Original Article

Technology Adoption and Agricultural Productivity: A Study of Mubuku and Rwimi Prisons Farms in Western Uganda

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ABSTRACT

This study examined the impact of technology adoption on agricultural productivity in Uganda's prison farms, focusing on Mubuku and Rwimi in Western Uganda. Operated by the Uganda Prisons Service (UPS, 2020), these farms combine vocational training with inmate rehabilitation through agriculture, offering a structured setting for evaluating modern farming practices. The research aimed to assess how government support, inmate involvement, and organized training influence the effectiveness of technology adoption, while also identifying the challenges limiting its broader implementation (Kimoni, 2024). The study further explored the potential of these prison farms as scalable models for national agricultural development (FAO, 2019). Despite the introduction of modern agricultural technologies, productivity levels, especially for staple crops like maize and beans, remain low (UBOS, 2020). To investigate this issue, the study used a descriptive, cross-sectional, mixed-methods approach, gathering data from 181 respondents including farm managers, inmates, extension officers, and government officials. Participants were selected through simple random and purposive sampling (Mugenda & Mugenda, 2003). Data collection tools included questionnaires, interviews, and secondary sources like farm records and official reports (UPSR, 2023). The findings revealed that maize was the primary crop, grown by 80% of respondents, while only 20% cultivated beans. Livestock farming was limited, with 27% engaging in mainly poultry, goats, and pigs, while cattle farming was the least practiced. Adopted technologies included automated irrigation systems, solar energy, modern machinery, pest control, and soil enhancement inputs (MAAIF, 2022). These technologies resulted in notable productivity increases: maize yields rose by 23.3%, cowpeas yield by 70%, and overall crop output improved by 21.3% (Kimoni, 2024). However, several challenges hindered the full adoption of these technologies. These included limited funding, inadequate infrastructure, insufficient technical training, and resistance to change among some stakeholders (World Bank,

2021). To overcome these barriers, the study recommends enhanced government investment, regular training for staff and inmates, public awareness campaigns to promote innovation, and partnerships with agricultural research institutions for technical support (NAADS, 2022). In conclusion, while technology adoption has improved productivity, sustained progress will depend on targeted interventions. With appropriate support, Uganda's prison farms can become both rehabilitation centers and models for national agricultural advancement (FAO, 2019).

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INTRODUCTION

Agriculture is a cornerstone of Uganda's economy, employing over 70% of the population and contributing significantly to the country's GDP (UBOS, 2020). However, the sector faces numerous challenges, including low productivity, inadequate use of modern farming techniques, and vulnerability to climate change. As Uganda seeks to improve agricultural output, the adoption of modern technologies has been identified as a crucial factor in enhancing productivity, improving food security, and ensuring sustainable agricultural practices (Ministry of Agriculture, Animal Industry and Fisheries [MAAIF], 2018).

The Uganda Prisons Service (UPS), as part of rehabilitation systems, offer a unique opportunity and manages farms in various regions, including Mubuku and Rwimi, where prisoners engage in agricultural activities as part of vocational training and rehabilitation. These farms serve as experimental grounds for new agricultural techniques and technologies, potentially benefiting both the agricultural sector and the inmates.

Technology adoption in Ugandan agriculture has been uneven, with smallholder farmers often hesitant to embrace innovations due to various barriers such as lack of information, financial constraints, and cultural resistance (Kisekka et al., 2019). However, institutions like prison farms, which are somewhat insulated from these challenges and often have access to government support, provide a unique setting for studying the effectiveness of technology transfer and its impact on agricultural productivity. Mubuku and Rwimi Prison Farms represent ideal case studies, given their diverse agricultural activities, the presence of structured training programs and government involvement in farm management.

The relevance of technology adoption in these prison farms is twofold. First, it can serve as a model for improving agricultural practices in Uganda, especially in the context of limited resources. Second, the focus on rehabilitation through vocational training can provide inmates with skills that improve their post-release prospects, thus contributing to broader social development goals. According to the World Bank (2020), prisoners who acquire productive skills while incarcerated have higher chances of reintegration and reduced recidivism rates.

Several studies have highlighted the relationship between technology adoption and agricultural productivity in Sub-Saharan Africa. The prison farms in Uganda could offer insights into overcoming these barriers and providing scalable models for wider adoption across the country.

This study aims to explore the adoption of agricultural technologies on Mubuku and Rwimi Prison Farms in Western Uganda and examine their impact on agricultural productivity. By focusing on these prisons, the research seeks to understand how inmates, government support, and technological interventions work together to drive improvements in farming practices and yield outcomes. Furthermore, it will assess the factors that either facilitate or hinder the adoption of such technologies within the unique context of Uganda's prison system.

STATEMENT OF THE PROBLEM

Agriculture remains the backbone of Uganda's economy, employing over 70% of the population and contributing significantly to the national GDP (UBOS, 2020). Despite its central role, the sector continues to experience low productivity due to limited adoption of modern farming technologies, inefficient practices, and increasing vulnerability to climate change (MAAIF, 2018). While technology adoption has been recognised as a key driver for enhancing agricultural productivity and ensuring food security, its uptake across the country remains inconsistent, particularly among smallholder farmers who face barriers such as financial constraints, lack of information, and cultural resistance (Kisekka et al., 2019).

In this context, Uganda's prison farms, specifically Mubuku and Rwimi, present a unique opportunity to study the integration of modern agricultural technologies within a controlled institutional setting. These farms, managed by the Uganda Prisons Service (UPS), engage inmates in agricultural production as part of vocational training and rehabilitation programs. With government involvement, structured training, and relative insulation from market and cultural barriers, prison farms are well-positioned to serve as experimental grounds for assessing the effectiveness of technology adoption in improving productivity and skill development.

However, despite the introduction of various modern technologies at these prison farms, productivity, particularly in staple crops like maize and beans remains suboptimal. This suggests a gap between technology implementation and tangible improvements in yield outcomes. Moreover, the extent to which inmates, institutional support, and the broader prison environment facilitate or hinder the adoption of agricultural technologies is not well understood.

This study, therefore, seeks to address the critical gap in understanding the relationship between technology adoption and agricultural productivity within Uganda's prison farms. It aims to explore how factors such as government support, inmate participation, and institutional training influence the effectiveness of technology use, and to identify barriers that may limit its impact. By focusing on Mubuku and Rwimi Prison Farms, the research has provided valuable insights into how institutional farms can serve both as models for national agricultural advancement and as tools for inmate rehabilitation and reintegration.

RESEARCH METHODOLOGY

This chapter presents the research design, the methods of data collection, population size, research instruments and sample size, source of data, validity, reliability and ethical considerations of the study.

Research Design

The study adopted a descriptive and cross-sectional research design. Further, it was also both quantitative and qualitative in nature. This is because the researcher used words, texts and graphs to describe the study findings, and the research was quantitative because the researcher used figures to examine some of the study variables, hence a mixed research design. Further, the study was cross-sectional in nature since the researcher collected data in a short period of time, and the study had no follow-up.

Study Population

The study targeted 340 participants who consisted of Prison Farm Managers/Supervisors, Inmates Involved in Agricultural Activities, Agricultural Extension Officers, and Government Representatives from the Uganda Prisons Service (UPS).

Table 1: Showing Sample Size and Sampling Method

Respondents	Target population	Sample size	Method of sampling
Prison Farm Managers/Supervisors	8	8	Purposive sampling
Inmates Involved in Agricultural Activities	287	128	Sampling random sampling
Agricultural Extension Officers:	15	15	Purposive sampling
Government Representatives from the Uganda Prisons Service (UPS).	30	30	Purposive sampling
Total	340	181	

Source: *Uganda Prison Farm Report (2024)*

Sample Size

The study adopted the Krejcie & Morgan (1970) table for determining sample size, and thus, 181 respondents were selected to constitute the sample size. The Prison Farm Managers/Supervisors were selected because they oversee the day-to-day operations of the farms and play a key role in the decision-making process regarding the introduction and adoption of agricultural technologies. They provided valuable insights into the implementation of new farming techniques and the overall management of farm activities.

Inmates actively engaged in farming at Mubuku and Rwimi Prison Farms were selected in order to provide first-hand accounts of their experiences with the adoption of technology, their training, and how it affects their productivity and rehabilitation. Their feedback was crucial for understanding the practical challenges and benefits of adopting modern farming techniques.

Agricultural Extension Officers are responsible for providing technical support and training to farmers, including those in prison farms. Their expertise and involvement in the technological aspects of farming were essential for evaluating the types of technologies introduced and their effectiveness in improving agricultural productivity.

Officials from the Uganda Prisons Service are involved in the policy and strategic planning of prison farm activities. They provided insights into the broader goals of integrating agricultural technologies into prison farms and the alignment of these efforts with national agricultural development plans.

Sampling Techniques

The study used simple random sampling and purposive sampling techniques to select respondents for this study. The methods were used appropriately to arrive at the target respondents and most importantly, to collect the intended information relevant to the study.

Sources of Data

This research used both primary and secondary sources of data as explained below.

Primary data was obtained through Self-Administered Questionnaires (SAQs) and interviews, which were conducted on the selected respondents. Data regarding the types of technologies and barriers to technology adoption were collected using primary sources. Secondary data was obtained directly from the production records of the prison farms, annual reports and websites of the prison farms.

Research Instruments

The researcher used the questionnaires and interview schedules to collect primary data and a documentary review checklist to collect secondary data.

Validity of Instruments

To ensure greater chances of data validity, the questionnaires were reviewed with some other researchers for expert input. A content validity index (CVI) was determined by dividing the relevant questions by the total number of questions (CVI=n/N). A CVI of 0.8 (8/10) was obtained, hence, the questionnaires were administered to the rest of the respondents as the instrument was valid since the benchmark was 0.7.

Reliability

To test for the reliability of the instrument, the researcher used the Cronbach alpha coefficient using data collected from the pilot study of 15 respondents. The data from the pilot study was entered into the computer Statistical Package for Social Sciences (SPSS), and a Cronbach Alpha coefficient of 0.82 was obtained, thus, the instruments were declared reliable since the Cronbach alpha coefficient was above 0.7 (Amin, 2005).

Ethical Consideration.

The researcher also requested the consent of the respondents to participate in the study, and they felt free to provide relevant information for the study. Further, the researcher will inform the respondents about the purpose of the research project and the expected outcome of the study.

The researcher also assured the respondents that the information provided was to be treated with maximum confidentiality and was to be used for academic purposes only.

Further, the researcher credited and extended his gratitude to all previous researchers whose literature has contributed to this study and was not allowed to take their work as his own.

The researcher also ensured validity by ensuring that the answers provided answered the questions at hand.

The researcher used a simple random sampling technique to avoid bias in the research findings.

Data Analysis

Before data was analysed, it was carefully classified, edited and coded based on clarity, completeness, accuracy and consistency to ensure reliability. This was done using Microsoft Excel. Data was then exported to SPSS version 23 for analysis.

FINDINGS

This section presents the key findings of the study conducted at Mubuku and Rwimi Prison Farms, which aimed to assess the impact of technology adoption on agricultural productivity. The study focused on various types of technologies integrated

into farming activities at the two prison farms, including irrigation systems, renewable energy sources, mechanised equipment, pest and disease control measures, and soil fertility enhancement practices.

Data collected from participants and institutional records revealed a marked shift toward modern agricultural practices, with significant adoption of automated irrigation technologies such as drip and sprinkler systems, use of solar energy for farm operations, and selective mechanisation through harvesters and tractors. The findings also highlight

widespread reliance on chemical pesticides for pest control, along with notable use of fertilisers and organic manure to boost soil fertility.

This section also provides an insightful view of the recorded, organised, coded and validated data that were collected from the respondents of the study. The findings of the study were presented in line with the research objectives. The findings were organised, coded and processed using the Special Package Social Sciences (SPSS) software and are presented as follows.

Response Rate

Table 2: Response Rate

Response	Questionnaires and interviews issued	Questionnaires issued and interviews scheduled	Response Rate (%)
Prison Farm Managers/Supervisors	8	8	100%
Inmates Involved in Agricultural Activities	128	118	92.1%
Agricultural Extension Officers:	15	15	100%
Government Representatives from the Uganda Prisons Service (UPS).	30	25	83.3%
Total	181	165	91.1%

Source: *Primary data (2024)*

All prison farm managers and supervisors (100%) responded to the questionnaires or interviews, indicating complete engagement from this group. This level of participation aligns with findings by Mutimba et al. (2020)**,** who noted that administrative personnel in correctional institutions often demonstrate high involvement in agricultural-based research, especially when the study aligns with institutional goals like rehabilitation, productivity, or policy reform. This suggests a high level of cooperation and commitment from these key participants. A substantial majority (92.1%) of inmates who were involved in agricultural activities completed the questionnaires or interviews. This indicates a strong willingness to participate from this group, although a small percentage (7.9%) did not respond or complete their participation.

Similarly, the strong response rate among inmates (92.1%) also supports findings by Okoye and Nwajiuba (2019), who explored prisoner engagement in agricultural reform projects in Nigerian prisons. They found that inmates often view participation in such activities and related research as a chance to be heard, gain skills, and influence better farming conditions or resources. The willingness of inmates in your study to respond may therefore be interpreted as a sign of perceived relevance and potential benefit of the research to their daily experiences.

Like the prison farm managers/supervisors, all agricultural extension officers responded, showing full engagement from this group. While a good majority (83.3%) of government representatives participated, a smaller percentage (16.7%) did not respond or complete their interviews or

questionnaires. This group had the lowest response rate among the categories, which could be due to factors like availability or other external constraints.

The overall response rate of 91.1**%** is considerably high and provides a solid foundation for the credibility of the study's findings. Baruch and Holtom (2008) suggest that response rates above 85% in organisational research are exceptional and typically indicate strong trust in the researchers, clear communication and relevance of the research topic. Therefore, the high engagement across all categories in this study not only strengthens the data validity but also reflects the critical relevance of agricultural activities within Uganda's prison system.

Background Information of the Respondents.

Gender of the Respondents

Table 3: Gender of the Respondents

Gender		Frequency	Percent
Valid	Female	38	23%
	Male	41	77%
	Total	165	100.0

Source: *Primary Date (2024)*

The findings from Table 3 show that 38 females participated in the survey, making up 23% of the total respondents, and 41 males participated, accounting for 77% of the total respondents. Moreover, FAO (2011) has emphasised that across African rural development programs, women frequently face structural and cultural constraints that hinder their full participation, including limited decision-making power, restricted land access and exclusion from training and extension services. These barriers are often magnified in controlled environments such as prisons, where program design may not consider gender equity or inclusivity. These findings suggest that the sample is predominantly male, with a significant overrepresentation of male respondents compared to female respondents.

The male group represents a large majority of the respondents, while females represent a smaller minority in this survey. The data indicates a potential gender imbalance within the respondent group. In the context of this study, the underrepresentation of female respondents may reflect similar systemic issues within Uganda's prison agricultural programs. It is likely that the design, access, and implementation of these programs are skewed toward male participants, where both were inmates or possibly the staff. This imbalance could also suggest the need for more gender-sensitive program planning and policy intervention to ensure equitable access and participation for female inmates and staff in agricultural development initiatives.

Thus, the findings are consistent with previous studies and highlight the critical need for gender-responsive approaches in correctional agricultural programming to address existing disparities and improve inclusivity.

Level of Education of the Respondents

Table 4: Level of Education of the Respondents

Level of education	Frequency	Percent
No education	19	11.5%
Primary	34	20.6%
Secondary	88	53.3%
Tertiary	18	10.9%
University	6	3.6%
Total	165	100%

Source: *(Primary data 2024)*

According to findings, 19 respondents (11.5%) were reported having no formal education, 34 (20.6%) had completed primary education, 88 respondents (53.3%) had attained secondary education and 18 respondents (10.9) had received tertiary education, and 6 respondents (3.6%) had University education. The majority of respondents (53.3%) have completed secondary education, indicating a relatively high level of education among the group. A significant portion (20.6%) have only completed primary education, suggesting that about a fifth of the respondents have a lower level of formal education. Only a small percentage (3.6%) have completed university education, pointing to a limited proportion of the sample with higher education. A notable 11.5% of the respondents have no formal education, indicating some lack of educational access within the sample.

Asfaw and Admassie (2004) found that education significantly influences the adoption of agricultural technologies in Ethiopia. They argue that farmers with at least secondary education are more likely to comprehend and implement new technologies effectively due to better access to information, higher levels of literacy, and improved decision-making skills. This aligns with the findings from the study that a majority (53.3%) had secondary education, which explains why some level of technology adoption is possible at Mubuku and Rwimi prison farms, despite productivity challenges.

Ogundele and Okoruwa (2006) also noted that education enhances farmers' ability to access extension services, process technical information, and manage risks associated with new agricultural technologies. Given that over 30% of respondents had at least tertiary or secondary education, it suggests that a significant proportion are likely to benefit from or engage with extension services and innovation. However, the low representation of university graduates (3.6%) may limit advanced knowledge application or leadership in agricultural innovation.

Kassie et al. (2011) found a positive correlation between formal education and the adoption of improved maize varieties in Sub-Saharan Africa. Since maize is a key crop at these prison farms, your findings imply that the relatively educated group (especially the 53.3% with secondary education) is potentially positioned to adopt such improved varieties. However, education alone may not suffice if other barriers, such as institutional support, training, and access to inputs are not addressed.

The above findings highlight that the majority of the respondents have secondary education, but there are also considerable portions with lower education levels or no formal education at all.

While the presence of a majority with secondary education is encouraging for the potential of technology adoption at Mubuku and Rwimi farms, the notable proportion of respondents with low or no education (32.1%) may act as a constraint on the full realisation of productivity benefits. This supports the argument by Rogers' Diffusion of Innovations Theory (2003), which highlights the importance of knowledge in the early stages of innovation adoption. Without sufficient educational

grounding, especially in understanding instructions, managing inputs, or interpreting data (e.g., on weather, pests, or soil), technology use may be partial or misapplied, leading to suboptimal outcomes.

Therefore, the findings support the broader consensus in the literature that education is a significant enabler of agricultural technology adoption. They also suggest that interventions at the prison farms must be designed with education levels in mind, such as offering simplified, hands-on training programs or visual learning aids for those with limited formal education.

Age of the Respondents

Graph 1: Age of the Respondents
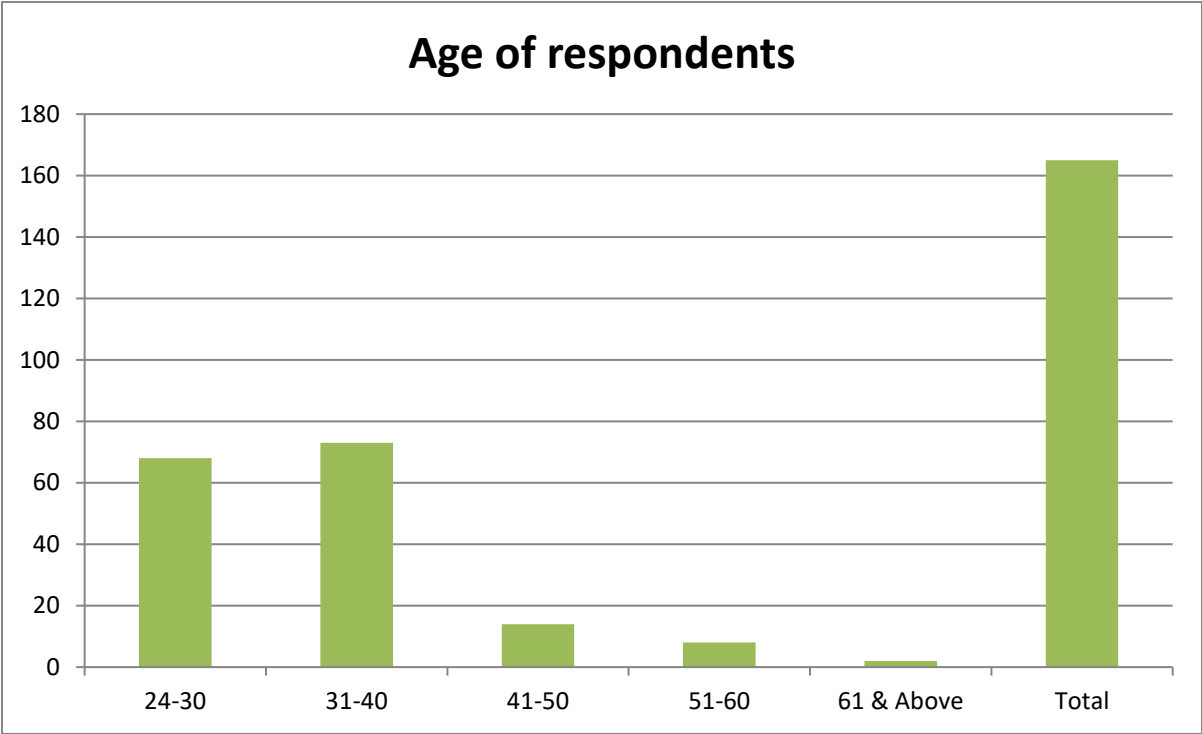
Source: *Primary data (2024).*

The findings reveal that the population was predominantly young, with the majority falling within the 24-40 age range. There was a steep decline in the number of individuals as the age increased beyond 40. Only a small fraction of the population was above 60 years old.

According to Mignouna et al. (2011) found that younger farmers are more likely to adopt improved agricultural technologies such as hybrid seeds, fertilisers, and mechanised tools. Their argument is rooted in the idea that younger individuals are more adaptable, open to new ideas, and generally more educated, which allows them to better understand and implement modern techniques. The predominance of young people (24–40 years) in your study supports this view and may help explain why some level of technology adoption is observed at Mubuku and Rwimi farms.

The age factor is also evident in Mwangi and Kariuki (2015), who similarly noted that age has an inverse relationship with the adoption of agricultural innovations. As age increases, the likelihood of adopting new technologies decreases, largely due to increased risk aversion, lower energy levels, and reduced interest in long-term investment returns.

This aligns with the findings that saw a decline in participation among those over 40, indicating that in the prison farms' labour force goes hand in hand with the demographic factor. Therefore, the prison farms are more likely to embrace and engage with modern farming methods with age. The findings indicate that the majority of respondents fall within the 24–40 age range, a demographic that is generally considered to be more dynamic, innovative, and receptive to change. This youthful population aligns with findings from multiple studies that suggest younger individuals are more likely to adopt agricultural technologies due to their openness to new ideas, longer-term investment perspectives, and higher probability of engaging with training and extension services.

On the other hand, the low representation of individuals above 60 years, who are often characterised by a higher resistance to change and lower propensity to invest in new methods, suggests a reduced risk of stagnation in technology uptake due to generational conservatism. Thus, the age structure of the prison farm population provides a favourable demographic window for targeted technology adoption programs, especially those that incorporate training, digital tools, and performance-based incentives.

Crops Grown At Mubuku & Rwimi Prison Farms

Figure 2: Crops Grown At Mubuku & Rwimi Prison Farms
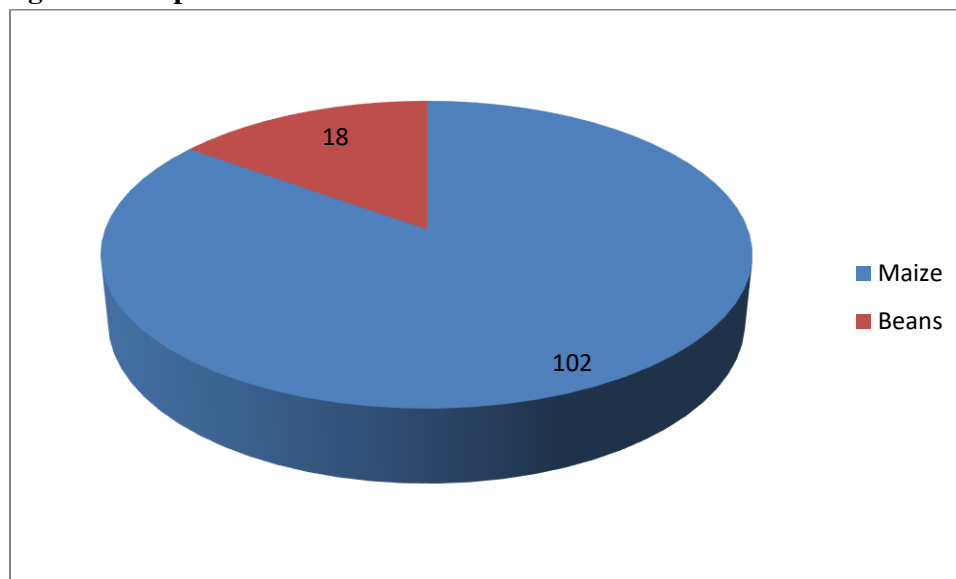
Source: *Primary data (2024).*

Findings showed that only 120 of the respondents were engaged in crop growing. Of these, the majority of the respondents (80%) were involved in growing maize, while only 20% of the respondents were involved in growing beans. This shows that most of the prison farms are used for maize growing.

The predominance of maize cultivation on the prison farms corresponds with findings by Mulema et al. (2017), who noted that maize is the most widely grown staple crop in Uganda, particularly due to its adaptability to different agro-ecological zones, ease of storage, and strong market demand. Similarly, UBOS (2021) reported that maize remains the leading cereal crop in Uganda in terms of acreage and production, especially in institutional and large-scale farming settings, where it serves both subsistence and commercial purposes.

In the context of prison farms, the emphasis on maize growing may be influenced by both economic and institutional factors. According to Nabulo et al. (2020), institutions often favour crops like maize due to their high caloric content, ease of mechanisation, and capacity to meet bulk food demands, all critical considerations in correctional facilities where food self-sufficiency is a major goal.

In contrast, the relatively low proportion (20%) of respondents growing beans may reflect limited land allocation, soil suitability, or institutional prioritisation, as beans generally require different agronomic conditions and may not be as easily mechanised or scaled up as maize. This finding is supported by Kassie et al. (2015), who observed that smallholder farmers often prioritise crops with high returns and lower labour input when resources are constrained, a principle that could equally apply in structured environments like prison farms.

The findings reinforce previous literature suggesting that crop selection is often driven by institutional goals, market value, and suitability for large-scale cultivation. The dominance of maize in prison farms may not only serve as a response to internal food supply needs but also reflect broader national agricultural patterns.

Moreover, the findings imply that technology adoption in terms of mechanised farming or improved maize seed varieties may be more feasible and impactful in maize cultivation than in beans. This is particularly relevant given studies like Gbekor et al. (2021), which indicate that technology adoption tends to be higher in crops like maize due to the availability of improved inputs and government or donor support.

Thus, the crop pattern observed in Mubuku and Rwimi prison farms aligns with national agricultural priorities and reveals how institutional farming systems selectively adopt crops that align with both practical needs and available technologies, reinforcing trends observed in previous empirical studies.

Livestock at Mubuku and Rwimi Prison Farms

Table 5: Livestock at Mubuku and Rwimi Prison Farms

Livestock	Frequency	Percent
Cattle	2	1.2%
Pigs	10	6.1%
Chicken	21	12.7%
Goat	12	7.2%
Crops	120	72.7%
Total	165	100%

Source: *Primary data (2024)*

According to the above findings in Table 5, out of 165 respondents, only 45 (or 27%) were engaged in livestock farming. This shows a relatively low level of engagement in livestock farming compared to other agricultural activities.

Only 2 respondents (1.2%) were involved in cattle farming. This indicates that cattle farming is the least common among the types of livestock mentioned. 10 respondents (6.1%) were engaged in pig farming. Pig farming is relatively more common than cattle farming, but still represents a small percentage of the total. The highest engagement among livestock types, with 21 respondents (12.7%) involved in chicken farming. This shows that poultry farming is a preferred choice for those who engage in livestock farming. 12 respondents (7.2%) were involved in goat farming. This places goat farming between pig and chicken farming in terms of popularity.

The overall low percentage (27%) of respondents involved in livestock farming suggests that either livestock farming is less feasible, less profitable, or

perhaps less accessible for the respondents. Among those engaged in livestock farming, chicken farming stands out as the most popular choice.

These findings are consistent with existing literature on livestock farming in resource-constrained or institutional settings. Several studies have shown that in such environments, poultry farming is often the most feasible form of livestock production due to lower startup costs, faster returns, and reduced space and feed requirements. According to Aklilu et al. (2008) found that poultry farming is highly preferred among low-income and land-limited farmers across East Africa because it provides a reliable source of food and income with minimal investment.

Similarly, Ouma et al. (2013) reported that in Uganda, the smallholder farmers and institutions, such as prisons in this case alike tend to favour poultry over large ruminants due to the high costs and risks associated with cattle and pig farming, such as disease outbreaks, feed scarcity, and theft. These findings resonate with the very low engagement in cattle farming (1.2%) observed in the study, which may reflect limited grazing land, high maintenance needs, or institutional constraints such as a lack of veterinary services and infrastructure for large animals within prison settings.

The moderate involvement in goat and pig farming can also be understood through the lens of previous studies. According to Njuki et al. (2011), the goats are often chosen in rural Uganda for their resilience, low feed demands, and dual-purpose utility (meat and milk). It should be noted that Pig farming, although profitable, is more resource-intensive and may be constrained by cultural and religious factors, as well as biosecurity concerns, particularly in institutional farms with limited sanitation facilities.

The study's findings on livestock farming align with previous research that identifies poultry as the most accessible and productive form of livestock farming in low-resource or institutional environments. The low engagement in cattle and pig farming suggests constraints related to resource availability, institutional capacity, and risk management, while the moderate uptake of goat farming reflects a middle ground between feasibility and productivity. These patterns underscore the need for targeted interventions, such as small-scale livestock support programs or **the** introduction of low-cost livestock technologies, to enhance productivity and diversify agricultural engagement in prison farms. This could be due to various factors such as lower investment requirements, quicker returns or higher market demand for poultry products.

Types of Technologies Adopted at Mubuku and Rwimi Prison Farms

Table 6: Types of Technologies Adopted at Mubuku and Rwimi Prison Farms

Type of technology	Frequency	Percentage
Automated irrigation systems		
1. Drip irrigation	56	33.9%
2. Sprinkler systems	20	12.1%
Total	76	46.1%
Renewable Energy Technologies		
1. Solar panels	48	29.1%
2. Wind turbines	4	2.4%
Total	52	31.5%
Agriculture machinery		
1. Tractors	17	10.3%
2. Tillers	3	1.8%
3. Harvesters	26	15.7%

Type of technology	Frequency	Percentage
Total	46	27.9%
Integrated pest management systems		
1. Disease resistant crops	10	6%
2. Pesticides	110	66.7%
Total	120	72.7%
Soil Boosters		
1. Organic Manure	45	27.3%
2. Fertilizers	75	45.4%
Total	120	72.7%

Source: *Primary data (2024)*

Based on the findings above, nearly half of the study participants have adopted automated irrigation systems, with drip irrigation covering 33.9% being the most common, while sprinklers covered 12.1%. This indicates a significant investment in water efficiency and precision agriculture at both prison farms.

On renewable energy technologies that have been adopted, a third of the participants, with solar panels being the predominant choice covered 29.1% whereas wind turbines covered 2.4%. This highlights a shift towards sustainable energy sources to reduce operational costs and environmental impact.

Agricultural machinery has been adopted by just over a quarter of the participants. This shows the abundance and availability of manual labour because of the existence of inmates/prisoners, the study asserts that tractors covered 10.3%, harvesters 15.7% and tillers 1.8 % an indication that the harvesters are the most common. This suggests a focus on mechanisation to increase productivity and efficiency in farming operations at both Mubuku and Rwimi prison farms.

Integrated pest management systems have seen the highest adoption rate, with a significant majority using pesticides covering 66% and disease-resistant crops covering only 6%. This indicates an emphasis on protecting crops from pests and diseases to ensure higher yields.

Soil boosters such as organic manure and fertilisers are also used and widely adopted, with a strong preference for fertilisers at 45.4% over organic manure, which covered 27.3%. This reflects a focus on enhancing soil fertility to improve crop productivity.

Level of Productivity Before and After Technology Adoption at Rwimi and Mubuku Prison Farms

Table 7: Level of Productivity Before and After Technology Adoption at Rwimi and Mubuku Prison Farms

Crop	Level of productivity (tones)	
	Before	After
Maize	12	40
Beans	6	12
Cassava	3	6
Cowpeas	1	8
Rice	1	6
Total	23	72

According to the findings in Table 6 above, there was an increase of 28 tons, which is a 233% improvement in maize productivity as a result of technology adoption at the prison farms. This is a substantial increase, indicating that the adoption of technology had a major positive impact on maize production. There was also an increase of 6 tons, representing a 100% improvement in beans productivity. The doubling of output shows that the technology applied has doubled the yield for beans. There was also an increase of 3 tons, leading to a 100% improvement. Cassava yield also doubled, reflecting the positive effects of technology on crop productivity.

An increase of 7 tons, resulting in a 700% improvement. Cowpea productivity shows the highest growth, indicating that technology adoption had a very strong positive effect on this crop. An increase of 5 tons, representing a 500% improvement in rice productivity. This is another significant gain, highlighting that the technology has had a major impact on rice farming. An increase of 49 tons, which represents a 213% overall increase in the total productivity of the crops at Rwimi and Mubuku Prison Farms after adopting technology. The adoption of technology at these farms led to substantial increases in productivity across all crops. Cowpeas and rice saw the highest percentage increases (700% and 500%, respectively), suggesting that these crops may have been particularly impacted by the technological interventions. Crops like beans and cassava experienced a 100% improvement, indicating that technology provided consistent and effective benefits for a range of crops.

The findings from Rwimi and Mubuku Prison Farms demonstrate a remarkable increase in agricultural productivity following the adoption of technology, with maize, beans, cassava, cowpeas, and rice all experiencing significant yield improvements.

It should be noted that Gbekor et al. (2021) found that the adoption of improved seeds, mechanised farming equipment, and modern irrigation systems led to substantial increases in crop yields across several African countries. Specifically, their study noted that maize yields improved by over 200% in areas where technology adoption was supported by training and government facilitation, figures that closely align with the 233% increase reported at the prison farms. This suggests that structured environments such as prison farms, which allow for close supervision and consistent application of technologies, may be especially conducive to achieving optimal results.

Similarly, Mwangi and Kariuki (2015) emphasised that access to extension services and consistent use of high-yield seed varieties could double or triple agricultural outputs. The 100% yield improvements in beans and cassava, as well as the 213% overall increase in total productivity at Rwimi and Mubuku, validate this assertion and reinforce the value of investing in targeted agricultural training and technology dissemination.

Moreover, Sheahan and Barrett (2017) explored the adoption of agricultural technologies across East Africa and found that productivity gains were most pronounced in underutilised or low-input systems such as prison farms prior to intervention. Their findings suggest that the dramatic improvements in cowpeas (700%) and rice (500%) productivity at Rwimi and Mubuku are likely due to the shift from minimal to optimised production systems, made possible through technology infusion.

Crucially, the study found a strong positive relationship between the adoption of these technologies and increases in crop productivity, particularly for maize, beans, cassava, rice, and cowpeas. The data suggest that even in a controlled institutional setting like prison farms, where labour is readily available, the introduction of appropriate technologies can lead to substantial improvements in efficiency, yield, and sustainability.

These findings provide critical insights into how structured environments can serve as pilot models

for agricultural transformation in Uganda and contribute to broader efforts toward food security, skills development, and sustainable farming practices.

The overall findings affirm that technology adoption significantly boosts agricultural productivity. The prison farms' results not only corroborate existing literature but also provide a practical demonstration of how technology, when applied in controlled environments with structured labour and support, can yield dramatic improvements in food production. These outcomes advocate for the broader application of such technologies in public institutions and underserved rural communities, where potential productivity gains remain untapped.

Barriers to Technology Adoption at Mubuku and Rwimi Prison Farms.

Based on interviews with 10 respondents regarding the barriers to technology adoption at prison farms in Uganda, here's a summary of the findings:

During the interview with Respondent 1, he mentioned that "insufficient funding is a significant barrier, preventing the purchase of modern equipment and technologies". Also, respondent 2 stated that the" budget constraints at prison farms make it difficult to invest in necessary technology".

Another respondent said, "Lack of training for both inmates and prison staff also makes it challenging to effectively use new technologies". Respondent 4 also emphasized "we need continuous training programs to keep up with advancements in agricultural technology at prison farms." Another respondent pointed out that "the existing infrastructure is not well-suited to support the implementation of advanced technologies" and respondent 6 mentioned that "poor infrastructure, such as unreliable electricity and water supply, hinders the adoption of new technology"

Respondent 7 noted that "there is often resistance to change among prison farm managers and staff, who

may prefer traditional methods over new technology", and respondent 8 discussed the challenge of changing mindsets and overcoming scepticism about the benefits of modern technology. Respondent 9 highlighted that "the high costs of purchasing and maintaining new technologies are a significant deterrent", and Respondent 10 explained that "the initial investment required for technology adoption is often prohibitive for prison farms." This study examined the impact of technology adoption on agricultural productivity in Uganda's prison farms, focusing on Mubuku and Rwimi in Western Uganda. Operated by the Uganda Prisons Service, these farms combine vocational training with inmate rehabilitation through agriculture, offering a structured setting for evaluating modern farming practices. The research aimed to assess how government support, inmate involvement, and organised training influence the effectiveness of technology adoption, while also identifying the challenges limiting its broader implementation. The study further explored the potential of these prison farms as scalable models for national agricultural development.

Despite the introduction of modern agricultural technologies, productivity levels, especially for staple crops like maize and beans remain low. To investigate this issue, the study used a descriptive, cross-sectional, mixed-methods approach, gathering data from 181 respondents, including farm managers, inmates, extension officers, and government officials. Participants were selected through simple random and purposive sampling. Data collection tools included questionnaires, interviews, and secondary sources like farm records and official reports.

The findings revealed that maize was the primary crop, grown by 80% of respondents, while only 20% cultivated beans. Livestock farming was limited, with 27% engaging in it, mainly poultry, goats, and pigs, while cattle farming was the least practised. Adopted technologies included automated irrigation systems, solar energy, modern machinery, pest

control, and soil enhancement inputs. These technologies resulted in notable productivity increases: maize yields rose by 23.3%, cowpea yields by 70%, and overall crop output improved by 21.3%.

However, several challenges hindered the full adoption of these technologies. These included limited funding, inadequate infrastructure, insufficient technical training, and resistance to change among some stakeholders.

To overcome these barriers, the study recommends enhanced government investment, regular training for staff and inmates, public awareness campaigns to promote innovation, and partnerships with agricultural research institutions for technical support. In conclusion, while technology adoption has improved productivity, sustained progress will depend on targeted interventions. With appropriate support, Uganda's prison farms can become both rehabilitation centres and models for national agricultural advancement.

Therefore, findings revealed a lack of funding and the high costs of technology are major barriers to adoption, limited training and expertise, inadequate infrastructure and resistance to change as the major barriers to technology adoption at Mubuku and Rwimi Prison farms.

CONCLUSION

The findings from the study at Mubuku and Rwimi Prison Farms reveal significant insights into the agricultural practices, technological adoption, and productivity outcomes at these farms. Maize is the dominant crop grown at both prison farms, with 80% of respondents engaged in its cultivation, followed by a smaller proportion (20%) involved in growing beans. This highlights the importance of maize as a staple crop and the preference for its cultivation within the prison farming system.

Livestock farming remains relatively less common, with only 27% of respondents engaged in livestock activities. The most common type of livestock is chicken farming, followed by goat and pig farming, while cattle farming is notably scarce. The low levels of livestock farming could be attributed to factors such as limited resources, lower profitability, or less accessibility compared to crop farming.

Technology adoption has played a crucial role in enhancing productivity at the prison farms. The use of automated irrigation systems, particularly drip irrigation, has increased water efficiency, contributing to higher crop yields. Renewable energy technologies, including solar panels, have been implemented to reduce reliance on traditional power sources and lower operational costs. Agricultural machinery, including harvesters and tractors, has been adopted to improve farming efficiency and increase productivity. Integrated pest management systems have been widely used, especially the application of pesticides, to protect crops from pests and diseases. Furthermore, the use of soil boosters such as fertilisers has significantly contributed to enhancing soil fertility and supporting better crop yields.

The introduction of technology has led to impressive improvements in crop productivity. For example, maize productivity increased by 233%, and cowpeas showed a remarkable 700% improvement in yield. Overall, there was a 213% increase in total crop productivity, underscoring the substantial positive impact of technology adoption on agricultural output at both farms.

Despite these advances, several barriers hinder the widespread adoption of technology. Insufficient funding and budget constraints are major obstacles, preventing the purchase of necessary modern equipment. Additionally, the lack of training for both inmates and prison staff on new technologies limits their effective use. Poor infrastructure, including unreliable electricity and water supply, as well as resistance to change from farm managers, further restricts technology adoption. The high initial costs of acquiring and maintaining new technologies are also significant deterrents.

The adoption of technology at Mubuku and Rwimi Prison Farms has led to considerable improvements in productivity, particularly in crops like maize, beans, cassava, and cowpeas. However, the overall success of these advancements is tempered by key challenges, including insufficient funding, poor infrastructure, and a lack of training.

The types of technologies adopted at Mubuku and Rwimi Prison Farms indicate a deliberate strategy to modernise agriculture in a structured and resource-aware setting. The integration of irrigation systems, renewable energy, mechanisation, chemical pest control, and soil fertility management reflects both a response to local challenges and an alignment with global best practices in institutional agriculture.

Addressing these barriers would allow prison farms to fully capitalise on technological innovations, further boosting agricultural productivity and sustainability. Efforts to secure funding, improve infrastructure, and provide continuous training programs could significantly enhance the impact of these technologies, enabling the prison farms to become more efficient and self-sustaining.

RECOMMENDATIONS OF THE STUDY

Based on the findings from the study at Mubuku and Rwimi Prison Farms, the following recommendations are essential to address the barriers to technology adoption and further enhance agricultural productivity as recommended below:

The government and other stakeholders should allocate more funds to the prison farms to facilitate the purchase of modern farming equipment, technologies, and infrastructure improvements.

Continuous training programs should be implemented for both inmates and prison staff to enhance their understanding and skills in using modern farming technologies.

The prison farms should invest in improving their infrastructure to support advanced agricultural technologies, particularly in the areas of reliable electricity, water supply, and storage facilities.

A more systematic approach to technology adoption should be adopted, involving pilot projects and showcasing successful case studies to reduce resistance to change among farm managers and staff.

Resistance to technology adoption due to scepticism and preference for traditional methods can be reduced by promoting awareness of the long-term benefits of technology. Conduct awareness campaigns to highlight the advantages of technology in terms of increased productivity, cost savings, and sustainability. Engage farm managers and staff in discussions to understand their concerns and offer solutions.

Prison farms should establish partnerships with agricultural technology providers, universities, and research institutions to gain access to cutting-edge innovations and receive technical support.

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