and was above the threshold of 0.50.

Table 3 Reliability & Convergent Validity

Construct	LR	CA	RHO_A	CR	AVE
Agricultural Extension Support	0.742-0.884	0.861	0.868	0.906	0.707
Digital Information Access	0.731-0.891	0.853	0.859	0.900	0.693
Institutional Trust	0.718-0.886	0.912	0.918	0.930	0.599
Adaptive Capacity	0.756-0.902	0.884	0.889	0.915	0.683
Livelihood Resilience	0.724-0.893	0.901	0.907	0.923	0.632

The HTMT method was used to assess discriminant validity. Coefficients were between 0.51 and 0.79 and hence lower than strict cut-off of 0.85. This means that the agricultural extension support, DAI, institutional trust, adaptive capacity, and livelihood resilience were empirically distinct variables (Henseler et al., 2015).

Table 4 HTMT Discriminant-Validity Matrix

Construct	AES	DAI	IT	AC	LR
AES	~				
DAI	0.62	~			
IT	0.55	0.58	~		
AC	0.74	0.71	0.67	~	
LR	0.68	0.64	0.61	0.79	~

Structural Model

After confirming acceptable measurement quality, structural model assessment was performed. The inner model VIF values were found to be less than 3.0, meaning no serious problem of the collinearity exists. Bootstrapping of 5,000 resamples was performed to compute standard error values, t-values, p-values, and 95% confidence intervals. All seven hypotheses were confirmed. Access to DAI had greatest influence on adaptive capacity ($\beta = 0.331$, $t = 6.27$, $p < 0.001$), followed by agricultural extension support ($\beta = 0.286$, $t = 5.41$, $p < 0.001$) and institutional trust ($\beta = 0.244$, $t = 4.76$, $p < 0.001$). Adaptive capacity showed a direct, strong influence on livelihood resilience ($\beta = 0.442$, $t = 8.31$, $p < 0.001$).

Table 5 Structural Path Estimates

Hypothesis	Path	beta	T	P	95% CI	Decision
H1	AES -> AC	0.286	5.41	<0.001	[0.181, 0.388]	Supported
H2	DAI -> AC	0.331	6.27	<0.001	[0.226, 0.432]	Supported
H3	IT -> AC	0.244	4.76	<0.001	[0.143, 0.344]	Supported
H4	AC -> LR	0.442	8.31	<0.001	[0.339, 0.545]	Supported
H5	AES -> LR	0.151	2.89	0.004	[0.049, 0.252]	Supported
H6	DAI -> LR	0.118	2.25	0.025	[0.014, 0.220]	Supported
H7	IT -> LR	0.172	3.44	0.001	[0.075, 0.270]	Supported

The regression model accounted for 56.0% of the variation in the adaptive capacity ($R^2 = 0.560$; Adjusted $R^2 = 0.556$) and 63.0% of variation in livelihood resilience ($R^2 = 0.630$; Adjusted $R^2 = 0.625$). Positive Q² scores were obtained for both endogenous variables (Q² = 0.377 for adaptive capacity and Q²).

Table 6 Explanatory & Predictive Relevance of Endogenous Constructs

Endogenous Construct	R ²	Adjusted R ²	Q ²	Interpretation
Adaptive Capacity	0.560	0.556	0.377	Substantial
Livelihood Resilience	0.630	0.625	0.401	Substantial

Mediation Analysis

Specific indirect effects were estimated by applying bootstrapped confidence intervals. All three indirect effects proved to be positive and statistically significant. Influence of agricultural extension on livelihood resilience occurred indirectly through adaptive capacity ($\beta = 0.126$; $t = 4.42$; $p < 0.001$); the indirect effect for DAI access was $\beta = 0.146$ ($t = 5.09$; $p < 0.001$); and for institutional trust it was $\beta = 0.108$ ($t = 3.91$; $p < 0.001$). As respective direct effects (H5-H7) proved to be positive and significant, indicates complementary partial mediation (Nitzl et al., 2016). Thus, hypotheses H8-H10 were confirmed.

Table 7 Specific Indirect Effects & Mediation Results

Hypothesis	Indirect Path	Indirect Beta	t	p	95% CI	Mediation
H8	AES -> AC -> LR	0.126	4.42	<0.001	[0.074, 0.187]	Complementary Partial
H9	DAI -> AC -> LR	0.146	5.09	<0.001	[0.093, 0.200]	Complementary

	LR				0.205]	Partial
H10	IT -> AC -> LR	0.108	3.91	<0.001	[0.060, 0.166]	Complementary Partial

The highest indirect effect was related to digital access to agricultural information ($\beta = 0.146$). This finding further confirms mechanism described by the study, namely that agricultural information plays significant role in building resilience through increased learning, anticipation & adaptation. Similar was the case for agricultural extension services and institutional trust, thus indicating that adaptive capacity is the behavioral process through which various external resources enhance the livelihood resilience.

DISCUSSION

The results indicate that livelihood resilience among farmers depends on combination of resources that include institutional, information, and behavioral ones. Each antecedent positively impacted the adaptive capacity, and the adaptive capacity emerged to be the best predictor of the livelihood resilience. Consequently, the core mechanism of the research was proved: the value of the external resources does not lie in their availability, but in their ability to empower farmers to understand change, resource mobilization, and adjustment of their livelihood and farm strategies. The extension support showed significant effects on the adaptive capacity ($\beta = 0.286$) and livelihood resilience ($\beta = 0.151$). The results match the theory offered by [Antwi-Agyei and Stringer \(2021\)](#) according to which the role of extension in the process of adaptation is defined by provision of the relevant information to the farmers. In addition, the research proves the idea of [Asfaw et al. \(2016\)](#) about the role of the agricultural institutions and supply-side factors in the formation of adaptive capacity of the farmers. The mediation effect helps to better understand the mechanism: the extension services contributed to the increase in the level of resilience through the improvement of problem-solving skills of the farmers.

Digital access to agricultural information emerged as the most prominent antecedent of adaptive capacity ($\beta = 0.331$) and had the highest indirect impact on livelihood resilience ($\beta = 0.146$). The result is highly meaningful in view of increasing relevance of mobile devices and information in farmers' access to markets, advisory services, and knowledge about production ([Khan et al., 2019](#); [Yaseen et al., 2016](#)). It changes focus from digital access to actions enabled by farmers in response to information. The information can be timely and relevant and reduce uncertainty but its value to resilience lies in interpretation, learning and acting on it. Mediation proves that adaptive capacity is such mechanism of conversion. Institutional trust, too, proved be conducive to adaptive capacity ($\beta = 0.244$) and livelihood resilience ($\beta = 0.172$). This finding expands explanations of rural adaptation into the relational dimension. [Grimmelikhuijsen and Knies \(2017\)](#) use the concepts of competence, benevolence and integrity to define institutional trust, which, according to [Ahsan et al. \(2021\)](#), can be low and inhibit sustainability-based adaptation. Within this particular model, the institutional trust increases probability that farmers will regard formal information and programs as trustworthy resources.

Its indirect significance over adaptive capacity implies that trustworthy relations facilitate more than just engagement; they help farmers build necessary confidence to activate their resources and

act under uncertainty. The capacity to adapt had the strongest direct impact on the resilience of livelihoods ($\beta = 0.442$), validating the distinction between the resource and the ability to use the resource. These findings are in line with perspective of livelihood resilience as presented by Quandt (2018) and the model of learning, self-organization and buffer capacity developed by Speranza et al. (2014). It also involves knowledge, the social relationships, institutional access, decision-making capabilities, flexibility, innovation, and ability to mobilize available resources at appropriate time. The findings further match rural literature, which shows a strong association between the capacity for resilience and capacity of households to reorganize their livelihood strategies (Liu et al., 2020). The explanatory value of the model is impressive for a social science study at the farmer level: the antecedents explained 56% of the adaptive capacity, while the whole model explained 63% of the livelihood resilience.

CONCLUSION

The current study investigated the impact of agricultural extension support, access to the digital agricultural information and institutional trust on livelihood resilience for 360 farmers in Sargodha Division, Punjab, Pakistan. All the antecedents were found to positively affect adaptive capacity and were found to have direct and significant effects upon the livelihood resilience. The strongest predictor of livelihood resilience was adaptive capacity, which significantly mediated relationship between all the antecedents and livelihood resilience. Access to digital agricultural information had the highest effect on adaptive capacity and the highest indirect effect on livelihood resilience. In this linking, the present study, therefore, suggests that rural support systems will be most effective if farmers can turn information, extension linkages, and institutional trust into learning, adjustment and resource mobilization. Consequently, resilience policy makers need not only to look at what is available to farmers in terms of services and information, nevertheless how they affect the farmers' adaptive capacity.

Theoretical Implications

The findings are significant for studies upon the rural resilience for the following reasons. First, they incorporate all three factors: agricultural extension services, digital agricultural information access, and institutional trust into same farmer-level model, making it possible to compare their respective roles. Second, the study distinguishes adaptive capacity from livelihood resilience and empirically shows that adaptive capacity works as a mechanism and not as a synonym for resilience. Third, the study introduces institutional trust into the resilience chain as an external factor and shows that the external resources become more behaviorally valuable if the actors who provide them are trusted in particular context.

Practical Implications

In terms of the practice of rural development, the most important implication is that the impact of any investments in digital or extension resources should be assessed in terms of their influence on farmers' decision-making capability. In this linking, digital systems should offer information which is localized and actionable instead of large amounts of generic information. The extension service should act as a system of problem solving and interpreting information to enable farmers to make decisions on their farms. On institutional front, consistency in service delivery and communication

becomes critical since it influences whether farmers are willing to depend on formal information as well as programs.

Limitations & Future Research

Some of the limitations of this research include the following. The study is based on a cross-sectional design, that is less effective in determining causation as compared to longitudinal or experimental one. Moreover, the self-reports are also prone to the common method and social desirability bias, as findings may not necessarily be generalized to areas of agriculture that operate under different ecosystems or institutions. Future studies should use panel data before and after climate or market shocks, compare provinces, extension systems, look for differences amid different farm sizes, genders, & digital readiness, triangulate farmer views with objective measures of service utilization, platform engagement or livelihoods.

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