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TECHNOLOGY ADOPTION AND AGRICULTURAL PRODUCTIVITY A STUDY OF MUBUKU & RWIMI PRISONS FARMS IN WESTERN UGANDA.

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Abstract

Background: This study examined the impact of technology adoption on agricultural productivity at Uganda's prison farms, focusing on Mubuku and Rwimi Prison Farms. The Uganda Prisons Service (UPS) integrates agricultural activities into the rehabilitation of inmates, using these farms to test new agricultural techniques and technologies. The study aims to identify adopted technologies, assess productivity, and explore barriers to their implementation.

Methdology: A descriptive and cross-sectional research design was used, incorporating both quantitative and qualitative methods. The sample consisted of 181 participants selected from a target population of 340, including Prison Farm Managers and inmates involved in farming. Data was collected via questionnaires, interviews, and document reviews, and analyzed using SPSS after classification and coding.

Results: Findings revealed that maize was the dominant crop, with 80% of respondents growing it, while only 20% cultivated beans. Livestock farming was less common (27%), with chicken farming being the most widespread. Technological adoption, including automated irrigation, renewable energy (solar panels), agricultural machinery, and integrated pest management, contributed to significant productivity increases. Notable yield improvements included a 700% increase for cowpeas and 500% for rice.

Conclusion: However, barriers to technology adoption included insufficient funding, high technology costs, limited training, poor infrastructure, and resistance to change. The study concluded that while technology adoption improved productivity, challenges like inadequate funding and infrastructure hinder broader implementation.

Recommendation: Increasing government funding, offering continuous training for prison staff and inmates, improving infrastructure, addressing resistance to change, and fostering partnerships with technology providers and research institutions to maximize the potential of these technological innovations and enhance farm sustainability.

Keywords: *Technology Adoption, Agricultural Productivity, Mubuku & Rwimi Prisons Farms, Western Uganda.*
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Background of the study

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).

Prison farms, as part of Uganda's prison rehabilitation system, offer a unique opportunity to examine the role of technology in agricultural productivity. The Uganda Prisons Service (UPS) 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 (Kimoni, 2024).

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. For example, a study by Gbekor et al. (2021) found that the adoption of modern agricultural technologies, such as improved seeds, irrigation systems, and mechanized farming tools, directly contributes to increased yields and better farm management. However, the implementation and uptake of such technologies remain a challenge in rural and semi-rural contexts. 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.

RESEARCH METHODOLOGY

Research Design

The study adopted a descriptive and cross-sectional research design. Further, it was also both quantitative and qualitative. This is because the researcher used words, texts, and graphs to describe the study the 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 and the study had no follow-up.

Study population

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

Table 3.1: 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 Kreijcie & Morgan (1970) table of 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 Uganda Prisons Services who 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 of 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 (SAD) and interviews were conducted with the selected respondents. Data regarding the types of technologies and barriers to technology adoption was 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 feel 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.
- 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 analyzed, it was carefully classified, edited, and coded based on clarity, completeness, accuracy, and consistence to ensure reliability. This was done using Microsoft excel. Data was then exported to SPSS version 23 for analysis.

FINDINGS

Response Rate

Table 1: 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 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.

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 across all groups is 91.1%, which is a strong rate indicating a high level of participation in the study. This suggests that the research effectively engaged with the target groups, with only a small percentage not completing their participation.

Background Information of the Respondents.

Table 2: 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 2, which shows 38 females participated in the survey, making up 23% of the total respondents and 41 males participated, accounting for 77% of the total respondents.

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.

Level of education of the respondents

Table 3: 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)

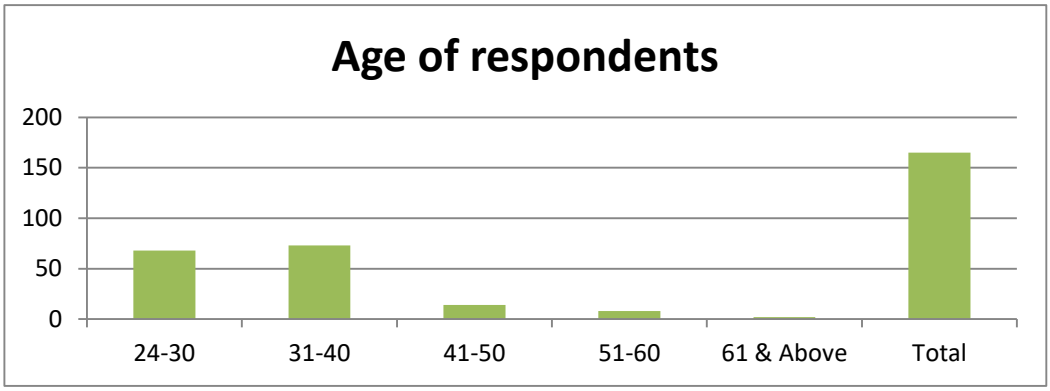
According to findings, 19 respondents (11.5%) were reported having no formal education, 34 (20.6%) had completed primary education, 88 respondents (53.3%) had attained secondary education and 18 respondents (10.9) had received tertiary education and 6 respondents (3.6%) had University education.

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.

These 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.

Age of the respondents

Graph 1: Age of the respondents

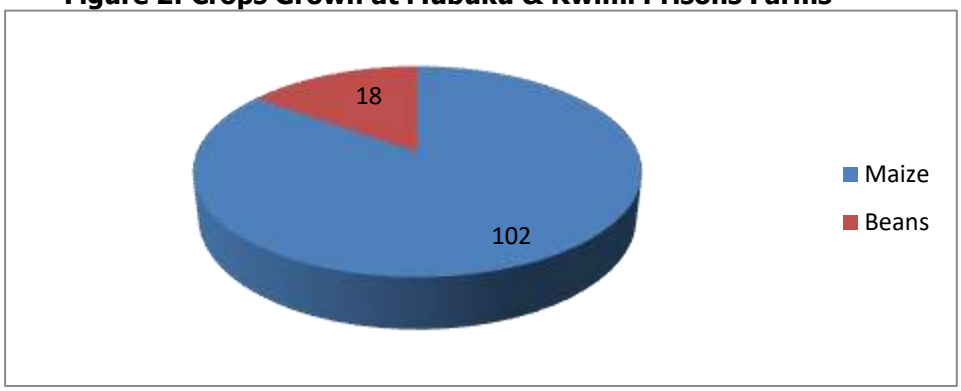


Source: Primary data (2024).

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 increases beyond 40. Only a small fraction of the population was above 60 years old.

Crops Grown at Mubuku & Rwimi Prisons Farms

Figure 2: Crops Grown at Mubuku & Rwimi Prisons Farms



Source: Primary data (2024).

Findings showed that only 120 of the respondents were engaged in crop growing. Of these, 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 prison farms are used for maize growing.

Livestock at Mubuku and Rwimi Prison Farms

Table 6: Livestock at Mubuku and Rwimi Prison Farms

Live stock	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 findings in Table 6 above, 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 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. 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 7: 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%
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%**

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

Renewable energy technologies have been adopted by nearly a third of the participants, with solar panels being the predominant choice. 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, with harvesters being the most common. This suggests a focus on mechanization 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. This indicates an emphasis on protecting crops from pests and diseases to ensure higher yields.

Soil boosters are widely adopted, with a strong preference for fertilizers over organic manure. 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 8: 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 8 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, resulted 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, represents 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.

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 also 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 skepticism 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"

Therefore, findings revealed 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 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 fertilizers 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 restrict 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. Addressing these barriers would allow prison farms to fully capitalize 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:

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 skepticism 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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The author is a Ugandan born in 1993 who possesses a bachelor's degree in Actuarial Science and is currently doing his Master of Science in Finance at Team University. He is also a lecturer at Team University.

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