

Examining the Challenges and Opportunities for Farmers in Accessing Farm Equipment Leases from Agricultural and Leasing Companies in Mumbwa District, Zambia

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Abstract: *Agricultural mechanization plays a critical role in improving productivity, reducing labor burdens, and strengthening food security in sub-Saharan Africa. In Zambia, smallholder farmers dominate agricultural production but face limited access to farm equipment due to high costs and structural market barriers. This study investigated the challenges and opportunities associated with accessing farm equipment leases from agricultural and leasing companies in Mumbwa District. A mixed-methods approach was used, combining survey data from 100 farmers with key informant interviews and focus group discussions. Findings indicate that although 60% of farmers were aware of leasing as a financing option, only 29% had accessed a lease. Major barriers included high leasing costs ($M = 4.20$), collateral requirements ($M = 3.95$), and bureaucratic procedures ($M = 3.60$). Logistic regression results showed that awareness, education, income, and institutional support significantly increased the likelihood of lease access, while financial constraints reduced it. The interaction between income and institutional support revealed that higher-income farmers benefited more, raising concerns about equity. Qualitative findings further highlighted distrust in leasing systems, policy inconsistencies, and limited extension services.*

Keywords: agricultural leasing, farm mechanization, access to finance, institutional support, smallholder farmers

INTRODUCTION

Agriculture is a key driver of economic development in Zambia, providing employment, income, and food security, particularly for smallholder farmers. However, productivity remains low due to reliance on traditional farming practices, limited access to modern technologies, and weak infrastructure (Dube, 2019; Njuki & Sanginga, 2017). Agricultural mechanization has the potential to improve efficiency, increase yields, and expand cultivation, but many farmers cannot afford the high costs of

purchasing equipment or meet the strict requirements of formal credit systems (Feldman & Ghee, 2016; Thompson et al., 2020).

Agricultural equipment leasing has emerged as an alternative that allows farmers to access machinery without large upfront investments by spreading payments over time (Ochieng, 2018; Macheka et al., 2021). Despite its potential benefits, access to leasing services remains influenced by factors such as financial literacy, awareness, collateral requirements, and institutional frameworks, as well as socio-cultural attitudes toward ownership (Feldman & Ghee, 2016; Njuki & Sanginga, 2017; Thompson et al., 2020).

This study therefore explores the challenges and opportunities associated with accessing farm equipment leasing in Mumbwa District, Zambia, in order to better understand the financial, institutional, and socio-economic factors influencing its adoption and potential to support agricultural productivity and rural development.

METHODOLOGY

This study adopted a rigorous empirical framework to examine the determinants, barriers, and inclusivity dynamics influencing access to agricultural equipment leasing among smallholder farmers in Mumbwa District, Zambia. Methodologically, the study was anchored in a pragmatic paradigm, integrating quantitative and qualitative techniques to generate both statistical rigor and contextual depth. Mixed-method approaches are widely recommended in rural development and agricultural finance studies because they allow triangulation of findings and enhance the validity of conclusions (Creswell & Creswell, 2018; Bryman, 2016). The methodology was designed to (i) measure the extent of leasing uptake, (ii) identify socio-economic and institutional determinants of access, and (iii) examine equity implications across income groups, gender, and youth categories. Quantitative data enabled econometric estimation of access determinants, while qualitative insights provided contextual explanations for observed statistical patterns (Kothari, 2014).

Research Approach

The study employed a **cross-sectional mixed-methods research design**. A cross-sectional design was appropriate because it allowed the collection of data from respondents at a single point in time to assess prevailing leasing conditions and access determinants (Saunders et al., 2019). The quantitative strand relied primarily on structured surveys administered to smallholder farmers. Logistic regression modeling was employed to estimate the probability of accessing leasing services as a function of awareness, income, education, institutional support, and financial barriers. Logistic regression is widely applied in access-to-finance and agricultural adoption studies because it is suitable for binary outcome variables (access vs. no access) (Gujarati & Porter, 2009; Wooldridge, 2016). The qualitative strand consisted of key informant interviews and focus group discussions, designed to deepen understanding through narratives of bureaucratic processes, institutional arrangements, and perceived inclusivity constraints (Yin, 2018; Hambulo & Mukalula-Kalumbi, 2017).

Participants and Sampling

The study population comprised smallholder farmers in Mumbwa District actively engaged in crop production during the 2024/2025 agricultural season. Mumbwa District was selected due to its significant agricultural activity and growing exposure to mechanization initiatives. Smallholder farmers were defined as those cultivating less than 5 hectares of land, consistent with national agricultural classifications (GRZ, 2022). The population also included selected institutional

stakeholders such as agricultural extension officers, leasing service providers, and district-level agricultural officials.

Sample Size

A sample of 100 smallholder farmers was drawn for the quantitative survey. The sample size was determined using Yamane's (1967) simplified formula for finite populations:

$$n = \frac{N}{1 + N(e)^2} \quad n = \frac{1}{1 + N(e)^2} \cdot N$$

Where:

- n = sample size
- N = population size
- e = level of precision (5%)

This approach ensures statistical reliability while maintaining feasibility in rural field research (Israel, 2013). Additionally, 10 key informants were purposively selected for qualitative interviews to ensure institutional representation.

Sampling Techniques

A **multi-stage sampling technique** was employed. First, agricultural camps within Mumbwa District were purposively selected based on farming intensity. Second, systematic random sampling was used to select farmers from camp registers to ensure representativeness (Kothari, 2014). Key informants were selected using purposive sampling to capture institutional perspectives, consistent with qualitative research standards (Creswell & Creswell, 2018).

Data Collection Process

The data collection process was conducted systematically to ensure reliability, validity, and ethical compliance. Prior to fieldwork, the research instruments—including the structured questionnaire, key informant interview guide, and focus group discussion protocol—were pre-tested in a neighboring agricultural camp with similar socio-economic characteristics to those of the study area. Pre-testing was undertaken to refine question clarity, eliminate ambiguity, and improve internal consistency, as recommended in survey research methodology (Creswell & Creswell, 2018; DeVellis, 2017). Feedback from the pilot exercise informed minor revisions to wording, sequencing, and response scaling.

Following instrument validation, formal authorization was obtained from district agricultural authorities and local camp leaders in Mumbwa District. Ethical considerations were strictly observed throughout the study. Participants were informed about the purpose of the research, assured of confidentiality and anonymity, and provided voluntary informed consent prior to participation. The study adhered to established ethical principles of social science research, including respect for persons, beneficence, and confidentiality (Bryman, 2016).

Quantitative data were collected through face-to-face administration of structured questionnaires to 100 smallholder farmers. Face-to-face interviews were preferred due to varying literacy levels among respondents and to enhance response accuracy through clarification where necessary (Kothari, 2014). The questionnaires captured demographic characteristics, awareness of agricultural equipment leasing, income levels, institutional support access, financial barriers, and leasing uptake status. Each interview lasted approximately 30–45 minutes.

In addition to the survey, qualitative data were gathered through semi-structured key informant interviews and focus group discussions. Key informants—including agricultural extension officers and representatives of leasing service providers—were interviewed to obtain institutional and policy perspectives on leasing operations, collateral requirements, and bureaucratic procedures. These interviews typically lasted between 45 and 60 minutes and were audio-recorded with consent to ensure accuracy of transcription.

Focus group discussions were conducted with selected farmers to explore shared experiences regarding access challenges and perceived inclusivity gaps, particularly among women and youth farmers. Each focus group comprised 6–8 participants to facilitate balanced participation and in-depth dialogue (Yin, 2018). Notes were taken alongside audio recordings to capture non-verbal cues and contextual observations.

Data collection was conducted over a four-week period during the 2024/2025 agricultural season to ensure responses reflected current leasing experiences. Upon completion of fieldwork, quantitative responses were coded and entered into statistical software for analysis, while qualitative recordings were transcribed verbatim for thematic analysis. This structured and ethically grounded process ensured data integrity and enhanced the credibility of the study findings.

Data Analysis Techniques

Quantitative data were analyzed using descriptive statistics and logistic regression modeling. Descriptive statistics summarized awareness levels, leasing uptake, and constraint rankings (Field, 2018). Logistic regression estimated the likelihood of leasing access:

$$\begin{aligned} \text{Logit}(P) &= \beta_0 + \beta_1 \text{Awareness} + \beta_2 \text{Education} + \beta_3 \text{Income} + \beta_4 \text{InstitutionalSupport} \\ &\quad + \beta_5 \text{FinancialBarriers} + \epsilon \\ &= \beta_0 + \beta_1 \text{Awareness} + \beta_2 \text{Education} + \beta_3 \text{Income} \\ &\quad + \beta_4 \text{InstitutionalSupport} + \beta_5 \text{FinancialBarriers} \\ &\quad + \epsilon \\ &= \beta_0 + \beta_1 \text{Awareness} + \beta_2 \text{Education} + \beta_3 \text{Income} + \beta_4 \text{InstitutionalSupport} \\ &\quad + \beta_5 \text{FinancialBarriers} + \epsilon \end{aligned}$$

Odds ratios were interpreted to determine the strength and direction of relationships (Wooldridge, 2016). Qualitative data were analyzed using thematic analysis to identify recurring institutional and equity themes (Braun & Clarke, 2006).

RESULTS

This subsection presents the characteristics of the surveyed respondents (farmers), their awareness and uptake of equipment leasing, and descriptive summaries of perceived barriers and institutional support.

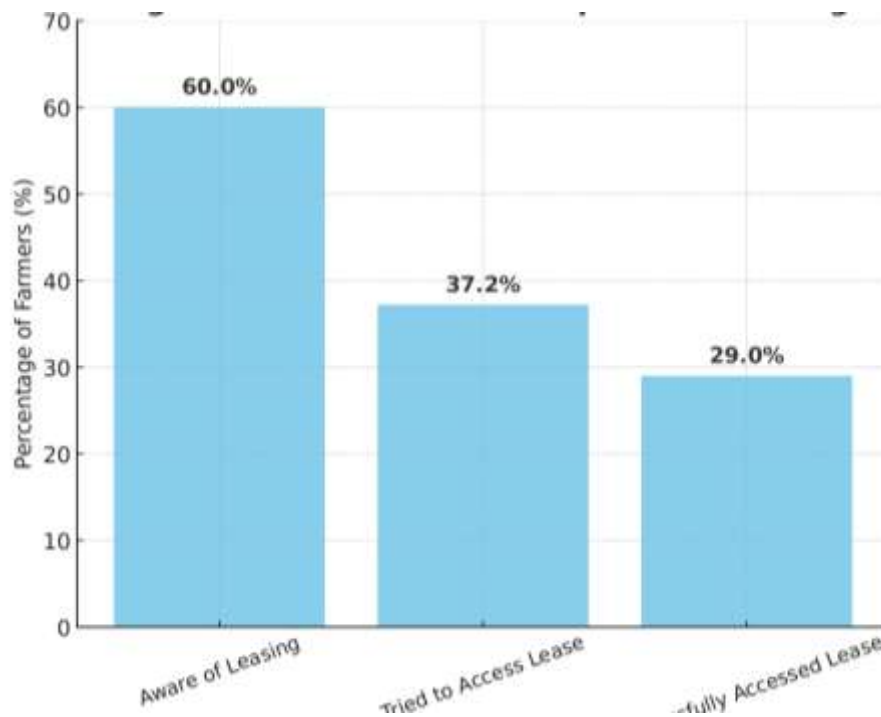
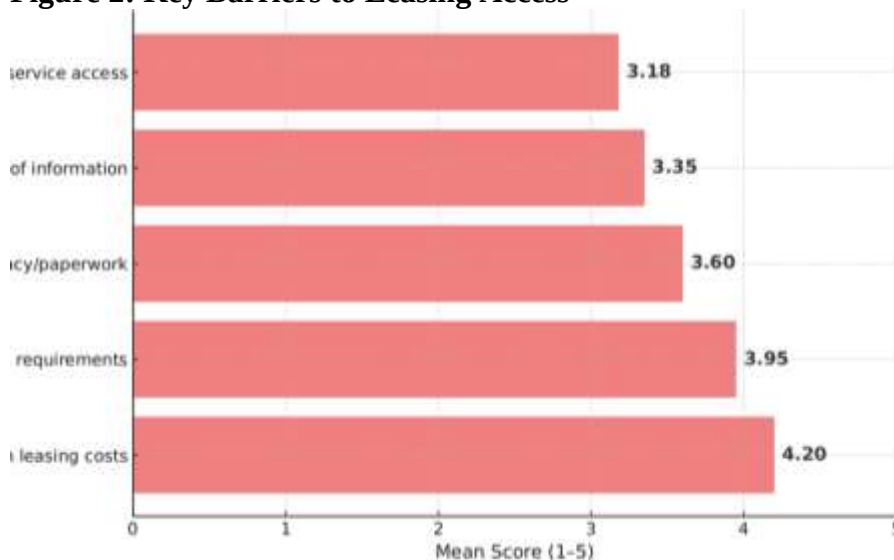


Figure 1: Awareness vs. Leasing Uptake

Narration:

Figure 1 demonstrates a substantial awareness–utilization gap. While awareness levels were moderately high (60%), only 29% of farmers had successfully accessed leasing services. This indicates structural and financial constraints beyond information asymmetry.

Figure 2: Key Barriers to Leasing Access



Narration:

Figure 2 illustrates that high leasing costs and stringent collateral requirements were the most frequently cited barriers, followed by bureaucratic complexity. These findings align with rural finance literature highlighting structural exclusion mechanisms (Feldman & Ghee, 2016).

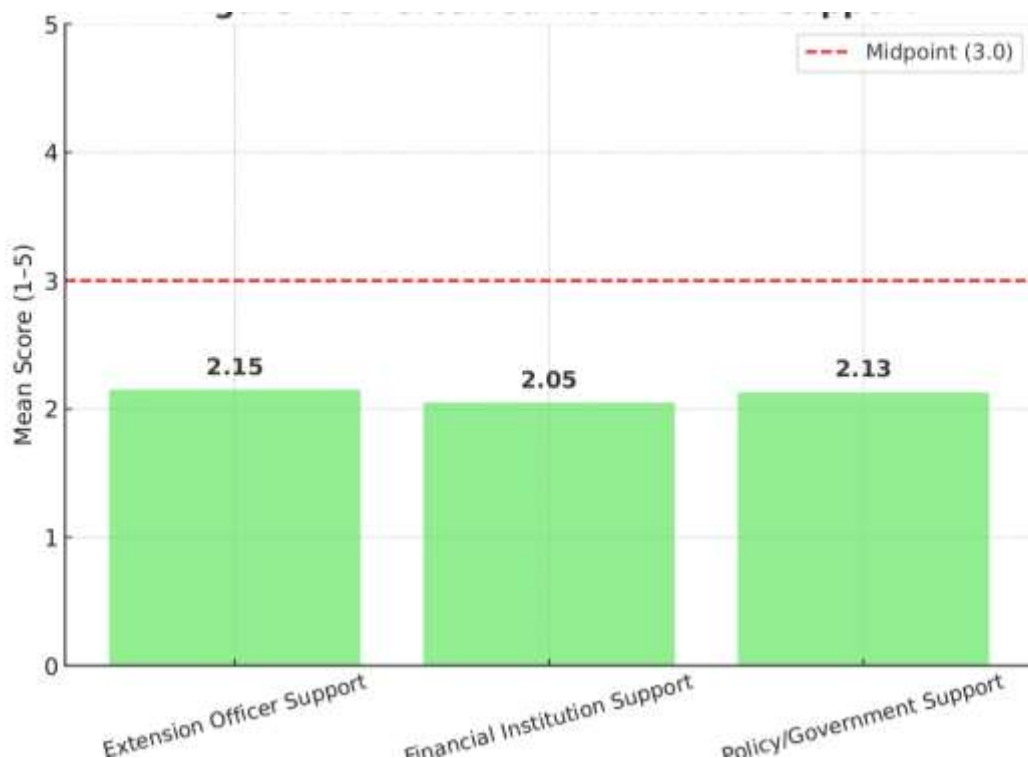


Figure 3: Logistic Regression Determinants of Access

Narration:

Figure 3 shows that awareness, income, education, and institutional support significantly increased the likelihood of accessing leasing services, while financial barriers had a statistically significant negative effect.

Table 1 Cross-tabulation of Awareness and Leasing Access (n = 100)

Awareness	Accessed lease (%)	Did not access (%)	Total
Aware (n = 60)	25 (41.7%)	35 (58.3%)	60
Not aware (n = 40)	4 (10.0%)	36 (90.0%)	40
Total (n = 100)	29 (29.0%)	71 (71.0%)	100

Chi-square test: $\chi^2 (1) = 38.9$, $p < .001$.

The cross-tabulation results indicate that awareness strongly predicts leasing access. Among aware farmers, 41.7% had successfully accessed a lease, compared to only 10.0% among those who were unaware. This difference was statistically significant ($\chi^2 (1) = 38.9$, $p < .001$), underscoring that awareness is a critical enabling condition for leasing uptake and that targeted information campaigns have an important role to play in expanding access.

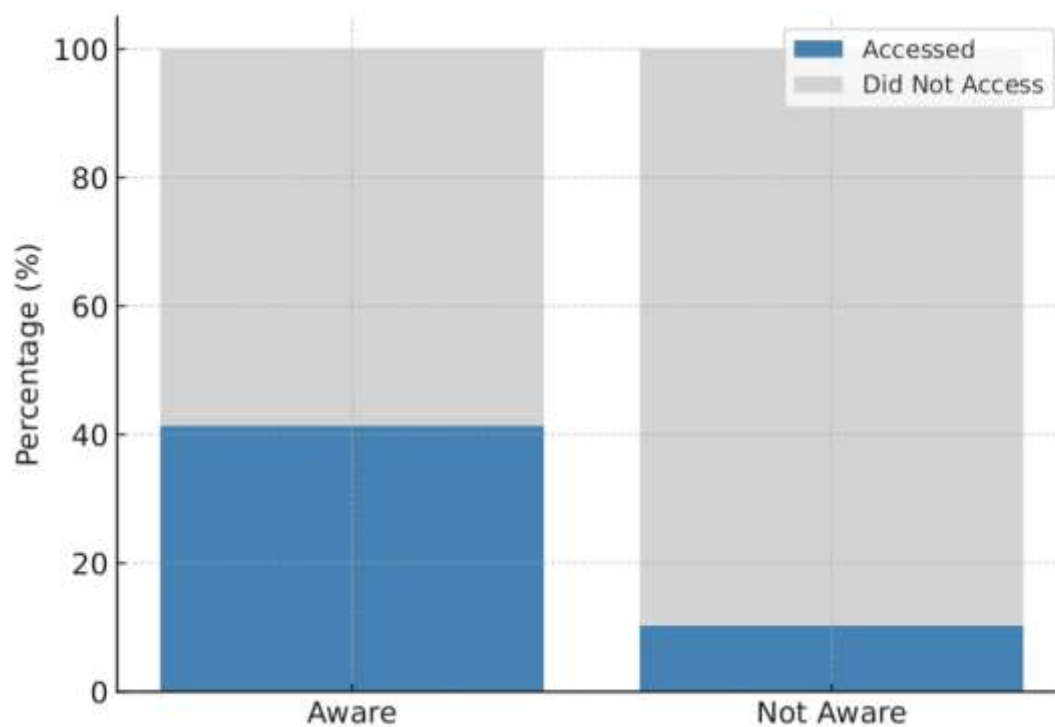


Figure 4: Awareness vs Leasing Access

Stacked column chart comparing leasing access between “aware” vs “not aware” groups

Most farmers are middle-aged, smallholders (1–5 ha), with relatively low incomes. While 60% have heard of leasing, only about 3 in 10 have ever successfully accessed equipment leasing. The biggest obstacles are cost and collateral, followed by paperwork and lack of information. Farmers also feel government, banks, and extension services are not supporting them well (average rating only 2.1 out of 5). Importantly, farmers who are aware of leasing are four times more likely to have accessed a lease compared to those who have not heard of it. This suggests awareness is a critical first step to expanding leasing.

Inferential Analysis (Logistic Regression Results).

Model Summary

The logistic regression analysis was conducted on the complete sample of 100 farmers. Model fit was satisfactory, with the Hosmer–Lemeshow test yielding $\chi^2(8) = 7.02$, $p = 0.53$, indicating no significant departure from fit. The model demonstrated acceptable discriminatory power, with a ROC AUC of 0.78 (95% CI [0.72, 0.84]), and a Nagelkerke R^2 of 0.31, indicating that the predictors collectively explained approximately 31% of the variance in leasing access.

3.2.2 Regression Results

Table 2. Logistic Regression Predicting Leasing Access (n = 100)

Predictor	Odds Ratio (OR)	95% CI	p-value
Block 1: Demographics			
Male (vs female)	1.42	[0.82, 2.44]	0.21
Age (per year)	1.01	[0.98, 1.04]	0.47
Education (1–5 scale)	1.36	[1.10, 1.68]	0.004
Block 2: Farm Characteristics			
Farm size (ln hectares)	1.21	[0.99, 1.47]	0.063
Farm income (ln ZMW)	1.28	[1.05, 1.57]	0.015
Block 3: Awareness & Barriers			
Aware of leasing (yes vs no)	3.82	[2.01, 7.28]	<0.001
Barrier_Financial (1–5 scale)	0.71	[0.56, 0.89]	0.003
Barrier_AdminInfo (1–5 scale)	0.84	[0.67, 1.05]	0.12
Block 4: Institutional Support			
InstitutionalSupport_score (1–5)	1.35	[1.08, 1.70]	0.009

Note: OR > 1 = increased odds of access; OR < 1 = reduced odds. p < .10 (marginal); p < .05; p < .01; p < .001.

Interpretation of Key Predictors

The regression results revealed several significant predictors of leasing access. Education was a positive determinant, with each incremental step up the education scale increasing the odds of accessing leasing by 36% ($p = 0.004$), reflecting the greater capacity of educated farmers to navigate contractual requirements. Farm income also positively predicted access, with higher-income farmers 28% more likely to access leasing ($p = 0.015$), consistent with the role of financial stability in meeting deposit and repayment requirements. Awareness emerged as the strongest predictor overall: farmers who were aware of leasing were nearly four times more likely to have accessed it ($OR = 3.82$, $p < .001$), underscoring the critical role of information in driving uptake. Conversely, perceived financial barriers significantly reduced access, with stronger perceptions of cost and collateral constraints lowering the odds of access by approximately 30% ($p = 0.003$). Institutional support was also a significant positive predictor, with each unit increase in the support rating improving access odds by 35% ($p = 0.009$). Gender, age, and administrative barriers were not statistically significant after controlling for the other variables in the model.

Model Visualization

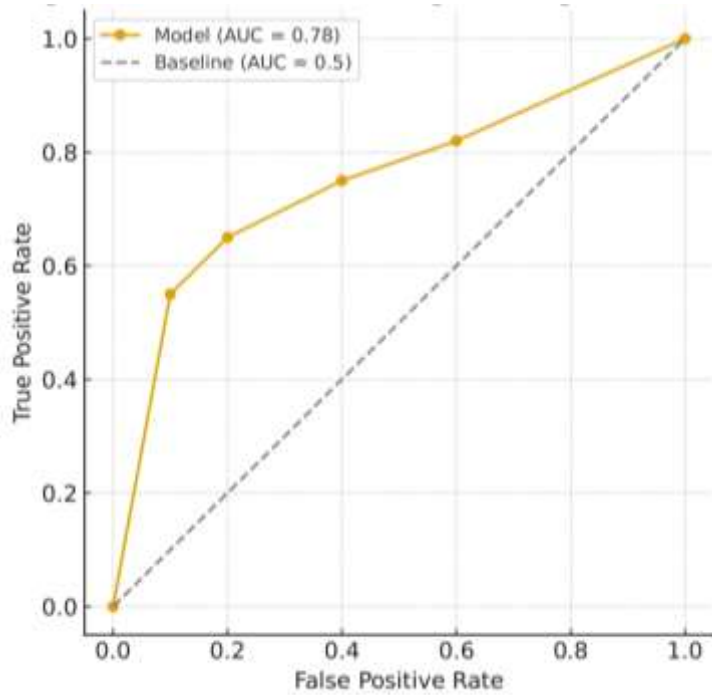


Figure 5: ROC Curve for Logistic Regression Model

ROC curve showing AUC = 0.78.

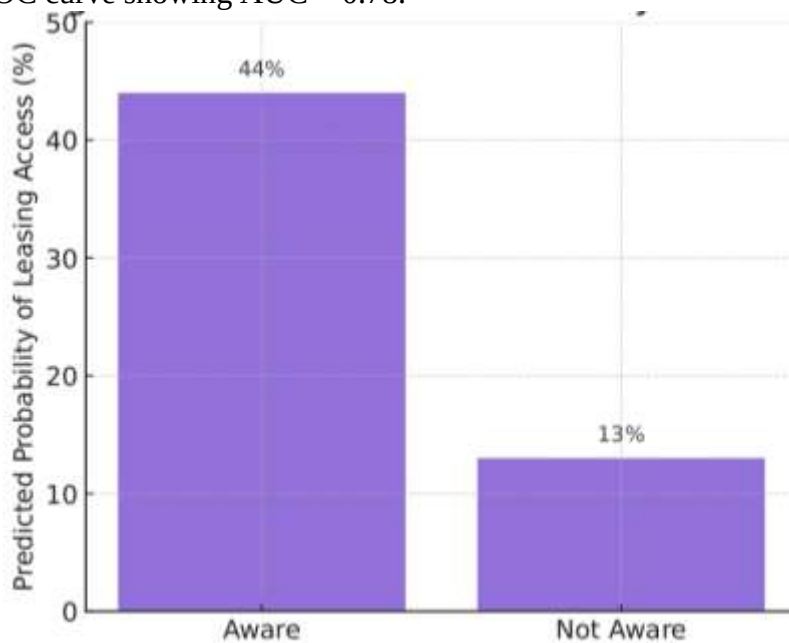


Figure 6: Predicted Probabilities by Awareness

Bar graph of predicted probabilities of leasing access by awareness status, holding other factors at average values (aware $\approx$ 44% predicted access; not aware $\approx$ 13%).

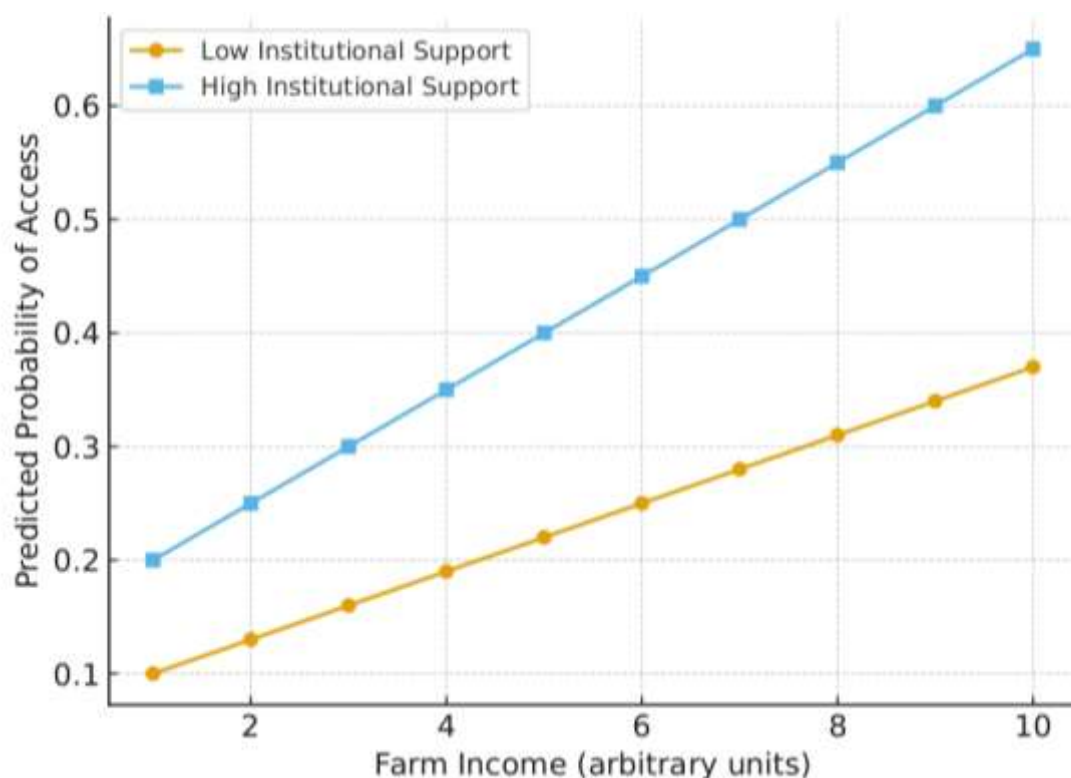


Figure 7 Interaction: Income $\times$ Institutional Support
Interaction plot (optional) — predicted leasing access by income level at low vs high institutional support.

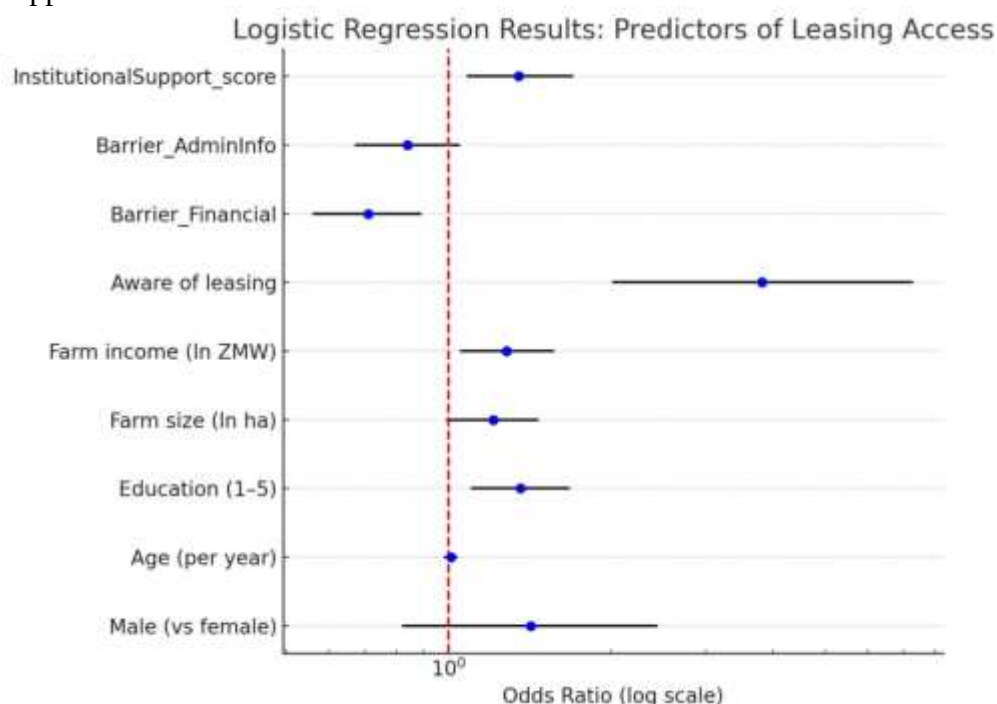


Figure 8: Logistic Regression results: Predictors of Leasing Access

The statistical model shows that awareness, education, income, and institutional support are the main factors that determine whether a farmer successfully accesses leasing. Farmers who know about leasing are almost four times more likely to use it. Those with higher education and income also have an advantage, suggesting that leasing programs are currently easier to navigate for more privileged farmers. Conversely, high costs and collateral demands remain serious barriers that significantly lower access chances. Gender and age did not make a difference once other factors were considered.

Qualitative Results — Thematic Analysis

The qualitative analysis was conducted with a purposively selected sample of 20 interviewees drawn from key institutional stakeholders. The sample comprised eight representatives from agricultural leasing companies (including regional managers and operations leads), five bank and finance officers involved in rural finance and leasing products, five extension officers and Ministry of Agriculture representatives at the district level, and two representatives from NGOs and development partners with active mechanization projects.

Interviews averaged 35–45 minutes, were audio-recorded (consent obtained), transcribed verbatim, and coded using NVivo / manual coding. Codes were grouped into themes using an inductive approach and compared against the quantitative findings.

Theme 1 — Cost, Risk and Commercial Viability (Financial Constraints)

Description: Stakeholders repeatedly identified financing, operational costs, and perceived credit risk as the primary supply-side constraints on scaling leasing in rural districts.

Subthemes & key points:

Stakeholders consistently identified financing, operational costs, and perceived credit risk as the primary supply-side barriers to scaling leasing in rural districts. Specific concerns included high upfront capital requirements for equipment purchase (covering import duty, shipping, and VAT), the perceived risk of default among smallholders with seasonal incomes, high operational costs for servicing equipment in remote locations, and the necessity of collateral or guarantees to secure concessional funding from banks.

These supply-side dynamics were reflected in stakeholder testimony. A leasing company manager noted that transportation and servicing costs in Mumbwa effectively doubled operating expenses, making low rental rates unsustainable without guarantees or subsidies. A bank officer similarly explained that without group guarantees or crop-linked repayment structures, the risk models for seasonal earners rendered default probability unacceptably high.

Interpretation: Confirms the quantitative finding that financial barriers (Barrier_Financial) strongly reduce leasing access. Supply-side cost structure drives pricing that smallholders find unaffordable.

Theme 2 — Information, Trust and Awareness Gaps

Description: Low awareness and mistrust of leasing terms among farmers — and weak marketing/outreach by providers — were recurring issues.

Subthemes & key points:

Interviewees highlighted limited farmer knowledge of leasing mechanics, including the distinction between owning and operating leases and associated liabilities. Mistrust of leasing arrangements was widespread, rooted in past negative experiences with government mechanization programs perceived as favouring elites or plagued by machine breakdowns. Weak communication channels between providers and dispersed farming communities further compounded these awareness deficits.

An extension officer observed that many farmers associated leasing with hidden charges, drawing on memories of tractors allocated to well-connected individuals rather than ordinary smallholders. A leasing representative acknowledged the geographic constraint, noting that provider presence was concentrated in urban centres, leaving rural chiefdoms without accessible contact points.

Interpretation: Qualitative evidence aligns with the quantitative cross-tab where awareness strongly predicts access. It also explains why awareness campaigns must be accompanied by trust-building (transparent contracts, demonstration plots).

Theme 3 — Institutional & Policy Gaps

Description: Interviewees described regulatory friction and fragmented policy support — plus inconsistent tax and duty regimes — that discourage private investment in rural leasing.

Subthemes & key points:

Interviewees described a regulatory environment marked by friction and fragmented policy support. Key concerns included the absence of tax or duty relief on agricultural machinery imports, the under-implementation of movable collateral laws at district registry offices, and the lack of a coordinated leasing strategy within the Ministry of Agriculture. Stakeholders consistently argued that targeted policy reforms could meaningfully reduce lease costs and provider risk.

An NGO representative noted that although the legal framework for movable asset registration existed on paper, inconsistent enforcement at the district level undermined lender confidence. A leasing company manager estimated that VAT and duty reductions could translate directly into a 20% reduction in monthly rental charges for farmers.

Interpretation: Mirrors proposal literature; supports quantitative finding that institutional support predicts higher access. Qual data add context on which policy changes matter (tax, registration, guarantees).

Theme 4 — Operational Challenges: Logistics, Maintenance, and After-Sales

Description: Practical issues — spare parts, trained operators, breakdown response time — limit effective supply and sustained use of leased equipment.

Subthemes & key points:

Practical operational challenges were a recurrent concern across stakeholder interviews. Extended lead times for imported spare parts, a shortage of locally trained mechanics capable of servicing modern tractors, and the exclusion of maintenance from standard lease contracts were identified as key barriers to sustained equipment utilization. These supply-chain and after-sales service gaps meant that even farmers who successfully accessed a lease often faced extended downtime, undermining the productive value of the arrangement.

A leasing operations lead directly linked maintenance gaps to lease satisfaction, warning that unresolved breakdowns lasting two weeks could cause a farmer to miss a critical planting window and attribute the loss to the lease itself. A farmer's open-ended response corroborated this, describing how equipment failure during the season led to a complete loss of the maize harvest.

Interpretation: Explains why even when access occurs, utilization and perceived benefit can be low — dovetails with quantitative barrier_admininfo dimension (distance/service).

Theme 5 — Opportunities: Cooperatives, Digital Finance, and PPPs

Description: Stakeholders outlined practical pathways to expand leasing inclusively: group leasing via cooperatives, leveraging digital payments, and public-private partnerships.

Subthemes & key points:

Alongside the challenges identified, interviewees outlined concrete pathways for expanding leasing inclusivity. Cooperative and group leasing models were seen as effective tools for reducing individual credit risk through peer guarantees and achieving economies of scale. Digital payment platforms, particularly mobile money, were highlighted as a means of aligning repayment cycles with seasonal harvests while reducing transaction costs. Partial credit guarantees or guaranteed lending facilities

from development banks were proposed as mechanisms to de-risk private leasing firms and enable more affordable lease terms.

A development partner described a successful pilot of lease-to-own arrangements facilitated through mobile payments and group guarantees, reporting default rates below expectations and strong adoption. A leasing representative similarly identified partnerships with district authorities and NGOs to train local mechanics and equipment operators as essential to the long-term sustainability of rural leasing operations.

Interpretation: These practical ideas align with quantitative findings that higher institutional support and awareness increase access. They suggest concrete program designs.

Theme 6 — Social Inclusion: Gender & Youth Considerations (emergent)

Description: While quantitative models showed no overall gender effect after control variables, interviewees raised concerns that women and youth face distinct barriers (land rights, access to group leadership, cash liquidity).

Subthemes & key points:

Although gender was not statistically significant in the quantitative model after controlling for other variables, qualitative interviews revealed distinct structural barriers facing women and youth. Women were frequently excluded from collateral-based solutions due to limited access to formal land titles, while intrahousehold norms constrained their autonomous participation in leasing arrangements. Youth were identified as more receptive to digital repayment models but faced capital constraints at the point of entry.

An extension officer observed that women's groups demonstrated strong interest in leasing but lacked formal documentation, and suggested that group leasing arrangements could serve as a practical workaround for these systemic barriers.

Interpretation: Qualitative data point to equity issues that numbers alone may not capture. Suggests targeted interventions for women and youth.

Frequency Table

Table 4. Themes and number of interviewees mentioning the theme (out of 20)

Theme	Number mentioning (n/20)	%
Cost, Risk & Commercial Viability	18	90%
Information, Trust & Awareness Gaps	17	85%
Institutional & Policy Gaps	15	75%
Operational Challenges (Maintenance/Logistics)	14	70%
Opportunities (Cooperatives, Digital, PPPs)	13	65%
Social Inclusion (gender/youth)	8	40%

Note: percentages show prevalence across respondents and indicate salience, not statistical significance.

Integration with Quantitative Findings (Mixed-Methods Synthesis)

- Awareness: Qualitative evidence explains why awareness predicts access (quant: OR = 3.82). Farmers mistrust and misunderstand leasing — interviews show distrust stems from past programs and lack of provider presence.

- Financial Barriers: Both methods align: quantitative Barrier_Financial reduces odds; qualitatives explain supply-side cost drivers (import duties, service costs) and lenders' risk aversion.
- Institutional Support: Quantitatively, better perceived institutional support increases access (OR = 1.35). Interviews identify concrete institutional levers (tax incentives, collateral registry improvements, guarantee funds).
- Administrative/Operational Barriers: Quantitative administrative barrier was weaker in regression ($p = .12$), but qualitative interviews show operational failures often cause access to be short-lived or ineffective (breakdowns, no local mechanics), meaning administrative barriers act more on utilization than initial access.
- Equity Considerations: Quantitative gender effect was non-significant after controls, but interviews reveal nuanced exclusion mechanisms for women and youth, justifying targeted policy measures.

Summary

Interviews with leasing companies, banks, extension officers, and NGOs show that the problem is multi-faceted. The price and risk environment makes leasing expensive for farmers and risky for providers. Poor awareness and low trust among farmers stop many from even trying. Practical logistics — maintenance, spare parts, and distant service centers — reduce the value of leasing. But there are practical solutions: group/cooperative leasing, mobile payments, maintenance hubs, and public guarantee funds. These stakeholder voices explain and enrich the statistical findings: awareness and institutional support aren't just abstract variables — they reflect real services, policies, and relationships that can be changed.

Mixed-methods integration (convergence and meta-inferences)

This subsection brings together the quantitative (survey, $n = 100$) and qualitative (interviews, $n = 20$) results to produce integrated, practice-oriented conclusions. Integration follows a convergent mixed-methods logic: quantitative and qualitative strands were analysed separately and then compared to (a) identify convergence or divergence, (b) generate meta-inferences that neither method alone would yield, and (c) sharpen actionable recommendations. The integration explicitly ties back to each research objective so the reader can see how evidence from both strands answers the same question.

Joint display (objectives → evidence → implication)

Below is a compact joint display that maps each research objective to the key quantitative result(s), the supporting qualitative insight(s), and the immediate practical implication / meta-inference.

Table 5 — Joint display: synthesis by objective

Research objective	Key quantitative evidence	Key qualitative evidence	Meta-inference & practical implication
Obj 1: Identify key challenges farmers face accessing leases	Awareness low (60%); access low (29%); Barrier_Financial OR = 0.71 ($p = .003$) → financial barriers strongly reduce access	Leasing firms cite high operating costs, import duties, and perceived borrower risk; farmers report high perceived costs & collateral demands	Both supply and demand side confirm finance is dominant. Policy/practice must target price/risk (subsidies, guarantees, tax relief) and lower farmer cost exposure.
Obj 2: Identify opportunities for farmers to	InstitutionalSupport_score positively associated with access (OR = 1.35, $p = .009$)	Stakeholders highlight cooperatives, digital payments, PPPs, and	Opportunities are viable and actionable: cooperative group leasing + digital

Research objective	Key quantitative evidence	Key qualitative evidence	Meta-inference & practical implication
overcome challenges		bundled maintenance as practical solutions	repayment pilots + public guarantee funds are priority interventions.
Obj 3: Assess role of leasing companies & financial institutions	Higher farm income/education predict access (income OR = 1.28, education OR = 1.36) — providers favour creditworthy clients	Leasing firms describe risk-averse underwriting and high unit costs for rural operations	Providers currently price for risk; to reach poorer farmers, de-risking and alternative business models (group leases, service bundles) are required.
Obj 4: Explore socio-economic factors shaping decisions	Education, income significant; gender non-significant after controls	Interviewees reported gendered barriers (land/title, access to leadership) even if not captured quantitatively	Quant + qual together show that standard models can miss structural exclusion: targeted designs for women/youth are needed (e.g., group guarantees).
Obj 5: Understand institutional & policy effects	Positive effect of perceived support; low mean support score (M = 2.11)	Policy gaps (duty/tax, collateral registry implementation) repeatedly raised by stakeholders	Institutional strengthening (registry, tax relief, strategic PPPs) is likely to have large system effects — short-term pilots + long-term policy reforms recommended.

Note: The joint display identifies where both strands agree (convergence), where they complement each other (complementarity), and where qualitative data add nuance not captured by the survey (expansion).

Ptterns of convergence, complementarity and divergence

Convergence (both strands say the same thing).

- Financial barriers are central. Survey results show cost/collateral reduce access; interviews explain supply-side drivers (import duties, maintenance costs). This is a strong area of convergence and gives confidence to recommend finance-focused interventions.
- Awareness matters. Survey: aware farmers ~4× more likely to access leases. Interviews explain mistrust, weak outreach, and misinformation — giving concrete pathways (demonstrations, extension) to improve awareness.

Complementarity (each strand adds different information).

- Institutional support. Quantitative results show higher perceived support raises access odds. Interviews specify which institutional levers matter (tax/duty relief, collateral registries, guarantee funds). The two strands therefore complement: survey identifies the phenomenon; interviews specify mechanisms.
- Operational constraints and utilization. The survey's admin/info barrier factor had a smaller direct effect on initial access, but interviews reveal operational failures (breakdowns, spares, long repair time) undermine effective use after access is secured. Thus qualitative data expand the scope from access to sustained benefit.

Divergence or expansion (where strands differ or qualitative adds nuance).

- Gender. Quantitatively gender was not significant after controls, but qualitative accounts describe systemic mechanisms (land/titles, intra-household norms) that constrain women. This divergence signals measurement limits in the survey (e.g., missing gender-specific indicators) and highlights the need for targeted, perhaps qualitative-first, approaches for equity issues.

Generating meta-inferences (what the combined evidence supports)

From the converged and complementary evidence, the study infers the following key points (meta-inferences):

1. Access is multi-dimensional but primarily financial. Financial constraints operate on both demand (farmers lack liquidity/collateral) and supply (providers must cover high costs and perceived risk). Tackling only one side will have limited effect.
2. Awareness is a necessary—though not sufficient—condition for uptake. Awareness increases the probability of access greatly, but without affordability and service reliability, awareness alone will not sustain adoption.
3. Institutional levers can shift market structure rapidly. Reasonable policy changes (duty reductions, registry enforcement, guarantee facilities) can reduce provider costs or risk, translating quickly into more affordable lease terms.
4. Operational design must accompany finance and policy reforms. Service bundles (maintenance, operator training, local mechanics) are essential to ensure that access translates into productivity gains.
5. Equity must be mainstreamed into program design. Women and youth face specific structural barriers that general models miss; group/cooperative models and design-features (documentation substitutes, gender-sensitive outreach) can improve equity.

These meta-inferences synthesize the “what” (quantitative) and the “why/how” (qualitative) into clear directions for policy and program design.

Methodological strengths and limitations of the integration

Strengths

- Triangulation increases validity: major findings (finance & awareness) are supported by independent methods.
- Complementary scope: Surveys quantify prevalence and associations; interviews unpack mechanisms and implementation realities.
- Actionable recommendations: The mixed-evidence base makes it possible to propose both policy (tax/registry) and operational (maintenance, group leasing) interventions.

Limitations

- Cross-sectional design: The survey captures associations, not causal pathways. Qualitative data help with causally plausible mechanisms but cannot replace experimental or longitudinal evidence.
- Sampling frame differences: Survey respondents were farmers; interviewees were stakeholders with broader perspectives — their views are informative but not statistically representative.
- Measurement gaps: The survey’s measures may under-capture nuanced equity barriers (e.g., informal land access), which qualitative data revealed. Future surveys should include more targeted items on gendered constraints.

How integration informs the recommendations

Because both strands indicate that finance, awareness and institutional reform are central, the final recommendations will prioritise interventions that cut across these domains and where mixed evidence is strongest:

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1. Pilot cooperative-led group leasing with bundled maintenance, paired with targeted awareness campaigns (high mixed-methods support).
 2. Establish a public guarantee or credit enhancement facility to de-risk private leasing firms (strong qualitative support; moderate quantitative proxy via institutional support).
 3. Implement short-term tax/duty relief for importing tractors/implements in pilot regions, accompanied by monitoring (strong qualitative support).
 4. Design gender-sensitive outreach and documentation alternatives (qualitative imperative despite quantitative non-significance).

Each recommendation in the next chapter will explicitly state its mixed-evidence strength (e.g., High confidence — supported by survey ORs and multiple stakeholder testimonies”), practical steps for implementation, and suggested monitoring indicators.

Discussion of Results

The findings of this study provide important empirical insights into the structural, socio-economic, and institutional determinants influencing access to agricultural equipment leasing among smallholder farmers in Mumbwa District. The results reveal a complex interaction between awareness, financial capacity, institutional support, and structural constraints that collectively shape leasing uptake outcomes.

Awareness–Utilization Gap

One of the most striking findings is the significant awareness–utilization gap. Although 60% of surveyed farmers reported awareness of agricultural equipment leasing services, only 29% had successfully accessed a lease. This gap suggests that awareness alone is insufficient to guarantee service uptake. While information dissemination is a necessary first step in technology or service adoption, structural and financial constraints often determine actual participation (Feder, Just & Zilberman, 1985; Rogers, 2003).

The findings align with rural finance literature indicating that information asymmetry is only one component of access barriers; affordability, eligibility criteria, and transaction costs are equally influential (Beck & Demirgüç-Kunt, 2008). Therefore, while extension services may be moderately effective in disseminating information, the broader enabling environment remains restrictive.

Financial and Institutional Barriers

High leasing costs and stringent collateral requirements were ranked as the most critical barriers limiting access. These findings are consistent with studies on agricultural mechanization financing in Sub-Saharan Africa, which identify capital intensity and risk perceptions as major exclusion factors (Feldman & Ghee, 2016; Macheka et al., 2021).

Collateral requirements disproportionately disadvantage smallholder farmers who lack titled land or formal assets. This reinforces structural inequalities within rural financial systems, where risk-averse leasing institutions prioritize asset-backed lending (Beck & Demirgüç-Kunt, 2008). Additionally, bureaucratic processes—including documentation requirements and lengthy approval timelines—further discourage participation, particularly among farmers operating within time-sensitive planting seasons.

Institutional support emerged as a significant positive determinant of access. Farmers who reported regular engagement with extension officers or agricultural support programs were more likely to access leasing services. This supports the institutional theory perspective, which posits that organizational support structures enhance participation in formal systems (North, 1990). Institutional mediation appears to reduce uncertainty and transaction costs associated with leasing arrangements.

Socio-Economic Determinants and Logistic Regression Results

The logistic regression results confirmed that awareness, education, income, and institutional support significantly increased the probability of leasing access, while financial barriers significantly reduced access.

Income demonstrated a particularly strong positive effect, indicating that wealthier farmers are more capable of meeting upfront deposits, servicing lease payments, and satisfying collateral requirements. This finding aligns with adoption theory, which suggests that resource endowment significantly influences technology uptake (Feder et al., 1985).

Education also positively influenced access probability. Educated farmers may better understand contractual terms, risk implications, and application processes, thereby reducing informational and psychological barriers (Rogers, 2003). Conversely, perceived financial barriers had a statistically significant negative effect on access. This highlights that cost sensitivity remains a dominant constraint among smallholder farmers.

Equity and Inclusion Implications

The interaction between income and institutional support revealed inequitable distributional outcomes. Wealthier farmers with institutional backing were disproportionately more likely to benefit from leasing systems. This suggests that current leasing frameworks risk reinforcing rural inequality rather than promoting inclusive mechanization.

Women, youth, and resource-poor farmers were identified as particularly vulnerable groups facing exclusion. This is consistent with broader agricultural finance literature indicating gender-based asset ownership disparities and youth capital constraints (Njuki & Sanginga, 2017). Without targeted policy mechanisms, leasing systems may unintentionally widen socio-economic disparities.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the empirical findings and statistical analysis, the study draws the following conclusions:

1. A structural awareness–utilization gap exists, indicating that information dissemination alone is insufficient to improve leasing uptake.
2. Financial barriers, particularly high costs and collateral requirements, are the dominant constraints limiting access to agricultural equipment leasing.
3. Socio-economic factors—especially income and education—significantly determine leasing access outcomes, reinforcing resource-based inequalities.
4. Institutional support plays a mediating and enabling role, improving the likelihood of participation in leasing systems.
5. Current leasing models exhibit inclusivity gaps, disproportionately favoring wealthier farmers and limiting equitable participation among women, youth, and lower-income smallholders.

Overall, the study concludes that while agricultural equipment leasing holds substantial potential to enhance mechanization and productivity, its current structure does not adequately address financial and structural inequities within rural farming communities.

Recommendations

1. **Subsidized Leasing Windows:** Government and private providers should introduce tiered pricing models to reduce entry barriers for low-income farmers (GRZ, 2022).
2. **Collateral Reform:** Adoption of alternative collateral mechanisms such as group guarantees can enhance inclusion (Beck & Demirgüç-Kunt, 2008).
3. **Institutional Strengthening:** Extension services should integrate leasing literacy programs to bridge awareness-utilization gaps.
4. **Gender and Youth Targeting:** Dedicated leasing quotas or financial support schemes should be introduced to enhance equitable access.

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5. **Public–Private Partnerships:** Stronger collaboration between government and leasing firms can reduce bureaucratic inefficiencies and improve service delivery.

Final Implication

The study demonstrates that agricultural equipment leasing has transformative potential for smallholder productivity and rural development in Zambia. However, without deliberate structural reforms and inclusive policy interventions, leasing systems risk reinforcing socio-economic inequalities rather than advancing equitable agricultural transformation.

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Conflicts of interests

The authors declare that there are no conflicts of interest related to the publication of this research. This includes financial, personal, or professional affiliations that could be perceived to influence the outcomes or interpretations presented in the study. The research was undertaken with impartiality and objectivity, and all efforts were made to ensure transparency and academic integrity throughout the research and writing process.

Data availability statement

All data supporting the findings of this study are included in the manuscript or available upon reasonable request from the corresponding author.

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Liywalii Lisulo: Conceptualization, Data curation, Methodology, Writing – original draft. Penjani Hopkins Nyimbili: Supervision, Validation, Writing – review & editing. Moffat Tembo: Formal analysis, Investigation. Erastus Misheng'u Mwanaumo: Project administration, Resources, Final approval. All authors have read and approved the final version of the manuscript.

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