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Assessment of Irrigation Systems for Dry Season Vegetable Production in Bauchi L.G.A of Bauchi State, Nigeria

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Abstract

The study on the "Assessment of Irrigation System for Dry Season Vegetable Production in Bauchi L.G.A OF Bauchi state, Nigeria" was conducted to evaluate the effectiveness and sustainability of irrigation practices in enhancing vegetable cultivation during the dry season. Bauchi L.G.A faces significant challenges related to water scarcity, which hinders agricultural productivity, particularly during the dry season. The research data was gathered through well-structured questionnaires administered to 100

randomly selected farms during the dry farming season. The data collection method employed descriptive statistics. The findings of this study revealed that the irrigation system in Bauchi L.G.A play a crucial role in sustaining vegetable production during the dry season. However, several challenges were identified, including the high cost of equipment maintenance, water scarcity, water supply limitations, and limited technical knowledge among farmers. In conclusion, the study highlighted strategies aimed at promoting sustainable dry season vegetable production to alleviate poverty and eliminate hunger in the study area. For improving dry season vegetable production in Bauchi L.G.A of Bauchi state, Nigeria it is recommended that investing in the maintenance and upgrading of the existing irrigation infrastructures, providing training and extension services to farmers on efficient irrigation practices, and promoting community-based water management initiatives will surely improve dry season vegetable production in Bauchi L.G.A of Bauchi state, Nigeria. These measures can help enhance the resilience of vegetable cultivation during the dry season, contribute to food security, and improve the livelihoods of local farmers in the region.

Introduction

Background of the study

Irrigation is an essential production input for the majority in Nigeria vegetable growers to achieve adequate yields and suitable crop quality. A

large percentage of vegetable production and farm income would not be realized without the aid of irrigation (Kara *et al.,* 2019). Therefore, because of the important contribution of irrigation to vegetable production and farm incomes, any major adjustment in irrigation system design, management practices, or use could have a large impact on vegetable profits. Irrigation is a major cost component of any vegetable enterprise (Balana, *et al.,* 2020). Dry season vegetable irrigation system plays a key role in the economics of Nigeria as a basic source of food, income, and employment generation especially in the off-season of rainfall agriculture. Vegetables are widely grown as a cheap and reliable source of protein, vitamins, zinc, and iron in most of sub-Sahara Africa (Osei *et al*., 2017). In resource-poor diets, they make up between 30% and 50% of iron and Vitamin A (Balana *et al.,* 2020). In Nigeria, vegetables such as tomatoes, okra, pepper, cabbage among others are widely grown along the banks of the river which stretch across villages, towns, and cities mostly by small scale farmers. This practice has been going on for decades, providing employment and income particularly during the long dry season to the growing population.

Problem statement/Justification

Irrigation costs of vegetable crops have increased significantly during the past 3 decades, primarily as a result of rising energy costs, higher interest rates, and inflation. In many areas, water has become a limited resource due to increased competition among agricultural and nonagricultural users, thus resulting in tighter restrictions on its use by regulatory agencies (Bidzakin and Fialor, 2018). However, inadequate resources, socio-economic and agricultural production variables restrict the growth of vegetable production (Osei *et al.*, 2017). As a result of recent increases in irrigation costs, limited water supplies, and new vegetable irrigation technology, many vegetable growers are considering alternative irrigation systems for new installations and/or the replacement of traditional irrigation systems as they either wear out or become cost-prohibitive. The selection of a vegetable irrigation

system is influenced by economic, biological physical, and institutional/regulatory considerations. Specifically, this paper evaluates the economics of owning and operating three different irrigation systems for the production of fresh-market vegetables on sandy soils with naturally high water in Nigeria.

Significance of the study

Vegetables are widely grown as a cheap and reliable source of protein, vitamins, zinc, and iron in most of sub-Sahara Africa (Osei *et al*., 2017). In resource-poor diets, they make up between 30% and 50% of iron and Vitamin A (Bekele, *et al.,* 2021). Vegetable production is done mainly during the rainy (major cropping) season in Nigeria. During this season, vegetables are easy to grow as water is available and farmers can avoid the cost of irrigation (Bekele, *et al.,* 2021). Vegetable production is one of the most important enterprises of production systems in Nigeria because vegetables are an important component of human diet and they can be easily cultivated on small areas. Whereas, the Food and Agricultural Organization of the United Nations (FAO) and the World Health Organization (WHO) recommended a daily vegetable intake of 200 g per person, the Nigerian.

Aim and Objectives of the Study

The main aim of this study is to assess the irrigation systems for dry season vegetable production in Bauchi L.G.A of Bauchi state, Nigeria.

The specific objectives of the study are:

i. To examine the irrigation system for dry season vegetable production in parts of Bauchi L.G.A of Bauchi State, Nigeria.
ii. To assess the challenges faced by the irrigation farmers in dry season vegetable production in parts of Bauchi L.G.A of Bauchi State, Nigeria.

Scope of the Study

The research study is restricted to dry season vegetable farmers in only parts of Bauchi metropolis of Bauchi state. The communities include: Gwallagan

Mayaka, Lushi, Bayara and Gudun Sayawa. The reason why the research is restricted to those communities is because studying from those places will be easier to collect data. In addition, limitation of time and financial implications will not permit the researchers to study beyond those places.

METHODOLOGY

Area of the Study

This study was conducted in Bauchi local government area (L.G.A) of Bauchi state. Bauchi is located between the *Latitude: 10° 18′ 37.15″ N Longitude: 9° 50′ 37.97″ E*. It is situated within northern Guinea Savannah ecological zone of Nigeria and has elevation of 623m = 2043 fit above the sea level. The climatic condition of the area is characterized by two season, dry and wet. The wet season last for five-month May to September. While the dry season begins in October and ends in April 7 months (Sylvester *et al*., 2015). The mean annual rainfall varies between 600mm to 1300mm, while the temperature ranges from 18. 33° C – 28. 39° C with April as the hotter month and January as the coldest. Month relatively Humidity is highest in August having the value of 66% and lowest in February with 16.5% the major language spoken in Bauchi L.G.A is Hausa.

Data sources

The data collected for this study were gathered through primary and secondary sources.

Primary Source

These are information gathered through personal interviews and Questionnaire that the researcher administered to the farmers in the study Area.Therefore, a structured questionnaire was developed and administered randomly among farmers within the selected communities (Gwallagan Mayaka, Lushi, Bayara and Gudun Sayawa).

Secondary Source

The secondary source encompass information gathered from published textbooks, journals, seminar papers, and documented materials in libraries.

Research Design

A proportional sampling techniques was used in the selection of the sample size. Four area that are known for dry season vegetable farming were selected within Bauchi L.G.A, in this four (4) selected areas were (100) questionnaires were distributed to assess the irrigation system for dry season vegetable production in the area.

Method of Data Collection

The instrument that has been used for collection of data was a well-structured questionnaires developed by the researchers.

Method of Data Analysis

We conducted an analysis using descriptive statistics, specifically focusing on frequency and percentage, to evaluate the irrigation farming system for dry season vegetable production in Bauchi L.G.A.

RESULTS AND DISCUSSION

Socio-economic Characteristics of Dry Season Vegetable Farmers

The study analyzed the socio-economic characteristics of dry season vegetable farmers, and the results are presented in Table 1. The data indicated the percentage of married farmers in each location: 76.7% from Gwallagan Mayaka, 88% from Lushi, 75% from Bayara, and 84% from Gudun Sayawa. These findings are in agreement with previous research conducted by Alade and Ademola (2013), which also reported a majority of farmers being married. It suggests that married individuals are more actively involved in farming compared to the youth.

The respondents' age distribution reveals that the majority of farmers (43.3% from Gwallagan Mayaka, 44% from Lushi, 30% from Bayara, and 32% from Gudin Sayawa) fall within the 20-30 years' age range. This observation aligns with Alade and Ademola's (2013) findings, indicating that most actively engaged farmers belong to this age group. This trend also implies that there is a decreasing interest among the youth in farming activities, leading them to seek employment in urban areas.

In terms of education, the data in Table 1 shows that a high percentage of farmers have attained a high school education, with 76.7% from Gwallagan Mayaka, 92% from Lushi, 85% from Bayara, and 88% from Gudun Sayawa. However, a lower percentage indicated having attained a college/university education, with 23.3% from Gwallagan Mayaka, 8% from Lushi, 15% from Bayara, and 12% from Gudun Sayawa. These findings are consistent with the research conducted by Oknola (2009) and Agamu (2006), emphasizing the influence of education on the adoption of new agricultural technologies.

Table1: Socio-economic Characteristics of Dry Season Vegetable Farmers in Bauchi Metropolis

Biodata of the		**Locations**		
Respondents	**Gwallagan Mayaka**	**Lushi**	**Bayara**	**Gudun Sayawa**
N	**30**	**25**	**20**	**25**
Mean age (%)				
20-30	6.7	32	35	20
31-40	26.7	44	30	28
41-50	23.3	12	25	32
50-above	43.3	12	10	16
Marital status (%)				
Married	76.7	88	75	84
Single	23.3	12	25	16
Year of experience (%)				
< 1 year	13.3	40	15	16
1-3 year	20	24	25	20
3-5 year	16.7	16	25	24
> 5 years	50	20	35	40
Educational background (%)				
High school	76.7	92	85	88
College/University	23.3	8	15	12

Source: Field survey, 2023.

N = Number of respondents; - Indicates no response.

Method of Irrigation of Crop land

Based on the responses received, it appears that the majority of farmers in the area practice flood irrigation (100%) for all their crops. They water the soil based on its moisture content or the specific needs of the crops. Other methods of irrigation were not reported by any respondents. The improvement of efficiency for dry season production aligns with Obuobie's findings (2003), which suggest that farmers are less concerned about the source or quality of water and more focused on its uninterrupted availability. Regarding watering crops, the majority of farmers in Gwallagan mayaka (63.3%), Lushi (64%), Bayara (35%), and Gudin Sayawa (16%) water their crops more than 5 days apart. On the other hand, Gwallagan Mayaka (10%), Lushi (16%), Bayara (30%), and Gudun Sayawa (20%) practice watering every 2 days, as reported by Usman and Bakari (2013). The key to successful irrigation farming is the availability of water, and according to respondents, the major source of irrigation water is the river, which is considered good by 100% of the community.

Table 2: Method of Irrigation of Crop land

Biodata	Location			
	Gwallagan Mayaka	Lushi	Bayara	Gudun Sayawa
N	**30**	**25**	**20**	**25**
Method of irrigation (%)				
Flood irrigation	85.9	90.5	92	88
Sprinkler irrigation	-	-	-	-
Drip irrigation	-	-	-	-
Watering crop (how often)				
Daily	-	-	15	-
Every 2 days	10	16	30	20
Every 3 days	26.7	20	20	64
More than 5 days	63.3	64	35	16
Available water (%)				
Excellent	-	-	-	-
Good	95	92	89	88.7

Source: Field survey, 2023.

N = Number of respondents; – Indicates no response.

Vegetable crop calendar during the dry season in Bauchi metropolis

The dry season in Bauchi metropolis begins in early November and lasts until the end of April. This extended period of dry weather provides an opportunity for farmers to cultivate vegetable crops that thrive in such conditions; the process of nursery bed preparation starts in November, 2023. During this time, farmers establish nursery beds where they sow seeds and nurture seedlings until they are ready for transplantation. The transplanting phase typically occurs between November and December. After the seedlings have grown sufficiently in the nursery beds, they are carefully transplanted to the main cultivation area. Weeding is carried out in January to remove unwanted weeds that compete for nutrients and space with the crops. Effective weeding ensures better yield and reduces the risk of pests and diseases.

The harvest season for the vegetable crops begins at the end of February and continues until April. During this period, farmers collect the matured vegetables from the fields. According to (BSADP, 2023) calendar of crops.

Table 3: Vegetable crop calendar during the dry season in Bauchi metropolis

BAUCHI LGA	Rainfall		Vegetable			
Bauchi	**Start of dry season** Early November	**Ending of dry season** Ending of April	**Nursery bed** November	**Transplanting** Nov/ Dec	**Weeding** January	**Harvesting** Ending of February till April

Source: BSADP, 2023.

Decision of Irrigation and Factors to Consider in Switching to Difference Crop.

Gwallagan mayaka, the soil moisture is 33.3%, Lushi 16%, Bayara 15%, and Gudinsayawa 5%. The choice of crops is based on their specific water needs.

Decision of irrigation depends on the moisture content of the soil. For Gwallagan Mayaka requires 66.7% soil moisture, Lushi 84%, Bayara 85%, and Gudun Sayawa 95%. Farmers should consider these factors before deciding to switch to different crops.

Olowa (2016) found that increasing crop production depends on several factors. However, the majority of farmers are inclined to switch crops due to the cost of equipment. For Gwallagan Mayaka, 5% consider switching, while for Lushi, it's 15%, Bayara 85%, and Gudun Sayawa 25% are open to the idea. Conversely, for Gwallagan mayaka, 95%, Lushi 85%, Bayara 15%, and Gudun Sayawa 75% are not willing to switch because of the high equipment costs.

The factors considered in switching crops were based on responses received. Over 56% of the respondents emphasized cost, followed by 30% for water conservation and 20% for improvement. This highlights that the cost of equipment plays a crucial role in farmers' decisions, which aligns with Swindell's (2005) findings that farmers often face challenges with price fluctuations.

Table 4: Decision of Irrigation and Factor to Consider in Switching of Different Crop

	Location			
Factors	**Gwallagan Mayaka**	**Lushi**	**Bayara**	**Gudun Sayawa**
N	**30**	**25**	**20**	**25**
Decision to irrigate crops				
Base on soil moisture	66.7	84	85	95
Base on crop needs	33.3	16	15	5
Consider switching to difference crop (%)				
Yes	5	15	85	25
No	95	85	15	75
Factors influence to switch (%)				
Cost	40	56	45	50
Ease of use	20	8	20	10
Water conservation	20	24	30	27
Improved crop yield	20	12	5	13

Source: Field survey, 2023.

N = Number of respondents; – Indicates no response.

Crops grown and Challenges faced in the study area.

According to the respondent's crops planted in irrigation farming are growing specific crops in each location during the dry season. Here are some notable observations:

i. Onion (*Allium cepa*): Grown by 26.7% of respondents in Gwallagan Mayaka, 60% in Lushi, 45% in Bayara, and 16% in Gudun Sayawa.
ii. Corn (*Zea mays*): Cultivated by 57% of respondents in Gwallaganmayaka, 72% in Lushi, 45% in Bayara, and 64% in Gudun Sayawa.
iii. Carrot (*Daucus carota*): Grown by a substantial percentage in all locations, with 90% in Gwallagan mayaka, 84% in Lushi, 65% in Bayara, and 76% in Gudin sayawa.
iv. Cabbage (*Brassica oleracea*): Grown by 63.3% of respondents in Gwallagan Mayaka, 60% in Lushi, 55% in Bayara, and 60% in Gudun Sayawa.
v. Lettuce (*Lactuca sativa*): Cultivated by 43.3% of respondents in Gwallagan Mayaka, 12% in Lushi, 23% in Bayara, and 32% in Gudun Sayawa.
vi. Cucumber (*Cucumus sativus*): Grown by 76.3% of respondents in Gwallagan Mayaka, 40% in Lushi, 16% in Bayara, and 20% in Gudun Sayawa.
vii. Spinach (*Spinacia oleracea*): Cultivated by 26.7% of respondents in Gwallagan Mayaka, 55% in Lushi, 45% in Bayara, and the data is incomplete for Gudun Sayawa.

Based on the data gathered from farmers in Gwallagan Mayaka, Lushi, Bayara, and Gudun Sayawa, several challenges have been identified in dry season vegetable farming. The primary challenge is the high cost of maintaining irrigation equipment, with percentages ranging from 45% to 86.7% across the different areas.

Additionally, water scarcity posed a significant obstacle, affecting Gwallagan Mayaka (8%), Lushi (60%), Bayara (25%), and Gudun Sayawa (11%). Respondents also reported issues with inefficient water use in Gwallagan mayaka (8%), Lushi (67%), Bayara (10%), and Gwallagan Sayawa (12%).

Table 5: Crops grown and Challenges faced in dry season vegetable farming in Bauchi metropolis.

Parameter	**percent respondents**			
	Gwallagan Mayaka	**Lushi**	**Bayara**	**Gudun Sayawa**
N	**30**	**25**	**20**	**25**
Crops (%)				
Onion (*Allium cepa)*	26.7	60	45	16
Corn (*Zea mays*)	57	72	45	64
Carrot (*Daucuscarota*)	90	84	65	76
Cabbage (*Brassica oleracea)*	63.3	60	55	60
Lettuce (*Lactuca sativa*)	43.3	12	23	32
Cucumber (*Cucumus sativus*)	76.3	40	16	20
Spinach (*Spinacia oleracea*)	26.7	55	45	30
Challenges faced (%)				
Maintenance of equipment	84	86.7	50	45
Water scarcity	8	60	26	11
Insufficient water	8	67	10	12

Source: Field survey, 2023.

N = Number of respondents; – Indicates no response.

Summary

The research successfully achieved its specific objectives, which involved describing and assessing the irrigation system for dry season vegetable production in Bauchi L.G.A, understanding the challenges faced by farmers in dry season vegetable farming, and integrating the dry season vegetable production in the study area. The study employed the descriptive method of

sampling, using frequency and percentage to gather data. Four areas, namely Gwallagan Mayaka, Lushi, Gudun Sayawa, and Bayara, were randomly selected from Bauchi L.G.A, a total of 100farmers in irrigation system for dry season vegetable production participated in the study.

Data were primarily collected through structured questionnaires, and direct observations were also used. The research findings revealed common challenges faced by farmers in sustainable irrigation system for dry season vegetable production, including high equipment costs, insufficient water supply for irrigation, and water scarcity. These findings align with previous studies, such as the work of Senyolo *et al*. (2009).

Conclusion

In conclusion, the assessment of the irrigation system for dry season vegetable production in Bauchi L.G.A has provided valuable insights into the current state of agricultural practices in the region. The findings of the study have highlighted both the potential and challenges associated with irrigation-based agriculture in mitigating the adverse effects of the dry season.

The study revealed that while irrigation systems have the potential to significantly increase vegetable production during the dry season, there are several factors that need to be addressed to fully exploit these benefits. Issues such as the availability of water resource, the efficiency of irrigation methods, and the knowledge and capacity of local farmers play crucial roles in determining the success of such initiatives.

Recommendations

In light of the discussion and conclusions drawn, the following recommendations are made:

- Water resource management: it is essential to establish sustainable water management practices to ensure a consistent and reliable water supply

for irrigation. This may involve the construction of reservoirs, rainwater harvesting system, or the implementation of water-saving technologies.

- Farmers training and capacity building: farmers in Bauchi L.G.A should be provided with training and capacity-building programs to enhance their knowledge and skills in irrigation techniques, crop management, and pest control during dry season vegetable production.

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