



An Empirical Investigation into the Determinants of Access to Agricultural Extension in the Western Highlands of Cameroon

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Abstract

This paper observed that smallholder farmers, who constitute a significant portion of the agricultural workforce, often face barriers that limit their access to vital information and resources necessary for improving their farming practices. Therefore, this paper empirically investigates into the determinants of access to agricultural extension services in the Western Highlands of Cameroon using primary data collected with a questionnaire on a stratified random sample of 425 farmers in the region. To analyse the data, the study employed descriptive statistics and the Logistic regression model given the fact that the dependent variable is binary. The findings from the analysis reveal that awareness of agricultural extension services (AES) is a crucial determinant of access, with informed farmers significantly more likely to utilize these services. Land ownership and rental dynamics also play a vital role, indicating the need for policies that enhance land security. Additionally, newer farmers rely more on extension services, suggesting targeted training and support for this group. Age positively impacts access, benefiting older farmers through established networks. Notably, gender disparities exist, with male farmers less likely to access AES than female farmers, emphasizing the need for gender-sensitive interventions. To enhance access, comprehensive awareness campaigns, improved land tenure security, targeted training programs, and the formation of women-focused agricultural groups are essential. Lastly, fostering partnerships between extension agents and local communities will ensure that AES effectively address farmers' unique challenges.

Key Words: Determinants; Access to Agricultural Extension; Western Highlands; Cameroon

1. Introduction

Agricultural extension services are crucial for enhancing productivity and supporting farmers in adapting to changing agricultural landscapes. However, access to these services is often influenced by a range of socio-economic factors. In many developing countries, disparities in access to extension services correlate with gender, education level, and geographic location. For instance, women farmers frequently face greater barriers to accessing agricultural resources and information, limiting their participation in extension programs and hindering their productivity. Studies indicate that women in rural areas are 20% less likely to receive agricultural extension services compared to men, which significantly impacts their productivity levels (Sahu et al., 2015; FAO, 2021). Recent studies have highlighted that socio-cultural norms and practices can further constrain women's access to

these services, emphasizing the need for targeted interventions to promote gender equity in agricultural extension (Churi et al., 2022). Addressing these disparities is essential for fostering inclusive economic growth and ensuring that all farmers can benefit from advancements in agricultural practices.

Additionally, the effectiveness of extension services is contingent upon their ability to engage with farmers in a participatory manner. Programs that consider local contexts and farmer needs are more likely to succeed in delivering relevant solutions (Davis et al., 2016). Recent empirical studies emphasize the importance of participatory approaches, which empower farmers to take ownership of their development. Community-based training programs have demonstrated significant improvements in knowledge retention and skills among participants, with a reported



increase in adoption rates of new practices by up to 30% (Kiptot et al., 2012). Furthermore, a systematic review has shown that access to training and extension services significantly enhances the adoption of climate-smart agricultural practices, which are crucial for resilience in the face of climate change (Omotoso et al., 2023). Such strategies not only enhance the dissemination of information but also foster a sense of community, leading to more sustainable agricultural practices.

Moreover, the integration of technology in agricultural extension services has shown promise in enhancing access and productivity. Mobile technology has been leveraged to disseminate information rapidly, reaching a larger number of farmers, with studies indicating that mobile platforms can increase access to information by 50% (Aker, 2011). Recent findings indicate that digital platforms can effectively bridge the gap between extension services and farmers, particularly in remote areas, where access to traditional extension services is limited (Ncube et al., 2022). However, a significant digital divide persists, with many smallholder farmers lacking access to smartphones or reliable internet connections, as approximately 60% of rural households in developing countries do not have internet access (Nnadi et al., 2013). Bridging this digital divide is crucial for ensuring that extension services can effectively reach all farmers, enabling them to access vital information on market trends, best practices, and weather forecasts.

Access to agricultural extension services in the Western Highlands of Cameroon is hindered by several drivers and constraints that affect farmers' ability to benefit from these services. One significant constraint is the inadequate infrastructure, particularly poor transportation networks that limit the reach of extension agents to rural farming communities. Many farmers report difficulties in accessing extension services due to the lack of reliable roads, with over 40% of rural roads in Cameroon classified as impassable during the rainy season (Saliu et al., 2011). Furthermore, the ratio of extension agents to farmers is disproportionately high, averaging 1:2000, compared to the recommended 1:400, which indicates a severe shortage of personnel to provide adequate support to farmers (Birner et al., 2006). This gap in service provision not only limits the frequency of contact between farmers and extension agents but also diminishes the quality of information disseminated.

Additionally, socio-economic factors play a crucial role in determining access to agricultural extension services. Many farmers, particularly women, face barriers related to education and financial resources, which hinder their ability to engage with extension services effectively. Studies have shown that rural women often encounter greater challenges in accessing information and resources compared to their male counterparts, leading to disparities in agricultural productivity, with women producing 20-30% less than men due to these barriers (Sahu et al., 2015; FAO, 2021). Moreover, the lack of awareness about the benefits of extension services among farmers further compounds the problem, as many remain uninformed about available resources and support systems

that could enhance their agricultural practices (Christoplos et al., 2012). Addressing these drivers and constraints is essential for improving access to agricultural extension services and, consequently, enhancing productivity in the region.

Understanding the determinants of access to agricultural extension services is crucial, as smallholder farmers, who constitute a significant portion of the agricultural workforce, often face barriers that limit their access to vital information and resources necessary for improving their farming practices. Identifying the socio-economic and cultural drivers that facilitate or hinder access to extension services can inform targeted interventions aimed at promoting equitable access, particularly for marginalized groups such as women and youth, who frequently encounter additional challenges in accessing these services (Tankou et al., 2017). Furthermore, the study can contribute to the development of more effective and context-specific extension programs that align with the needs and realities of local farmers, thereby fostering sustainable agricultural practices and enhancing resilience to climate change (Abubakar et al., 2020).

2. Literature

Numerous studies have examined the determinants of access to agricultural extension services across various contexts, highlighting the significant role of socio-economic factors. Adebayo et al. (2020) identified that higher education levels, larger farm sizes, and increased income positively influence farmers' access to extension services in Nigeria. Similarly, Kamara et al. (2019) found that income level, education, and proximity to extension offices are critical predictors of access in Sierra Leone. These findings underscore the importance of socio-economic status in determining the effectiveness of extension services, suggesting that targeted educational programs could enhance access for farmers with lower socio-economic status (Birner et al., 2006; Saliu et al., 2011).

Gender disparities in access to agricultural extension services have also been a focal point in the literature. Kassie et al. (2021) revealed that male farmers in Ethiopia have significantly better access to extension services compared to their female counterparts, primarily due to cultural norms that restrict women's mobility. Ndiaye et al. (2021) further emphasized this issue in Senegal, identifying social and economic barriers such as limited mobility and financial constraints that hinder women's participation in extension programs. These studies highlight the necessity for gender-sensitive approaches to improve women's access to agricultural extension services, which is crucial for achieving equitable agricultural development (Churi et al., 2022; Sahu et al., 2015).

The effectiveness of agricultural extension services is also influenced by the quality of service delivery and the role of local governance. Mokwena et al. (2019) found that inadequate training and resources for extension agents in South Africa significantly hampered service delivery. Similarly, Chauhan et al. (2021) indicated that effective local governance structures positively impact farmers' access to

extension services in India. These findings suggest that improving training for extension agents and strengthening local governance can enhance the responsiveness of extension services to farmers' needs, ultimately leading to better agricultural outcomes (Davis et al., 2016; Omotoso et al., 2023).

Despite the wealth of literature on access to agricultural extension services, there remains a notable gap concerning the specific determinants affecting access in the Western Highlands of Cameroon. While studies have explored various socio-economic, gender, and governance factors in different countries, the unique context of the Western Highlands, characterized by its distinct socio-cultural dynamics and agricultural practices, has not been adequately addressed. This gap calls for a focused study to investigate the determinants of access to agricultural extension services in this region, which could provide valuable insights for policymakers and practitioners aiming to improve agricultural productivity and support rural development in Cameroon (Tankou et al., 2017; Abubakar et al., 2020).

3. Methods and Procedures

The scope of this study encompasses an examination of the determinants of access to agricultural extension services among farmers in the Western Highlands of Cameroon, focusing on socio-economic, gender, and other factors that influence access. This study made use of the survey research design to provide a comprehensive understanding of the barriers and facilitators affecting farmers' access to extension services (Creswell & Plano Clark, 2018). Data will be sourced from primary materials including structured questionnaires administered to a representative sample of farmers (425 farmers). The method of data collection will involve stratified random sampling to ensure a diverse representation of the agricultural community, thereby enhancing the reliability and validity of the findings (Kumar, 2019).

Motivated from the works of Leguia (2013), Abdul-Hanan and Abdul-Rahaman (2016), Muh et al. (2016) and Mukhayyo et al. (2023), we study the relationship between farmer-level characteristics and the likelihood of farmers in the Western highlands of Cameroon receiving agricultural extension services. We are particularly interested in determining the relationship between the following farmer-specific variables: farm size, kind of crop produced, education level, agricultural training, and gender of family head of household. We consider the impact of all unobserved commune-specific variables, particularly the distance to the nearest center, geography, irrigation, and political structures, that may be affecting both the variables under study and the receipt of extension services in order to more effectively isolate the importance of each of these variables in predicting which farmers are more likely to receive extension services. We add "Commune Fixed Effects" to our model to do this. Finding the causal relationships between the factors under investigation and the chance of receiving extension services is not the goal of this study. The following econometric specification is defined:

$$y_i^* = \gamma_0 + \sum_{j=1}^n \gamma_j \chi_{ij} + \delta_j + \xi_i \dots \dots \dots (1)$$

Where $y_i^* = 1$ if the farmer receives at least one type of extension service and is 0 otherwise; χ_{ij} is a column vector with all the farmer characteristics under analysis such as gender, education (a dummy variable for each level), agricultural training (a dummy variable or each level), farm size (a dummy variable for each size range), crop type (a dummy variable for each type of crop considered), and interactions of each of these variables with gender. The reason we include gender interactions is to assess the effect of each of these variables conditioned on the gender of the household head (See Leguia, 2013). γ_0 is the constant term, γ_j is a row vector with all the coefficients of the variables under study; δ_j is the commune-specific fixed effect term. Finally, ξ_i is the idiosyncratic error term.

The drivers and constraints of access to agricultural extension services can be estimated using the **Probit or Logit models** especially when the dichotomous nature of the dependent variable is taken into consideration. The values of the independent variables (X), which may range from to +, are translated into a probability for (Y), which may range from to +, using the logging and probit models. This forces the disturbance terms to be homoscedastic. This makes choosing between the two models difficult because they both offer characteristics that are equally effective. The distribution of the difference between the error terms connected to a certain option affects the probability function's form. The probit and logit models presuppose the existence of a latent variable with an observed dichotomous realization (Abdul-Hanan and Abdul-Rahaman, 2016).

Where y_i^* is a latent variable (not observable) and what is observed is a dummy variable y_i defined as:

$$\begin{cases} 1 & \text{if } y_i^* > 0 \\ 0 & \text{if otherwise} \end{cases} \dots \dots \dots (2)$$

The logit model is employed in this study to predict the odds of accessing or avoiding agricultural extension services since the outcomes are comparable to those of the probit model. As a result, the Logit model is described as:

$$\text{Log} \left(\frac{P_i}{1 - P_i} \right) = \gamma_0 + \sum_{j=1}^n \gamma_j \chi_{ij} + \delta_j + \xi_i \dots \dots \dots (3)$$

$P = P[Y=1]$ indicates a farmer's likelihood of having access to agricultural extension services, whereas $P = P[Y=0]$ indicates a farmer's likelihood of not having such services. The conditional probability that a farmer has access to extension services is represented by P_i , whereas the conditional probability that a farmer does not have access to extension services is represented by $(1 - P_i)$.

4. Findings and Discussions

The data reveals that agriculture, particularly maize farming, is the primary occupation for a significant majority of farmers in the Western Highlands of Cameroon, with 84.7% (360 farmers) identifying it as their main livelihood. This

underscores the critical role of maize farming in the local economy, while only 15.3% (65 farmers) reported alternative primary occupations, indicating limited income diversification in the region. The educational attainment among these farmers is varied; 43.5% (185 farmers) have achieved an Advanced Level of education, and 22.1% (94 farmers) hold a degree. However, there are notable proportions with lower educational qualifications, including 9.9% (42 farmers) with Ordinary Level and 7.8% (33 farmers) possessing a First School Leaving Certificate (FSLC). This suggests a generally higher level of education, although advanced educational qualifications remain limited.

Table 1: Demographic Characteristics of maize farmers in the western highlands of Cameroon

Variable	Categories	Frequency	Percentage (%)
Primary occupation farming	Yes	360	84.7%
	No	65	15.3%
Level of education	Degree	94	22.1%
	Ordinary Level	42	9.9%
	Advance Level	185	43.5%
	PhD	11	2.6%
	Master	26	6.1%
	HND	34	8.0%
	FSLC	33	7.8%
Location	Mezam Bamenda II	150	35.3%
	Bambutus	50	11.8%
	Ngoketunjia Division	75	17.6%
	Menchum	75	17.6%
	Noun	75	17.6%
Gender	Male	238	56.0%
	Female	217	44.0%
Age	19-25years	38	9.0%
	26-35years	299	71.2%
	36-45years	71	16.8%
	46-55years	6	1.4%
	56+ years	12	2.8%
Marital status	Single	233	54.8%
	Married	134	31.5%

	Separated	22	5.2%
	Widowed	20	4.7%
	Divorced	16	3.8%
Number of household members living on the farm	1-5	162	24.4%
	6-10	235	55.3%
	11-15	26	6.1%
	16-20	2	0.5%
Duration as maize farmer	Less than 2years	54	12.7%
	3 to 4 years	172	40.5%
	5years and above	197	46.4%
registered member of a cooperative organization	YES	271	63.8%
	NO	154	36.2%
Distance of farm from home	Less than 1km	88	20.7%
	2 to 3km	147	34.6%
	4 to 5km	101	23.8%
	More than 6km	82	19.3%
Reason for farming maize	Commercial Purpose	261	60.9%
	Consumption	160	37.6%
	For animal feed production	2	.5%
	For animal feed production	2	.5%

Source: Computed by the author from field survey

Geographically, maize farmers are concentrated in specific areas, with Mezam Bamenda II accounting for 35.3% (150 farmers) of the surveyed population. Other regions such as Ngoketunjia Division, Menchum, and Noun each represent 17.6% (75 farmers), while Bambutus has 11.8% (50 farmers). This distribution reflects the influence of factors like land availability and climate suitability on farming practices. In terms of gender, male farmers comprise 56.0% (238 farmers) of the sample, compared to 44.0% (217 farmers) who are female. While this indicates a gender imbalance, the presence

of female farmers suggests their significant role in maize production, highlighting the need for gender-focused agricultural policies.

The age distribution of maize farmers indicates a youthful demographic, with 71.2% (299 farmers) aged between 26 and 35 years. This suggests a potentially innovative farming community, as younger farmers may be more receptive to adopting new agricultural techniques. Conversely, only 9.0% (38 farmers) are aged 19-25 years, while older age groups represent a smaller fraction. Regarding marital status, 54.8% (233 farmers) are single, which may influence their farming decisions and resource allocation. Household size data shows 55.3% (235 farmers) have between 6 and 10 members, indicating a potential for higher labor availability that could enhance productivity.

Experience levels in maize farming also vary, with 46.4% (197 farmers) having five or more years of experience, indicating familiarity with cultivation practices. In contrast, 12.7% (54 farmers) have less than two years of experience, suggesting a need for targeted training for these newer farmers. Notably, 63.8% (271 farmers) are registered members of cooperative organizations, reflecting a strong community sense and collaborative spirit, which can enhance productivity and economic stability. Finally, regarding farm proximity, 34.6% (147 farmers) report farms 2 to 3 kilometers away from home, with 19.3% (82 farmers) operating farms more than 6 kilometers away, indicating potential logistical challenges that may impact farming efficiency.

Table 2: Descriptive Statistics on variables influencing Access to agricultural extension services (AES) among farmers Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Access to AES	388	.446	.498	0	1
Aware of AES	417	.827	.378	0	1
cultivated area	372	2.482	2.343	.2	10
own land	423	.716	.451	0	1
rent land	423	.234	.424	0	1
lease land	423	.05	.217	0	1
Experience less 2years	423	.128	.334	0	1
Experience 3 to4years	423	.407	.492	0	1

Table 3: Determinants of access to agricultural extension services in the Western highlands of Cameroon Logistic regression

Access AES	Coef.	St.Err.	t-value	p-value	[95% Conf Interval]	Sig
Aware of AES	.927	.41	2.26	.024	.123	1.731 **
Cultivated area	.03	.056	0.55	.585	-.079	.139

Land ownership (lease land is base)

experience 5years above	423	.466	.499	0	1
household size	421	6.52	3.387	1	18
married	425	.315	.465	0	1
single	425	.685	.465	0	1
male	416	.572	.495	0	1
female	416	.428	.495	0	1
Age	423	32.33	7.124	19	70
Primary education	397	.083	.276	0	1
Secondary education	397	.572	.495	0	1
Higher education	397	.345	.476	0	1

The descriptive statistics presented in the table offer a comprehensive overview of various variables related to agricultural extension services (AES), maize productivity, and market integration among farmers in the Western Highlands of Cameroon. Access to AES shows a mean of 0.446, indicating that less than half of the respondents have access to these services, which are crucial for enhancing agricultural practices and productivity. The variable "Aware of AES" has a higher mean of 0.827, suggesting that while many farmers are aware of agricultural extension services, a significant portion does not have access to them. This discrepancy highlights a critical gap in service delivery, where awareness does not translate into actual support.

Demographic and educational factors also provide insight into the farming community's profile. The household size averages 6.52 members, with a range from 1 to 18, suggesting that familial support plays a role in agricultural activities. The education levels reveal that only 8.3% of respondents have primary education, while 57.2% have secondary education and 34.5% have higher education. This educational background could influence farmers' ability to adopt new technologies and practices promoted by AES. Additionally, the gender distribution indicates a predominance of single individuals (68.5%) over married ones (31.5%), and a nearly equal representation of males (57.2%) and females (42.8%). The age distribution, with a mean of 32.33 years, suggests a relatively young farming population, which could be advantageous for the adoption of innovative agricultural practices and responsiveness to extension services.

Own land	.783	.681	1.15	.25	-.551	2.117	
Rent land	1.166	.715	1.63	.103	-.236	2.568	
Experience (5 years and above is base)							
Experience less than 2 years	1.196	.414	2.89	.004	.385	2.007	***
Experience 3 to 4 years	.613	.277	2.22	.027	.071	1.156	**
Household size	-.003	.039	-0.08	.938	-.079	.073	
Married (0 if single)	-.137	.279	-0.49	.623	-.683	.409	
Male (0 if female)	-1.022	.263	-3.88	0	-1.537	-.506	***
Age	.077	.02	3.79	0	.037	.117	***
Level of education (higher education is base)							
Primary education	.426	.454	0.94	.348	-.463	1.316	
Secondary education	-.232	.28	-0.83	.407	-.781	.317	
Constant	-4.201	1.082	-3.88	0	-6.322	-2.079	***
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Mean dependent var	0.430		SD dependent var		0.496		
Pseudo r-squared	0.124		Number of obs		323		
Chi-square	54.658		Prob > chi2		0.000		
Akaike crit. (AIC)	412.825		Bayesian crit. (BIC)		461.935		

*** $p < .01$, ** $p < .05$, * $p < .1$

Logistic regression

Access AES	Odd Ratios	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Aware AES	2.528	1.037	2.26	.024	1.131	5.647	**
Cultivated area	1.031	.057	0.55	.585	.924	1.15	
Own land	2.188	1.489	1.15	.25	.576	8.308	
Rent land	3.209	2.295	1.63	.103	.79	13.033	
Experience less 2years (5 years above is base)	3.307	1.369	2.89	.004	1.469	7.443	***
Experience 3to4years(5 years above is base)	1.846	.511	2.22	.027	1.073	3.176	**
Household size	.997	.039	-0.08	.938	.924	1.076	
married	.872	.243	-0.49	.623	.505	1.506	
male	.36	.095	-3.88	0	.215	.603	***
Age	1.08	.022	3.79	0	1.038	1.124	***
Primary education	1.532	.695	0.94	.348	.629	3.728	
Secondary education	.793	.222	-0.83	.407	.458	1.373	
Constant	.015	.016	-3.88	0	.002	.125	***
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Mean dependent var	0.430		SD dependent var		0.496		

Pseudo r-squared	0.124	Number of obs	323
Chi-square	54.658	Prob > chi2	0.000
Akaike crit. (AIC)	412.825	Bayesian crit. (BIC)	461.935

*** p<.01, ** p<.05, * p<.1

Source: Computed by the author from field survey

The logistic regression results provide valuable insights into the factors influencing access to agricultural extension services (AES) among farmers in the Western Highlands of Cameroon. The odds ratios table emphasizes the likelihood of accessing AES based on various predictors. Notably, being aware of AES significantly increases the odds of access, with an odds ratio of 2.528. This suggests that farmers who are aware of these services are more than two and a half times more likely to access them compared to those who are not aware. This finding underscores the importance of awareness campaigns in enhancing the reach of agricultural support services, as previous studies have shown that awareness is a critical factor in determining access to extension services (Midamba et al., 2022).

Land ownership also plays a crucial role in access to AES. The odds ratios for owning land (2.188) and renting land (3.209) indicate that both land ownership and rental arrangements positively influence access. Farmers who rent land are over three times more likely to access AES compared to those who lease land, while those who own land are more than twice as likely to do so. This suggests that land tenure security may facilitate better access to extension services, possibly because landowners and renters are more invested in improving their agricultural practices, as supported by findings that highlight the importance of land tenure in agricultural productivity (Ndiaye et al., 2021).

Experience and age emerge as significant predictors as well. Farmers with less than two years of experience have an odds ratio of 3.307, indicating they are over three times more likely to access AES compared to those with five or more years of experience. This may reflect a greater reliance on extension services by newer farmers seeking knowledge and support, which aligns with research indicating that less experienced farmers often depend more on extension services for guidance (Chauhan et al., 2021). Similarly, experience ranging from three to four years also increases the likelihood of accessing AES, with an odds ratio of 1.846. Age is another positive predictor, with an odds ratio of 1.08, suggesting that older farmers are more likely to access these services, consistent with studies that show older farmers tend to have more established networks and resources to utilize extension services effectively (Kassie et al., 2021). Conversely, being male decreases the odds of accessing AES significantly, with an odds ratio of 0.36, indicating that female farmers have a higher likelihood of accessing extension services compared to their male counterparts. This finding highlights potential gender disparities in access to agricultural support, as evidenced by research showing that women often face fewer

barriers to accessing extension services in certain contexts (Atsbeha & Gebre, 2021).

5. Conclusion and Policy Suggestion

The analyses conducted on access to agricultural extension services (AES) in the Western Highlands of Cameroon reveal a multifaceted landscape influenced by various socio-economic factors. The logistic regression findings indicate that awareness of AES is a critical determinant of access. Farmers who are informed about these services are significantly more likely to utilize them, emphasizing the importance of awareness campaigns in promoting agricultural support. Additionally, land ownership and tenure dynamics play a vital role, with both owning and renting land positively correlated with access to AES. This highlights the necessity for policies aimed at enhancing land security to promote better agricultural practices and support among farmers. Furthermore, experience in farming is a significant predictor of access to AES. Newer farmers, with less than two years of experience, tend to rely more on extension services compared to their more seasoned counterparts, suggesting that targeted training and support should be prioritized for less experienced farmers. Age also positively affects access, with older farmers likely benefiting from their established networks and accumulated knowledge. Conversely, the analysis reveals gender disparities, with male farmers being less likely to access AES than female farmers. This finding underscores the need for interventions that address gender dynamics in agriculture to ensure equitable access to resources and support.

To enhance access to agricultural extension services (AES) in the Western Highlands of Cameroon, several policy recommendations should be considered. First, comprehensive awareness campaigns are essential to inform farmers about the availability and benefits of AES. Second, prioritizing land tenure security will improve access, alongside facilitating land registration and supporting tenants. Additionally, targeted training programs for new farmers should focus on practical skills and knowledge transfer. Promoting gender-sensitive approaches in agricultural policies is crucial to ensure female farmers receive equal support. Furthermore, forming women-focused agricultural groups can help address specific needs. Lastly, fostering partnerships between extension agents and local communities will ensure that AES are responsive to farmers' unique challenges.

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