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Willingness to Pay for Improved Irrigation: A Study of Socioeconomic Factors Influencing Sprinkler System Adoption in Southwest Nigeria

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Abstract

Irrigation farming is essential for all-season farming in the areas that usually depend on seasonal rainfall, like Southwest Nigeria. This study assesses farmers' willingness to pay (WTP) for sprinkler irrigation systems in Oyo and Osun States and the socioeconomic determinants of such investment decisions. Using a multi-stage sampling method, data were collected from 476 farmers through structured questionnaires using the Contingent Valuation Method (CVM) and analyzed using descriptive analysis and logit regression. Results show that 75.42% of farmers are willing to pay for sprinkler systems with an average WTP of ₦246,159.7 per acre per season. Key positive influences on WTP include age, access to credit, and cultivation of water-intensive crops like fruit vegetables, while secondary occupations, farming experience, and cereal production negatively impact WTP. The fit is very good, as evidenced by a pseudo-R^2 of 0.92. The study recommends increasing the availability of appropriate credit through the Bank of Agriculture and commercial banks and flexible payment options. Also, educational programs highlighting the benefits of irrigation could encourage traditional farmers to adopt modern practices. The results show that these interventions need financial and knowledge inputs to improve sustainable agriculture and food security in Nigeria.

Keywords: Sprinkler Irrigation, Willingness to Pay (WTP), Contingent Valuation Method (CVM), Agricultural Productivity, Credit Access, Southwest Nigeria, Sustainable Agriculture.

Introduction

Agriculture remains the foundation of Nigeria's economy, sustaining much of the population. The sector contributes about 33% of Nigeria's Gross Domestic Product (GDP) and employs approximately 23% of the labour force (World Bank, 2021; FAO, 2021). In the 1960s and early 1970s, Nigeria was a leading global producer of crops like groundnuts, palm oil, and cocoa. Within Africa, it ranked high in producing staples such as millet, maize, yam, and cassava (Ladan, 2014). However, since the 1970s oil boom, agriculture has suffered from neglect, leading to a decline in its contribution to the economy and a growing reliance on food imports (Akande et al., 2017).

In many Sub-Saharan African countries, including Nigeria, food insecurity is driven by a combination of rapid population growth, poor agricultural infrastructure, and recurrent

climate shocks (UNICEF, 2022). Although the country possesses vast arable agricultural lands, its agriculture relies heavily on seasonal rainfall, leaving it vulnerable to climate variability. Effective irrigation could enable year-round farming, boosting productivity and enhancing food security (Xie et al., 2017).

Nigeria's climate is characterized by high temperatures and fluctuating rainfall, with a marked rainy season from April to October and a dry season from November to March. Rainfall distribution varies across agro-ecological zones, with the south receiving the highest annual rainfall (1,524–2,035 mm over eight to nine months) compared to the middle belt (508–1,524 mm) and the north, which receives less than 508 mm over five to six months (Oriola & Alabi, 2014; Akande et al., 2017; Bibi et al., 2014). During the dry season, many farmers experience declining employment opportunities and face increased food prices due to scarcity (Adelodun & Choi, 2018). Year-round farming through irrigation is essential to mitigate these challenges, as irrigation facilitates enhanced agricultural production, enabling higher crop and livestock productivity and enhancing output predictability (Svendsen et al., 2007).

The sprinkler irrigation system represents a viable solution for enhancing water efficiency and enabling consistent crop production in Nigeria. Sprinkler systems distribute water evenly over fields, conserving water resources and supporting crop yields even in dry seasons. However, the initial cost of installing a basic sprinkler system, estimated at ₦250,000 to ₦500,000 per acre as of 2021/2022, poses financial challenges, especially for smallholder farmers. Nigeria's irrigation infrastructure comprises public irrigation schemes, farmer-owned systems, and floodplain (fadama) irrigation. However, public irrigation schemes face substantial challenges, such as high operating costs and inadequate maintenance, often limiting efficiency.

The introduction of the National Fadama Development Program, with support from the World Bank, attempted to address these limitations by enabling farmers to acquire irrigation facilities such as boreholes, pumps, and tube wells in water-rich Fadama areas (Nkonya et al., 2012). However, the overall impact of these programs on food production has been limited, underscoring the need for further development and investment in irrigation.

Despite growing recognition of the importance of irrigation for addressing food insecurity and enhancing agricultural productivity in Nigeria, there needs to be more research on farmers' willingness to pay (WTP) for modern irrigation technologies, such as sprinkler systems (Fakayode et al., 2021). Existing irrigation programs, such as the National Fadama Development Program, have had limited success due to barriers like high costs, inadequate infrastructure, and poor maintenance (GSSP Notes, 2020). This shows that more research is needed into the socioeconomic characteristics and agricultural practices that influence farmers' decisions regarding the adoption of sprinkler irrigation systems (Ibrahim, 2021). As a result, there needs to be more understanding of the factors driving investment in modern irrigation systems.

Statement of Problem

Nigeria's agriculture sector, once a cornerstone of its economy, has been overwhelmed by declining productivity due to neglect, heavy reliance on seasonal rainfall, and insufficient irrigation infrastructure (Adelodun & Choi, 2018). Despite vast arable land and a growing population exceeding 211 million, the country struggles with food insecurity, affecting 56% of the population in the southwest and up to 84% in the north (Akande et al., 2017).

Irrigation, particularly sprinkler systems, offers a potential solution by enabling year-round farming and improving water efficiency. However, the adoption of sprinkler systems is limited due to high installation costs and financial constraints among smallholder farmers (Fakayode et al., 2021). Existing irrigation programs, such as the National Fadama Development Program, have had limited success addressing these challenges (GSSP Notes, 2020).

This study addresses these problems by examining the socioeconomic factors influencing farmers' willingness to invest in sprinkler irrigation systems, identifying financial constraints and other barriers, and providing insights to help guide policies for increasing irrigation adoption in Nigeria.

Research Questions

1. What are the socioeconomic characteristics of farmers in the study area?
2. How do existing agricultural practices influence farmers' decisions regarding adopting sprinkler irrigation systems?
3. What is the willingness of farmers in Southwest Nigeria to pay for sprinkler irrigation systems?
4. What key socioeconomic factors influence farmers' willingness to invest in sprinkler irrigation?

Research Objectives

1. To examine the socioeconomic characteristics of farmers in the study area and their relevance to irrigation practices.
2. To analyze how existing agricultural practices shape farmers' decisions regarding the adoption of sprinkler irrigation systems.
3. To evaluate the willingness potential of farmers in Southwest Nigeria to pay for sprinkler irrigation systems.
4. To identify the critical socioeconomic factors determining farmers' willingness to invest in sprinkler irrigation systems.

Literature Review

The willingness of farmers to pay (WTP) for irrigation systems has been extensively studied, with research focusing on economic barriers and the role of socioeconomic characteristics. Fakayode et al. (2021) pointed out that farmers with higher household incomes and access to credit are more likely to invest in irrigation technologies. Similarly, Ibrahim (2021) found

that access to credit plays a crucial role in adopting sprinkler irrigation, showing how it helps lower financial hurdles. In addition to financial factors, GSSP Notes (2020) suggested that the perceived benefits of irrigation, such as increased yield and water efficiency, significantly influence farmers' decisions. However, most studies focus narrowly on financial barriers, overlooking psychological and social factors like trust in irrigation systems and the influence of community practices.

Socioeconomic factors have a significant impact on whether farmers use irrigation. Fakayode et al. (2021) discovered that younger farmers, those with larger farm sizes, and those with higher levels of education are more likely to use sprinkler systems. Akande et al. (2017) backed this up, pointing out that family size and farm size make a big difference, as larger operations often necessitate consistent water supplies. Nevertheless, we do not know much about the differences between regions and how gender affects things. Bibi et al. (2014) noted that women often struggle to adopt irrigation technologies due to limited access to financial resources and decision-making authority. Further research is needed to understand how gender roles and local ways of doing things affect farmers' willingness to adopt irrigation technologies.

Barriers to irrigation adoption extend beyond financial constraints. Ibrahim (2021) and Svendsen et al. (2007) highlighted high initial costs, poor infrastructure, and inadequate financing as main roadblocks. Farmers also worry about how well sprinkler systems will work in the long run (Adelodun & Choi, 2018). Institutional and policy-related challenges, such as inefficient implementation and poor maintenance of public irrigation programs like the National Fadama Development Program, further compound these issues (GSSP Notes, 2020). Social acceptability and community involvement in decision-making are often overlooked but play crucial roles in ensuring sustainable adoption.

Public irrigation programs, including the National Fadama Development Program, have had limited success due to poor management and lack of local ownership (Nkonya et al., 2012). Ward and Michelson (2002) noted that such schemes often fail to address the specific needs of smallholder farmers, resulting in low adoption rates despite available infrastructure. Fakayode et al. (2021) suggested that adoption rates could be improved through the provision of financial instruments like subsidized loans, whereas GSSP Notes (2020) proposed public-private partnerships as a way of enhancing facilities' maintenance and management.

Measuring WTP for irrigation systems typically involves the Contingent Valuation Method (CVM), which estimates farmers' willingness to invest in non-market goods through hypothetical scenarios (Hanemann, 1999; Boyle et al., 1996). Although working reliably, CVM does have shortcomings which centre on bias due to the ability to overestimate or underestimate WTP based on perceived benefits or expectation subsidies (Venkatachalam, 2004). Alternatives like revealed preference methods, which analyze actual investments, provide more accurate insights but are less commonly used in irrigation studies.

Research Methodology

Study Area and Context

This study focuses on assessing farmers' WTP specifically for sprinkler irrigation systems in Southwest Nigeria. Sprinkler systems are advantageous in regions with limited water access, as they distribute water evenly over crops, enhancing and supporting year-round agricultural production. However, these systems' high installation and maintenance costs can limit their accessibility for smallholder farmers. As of 2021/2022, the average cost of installing a basic sprinkler in Nigeria ranged between ₦250,000 to ₦500,000 per acre, depending on the equipment quality and additional infrastructure requirements (For example, water pumps and storage).

The study was conducted in Southwest Nigeria, comprising six states: Ekiti, Lagos, Ogun, Ondo, Osun, and Oyo. Predominantly inhabited by Yoruba-speaking populations, each state has a unique dialect, while English is the official language used for communication. Southwest Nigeria lies between longitudes 2°31′ and 6°00′ East and latitudes 6°21′ and 8°37′ N, covering a land area of approximately 77,818 km². The climate in Southwest Nigeria features two primary seasons: a rainy and dry season. Temperatures range between 21°C and 34°C, with annual rainfall between 1500 mm and 3000 mm. The region's agriculture-friendly ecosystem includes freshwater swamps, mangrove forests, and derived savannah, supporting crop and livestock production. While agriculture remains the main livelihood, people in the region also engage in activities like trading, transportation, and civil service.

Sampling Procedure and Sample Size

A multi-stage sampling technique was employed to ensure comprehensive representation across communities with varying access to irrigation. First, Oyo and Osun States were randomly selected within the southwest region. Two Local Government Areas (LGAs) were chosen in each state: Iseyin and Oyo-East in Oyo and Obokun and Oriade in Osun. Within these LGAs, 16 communities were stratified by irrigation access type (public or farmer-owned), and a proportional sample of 500 respondents was drawn, with 476 valid responses after data cleaning.

Valuation Techniques: Contingent Valuation Method (CVM)

The contingent Valuation Method (CVM) was applied to assess farmer's willingness to pay for the sprinkler irrigation systems. CVM is particularly suitable here because it enables researchers to estimate values for non-market goods, such as irrigation facilities, by presenting hypothetical scenarios to respondents (Bockstael et al., 2005). Given sprinkler systems' high initial investment cost, CVM provides a means to gauge farmers' price sensitivity and financial capacity in adopting such technology. In this study, the payment card approach within CVM was used to present respondents with a range of potential payment options for sprinkler system access. By specifying options within the cost range of ₦ 100,000 to ₦ 500,000 per acre per season, we aligned the valuation exercise with realistic cost estimates for sprinkler systems in Nigeria.

Data Analysis

Data from 476 respondents were analyzed using descriptive statistics and logit regression to assess farmers' WTP for sprinkler irrigation. Descriptive statistics summarized vital socioeconomic characteristics, providing a profile of respondents' background and agricultural practices. The logit regression model examined factors influencing WTP as a binary variable. A logit is specified to identify the relationship between socioeconomic variables and WTP for sprinkler irrigation systems.

Explanatory variables include age, education, secondary occupation, farming size, access to credit, and crop types. This model provides insights into each variable's significance and direction of influence on farmers' WTP decisions.

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots\ldots + + \beta_{11} X_{11} + \varepsilon.$$

Where Y= WTP (dummy)

α = constant

β= coefficients

X= independents variables; X_1 = age (years); X_2 = education (years); X_3 = secondary occupation(dummy); X_4= Farming experience(years); X_5= Farm sizes(acres);X_6= access to credits(dummy; X_7 =cereals; X_8 = productionof root and tubers; X_9 = fruit vegetables; X_{10}=fruits; X_{11}= irrigation experience(years). e= error term

Results and Discussions

A: Socioeconomics characteristics of farmers

The socioeconomic characteristics of farmers in the study area highlight notable trends influencing their agricultural practices and attitudes toward irrigation investment. As shown in Table 1, 60.29% of respondents were male, and 67.86% were married, suggesting that family structures and labour demands are significant in the region. The age distribution indicates that most farmers are within their productive years, with an average age of 45. Larger household sizes were common, with an average of five members, providing potential labour support for farming activities.

Education levels were relatively high, with most farmers completing secondary education (48%) and the average years of schooling at 11. This literacy level is beneficial, as it may enhance understanding of irrigation technologies and willingness to adopt them. Farm size and farming experience also play a notable role. The average farm size was 8.5 acres, with 62.39% of farmers cultivating between 5.1 and 10 acres. Larger farm size may allow for diversified crop production, increasing the potential utility of sprinkler irrigation systems. Farming experience varied widely, with half of the respondents having 10 years or less and an average experience of around 15 years. More experienced farmers may have established practices and resources for adopting new irrigation methods.

In terms of primary occupation, 66.88% identified farming as their main activity, while others engaged in trades, business, or civil services. The mix of primary and secondary occupations could affect WTP, as those with alternative income sources may have less

financial dependency on farming. Additionally, 70.94% of respondents reported access to credit facilities, an essential factor that could influence their ability to invest in cost-intensive sprinkler systems. These socioeconomic characteristics suggest that farmers with larger farms, more experience, and access to credit may be better positioned to invest in irrigation systems.

Table 1: Distribution of the respondents by their socioeconomic characteristics

Socioeconomics	Frequency	Percentage	Socioeconomics	Frequency	Percentage
Age			**Farming experience**		
≤30	89	18.70	≤10	234	49.16
31- 40	124	26.05	11-20 years	125	26.26
41- 50	116	24.37	21- 30 years	74	15.55
51- 60	89	18.70	31- 40 years	33	6.93
>60	58	12.18	>40 years	18	2.10
Mean=45.28;			Mean=14.96;		
±SD= 13.57			±SD=12.14		
Gender			**Farm size**		
Male	287	60.29	≤5	17	3.57
Female	189	39.71	5.1- 10	297	62.39
Marital status			10.1-15	96	20.17
Single	69	14.50	15.1-20	66	13.87
Married	323	67.86	Mean=8.59; ±SD=9.53		
Divorced	20	4.20	**Irrigated farmland**		
Separated	23	4.83	≤1acre		
Widowed	41	8.61	1.1-1.5	68	14.29
Household size			1.51-2	54	11.34
≤3	97	20.38	>2	137	28.78
4-6	265	55.67	Mean=4.53; ±SD=5.17	217	45.59
7-9	93	19.54			
>9	21	4.41			
Mean=5.15; ±SD=2.25			**Access to credit**		
Education			No	136	29.06
0 years	41	8.61	Yes	332	70.94
1-6years	73	15.34	**Hired labour**		
7-12 years	228	47.90	No	16	3.36
13-17years	105	22.06	Yes	460	96.64
>17years	29	6.09	**Secondary**		
Mean=10.54;			**occupation**	193	40.55
±SD=4.81			None	157	32.98
Primary occupation			Trading	57	11.97
Farming	317	66.88	Artisan	33	6.93
Artisan	42	15.61	Self-employment	36	7.56
Trading/ Business	36	7.59	Farming	**476**	**100**
Civil servant	12	2.53	**Total**		
Self-employment	17	3.59			
Student	20	4.20			
Total	**476**	**100**			

Source: Field survey,2021

B: The existing agricultural practices used by farmers and irrigation needs

The farmers' agricultural practices in the study area, as presented in Table 2, indicate the specific irrigation needs of farmers. Most respondents (58.86%) are engaged solely in crop production, while 25.11% practice mixed farming. A small portion (12.45%) is involved in livestock farming, with only 3.16% in fish farming. Among crop producers, cereals (46.62%) and root and tuber crops (38.84%) are the most commonly grown, with significant portions also cultivating fruit, vegetables (32.88%) and bananas (35.36%). These crops, especially fruit and vegetables, generally require consistent water access, making reliable irrigation essential to productivity.

Additionally, vocational training and support from government programs play a role in farmers' irrigation practices. About 65.76% of respondents had access to vocational training related to agriculture, which can improve their understanding of modern irrigation technologies. Moreover, 52.63% reported receiving government support, such as subsidized inputs and irrigation infrastructure, which may further encourage irrigation adoption.

Equipment ownership is also relevant, with 6.55% of farmers owning large farming equipment such as tractors, ploughs, and harrows. This factor may influence their capacity to integrate sprinkler systems into their practices. Technical advice sources varied, with 52.52% consulting agricultural officers and 22.9% receiving guidance from development agencies, while a smaller portion relied on fellow irrigation water users. This support network highlights the role of agricultural extension services in shaping farmers' irrigation choices and potentially their willingness to pay for sprinkler systems.

These findings illustrate that farmers' irrigation needs and their openness to investing in irrigation infrastructure are shaped by the types of crops they grow, their access to training, and the extent of government support and resources.

Table 2: Distribution of the respondents based on general agricultural practices

Agricultural practised	Frequency	Percentage
Type of farming		
Crop production	281	58.86
Fish farming	15	3.16
Livestock farming	59	12.45
Mixed farming	119	25.11
Type of crop grown**		
Cereals	207	46.62
Root and tubers	272	38.84
Legumes	138	31.08
Fruit vegetables	146	32.88
Leafy vegetables	146	32.88
Banana	157	35.36
Fruits	111	23.32
Tree crops	122	27.48
Multiple choices		
Vocational training	313	65.76
Owned large equipment	293	61.55
Seek Technical advice		
None	46	9.66
Development agent	109	22.90
Agricultural Officer	250	52.52
Irrigation water users	72	15.13
Total	**476**	**100**

Source: Field survey,2021

C: Distribution of the respondents based on the willingness potential to pay

The findings on farmers' willingness to pay (WTP) for sprinkler irrigation systems reveal significant interest in improving irrigation access. As shown in Table 3, 75.42% of farmers were willing to pay, with an average WTP per acre per season estimated at ₦ 246,159.7. The WTP amounts varied, with 40.76% willing to pay more than ₦ 300,000, 22.06% opting for amounts between ₦ 200,000 and ₦ 300,000, and 37.18% willing to pay ₦ 200,000 or less. This variation reflects differing levels of financial capability and perceived value of the sprinkler systems among farmers.

Payment preferences were also diverse, with 55.00% favouring instalment payments as a manageable way to afford irrigation infrastructure. Another 33.33% preferred contributions to pooled trust funds, while 11.61% supported an additional levy on annual income tax. These preferences suggest that flexible and communal payment options could increase WTP among farmers, accommodating those with limited immediate capital.

The motivation behind WTP underscores the perceived benefits of sprinkler irrigation. For instance, 38.33% of respondents indicated that sprinkler systems would reduce dependence on rain-fed agriculture, while 24.72% cited improved water-use efficiency. Another 36.95%

believed that the benefits of irrigation were worth the investment, showing a general awareness of the productivity gains that could result from reliable water access.

Finally, the distance from water sources also played a role in WTP. The majority (80.04%) of farmers reported that their farms were more than 2km from the nearest water source, with an average distance of 2.31km. This distance highlights farmers' logistical challenges, potentially making on-site sprinklers to minimize water transport needs and maximize productivity.

These insights reveal a strong WTP among farmers and indicate the need for flexible financing options and logistical support to facilitate irrigation adoption.

Table 3: Distribution of the respondents based on WTP potentials

Willingness to pay	Frequency	Percentage
No	117	24.58
Yes	359	75.42
Total	**476**	**100**
Amount willing to pay		
≤ ₦200,000	177	37.18
₦ 200,000- ₦300,000	105	22.06
>₦300,000	194	40.76
Total	**476**	**100**
Mean= ₦246,159.7; ±SD=206832.6		
Mechanism of payment		
Contribution as a trust fund	120	33.33
Addition to annual income tax	43	11.95
Installment payment	197	54.72
Total	**360**	**100**
Reason of willingness to pay		
Reduce dependence on rain-fed	138	38.33
Efficient and effective water usage	89	24.72
Benefit worth its cost	133	36.94
Total	**360**	**100**
Distance to source of water intake(km)		
≤ 1	9	2.00
1.1 - 1.5	54	11.97
1.51- 2	27	5.99
>2	361	80.04
Total	**451**	**100**
Mean= 2.31km; ±SD= 1.89		

Source: Field survey,2021

D: Factor influencing farmers' WTP for improved irrigation facilities

The logit regression analysis in Table 4 identifies several significant factors affecting farmers' WTP for sprinkler irrigation systems, providing a deeper understanding of economic, demographic, and crop-related variables influencing investment decisions. The model achieved a high pseudo R^2 of 0.92, indicating that the included variables can explain 92% of the variation in farmers' WTP for sprinkler irrigation.

The analysis indicates that age is positively associated with WTP, suggesting that older farmers are more inclined to invest in irrigation technologies. The indication may reflect a greater awareness of the long-term benefits of irrigation or a need to reduce the physical demands of farming as farmers age. Studies by Moffat et al. (2012) and Akter (2007) also support the idea that older farmers are more willing to invest in irrigation.

Access to credit also shows a strong positive influence on WTP, as access to financial resources facilitates the affordability of sprinkler systems, allowing more farmers to consider this investment. Similar findings by Addis (2010) and Illukpitiya and Gopalakrishnan (2004) indicate that credit access significantly enhances farmers' willingness to pay.

Fruit vegetable production similarly exhibits a positive association with WTP, likely due to the high water requirements of these crops, which benefit directly from consistent irrigation.

Conversely, several variables demonstrate a negative association with WTP. Secondary occupation negatively impacts WTP, indicating that farmers with additional income may prioritize investment outside agriculture. Farming experience also negatively impacts WTP, suggesting that experienced farmers may rely on traditional rain-fed practices and are less inclined to adopt new irrigation technologies. Cereal production is negatively associated with WTP, likely because cereal crops generally require less intensive irrigation, reducing the perceived value of sprinkler systems for these farmers. Fruit production similarly shows a negative influence, as many fruit crops require less frequent irrigation compared to high-water-demand crops like vegetables.

These findings underscore the influence of economic access (e.g., credit availability) and crop type on irrigation investment decisions. Farmers cultivating water-intensive crops with access to credit or who are older are more likely to invest in sprinkler systems. In contrast, those with diversified incomes relying on traditional methods or crops with low irrigation needs are less willing to pay. This nuanced understanding of WTP drivers provides valuable insights for tailoring policies and programs to encourage irrigation adoption among targeted farmer groups.

Table 4: Factors influencing farmers' WTP for irrigation facilities

Variables	Coefficient	Standard error	Z value
Constant	13.2930	6.3563	2.09
Age	0.1853*	0.0943	1.97
Years spent(education)	-0.0131	0.1366	-0.10
Secondary occupation(dummy)	-5.2969*	3.1300	-1.69
Farming experience	-0.2708*	0.1390	-1.95
Farm size	0.1198	0.0983	0.12
Access to credits	4.5191**	1.9825	2.28
Cereals	-5.4350**	2.2348	-2.43
Root and tubers	-3.5867	2.7093	-1.32
Fruit vegetables	9.5013***	3.2061	-2.96
Fruits	-15.5649**	5.8664	-2.65
Irrigation experience	0.0226	0.1579	0.14

Source: Field survey,2021

*** significant at 1%

** significant at 5%

*significant at 10%

No of observation= 476

LR chi (11)= 290.98

Prob>chi2= 0.0000

Pseudo R^2= 0.9176

Log likelihood=13.072267

Comparative Analysis with Other Regions

These findings align with studies from other developing regions, such as Ethiopia and Bangladesh, where access to credit and age are significant factors influencing farmers' WTP for irrigation facilities (Akter, 2006; Addis, 2010). In Ethiopia, for example, older farmers were more willing to pay for irrigation to enhance productivity and reduce labour intensity (Addis, 2010). These parallels underscore the importance of financial accessibility and targeted support in promoting irrigation adoption among smallholder farmers.

Policy Implications

The farmers' willingness to pay in southwestern Nigeria indicates that sprinkler-type irrigation systems can be adopted to increase sustainable productivity in agricultural activities. In relation to this, institutions such as the Bank of Agriculture (BOA) and the Nigerian Agricultural Cooperative and Rural Development Bank (NACRDB) need to increase the availability of credit facilities that target irrigation investments, particularly those relevant to smallholder farmers. Also, commercial banks with disbursed agriculture-oriented loan facilities, like First Bank of Nigeria, Union Bank, and Access Bank, can develop specific financing products with government agencies that might lower the interest rates or repayment duration for irrigation investments.

Additionally, introducing flexible payment structures such as instalments and pooled funds would increase the affordability of irrigation technologies, leading to a broader scope of farmers adopting sprinkler systems. Targeted education and training on the long-term benefits of irrigation, mainly through organizations like Agricultural Development Programs (ADP) and the Federal Ministry of Agriculture and Rural Development (FMARD) will encourage a shift in the mindsets towards modernized practices. These strategies will improve agricultural productivity and food security and increase resilience among farmers in the face of climate variability, supporting sustainable development across the region.

Conclusion

This study underscores the significant potential for adopting sprinkler irrigation systems among farmers in Southwest Nigeria, with 75.42% of respondents expressing a willingness to pay (WTP) and an average WTP of ₦246,159.7 per acre per season. The findings reveal that age, access to credit, and the cultivation of water-intensive crops such as fruit vegetables positively influence farmers' willingness to invest in sprinkler irrigation. Conversely, factors such as secondary occupations, extensive farming experience, and the production of cereals and fruits negatively impact WTP, reflecting financial constraints or a perceived lower necessity for intensive irrigation.

The high pseudo R^2 value of 0.92 indicates that economic and practical considerations are key drivers of farmers' WTP. These insights are crucial for policymakers, financial institutions, and agricultural extension services, offering a roadmap for interventions to address financial, infrastructural, and educational barriers. By fostering the adoption of sprinkler irrigation, year-round farming can be achieved, leading to enhanced productivity and improved food security in Nigeria.

RECOMMENDATIONS

To facilitate the widespread adoption of sprinkler irrigation systems and maximize their impact on agricultural productivity and food security, the following strategies are recommended:

1. **Enhanced Financial Support**:
- Develop affordable, targeted credit facilities through institutions such as the Bank of Agriculture (BOA), the Nigerian Agricultural Cooperative and the Rural Development Bank (NACRDB), and commercial banks like First Bank, Union Bank, and Access Bank. These facilities should feature lower interest rates and flexible repayment terms.
- Introduce flexible payment mechanisms, including instalment plans or pooled trust funds, to improve affordability for smallholder farmers.
2. **Educational and Awareness Programs**:
- Launch training initiatives under Agricultural Development Programs (ADPs) and the Federal Ministry of Agriculture and Rural Development (FMARD) to educate farmers on the long-term benefits of sprinkler irrigation systems.

- Implement awareness campaigns to encourage traditional rain-fed farmers to adopt modern irrigation techniques, emphasizing productivity, income stability, and climate resilience.

3. **Government and Institutional Support**:

- Strengthen collaborations between government agencies and financial institutions to provide subsidies or low-interest loans for irrigation equipment.
- Expand and enhance agricultural extension services to provide technical support and guidance for effective irrigation practices.

4. **Infrastructure Development**:

- Improve access to water resources by investing in the construction and maintenance of irrigation infrastructure, ensuring proximity to farming communities.
- Facilitate public-private partnerships to make sprinkler irrigation systems more affordable and accessible to farmers.

5. **Targeted Policy Interventions**:

- Design policies that address the needs of specific farmer groups, such as older farmers, those cultivating water-intensive crops, and farmers with access to credit.
- Address barriers faced by farmers engaged in secondary occupations or cultivating low-irrigation-demand crops by highlighting the broader benefits of irrigation technologies.

These recommendations aim to overcome the challenges limiting irrigation adoption, enabling sustainable year-round farming practices and bolstering food security in Southwest Nigeria.

References

Addis, T. (2010). *Economic valuation of irrigation water: The case of the Erere-Woldia irrigation project in Harari Regional State, Ethiopia* (Master's thesis). Addis Ababa University.

Adelodun, B., & Choi, K. (2018). Review of the evaluation of irrigation practice in Nigeria. *African Journal of Agriculture Research, 13*(40), 2087–2097.

Akande, A., Costa, C. A., Mateu, J., & Henriques, R. (2017). Geospatial analysis of extreme weather events in Nigeria (1985–2015) using self-organizing maps. *Advances in Meteorology, 2017*, Article ID 8576150. https://doi.org/10.1155/2017/8576150

Akter, S. (2006). Farmers' willingness to pay for irrigation water under government-managed small-scale irrigation projects in Bangladesh. *Journal of Bangladesh Studies, 9*(1), 21–31.

Bibi, U., Oriola, E. O., & Alabi, M. O. (2014). Assessing river basin system potentials to enhance sustainable irrigation farming operations and management in Nigeria. *Journal of Environmental Research and Development, 8*(3), 515–522.

Bockstael, I., Naney, A., & Freeman, M. (2005). Welfare theory and valuation: Edited in the *Handbook of environmental changes* (Vol. 2). Elsevier.

Fakayode, O., Adeyemi, O., & Ajayi, A. (2021). Examining the impact of irrigation systems on agricultural productivity in Nigeria. *Nigerian Journal of Agricultural Economics, 15*(2), 122–134.

FAO. (2021). *Statistical Yearbook: World Food and Agriculture.* Food and Agriculture Organization of the United Nations. Retrieved from https://openknowledge.fao.org

GSSP Notes. (2020). *Irrigation systems in Nigeria: Typologies and smallholder constraints*. Nigeria Strategy Support Program, International Food Policy Research Institute. Retrieved from https://nssp.ifpri.info

Hanemann, M. W. (1999). The economic theory of WTP and WTA. *Journal of Economic Perspectives, 14*(3), 23–46.

Illukpitiya, P., & Gopalakrishnan, C. (2004). Decision-making in soil conservation: Application of a behavioural model to potato farmers in Sri Lanka. *Land Use Policy, 21*(4), 321–331.

Ibrahim, M. (2021). Socioeconomic factors influencing irrigation adoption among smallholder farmers in Sub-Saharan Africa. *African Journal of Rural Development, 8*(1), 44–58.

Ladan, S. I. (2014). An appraisal of climate change and agriculture in Nigeria. *Journal of Geography and Regional Planning, 7*(9), 176–184.

Moffat, B., Motlaleng, G. R., & Thukuza. (2012). Households' willingness to pay for improved water quality and reliability of supply in Chobe Ward, Maun. *Botswana Journal of Economics, 8*(12), 45–61.

Nkonya, E., Phillip, D., Mogues, T., Pender, J., & Kato, E. (2012). Impacts of community-driven development programs on income and asset acquisition in Africa: The case of Nigeria. *World Development, 40*(9), 1824–1838. https://doi.org/10.1016/j.worlddev.2012.04.004

Oriola, E. O., & Alabi, M. O. (2014). Assessing river basin system potentials to enhance sustainable irrigation farming operations and management in Nigeria. *Journal of Environmental Research and Development, 8*(3), 515–522.

Svendsen, M., Ewing, M., & Msangi, S. (2007). Re-inventing irrigation in Molden et al. (Eds.), *Water for food, water for life*. Earthscan.

UNICEF. (2022). State of food security and nutrition in the world. United Nations Children's Fund. Retrieved from https://www.unicef.org

Venkatachalam, L. (2004). The contingent valuation method: A review. *Environmental Impact Assessment Review, 24*(1), 89–124. https://doi.org/10.1016/S0195-9255(03)00138-0

Ward, F., & Michelson, A. (2002). The economic value of water in agriculture: Concepts and policy applications. *Water Policy, 4*(5), 423–446. https://doi.org/10.1016/S1366-7017(02)00039-9

World Bank. (2021). *Agriculture, forestry, and fishing, value added (% of GDP).* World Bank national accounts data and OECD National Accounts data. Retrieved from https://data.worldbank.org

Xie, H., You, L., & Takeshima, H. (2017). Invest in small-scale irrigated agriculture: A national assessment on the potential to expand small-scale irrigation in Nigeria. *Agricultural Water Management, 193*, 251–264. https://doi.org/10.1016/j.agwat.2017.08.016