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Adoption of Connect Potato Variety for Late Blight Diseases Management among Irish Potato Farmers in Mangu Local Government Area of Plateau State, Nigeria

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Abstract

This study assessed the adoption of the connect potato variety for late blight disease management among Irish potato farmers in Mangu Local Government Area of Plateau State, Nigeria. A multi-stage sampling procedure was used to select 136 potato farmers. The data collected were analysed using descriptive statistics and a logit regression model. The findings revealed a high level of awareness (96.0%) and a moderate adoption rate (58.0%) of the Connect potato variety. Farmers generally perceived the variety positively, particularly for its resistance to late blight and its reduced disease control costs. The logit regression results showed that educational status (β = 0.096), household size (β = −0.054), awareness (β = 1.397), annual income (β = 1.209), and extension contact (β = 8.696) significantly influenced adoption decisions. Major constraints identified included high cost of certified seed (65.0%), inadequate extension services (48.5%), perceived production risk (34.0%), and limited seed availability (32.0%). The study concluded that adoption is shaped by socio-economic and institutional factors. It recommends strengthening extension services, improving access to affordable certified seed and sustaining awareness campaigns to enhance adoption and improve potato productivity in the area.

Keywords: Adoption of connect potato variety, late blight diseases of Irish potato farmers

Introduction

Irish potato (Solanum tuberosum L.) is one of the most important food and cash crops globally, contributing significantly to food security, rural income generation, and employment (Majeed et al., 2022). In sub-Saharan Africa, potato production has expanded steadily due to rising population, urbanization, and increasing demand for nutritious staple foods (Tadesse et al., 2021;). Nigeria ranks among the leading potato-

producing countries in West Africa, with Plateau State recognized as the principal production hub owing to its favourable highland ecology, cool climate, and suitable agro-ecological conditions (Ojediran et al., 2025; PotatoPro, 2023). Within Plateau State, Mangu, Bokkos, Barkin Ladi, and Jos South Local Government Areas are widely known for intensive Irish potato cultivation (Ojediran et al., 2025). Despite its economic importance, potato productivity in Nigeria remains relatively low compared with global standards due to a combination of biotic, abiotic, and institutional constraints (Maurya et al., 2025; Majeed et al., 2022). The highest among these constraints is late blight disease, caused by Phytophthora infestans, widely regarded as the most destructive pathogen affecting potato production worldwide (Dong & Zhou, 2022; Majeed et al., 2022; Tadesse et al., 2021). Historically, this pathogen caused the Great Irish Potato Famine, demonstrating its capacity to cause widespread crop failure (Majeed et al., 2022). In Plateau State, the cool and humid climatic conditions favour rapid disease development, infecting both foliage and tubers, often resulting in severe yield losses in susceptible varieties (Tadesse et al., 2021; Cucak et al., 2021).

Scientific studies highlight the high genetic variability and adaptive potential of P. infestans, which enables it to overcome host resistance and develop tolerance to fungicides (Dong & Zhou, 2022; Paluchowska et al., 2022). Consequently, smallholder farmers traditionally rely heavily on repeated fungicide applications to manage late blight (Tiwari et al., 2021). While fungicides reduce disease severity, frequent application increases production costs, reduces profitability, and raises environmental and health concerns (Tiwari et al., 2021; Maurya et al., 2025). Integrated disease management strategies, including the use of resistant varieties, cultural practices, and rational fungicide application, are increasingly recommended as sustainable alternatives (Maurya et al., 2025; Tadesse et al., 2021). Disease forecasting tools have also been shown to improve fungicide efficiency and minimize unnecessary applications (Cucak et al., 2021). Breeding for durable late blight resistance has become central to sustainable potato production worldwide (Angmo et al., 2023; Berindean et al., 2024). Advances in molecular breeding techniques, including marker-assisted selection, genomic selection, and gene pyramiding, have enhanced the development of resistant cultivars (Angmo et al., 2023; Paluchowska et al., 2022). These strategies aim to stack multiple resistance genes to improve durability and reduce the likelihood of resistance breakdown (Berindean et al., 2024).

In Nigeria, a major intervention in late blight management was the introduction of the Connect potato variety in 2014 (Ojediran et al., 2025). Developed by Solana in Germany and introduced through collaborative efforts involving the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the National Root Crops Research Institute (NRCRI) under the Pro-Poor Growth and Promotion of Employment in Nigeria (SEDIN) programme, Connect was aimed at addressing low productivity, disease susceptibility, and limited access to improved seed (Ojediran et al., 2025; GIZ, 2015; NRCRI, 2016). Connect is a high-yielding, late blight-tolerant variety with adaptability to local agro-ecological conditions, making it particularly suitable for smallholder farming systems in Plateau State (Ojediran et al., 2025; Ifeduba et al., 2021). Field assessments in Plateau State demonstrate slower disease progression and superior field performance under late blight pressure compared with traditional varieties

(Ifeduba et al., 2021). Broader institutional efforts led by the International Potato Center further emphasize the development and dissemination of climate-smart, disease-resistant potato varieties to strengthen the potato value chain and enhance farmers' resilience (CIP, 2023).

Despite the availability of improved varieties such as Connect, adoption among farmers is uneven. Adoption of agricultural technologies is influenced by socio-economic characteristics, institutional factors, and farmers' perceptions of relative advantage (Feder et al., 1985; Rogers, 2003). Empirical evidence from Nigeria indicates that education level, extension contact, farm size, access to credit, and participation in development programmes significantly shape adoption decisions (Ojediran et al., 2025). Weak seed systems, limited access to certified seed, and high seed costs remain major barriers to the widespread diffusion of improved potato varieties (Maurya et al., 2025; Agroberichten Buitenland, 2025).

In Mangu Local Government Area, potato farming constitutes a major livelihood activity for smallholder farmers. However, recurrent late blight outbreaks continue to undermine productivity and income stability due to the cool, humid environmental conditions that favour the proliferation of Phytophthora infestans (Ifeduba et al., 2021; Tadesse et al., 2021). Farmers' reliance on frequent fungicide applications increases production costs, reduces profitability, and exposes them to economic and environmental risks (Tiwari et al., 2021; Maurya et al., 2025). Although the Connect potato variety was introduced as a high-yielding and late blight-tolerant cultivar suitable for Plateau State conditions, its level of adoption among smallholder farmers in Mangu remains unclear (Ojediran et al., 2025; Ifeduba et al., 2021). Limited access to certified seed, high seed cost, inadequate extension services, and weak institutional support may constrain wider uptake (Ojediran et al., 2025; Maurya et al., 2025). Furthermore, there is limited empirical evidence on farmers' perceptions of Connect's effectiveness under real farming conditions, and the specific constraints they face in adopting the variety have not been systematically documented. Understanding these gaps is crucial for guiding policy, improving extension services, strengthening seed systems, and promoting sustainable late blight management strategies in Mangu Local Government Area. The study therefore investigates the adoption of the Connect potato variety for late blight management among Irish potato farmers in Mangu Local Government Area, Plateau State, Nigeria. Specifically, the study seeks to assess the level of adoption of the Connect potato variety among Irish potato farmers in Mangu, determine the socio-economic and institutional factors influencing farmers' decisions to adopt the Connect potato variety, examine farmers' perceptions of the Connect potato variety's tolerance to late blight compared with traditional potato varieties and identify the constraints faced by farmers in adopting the Connect potato variety for late blight management.

Methodology

The study was conducted in Mangu Local Government Area (LGA) of Plateau State, Nigeria. The area lies between latitudes 9°00′ and 9°30′ N and longitudes 9°00′ and 9°30′ E within the Guinea Savannah ecological zone. Mangu LGA shares boundaries with Bokkos, Barkin Ladi, Pankshin and Qua'an Pan Local Government Areas. The area

had a population of 294,931 persons according to the 2006 National Population Census, which was projected to about 553,751 persons in 2026 using an annual growth rate of 3.2%. The favourable climate and fertile soils of the area support extensive agricultural activities, particularly Irish potato production, which constitutes an important source of livelihood for rural households. The population of the study comprised all Irish potato farmers in Mangu Local Government Area. Mangu LGA is administratively divided into eleven wards: Ampang East, Ampang West, Chanso, Chakfem, Kombun, Langai, Mangu I, Mangu II, Mangu III, Panyam and Pushit. A multistage sampling technique was employed for the selection of respondents. In the first stage, four wards namely Ampang West, Panyam, Pushit, and Mangu I were purposively selected based on their high concentration of Irish potato farmers, frequent occurrence of late blight disease, accessibility, and active presence of extension services. In the second stage, lists of Irish potato farming communities in the selected wards were compiled with the assistance of extension agents and community leaders, from which communities were selected using simple random sampling. In the third stage, a sampling frame of Irish potato farmers was obtained from the Plateau Agricultural Development Programme (PADP) in the selected wards. The sampling frame comprised 1,360 Irish potato farmers. Applying a sampling proportion of 10%, a total of 136 farmers were selected for the study. The respondents were selected proportionately from each ward based on the number of Irish potato farmers in the sampling frame to ensure adequate representation.

Data collected were analyzed using descriptive and inferential statistical tools. Descriptive statistics, including frequency counts, percentages, means, and standard deviations, were used to describe the socio-economic characteristics of respondents, adoption status, and farmers' perceptions of the Connect potato variety. Perception was measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), and a mean score of 3.0 was used as the decision benchmark for determining positive or negative perceptions. Binary logistic regression analysis was employed to determine the socio-economic and institutional factors influencing the adoption of the Connect potato variety. The dependent variable was adoption status, coded as 1 for adopters and 0 for non-adopters. The logistic regression model was specified as:

$$Ln\left(\frac{Pi-1}{1-Pi}\right) = \beta o + \beta_1 X_1 + \beta_2 X_2 + \beta 3X3 + - - - - \beta n\ Xn + ei$$

Where,

Pi represents the probability that the ith farmer adopts the Connect potato variety;

1−Pi denotes the probability of non-adoption;

β_0 is the intercept;

$\beta_1, \beta_2, \ldots, \beta n$ are the parameters to be estimated;

$X_1, X_2, \ldots$,Xn represent the explanatory variables; and

εi is the error term.

X_1 - - - - n = set of independent variables

X_1 = Age of the farmers (years)

X_2 = Educational status (years spent in school)

X_3 = Farming experience (years)

X_4 = Farm size (hectares)

X_5 = Household size (number of persons in the household)

X_6 = Awareness of improved practices

X_7 = Access to credit (1 if yes, 0 if otherwise)

X_8 = Annual income (Naira)

X_9 = Extension contact (number of visit)

Results and Discussion

Awareness and Adoption Status of Connect Potato Variety

Table 1 presents the level of awareness and adoption of the Connect potato variety among farmers. The results indicate that the majority (96.0%) of the respondents were aware of the Connect potato variety, while only 4.0% reported that they were not aware of it. This suggests that information about the variety has been widely disseminated. The high level of awareness may be attributed to the efforts of research and development institutions, as well as farmer-to-farmer information exchange. This finding is consistent with Udoh et al. (2025), who reported high levels of awareness of improved potato technologies among farmers in Bokkos Local Government Area of Plateau State, where both institutional and informal communication channels facilitated information dissemination.

The results further revealed that 58.0% of the respondents had adopted the Connect potato variety. This suggests that the variety has gained considerable acceptance among Irish potato farmers in the study area, possibly due to its perceived resistance to late blight and its potential yield advantages. The gap between awareness (96.0%) and adoption (58.0%) indicates that awareness alone does not automatically lead to adoption. Other socio-economic and institutional factors may influence farmers' decisions. This observation aligns with Girei (2020), who found that awareness of recommended Irish potato production technologies in Plateau State did not necessarily guarantee adoption, as factors such as access to credit, farm size, and extension contact played significant roles. Similarly, Udoh et al. (2025) reported that although many farmers were aware of improved technologies, adoption levels were constrained

by financial and institutional factors. The moderate adoption rate may also reflect farmers' cautious response to new varieties under conditions of persistent late blight pressure in the Jos Plateau region.

Table 1: Awareness and Adoption Status of Connect Potato Variety among the Farmers

Adoption Status	Percentage (%)
Aware	96.0
Not Aware	4.0
Adopters (1)	58.0
Non-adopters (0)	42.0

Source: Field Survey, 2026

Farmers' Perceptions of the Connect Potato Variety

Table 2 presents farmers' perceptions of the Connect potato variety in Mangu Local Government Area. The results show that farmers generally held positive perceptions of the variety, as four out of the five perception statements recorded mean scores above the decision benchmark of 3.0. Farmers most strongly agreed that the Connect potato variety is less affected by late blight than traditional varieties (Mean = 4.16; SD = 0.79), indicating a strong perception of its disease resistance. This finding is consistent with recent reports that the Connect variety was introduced as a late blight-resistant potato variety to address the persistent challenge of the disease in major potato-producing areas of Nigeria. The variety has been widely promoted for its resistance to late blight and its potential to improve productivity among potato farmers in Plateau State (Ojediran et al., 2025). Respondents also perceived that the Connect variety reduces the cost of disease control (Mean = 3.62; SD = 1.10), produces tubers of better quality than traditional varieties (Mean = 3.41; SD = 1.48), and increases profit from potato farming (Mean = 3.27; SD = 1.44). These results suggest that farmers associate the variety with economic and production benefits. Similar observations have been reported for recently introduced disease-resistant potato varieties, which are valued for reducing dependence on fungicides, improving tuber quality, and enhancing farm profitability (Ojediran et al., 2025; International Potato Center, 2023).

However, the statement that the Connect variety produces higher yields than traditional potato varieties recorded a mean score of 2.93 (SD = 1.50), which is below the decision threshold. This suggests that farmers were not convinced that the variety offers a significant yield advantage over existing varieties. The finding implies that although farmers appreciate the disease resistance and economic benefits of the variety, perceived yield gains may depend on complementary factors such as seed quality, input use, and farm management practices. Overall, the findings indicate that farmers perceive the Connect potato variety favourably, particularly in terms of disease resistance, reduced disease-control costs, improved tuber quality, and profitability.

Table 2: Farmers' Perceptions of the Connect Potato Variety among Farmers in Mangu LGA

Farmers' Perceptions of the Connect Potato Variety	Mean	Standard Deviation
The Connect potato variety is less affected by late blight than traditional varieties	4.16	0.79
Using the Connect variety reduces my cost of disease control	3.62	1.10
The Connect variety increases my profit from potato farming	3.27	1.44
The Connect variety produces higher yield than traditional potato varieties	2.93	1.50
The Connect variety produces tubers of better quality than Traditional varieties	3.41	1.48

Source: Field Survey, 2026.

Decision Rule: Mean ≥ 3.0 = Positive perception; Mean < 3.0 = Negative perception.

Factors Influencing Adoption of Connect Potato Variety in Mangu LGA

Table 3 presents the logistic regression estimates of factors influencing the adoption of the Connect potato variety among farmers in Mangu Local Government Area. The likelihood ratio chi-square value ($\chi^2 = 30.170$) was statistically significant, indicating that the explanatory variables jointly influenced farmers' adoption decisions. The results revealed that educational status, household size, awareness, annual income, and extension contact significantly influenced adoption of the Connect potato variety.

Educational status had a positive and significant effect at the 10 percent level ($\beta = 0.096$; $p = 0.088$). This implies that more educated farmers were more likely to adopt the Connect variety, as education improves the ability to understand and evaluate new agricultural technologies. This finding aligns with the technology diffusion theory of Rogers and corroborates earlier studies by Girei (2020) and Udoh et al. (2025), who reported that education enhances adoption of improved agricultural technologies.

Household size had a negative and significant effect at the 10 percent level ($\beta = -0.054$; $p = 0.057$), suggesting that farmers with larger households were less likely to adopt the variety. This may be due to increased household consumption needs and financial pressure, which reduce the capacity to invest in improved seed technologies. This finding is consistent with Gulak (2021), who observed that household demographic pressure can constrain adoption decisions.

Awareness of the Connect variety had a positive and significant effect at the 5 percent level ($\beta = 1.397$; $p = 0.030$). This indicates that informed farmers were more likely to adopt the variety, as awareness reduces uncertainty about performance attributes such

as disease resistance and yield potential. This supports earlier findings that knowledge of improved and disease-resistant varieties enhances adoption decisions.

Annual income also had a positive and significant influence at the 5 percent level (β = 1.209; p = 0.035), indicating that financially stronger farmers were more able to invest in improved seed varieties and associated inputs. This agrees with Girei (2020) and Udoh et al. (2025), who reported that income positively influences adoption of agricultural innovations.

Extension contact showed a strong positive and significant effect at the 5 percent level (β = 8.696; p = 0.012). This suggests that farmers who had more frequent interaction with extension agents were more likely to adopt the Connect variety due to improved access to information and technical support. This finding corroborates Chingle and Kwon-Ndung (2019), who emphasized the importance of extension services in promoting adoption of improved crop and disease management technologies.

Table 3: Factors influencing adoption of connect potato variety

Variable	Coefficient	Std. Error	Z
Constant	16.895	6.626	2.550**
Age (X1)	-0.072	0.704	-0.100
Educational status (X2)	0.096	0.056	1.700*
Farming experience (X3)	2.558	1.682	1.520
Farm size (X4)	0.370	1.160	0.320
Household size (X5)	-0.054	0.028	-1.900*
Awareness (X6)	1.397	0.642	2.170**
Access to credit (X7)	0.442	0.435	1.020
Annual income (X8)	1.209	0.573	2.110**
Extension contact (X9)	8.696	3.468	2.510**
No. of observations = 136			
LR Chi^2 (9) = 30.170			
Log likelihood = -76.087			
Pseudo R^2 = 0.165			

Note: Statistical significance is based on p-values reported in the table.

Constraints to Adoption of Connect Potato Variety among Farmers in Mangu LGA

Table 4 highlights several factors that hinder the uptake of the Connect potato variety among farmers. The data show that the high cost of certified seed was reported by 65% of respondents as a major constraint. This implies that many farmers may be unable to access or consistently purchase improved seed, which can slow down adoption rates and limit the expansion of the variety, even where awareness and positive perceptions are relatively high. This finding is consistent with studies in Plateau State and other Nigerian contexts, which indicate that smallholder farmers often face financial limitations that restrict access to improved seeds (Udoh et al., 2025; Girei, 2020). High seed costs increase production expenses and reduce the economic attractiveness of adopting new varieties, particularly for resource-constrained farmers.

The limited availability of certified seed was identified by 32% of respondents. This aligns with previous reports highlighting weak seed distribution systems and inadequate supply of quality planting material as key barriers to technology diffusion in Plateau State (Salau et al., 2020; Ojediran et al., 2025). Even when farmers are aware of improved varieties such as Connect, unavailability at the local level constrains adoption.

Inadequate extension services emerged as another significant constraint, cited by 48.5% of respondents. The critical role of extension in promoting awareness, providing technical advice, and supporting adoption of improved potato varieties has been well documented in the Jos Plateau (Chingle & Kwon-Ndung, 2019; Udoh et al., 2025). Limited extension contact in Mangu reduces farmers' knowledge of proper management practices for Connect, including optimal planting, disease management, and post-harvest handling.

Other constraints identified include perceived production risk or uncertainty (34%), lack of adequate information on the Connect variety (28%), and preference for traditional varieties (18%). These socio-psychological and informational factors are important, as farmers often rely on familiarity and prior experience when making planting decisions (Girei, 2020).

Lack of access to credit (15%) and poor market demand or price uncertainty (8%) were less frequently reported but remain relevant. Access to credit facilitates the purchase of improved seed and inputs, while assured market opportunities encourage farmers to adopt higher-yielding varieties (Udoh et al., 2025; Gulak, 2021).

Table 4: Constraints to Adoption of Connect Potato Variety among Farmers in Mangu LGA

Constraints to Adoption	Percentage (%)
High cost of certified seed	65.0
Limited availability of certified seed	32.0
Inadequate extension services	48.5
Lack of access to credit	15.0
Preference for traditional varieties	18.0
Perceived production risk/uncertainty	34.0
Lack of adequate information on Connect variety	28.0
Poor market demand or price uncertainty	8.0

Source: Field Survey, 2026
Note: Multiple responses allowed.

Conclusion and Recommendations

The study concludes that although farmers in Mangu Local Government Area exhibit high awareness and favourable perceptions of the Connect potato variety, particularly regarding its resistance to late blight and reduction in disease control costs, this does not translate into universal adoption, with adoption recorded at 58%. Adoption decisions are largely shaped by socioeconomic and institutional factors, as educational status, household size, awareness, annual income, and extension contact significantly

influenced adoption behaviour. While awareness, income, and extension contact increased the likelihood of adoption, household size negatively influenced it, suggesting that resource constraints within larger households may limit investment in improved seed technologies. The relatively low explanatory power of the model further indicates that other unobserved factors may also influence adoption decisions. Based on these findings, it is recommended that extension services be strengthened through regular training and on-farm demonstrations to enhance farmers' knowledge and practical skills on the use of the Connect potato variety. In addition, government and relevant stakeholders should improve access to affordable certified seed through subsidies and more efficient distribution systems to reduce cost and availability barriers. Efforts should also be made to enhance farmers' income levels and access to credit facilities in order to improve their capacity to invest in improved agricultural technologies.

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