Determinants of Irish Potato Production and Value Chain Performance among Smallholder Farmers in Rubanda District

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ABSTRACT

Irish potato (Solanum tuberosum L.) plays a crucial role in food security and income generation for smallholder farmers in southwestern Uganda. However, its production and overall value chain performance are influenced by a complex interplay of environmental, socioeconomic, and institutional factors. This study examines the key determinants affecting Irish potato farming among smallholder farmers in Rubanda District, using primary data collected through structured surveys and supported by literature review. Findings reveal that limited access to quality seed, fertilizers, credit, and agricultural extension services significantly constrain productivity. Poor infrastructure including roads, storage, and electricity further limits market access and increases post-harvest losses. Market-related challenges such as price fluctuations, limited bargaining power, and inadequate information systems undermine income stability. Climate variability, including erratic rainfall and rising pest and disease incidence, also impacts yields and resource availability. Despite these challenges, farmers demonstrate resilience through cooperative marketing, crop diversification, and adoption of improved techniques. The study underscores the need for integrated interventions targeting input access, infrastructure development, capacity building, and climate-smart practices to enhance the sustainability and profitability of Irish potato value chains. These insights offer guidance for policymakers, development practitioners, and agricultural stakeholders aiming to strengthen rural livelihoods in Uganda.

Keywords: Irish potato, Climate change, Smallholder farmers, Value chains, Agricultural constraints, Market access, Adaptation strategies.

INTRODUCTION / BACKGROUND

Irish potato (Solanum tuberosum L.) is a staple food and a critical source of income for millions of smallholder farmers in developing countries, particularly in East Africa (Kyomugisha, Sebatta, & Mugisha, 2018). In Uganda, it contributes significantly to household food security, nutrition, and rural livelihoods, playing a central role in poverty alleviation and agricultural commercialization (Ferris et al., 2003; NAADS, 2020).

Despite its importance, the performance of Irish potato production systems and associated value chains is undermined by a range of interrelated challenges. These include poor agronomic practices, limited access to quality inputs such as certified seed and fertilizers, and weak extension support services (Stephen, 2011). Infrastructural bottlenecks, particularly poor road networks, inadequate storage, and limited access to electricity, further constrain the efficiency of post-harvest handling, market access, and value addition opportunities (Shaun Ferris et al., 2006).

Market dynamics also present significant hurdles. Smallholder farmers often face volatile prices, limited market information, high transportation costs, and weak bargaining power—factors that collectively lead to

income instability and discourage investment in production (Kyomugisha et al., 2018). These constraints are compounded by financial exclusion and limited access to credit facilities, which restrict the adoption of improved technologies and farming practices.

Climate variability is another critical determinant affecting Irish potato farming. Erratic rainfall, prolonged droughts, and increased incidences of pests and diseases have disrupted planting schedules, reduced yields, and heightened production risks (Zhu et al., 2021; Aroyehun, Ugwuja, & Onoja, 2024; Adekanmbi et al., 2023). While climate change is a major stressor, it interacts with and often amplifies pre-existing vulnerabilities within the value chain.

Despite these challenges, opportunities exist to enhance productivity and value chain performance. The adoption of climate-smart practices, improved seed varieties, integrated pest management, and cooperative marketing models has shown promise in improving resilience and profitability (Jennings et al., 2020; Cătuna Petrar et al., 2024). Furthermore, ongoing investments in rural infrastructure and the increasing demand from urban markets provide avenues for income growth and diversification.

Understanding the determinants that influence both production outcomes and value chain dynamics is essential for designing effective interventions. This study therefore explores the key factors both environmental and structural that shape Irish potato production and value chain performance among smallholder farmers in Rubanda District. By analyzing farmer practices, resource access, infrastructural and market challenges, and adaptation strategies, the research aims to inform policies and programs that promote sustainable agricultural development and improved rural livelihoods.

This study aimed to identify and analyze the key determinants influencing Irish potato production and value chain performance among smallholder farmers in Bubaare Sub-county, Rubanda District, focusing on agricultural practices, access to resources, market dynamics, infrastructure, and climate-related factors. Additionally, it sought to assess the socioeconomic impacts of Irish potato farming on household income, food security, and overall welfare. By examining the relationships between these production determinants and farming outcomes, the research provides insights into critical constraints and opportunities for improving productivity and livelihoods in the region.

LITERATURE REVIEW

Irish potato production among smallholder farmers is influenced by a complex interplay of factors including agricultural practices, access to inputs, market dynamics, infrastructure, and climate variability. Several studies emphasize the critical role of agricultural inputs such as quality seed, fertilizers, and pest management in determining potato yields and overall productivity. For instance, Cătuna Petrar et al. (2024) demonstrate how both environmental factors and the use of agricultural inputs significantly impact potato traits and yields, highlighting the importance of integrated management practices. However, constraints to input use, particularly fertilizer, remain a persistent challenge in Uganda and similar contexts. Geoffrey and Mildred (2012), along with Stephen (2011) and Todd et al. (2012), note that limited access, lack of affordability, and knowledge gaps restrict smallholders' fertilizer adoption, directly influencing production efficiency and profitability. These findings are supported by Maganga (2012), who found that technical efficiency in Irish potato production was strongly linked to farmers' access to and use of inputs, underscoring the importance of improving input supply chains and farmer training.

Access to markets and infrastructure further complicates production outcomes and value chain performance. Kyomugisha et al. (2018) provide evidence from Uganda illustrating how poor market access and limited infrastructure, such as roads and storage facilities, lead to inefficiencies and reduced on-farm value addition. Similarly, Benfica and Tschirley (2012) argue that market fragmentation and limited bargaining power among smallholders exacerbate these inefficiencies, hindering farmers' ability to fully benefit from production gains. Strengthening farmer organizations and market empowerment strategies, as discussed by Kataama (2002) and

KIT & IIRR (2006), have shown promise in improving market participation and value chain dynamics. These organizational efforts help address information asymmetry and provide collective bargaining advantages, which are crucial for smallholder profitability and sustainability.

Climate change emerges as an increasingly significant factor shaping potato production dynamics. Adekanmbi et al. (2023) and Zhu et al. (2021) provide detailed assessments of how changing temperature and precipitation patterns alter the suitability of regions for potato cultivation, with implications for yields and production stability. Their studies emphasize that climate variability demands adaptive strategies to mitigate negative impacts. Aroyehun et al. (2024) highlight how farmers in vulnerable regions employ various adaptation strategies including diversification, adjusted planting dates, and soil conservation to cope with climate-related hazards. Beyond production impacts, Adom (2024) reviews the broader socioeconomic consequences of climate change, underscoring its role in influencing household incomes, food security, and overall welfare, particularly among smallholder communities dependent on agriculture in developing countries.

Market dynamics and price volatility also play pivotal roles in shaping farmers' production decisions and livelihoods. Habyarimana and Nkunzimana (2018) document how food price volatility affects market efficiency and welfare within the East African Community, creating uncertainty that hampers investment and productivity. Monteiro and Jammer (2024) further elaborate on these dynamics in South Africa, showing how cross-commodity spillovers between grain and livestock markets create complex price interactions that smallholder farmers must navigate. This market uncertainty is compounded by structural inefficiencies in staple food markets documented by Jones (1996), who explains that fragmented market systems and weak linkages limit the benefits smallholders derive from their produce.

The socioeconomic impacts of Irish potato farming extend beyond production to affect household income and food security. Government of Uganda (2002) and Nkonya et al. (2004) argue that potato production is a vital component of poverty reduction strategies in rural Uganda, providing critical income streams and employment. Maganga (2012) similarly finds that technical efficiency gains in potato production translate into improved household welfare. Fine (1998) and Pearson Education Ltd (2004) discuss the role of potatoes as a staple crop contributing to dietary diversity and nutritional security, which are essential for community health outcomes. However, these benefits are threatened by the combined pressures of climate change and market challenges, which require integrated policies and support mechanisms to sustain and enhance the livelihoods of smallholder farmers

METHODS

Study Area

The study was conducted in Bubaare Sub-county, Rubanda District, Uganda, a key Irish potato-producing region in southwestern Uganda. This location was selected due to its significance in potato cultivation and to represent typical smallholder farming dynamics in the area.

Research Design

A descriptive cross-sectional research design was adopted to capture a snapshot of the current state of Irish potato production. This design enabled the collection and analysis of quantitative data without manipulating variables, facilitating an understanding of the challenges and opportunities faced by farmers at a single point in time.

Research Approach

The study employed a quantitative research approach, utilizing structured questionnaires designed to gather numerical data relevant to production, marketing, and livelihood outcomes within the Irish potato value chain.

Study Population and Sampling

The target population comprised 200 Irish potato farmers organized into groups, associations, and cooperatives within Bubaare Sub-county. Using Yamane's formula for sample size determination (Yamane, 1973; Israel, 1992), a sample size of 130 respondents was calculated. Simple random sampling was used to select participants from farmer group lists to ensure unbiased representation.

Data Collection Tools

A semi-structured questionnaire with both closed and open-ended questions was the primary data collection instrument. This format allowed for quantifiable data collection while providing flexibility for capturing qualitative insights into farmers' experiences and perceptions.

Data Quality Assurance

Content validity was ensured through consultation with experienced researchers, including the study supervisor. The reliability of the instrument was tested via a pre-test with a similar farmer population outside the study area, and a Cronbach Alpha coefficient between 0.7 and 0.8 was obtained, confirming acceptable reliability.

Research Procedure

Ethical clearance was obtained from the Faculty Directorate of Graduate Studies and Bishop Stuart University Research Ethics Committee (BSU-REC). Before data collection, permission was secured from relevant local authorities, and informed consent was sought from all participants. The researcher ensured that participation was voluntary, and respondents were assured of confidentiality and anonymity.

Data Management and Analysis

Data editing, coding, entry, and cleaning were conducted before analysis. Quantitative data were analyzed using descriptive statistics and percentages via the Statistical Package for Social Scientists (SPSS).

RESULTS PRESENTATION AND DISCUSSION

Introduction

Reliability analysis of 45 survey items from 123 respondents (110 valid cases after listwise deletion) produced a Cronbach's Alpha of 0.924, indicating high internal consistency. This confirms the survey instrument's reliability for measuring constructs such as agricultural practices, resource access, market factors, infrastructure, climate challenges, opportunities, and impacts.

Descriptive Analysis

Agricultural Practices

Farmers strongly agreed that poor soil management reduces yields (Mean=4.17), along with inadequate crop rotation knowledge (Mean=4.11) and lack of pest control training (Mean=4.11). Adoption of improved techniques was moderate (Mean=3.98), while guidance on sustainable practices was limited (Mean=3.60), indicating critical gaps in agronomic knowledge.

Access to Resources

Moderate challenges were reported in accessing quality seed (Mean=2.48) and fertilizers (Mean=2.78). Credit access was difficult (Mean=2.91), and irrigation supply insufficient (Mean=2.78). Notably, lack of agricultural extension services was a significant barrier (Mean=3.02).

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Market Dynamics

Marketing difficulties included high competition (Mean=3.57), price fluctuations (Mean=3.77), limited market information (Mean=3.78), high transportation costs (Mean=4.19), and low bargaining power (Mean=3.80), revealing structural inefficiencies in the value chain.

Infrastructure

Poor road conditions (Mean=4.46), inadequate transportation (Mean=4.48), lack of storage (Mean=4.16), and insufficient electricity (Mean=3.76) were critical constraints. Communication infrastructure also posed challenges (Mean=4.03), all impacting timely market access and value addition.

Climatic and Environmental Factors

Farmers moderately agreed that changing weather patterns (Mean=3.89) and droughts (Mean=3.80) reduce yields. Increased pests and diseases due to climate change were widely recognized (Mean=3.98). Access to climate-resilient seeds had mixed perceptions (Mean=3.59), and environmental degradation was noted as limiting productivity (Mean=3.93).

Opportunities

Farmers showed moderate optimism for cooperative marketing (Mean=3.33), value addition through processing (Mean=3.36), and urban market demand (Mean=3.67). Access to modern technique training (Mean=2.59) and government/NGO support (Mean=2.31) were limited. Other prospects included irrigation (Mean=2.86), innovative technologies (Mean=3.33), export potential (Mean=3.20), farmer groups (Mean=3.84), and rural infrastructure improvements (Mean=3.69).

Impact on Household Income and Food Security

Irish potato farming significantly contributes to household income (Mean=4.43) and food security (Mean=4.56). Income supports healthcare (Mean=4.24), education (Mean=4.24), dietary diversity (Mean=4.24), living standards (Mean=4.12), food access (Mean=4.15), savings/investment (Mean=4.29), and nutritional security (Mean=4.37), positively affecting overall quality of life (Mean=4.05).

Correlation Analysis

Correlation Analysis

The correlation analysis sought to explore the relationships between key factors influencing Irish potato production, including agricultural practices, access to resources, market dynamics, infrastructure, climatic and environmental factors, opportunities, and the impact of potato farming on household income and food security. The Pearson correlation coefficients indicate varying degrees of association between these variables.

Table 8: Feature Correlation Analysis

		Agricultural Practices	Access to resources	Market dynamics	Infrastructure
Agricultural Practices	Pearson Correlation	1	.553**	.307**	.076
	Sig. (2-tailed)		.000	.001	.404
	N	121	121	121	121
Access to resources	Pearson Correlation	.553**	1	.064	.120
	Sig. (2-tailed)	.000		.483	.185
	N	121	123	123	123

Market dynamics	Pearson Correlation	.307**	.064	1	.033
	Sig. (2-tailed)	.001	.483		.714
	N	121	123	123	123
Infrastructure	Pearson Correlation	.076	.120	.033	1
	Sig. (2-tailed)	.404	.185	.714	
	N	121	123	123	123
Climate and Environemental factors	Pearson Correlation	.238**	.719**	-.039	.497**
	Sig. (2-tailed)	.009	.000	.668	.000
	N	121	123	123	123
Opportunities	Pearson Correlation	.399**	.610**	.151	.480**
	Sig. (2-tailed)	.000	.000	.096	.000
	N	121	123	123	123
Impact	Pearson Correlation	.453**	.622**	.068	.180
	Sig. (2-tailed)	.000	.000	.474	.058
	N	110	112	112	112

A strong positive correlation was observed between Agricultural Practices and Access to Resources ($r = 0.553$, $p < 0.001$), suggesting that improvements in agricultural practices are closely linked with better access to necessary resources, such as seeds, fertilizers, and tools. Additionally, Agricultural Practices were positively correlated with Opportunities ($r = 0.399$, $p < 0.001$), indicating that better farming practices are associated with increased market and development opportunities for farmers.

The relationship between Access to Resources and Opportunities was also strong ($r = 0.610$, $p < 0.001$), highlighting the importance of resource availability in creating avenues for market expansion and agricultural improvements. Moreover, Access to Resources showed a significant positive correlation with Impact ($r = 0.622$, $p < 0.001$), indicating that farmers with better access to resources are more likely to experience positive impacts on income, food security, and overall quality of life.

The Market Dynamics variable had moderate correlations with Agricultural Practices ($r = 0.307$, $p < 0.001$) and weak or non-significant correlations with other variables such as Access to Resources ($r = 0.064$, $p = 0.483$) and Infrastructure ($r = 0.033$, $p = 0.714$). These results suggest that market dynamics have some influence on agricultural practices, but are less affected by access to resources and infrastructure.

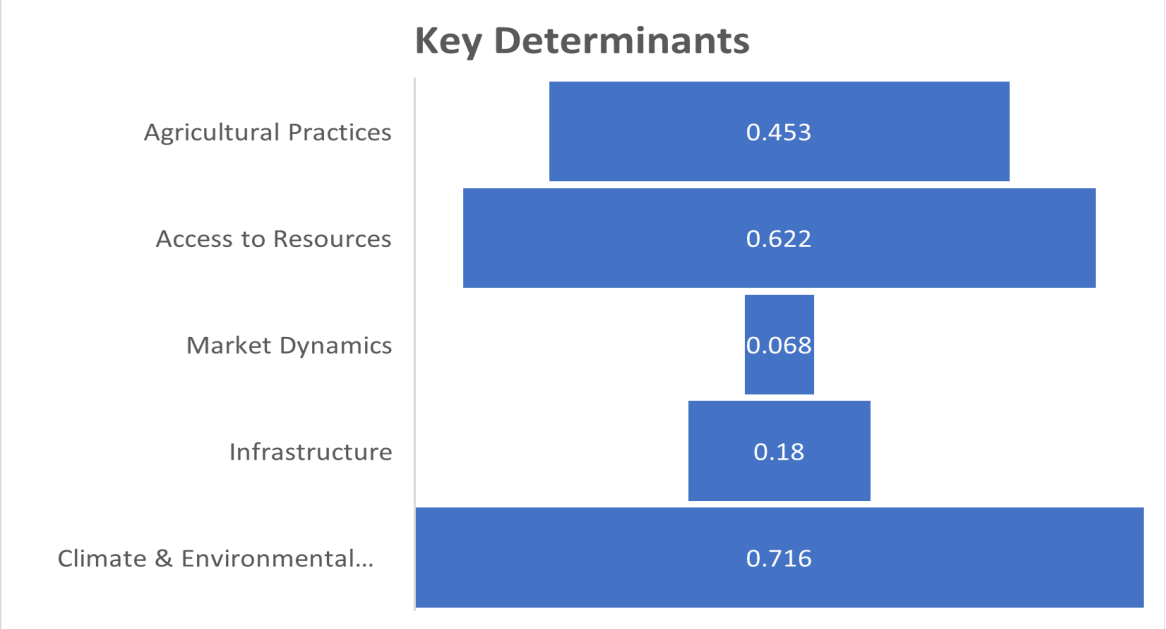
The correlation between Climate and Environmental Factors and Agricultural Practices was modest ($r = 0.238$, $p = 0.009$), suggesting that climate-related challenges do affect farming practices, although the association is not as strong as other factors. On the other hand, Climate and Environmental Factors showed a strong positive correlation with Access to Resources ($r = 0.719$, $p < 0.001$), suggesting that challenges such as climate variability influence the availability and accessibility of resources for potato farming.

Finally, Infrastructure had a weak correlation with most variables. It showed no significant relationship with Agricultural Practices ($r = 0.076$, $p = 0.404$), Market Dynamics ($r = 0.033$, $p = 0.714$), and only a moderate positive correlation with Opportunities ($r = 0.480$, $p < 0.001$) and Climate and Environmental Factors ($r = 0.497$, $p < 0.001$), suggesting that infrastructure improvements may facilitate better opportunities and help mitigate some environmental challenges faced by farmers.

The results indicate that agricultural practices, access to resources, and climate-related factors are strongly interlinked, while infrastructure and market dynamics show weaker correlations with the other variables, pointing to areas where interventions may be more or less effective in improving potato farming outcomes in Bubaare Sub-county

Inferential statistics for Key Determinants Influencing Irish Potato Farming Impact

Factor	Pearson R	R^2 (%)	Eta Squared (%)	Strength of Relationship
Agricultural Practices	0.453	20.6	42.0	Moderate
Access to Resources	0.622	38.7	59.1	Moderate–Strong
Market Dynamics	0.068	0.5	73.2	Very Weak (but non-linear effect)
Infrastructure	0.180	3.2	63.6	Weak (with significant variability)
Climate & Environmental Factors	0.716	51.3	86.8	Strong



The table presents a comparative analysis of six key factors influencing the impact of Irish potato farming among smallholder farmers. Climate and environmental factors emerged as the most influential determinant, with a strong linear correlation (R = 0.716) and the highest explanatory power (R^2 = 51.3%), accounting for 86.8% of the overall variation in impact. Access to resources also showed a substantial influence, with a moderate-to-strong correlation (R = 0.622) and 59.1% effect size, highlighting the critical role of inputs, credit, and technology. Agricultural practices had a moderate correlation (R = 0.453), explaining about 20.6% of the impact variation, indicating that improvements in farming techniques moderately enhance productivity and livelihoods. Infrastructure and market dynamics demonstrated weak linear relationships (R = 0.180 and 0.068 respectively), yet both exhibited high effect sizes (63.6% and 73.2%), suggesting significant non-linear influences on production outcomes. These results underscore that while some factors like climate and resource access have both strong linear and total effects, others like infrastructure and markets may exert their influence in more complex, non-linear ways that still meaningfully shape the value chain performance.

Determinants of Irish Potato Production and Their Socioeconomic Impact

The study of 123 Irish potato farmers in Bubaare Sub-county highlights several interconnected factors influencing production outcomes and rural livelihoods. Agricultural practices show a moderate positive correlation with impact ($r=0.453$, $p<0.001$), and ANOVA confirms significant group differences ($F=10.53$, $p<0.001$), accounting for 20.6% of the variance ($Eta^2=0.42$). Poor soil management, limited crop rotation, and lack of pest control training were identified as key challenges, underscoring the need for enhanced extension services and farmer education. Access to resources—such as quality seeds, affordable fertilizers, and credit—exhibited a strong correlation with impact ($r=0.622$, $p<0.001$) and explained 38.7% of the variability ($F=14.60$, $Eta^2=0.591$), confirming the critical role of resource availability in productivity. Market dynamics, though statistically significant ($F=24.87$, $p<0.001$), showed a weak correlation ($r=0.068$), suggesting non-linear and possibly moderated effects on farming impact, with competition, price volatility, and transport costs reducing

income stability. Similarly, infrastructure, including poor roads, limited storage, and lack of electricity, had a weak correlation (r=0.18) but a large ANOVA effect size (F=25.98, Eta^2=0.636), indicating nuanced influences that constrain market access and increase post-harvest losses. Climate and environmental factors emerged as the most influential, with a strong correlation (r=0.716, R^2=0.513) and the largest effect size (F=84.41, Eta^2=0.868), reflecting the major threats posed by weather variability, droughts, and pest outbreaks. Despite these challenges, farmers identified key opportunities for growth, including cooperative marketing, value addition, growing urban demand, and improved infrastructure. Irish potato farming significantly contributes to household income, food security, education, and healthcare, affirming its central role in rural livelihoods. Strategic interventions focusing on farming techniques, input access, market integration, infrastructure development, and climate adaptation are essential for boosting productivity and improving the socioeconomic well-being of farming communities in the region.

Category	**Key Issues/Opportunities**	**Mean Scores (1-5 scale)**	**Correlation with Impact**	**Implications**
Agricultural Practices	Poor soil management, crop rotation, pest control training	4.11 - 4.17	Moderate positive (r = 0.453)	Improved practices enhance yields and livelihoods
Access to Resources	Quality seeds, fertilizer costs, credit access, extension	2.48 - 3.02	Strong positive (r = 0.622)	Resource availability critical for productivity
Market Dynamics	Competition, price fluctuations, transport costs	3.57 - 4.19	Weak positive (r = 0.068)	Market issues reduce income stability
Infrastructure	Poor roads, transport, storage, electricity	3.76 - 4.48	Weak positive (r = 0.18)	Infrastructure limits market access and value addition
Climate & Environmental Factors	Weather variability, drought, pests	3.59 - 3.98	Strong positive (r = 0.716)	Climate threats impact resource availability and yields
Opportunities	Cooperative marketing, value addition, urban demand	2.59 - 3.84	Moderate positive (r ~0.4-0.6)	Potential areas for growth and investment
Impact on Income & Food Security	Contribution to income, food access, education, healthcare	4.05 - 4.56	—	Potato farming vital for socioeconomic wellbeing

The table outlines six major factors influencing Irish potato farming outcomes in Bubaare Sub-county. Agricultural practices scored relatively high (4.11–4.17), indicating widespread agreement on the challenges like poor soil management and pest control; their moderate correlation with impact (r = 0.453) suggests that improved practices could boost yields and livelihoods. Access to resources—though rated low (2.48–3.02)—showed a strong correlation with impact (r = 0.622), emphasizing its critical role in productivity and income generation. Market dynamics and infrastructure, despite higher average scores, showed only weak correlations (r = 0.068 and r = 0.18 respectively), suggesting their effects may be non-linear or moderated by other factors, yet still limit income stability and market access. Climate and environmental factors scored moderately (3.59–3.98) but had the strongest correlation with impact (r = 0.716), underlining the significant threat of climate variability to yields and resource availability. Opportunities like cooperative marketing and value addition had moderate scores (2.59–3.84) and moderate correlations (~0.4–0.6), pointing to underutilized growth areas. Finally, the impact on income and food security scored high (4.05–4.56), confirming the central role of potato farming in supporting household well-being.

DISCUSSION

Our findings highlight several key determinants shaping Irish potato production and its socioeconomic impact in Bubaare Sub-county, and these align well with existing literature. The moderate correlation between

agricultural practices and farming impact underscores the critical role of proper soil management, crop rotation, and pest control training. Similar to Cătuna Petrar et al. (2024), who emphasized integrated management practices for optimal potato yield, your results reveal significant gaps in agronomic knowledge that constrain productivity. The strong positive link between access to resources and impact confirms prior findings by Geoffrey and Mildred (2012) and Maganga (2012), which stressed how availability of quality seed, fertilizers, credit, and extension services directly influences production efficiency and household livelihoods. Limited access to these resources remains a substantial barrier for smallholders, consistent with challenges reported in Uganda and other developing contexts.

Market dynamics and infrastructure exhibited weaker direct correlations with impact but nonetheless remain important constraints shaping the value chain performance. The reported challenges with price fluctuations, high transport costs, and limited bargaining power reflect the fragmented and inefficient market structures documented by Habyarimana and Nkunzimana (2018) and Kyomugisha et al. (2018). Poor roads, inadequate storage, and unreliable electricity further exacerbate post-harvest losses and restrict timely market access, which echoes Benfica and Tschirley's (2012) observations on infrastructure deficits limiting smallholder competitiveness. While these factors had weaker linear relationships with impact, the large effect sizes suggest complex and nonlinear influences, highlighting that infrastructure and market improvements are still vital for enabling farmers to fully capitalize on production gains and improve income stability.

Climate and environmental factors emerged as the most influential determinants in your study, showing strong correlations with production impact and resource access. This finding resonates strongly with Adekanmbi et al. (2023) and Zhu et al. (2021), who identified climate variability, drought, and pest outbreaks as significant threats to potato yields. The farmers' recognition of changing weather patterns and increased pest pressure confirms the critical vulnerability of smallholder potato systems to climate change, necessitating adaptive strategies as suggested by Aroyehun et al. (2024). Moreover, the positive correlation between climate factors and access to resources suggests that climate stress affects resource availability, a nuance that has been less emphasized in prior studies but is crucial for integrated climate-smart interventions. Overall, your findings reaffirm the interconnectedness of agronomic practices, resource availability, market forces, infrastructure, and climate variability in shaping potato farming outcomes and underscore the need for holistic, multi-sectoral support to enhance productivity and rural livelihoods in Bubaare Sub-county.

CONCLUSION

The study of Irish potato production among smallholder farmers in Bubaare Sub-county, Rubanda District, reveals that climate and environmental factors, access to resources, and agricultural practices are the most influential determinants affecting productivity and socioeconomic outcomes. Climate variability poses significant risks to yield and resource availability, while limited access to quality inputs, credit, and extension services constrain farmers' ability to improve production. Although market dynamics and infrastructure showed weaker direct correlations with farming impact, their complex and non-linear effects still impede value chain efficiency and income stability. Despite these challenges, Irish potato farming remains a vital source of income and food security for households, contributing positively to welfare aspects such as education, healthcare, and nutrition. There are promising opportunities in cooperative marketing, value addition, and infrastructure development that can support sustainable growth.

RECOMMENDATIONS

To improve Irish potato production and enhance smallholder farmers' livelihoods in Rubanda District, it is crucial to promote climate-smart agricultural practices and support access to drought- and pest-resistant seeds. Strengthening extension services and facilitating access to quality inputs and affordable credit will boost productivity. Investments in rural infrastructure such as roads, storage, and electricity are needed to improve market access and reduce post-harvest losses. Encouraging cooperative marketing and value addition can increase farmers' bargaining power and income diversification. Finally, coordinated policy support and

partnerships are essential to address resource constraints, climate challenges, and market inefficiencies for sustainable value chain development.

REFERENCES

1. Adekanmbi, T., Wang, X., Basheer, S., Nawaz, R. A., Pang, T., Hu, Y., & Liu, S. (2023). Assessing future climate change impacts on potato yields - A case study for Prince Edward Island, Canada. Foods, 12(6), 1176. https://doi.org/10.3390/foods12061176
2. Adekanmbi, T., Wang, X. (X.), Basheer, S., Cheng, H., & [additional authors]. (2023). Climate change impacts on global potato yields: A review. Environmental Research: Climate, 3(1). https://doi.org/10.1088/2752-5295/ad0e13
3. Adom, P. K. (2024). The socioeconomic impact of climate change in developing countries over the next decades: A literature survey. Heliyon, 10(15), e35134. https://doi.org/10.1016/j.heliyon.2024.e35134
4. Aroyehun, A. R., Ugwuja, V. C., & Onoja, A. O. (2024). Determinants of melon farmers' adaptation strategies to climate change hazards in south–south Nigeria. Scientific Reports, 14(1), 17395. https://doi.org/10.1038/s41598-024-61164-6
5. Benfica, R., & Tschirley, D. (2012). The dynamics of agricultural market participation and performance in Central and Northern Mozambique: Evidence from a panel survey. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3305062
6. Cătuna Petrar, T. M., Brașovean, I., Racz, C.-P., Mîrza, C. M., Burduhos, P. D., Mălinaș, C., Moldovan, B. M., & Odagiu, A. C. M. (2024). The impact of agricultural inputs and environmental factors on potato yields and traits. Sustainability, 16(20), 8759. https://doi.org/10.3390/su16208759
7. Damalie Magala, S., Mayanja, S., Jagwe, J., Ssemwanga, J., & Ojok, R. L. (2005). Implementation of PMCA Phase I activities on the potato sector in Uganda.
8. Fine, B. (1998). The political economy of diet, health and food policy. Routledge.
9. Geoffrey, O., & Mildred, B. (2012). Constraints to fertilizer use in Uganda: Insights from Uganda Census of Agriculture 2008/9.
10. Government of Uganda. (2002). Plan for Modernisation of Agriculture: Eradicating Poverty in Uganda, Government Strategy and Operational Framework.
11. Habyarimana, J. B., & Nkunzimana, T. (2018). Modeling the effect of food price volatility and transmission to market efficiency and welfare in the East African Community. In Determinants of economic growth in Africa (pp. 179–191). Springer. https://doi.org/10.1007/978-3-319-76493-1_12
12. IITA-Foodnet, CIP, PRAPACE, ASARECA. (2001). Uganda's Irish potato sector.
13. Jennings, S., Koehler, A.-K., Nicklin, K. J., Challinor, A. J., et al. (2020). Global potato yields increase under climate change with adaptation and CO2 fertilisation. Frontiers in Sustainable Food Systems, 4. https://doi.org/10.3389/fsufs.2020.519324
14. Jones, S. (1996). Marketing staple food crops in tropical Africa: What do we know? Cornell University Press.
15. Jones, S. (1996). Food markets in developing countries: What do we know? American Economic Review, 86(4), 830–851.
16. Kataama, D. M. (2002). Promotion and strengthening of farmers organizations in Mukono district, Uganda. Nordic Agricultural Academy.
17. KIT & IIRR. (2006). Chain empowerment; Supporting African farmers to develop markets.
18. Kyomugisha, H., Sebatta, C., & Mugisha, J. (2018). Potato market access, marketing efficiency and on-farm value addition in Uganda. Scientific African, 1, e00013. https://doi.org/10.1016/j.sciaf.2018.e00013
19. Maganga, A. M. (2012). Technical efficiency and its determinants in Irish potato production: Evidence from Dedza District, Central Malawi. African Journal of Agricultural Research, 7(12). https://doi.org/10.5897/AJAR11.1463
20. Michel, P. P., Thompson, J., Vorley, W. T., Fox, T., Kanji, N., & Tacoli, C. (2001). Global restructuring, agri-food systems and livelihoods. IIED.

21. Ministry of Finance, Planning and Economic Development. (2004). Poverty eradication action plan, 2004/5–2007/8.
22. Ministry of Finance, Planning and Economic Development. (2005). Background to the budget.
23. Monteiro, M., & Jammer, B. D. (2024). Price dynamics in South African agriculture: A study of cross-commodity spillovers between grain and livestock markets. Sustainability Science, 16(8), 3136. https://doi.org/10.3390/su16083136
24. Munyua, H., & Stilwell, C. (2013). Three ways of knowing: Agricultural knowledge systems of small-scale farmers in Africa with reference to Kenya. Library & Information Science Research, 35(4), 326–337. https://doi.org/10.1016/j.lisr.2013.04.005
25. NAADS. (2020). Opportunities and challenges of Irish potato production (ASSP 2015/6–2019/20).
26. Nkonya, E., Pender, J., Jagger, P., Serunkuma, D., Kayizzi, C., & Ssali, H. (2004). Strategies for sustainable land management and poverty reduction in Uganda (Research Report 133). International Food Policy Research Institute.
27. Pearson Education Ltd. (2004). Uganda primary atlas. Beatrice Adimola, NEMA, Kampala.
28. Ferris, R. S. B., et al. (2003). Performance and growth prospects of Irish potatoes as a component for the development of strategic exports in Uganda.
29. Kaplinsky, R., & Morris, M. (2000). A handbook for value chain research.
30. Richardson, J. T. E. (2011). Eta squared and partial eta squared as measures of effect size in educational research. Educational Research Review, 6(2), 135–147. https://doi.org/10.1016/j.edurev.2010.12.001
31. Ferris, S., et al. (2006). A market facilitators guide to participatory agro-enterprise development.
32. Stephen, B. K. (2011). Inorganic fertilizer in Uganda—Knowledge gaps, profitability, subsidy, and implications of a national policy.
33. Bernnet, T., Thiele, G., & Zschocke, T. (2005). Participatory Market Chain Approach (PMCA) user guide.
34. Todd, B., Patrick, L., Stephen, B. K., Tewodaj, M., & Julian, N. (2012). The supply of inorganic fertilizers to smallholder farmers in Uganda: Evidence for fertilizer policy development.
35. Uganda Bureau of Statistics. (2003). Statistical abstract, 2005.
36. World Bank. (2002). World development report: Markets and development. Oxford University Press.
37. World Bank. (2003). World development report: Sustainable development in a dynamic world: Transforming institutions, growth, and quality of life.
38. Zhu, Y., Yu, Q., Luo, Q., Zhang, H., Zhao, J., Ju, Z., Du, Y., & Yang, Y. (2021). Impacts of climate change on suitability zonation for potato cultivation in Jilin Province, Northeast China. Scientific Reports, 11(1), 13103. https://doi.org/10.1038/s41598-021-91273-5