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Assessment of Water Management Practice for Irrigation Around Daura-Mai'adua Area Katsina State Nigeria

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Abstract

The Study assesses the Water Management Practices for Irrigation in Daura–Mai'adua areas. Inconsistencies in Water Management for irrigation constitute a lot of problems to the farmers in the study area which needs to be investigated. The research aimed at assessing the Water Management practices for effective irrigation practice in the area. Stratified Random and availability sampling techniques were used for selection of the sampling site and respondents respectively. Data was collected through the use of questionnaire, semi- structured interview, field observation and field measurements. Descriptive statistic, X^2Homogeneity and Analysis of Variance (ANOVA) were carried out to analyse the data using SPSS software. The result revealed that, about 65.9% of the respondents use dams as their major source of irrigation water. The study also revealed that, poor management, inadequate machines, improper channels, inadequate implementation of modern techniques were identified as limiting factors hindering effective management of irrigation water. However, there is significant different of limiting factors among the three-study site at $p = 0.05$. It was concluded that indigenous method of irrigation management is the dominant irrigation management with very few modern ones (Sprinkler and Drip) in the area. Among recommendation, there is need for Community and government intervention to provide user frame work for the Dams to control erosion and siltation so as to restore the Dams with adequate water for users.

Keywords: *Water Management, Practice, Irrigation*

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Background to the Study

World population is expanding rapidly, with corresponding increasing pressures on food supply and the environment, competition for water is becoming critical, and environmental degradation related to water usage is serious. Availability of water is becoming a limiting factor for agricultural production in many parts of the world. (World Water Assessment Programme, 2015). Developing countries are experiencing high rates of population, urban, and income growth which is putting tremendous pressure on available water resources. These information's were ascertained by United Nations, (UN 2015) that the global population is increasing continuously and is expected to reach the 9.7 billion in 2050 from the current 7.4 billion. These 2.3 billion increases in population needs about 60% more foods in the next 35 years Food Agricultural Organisation. (FAO, 2013).

The provision of irrigation is vital for achieving food security (Bowmer and Meyer, 2014, Das *et al*, 2015). At the same time, growing populations make it necessary to ensure that crop yields continue to rise. Therefore, developing countries must find ways to grow more food with the same or less water consumption. There are three principal ways to do this: Improve water use efficiency (yield/water consumed); Reduce water quality degradation; and Reduce return flows into saline sinks. All three options require better on-farm water management, which depends upon improved quality and reliability of water delivery service to the field (Burt and styles, 1998). Water has to be applied in the right amounts, at the right time, in order to achieve the right crop results. At the same time, users of water should avoid waste of this valuable resource and be in sympathy with the environment as a whole. Understanding, measuring and assessing how water flows around the farm, and recognizing how farming practices affect flows, will help farmers to manage water efficiently and reduce pollution risks in the environment of men. (FAO, 2013).

Careful and effective water management will form environmental considerations, as well as helping the farmer to continue producing profitable crops. Farmers aim to guarantee that the safety and quality of the water which they use will satisfy the highest expectations of the food industry and consumers. In addition, on-farm practices should ensure that water management is adopted under sustainable economic, social, environmental conditions (Das *et al*, 2015). The Use of Irrigation Technologies and Water Management Practices have suggested that switching to more-efficient irrigation technologies has often been proposed as a solution to declining water supplies. For example, sprinklers such as centre pivot and drip irrigation could reduce irrigation application rates per unit of land relative to gravity irrigation by distributing water more evenly, reducing percolation below the root zone and eliminating runoff (Negri and Hanchar, 1989 in Huang *et al.,* 2016).

Literature Review

Water Management

Water resources management is essentially the modification of the hydrological cycle for socio-economic development. It involved not only the beneficial use of water resources but also the prevention, avoidance or minimisation of the effect of water excess (flood) or deficiency (drought) (Douglas, 1973). Water management is the activity of planning,

developing, distributing and optimum utilisation of water resources under defined water polices and regulations. It includes: management of water treatment for drinking water, industrial water, sewage or wastewater, management of water resources, management of flood protection, management of irrigation, and management of the water table.

The need for water is universal. It is present everywhere, and without water, life, as we know it, will simply cease to exist. Water is constantly in motion, passing from one state to another, and from one location to another, which makes its rational planning and management a very complex and difficult task under the best of circumstances. Water may be everywhere, but its use has always been constrained in terms of availability, quantity and quality. Water problems of the world are neither homogenous, nor constant or consistent over time. They often vary very significantly from one region to another, even within a single country, from one season to another, and also from one year to another (Olokesusi, 2006).

Solutions to water problems depend not only on water availability, but also on many other factors, among which are the processes through which water is managed, competence and capacities of the institutions that manage them, prevailing socio-political conditions that dictate water planning, development and management processes and practices, appropriateness and implementation statuses of the existing legal frameworks availability of investment funds, social and environmental conditions of the countries concerned, levels of available and usable technology, national, regional and international perceptions, modes of governance including issues like political interferences, transparency, corruption, etc., educational and development conditions, and status, quality and relevance of research that are being conducted on the national, sub-national and local water problems (Beshah, Pekka and Tapio, 2016).

The current and the foreseeable trends indicate that water problems of the future will continue to become increasingly more and more complex, and will become more and more interweave with other development sectors like agriculture, energy, industry (Biswas, 2004 and Beshah, Pekka and Tapio, 2016).

Water Management for Irrigation

The process of determining and controlling the volume, frequency and application rate of irrigation water to plant is planned in efficient manner. Irrigation water management primarily aims to control the volume and frequently of irrigation water applied to crops so as to meet the crop moisture requirement at minimum losses of water, soil plant nutrients or energy. The U.S. Department of Agriculture identifies improvements in water management as one of the primary agricultural policy objectives for the 1990's (USDA, 1994). Irrigation Water Management (IWM) involves the managed allocation of water and related inputs in irrigated crop production, such that economic returns are enhanced relative to available water. Conservation and allocation of limited water supplies is central to irrigation management decisions, whether at the field, farm, irrigation district, or river basin level. Irrigation water is managed to conserve water supplies, to reduce water-quality impacts, and to improve producer net returns (Pahl-Wostl, 2016).

Forms of Water Management for Irrigation

The water management approaches may be indigenous or modern management. National governments and partner organizations used modern techniques in managing water resources (Schelwald-van der Kley, 2009). These modern systems are deemed to replace the indigenous or traditional ones in search of sustainable services. In fact, the dynamism of management which is influenced by various factors, including technology, climate change, population growth, and education level of the people in charge requires flexible systems that are adaptable to different situations. However, striving to achieve sustainability by introducing new technologies and ignoring the existing local knowledge is of no use to the people who dominantly depend on traditional practices (Beshah, Pekka and Tapio, 2016). The communities which have long-served traditional management systems are not easily willing to work with the imported (modern) techniques if they have not been involved in the development of those systems, or if their social components are interpreted wrongly or even ignored. In such cases, traditional people prefer to remain observers rather than become involved as real participators. In consequence, modern water systems are used while the services are operational, but the communities return to unimproved sources after the services break down (Beshah, Pekka and Tapio, 2016).

Challenges for Water Management

Water management is facing major challenges due to increasing uncertainties caused by climate and global change and by fast changing socioeconomic boundary conditions. More attention has to be devoted to understanding and managing the transition from current management regimes to more adaptive regimes that consider environmental, technological, economic, institutional and cultural characteristics of river basins. This implies paradigm shift in water management from a prediction and control to a management as learning approach (Pahl-Wostl, 2016).

Sustainable water management has become an issue of major concern over the past decade. It has become increasingly clear that the pressing problems in this field have to be tackled from an integrated perspective considering environmental, human and technological factors and in particular their interdependence. To emphasise the need for adopting an integrated approach the notion of "water system" is introduced encompassing all environmental (Pahl-Wostl, 2016). Factors of the resource base, technologies and human beings Water management is a purposeful activity with multiple and partly conflicting goals to maintain and improve the state of water resources.

Water as a resource must be allocated among competing uses. In many areas the available water is polluted and hence cannot be used for many purposes or requires expensive treatment. Improved water management can also help minimize offsite water-quality impacts of irrigated production. Irrigated agriculture affects water quality in several ways, including higher chemical use rates associated with irrigated crop production, increased field salinity and erosion due to applied water, accelerated pollutant transport with drainage flows, degradation due to increased deep percolation to saline formations, and greater in stream pollutant concentrations due to reduced flows. Strategies to improve the Nation's water quality must

address the effect of irrigation on surface and groundwater bodies (National Research Council, 1996). Furthermore, water management practices have been developed over thousand decades by local communities to enable them cope with water scarcity and further improve their livelihood.

The knowledge of coping with water shortage has been passed from generation to other but it is recently faced with many challenges in the contemporary world. Some of identified challenges includes: Water bodies that are critical to cultural and physical well-being are being polluted by our forces beyond their control; Very limited research effort has been undertaken to improve these traditional technologies to better cope with the stresses improved as a result of population growth, desertification, and other external social and economic driving force (United Nation Convention to Convert Desert, 2005); Many successful local water management practices do not receive due recognition from government and development organization when they are designing support and there is therefore a risk that these practice will get lost (MOSTE, 2015); Local communities are not included meaningfully in water policy and planning process, their cultural and spiritual understanding about water are either misunderstood or simply ignored; Investment into research, evaluation, maintenance and deployment of traditional technologies is virtually non-existent (United Nation Convention to Convert Desert, 2005).

Environmental Threat to Water Management

The threat of irrigation induced soil and groundwater solemnization is increasing and becoming a major issue in hydrology, agronomy, and soil sciences (Valipour, 2015). The yield reductions in various crops due to water logging and solemnisation have been reported by researchers around the world (Milroy *et al.*, 2012), presented an assessment on the sources, causes and extent of water logging and salinity problems in the Indus Basin. Water logging also causes huge environmental damages in the form of damaged roads, buildings and other structures, and spread of endemic diseases. Heavy seepage losses from the unlined canal networks, percolation from irrigation fields, poor water management, inadequate drainage, low lying areas, and under-exploitation of poor-quality groundwater are the specific factors contributing to the problems of excess water and solemnization (Goyal *et al.*, 2005).

Farmers' Participation and Involvement in Water Management

The failure of smallholder irrigation schemes in Africa has been linked to weaker participation of water users (FAO, 2015). Farmers 'participation in the establishment, rehabilitation and management of smallholder irrigation schemes in Ethiopia, Zimbabwe, Mozambique, South Africa and Tanzania have largely been peripheral as the engagement of farmers by the development agencies in hectors often lacked materiality, (FAO, 2015). The weak participation of farmers in most African countries left behind debilitating dependency among the farmers, weak water user associations and poor operation and maintenance practices that made smallholder irrigation schemes unsustainable (Gomo, 2010; Namara *et al.*, 2011; Mutambara*et al.*, 2014a). The long history of irrigation development in Asia reveals that farmers need to be involved in the planning decisions, contribute at least a part of the capital costs, and have full responsibility for operation and maintenance to make the smallholder irrigation schemes sustainable (Mukhenji and Facon,2013).

Definitions of Irrigation

Irrigation is the application of controlled amounts of water to plants at needed intervals. Irrigation helps grow agricultural crops, maintain landscapes, and re-vegetate disturbed soils in dry areas and during periods of less than average rainfall. Irrigation also has other uses in crop production, including frost protection (Snyder and Melo-Abreu, 2005). Suppressing weed growth in grain fields (Williams, Roberts; Hill; Scardaci and Tibbits, 2014) and preventing soil consolidation (International Association of Hydrological Science, 2004).Irrigation systems are also used for cooling livestock, dust suppression, disposal of sewage, and in mining. Irrigation is often studied together with drainage, which is the removal of surface and sub-surface water from a given area. In contrast, agriculture that relies only on direct rainfall is referred to as rain-fed or dry land farming.

Types of Irrigation

There are several methods of irrigation. They vary in how the water is supplied to the plants. The goal is to apply the water to the plants as uniformly as possible, so that each plant gains the amount of water it needs, neither too much nor too little. The types of irrigation practices include; *Surface irrigation, Micro irrigation and Drip Irrigation.*

Methodology

A reconnaissance survey was carried out in order to be more acquainted with the irrigated area under investigation as well as to acquire information on the size and number of farms that are presently under irrigation in the area. Through this survey, information pertaining the number of farmer and size is approximately 700 farmers, 1000 farmers and 350 farmers in Sabke, Daberan and Koza Dams irrigated area respectively (Table 1).

Table 1: Number of Sample Farmers per Dam Irrigated Area

S/N	Dam	Total Farmers	Number of Sample Farmers
1	Sabke	700	114
2	Daberan	1000	163
3	Koza	350	57
4	Total	2050	334

Source: Fieldwork, 2024

The research covered three earth Dams addressing the issue of water management practices for irrigation in the areas as: Daura, around Daberan earth Dam and Mai-Adu'a around Sabke and Koza earth Dams. These areas have been stratified into three according to the dam's location and user's relationship with the dams.

A sample size indicates the proportion of a research population adequately selected to represent the study population, the population happen to be 2050 farmers as acquired from the authorities in charge of the irrigation system of the area. The sample size of this study was (n = 334) and it was determined using Yamane formula for calculating sample size (Tejada and Punzala, 2012).

Sample allocation to the dam areas (Stratums) proposed by Bowley captured by Pandy and Verma (2008)

$\mathbf{n_1 = n \times Ni/N}$ $\mathbf{n_2 = n \times Ni/N}$ $\mathbf{n_3 = n \times Ni/N}$

= 334 x 700/2050 = 334 X 1000/2050 = 334 X 350/2050

= 114 = 163 = 57

The research employed availability sampling techniques for selecting each farmer in each stratum.

The type of data to be collected and use in this research are field data; which are information collected from the participants through the interviews, observation and data from field measurement. While the achieved data are information that is used in part of the literature review: such as peer review journals, text books, unpublished researches among others. The data were collected using questionnaire and interviews after pilot study, were information on sources of water for irrigation, method of water application on farmland and problems associated with managing irrigation water in the areas of study were identified.

Findings

Research Question 1

What are the sources of water for irrigation in the area?

Table 2: Sources of Water for Irrigation in the Areas Location

		Koza	Sabke	Daberan	
Sources of Water	Dam	[illegible]	30.8%	31.4%	65.9%
	Stream	2.1%	.6%	2.4%	5.1%
	Open Well	9.3%	1.2%	10.5%	21.0%
	Ditch	.3%	.3%	0.0%	.6%
	Borehole	1.5%	1.5%	4.2%	7.2%
	Others	.3%	0.0%	0.0%	.3%
	Total	17.1%	34.4%	48.5%	100%

Source: Field Work, 2024

The result above reveals that 65.9% of the respondents use dam as the source of their water for irrigation. About 5.1% of the respondents use stream as their source of water and 21% of the respondents use open-well to provide water to their farms. Only 0.6% of the respondents use Ditch as their source of water for irrigation. While 7.2% of the respondents use borehole as their source of water for irrigation. About 0.3% of the respondents use other sources of water, such as *Tafki* and *Babban Rami* (Table 2). The result implies that Dam is the major source of water for irrigation in the areas. It also shows high usage of dam water for irrigation in Daberam and Sabke areas with 31.4% and 30.8% respectively and minimal usage of dam water for irrigation in Koza area with only 3.6% usage.

Research Question 2
What are the methods of water application on Farmland in the Irrigation Areas?

Table 3: Method of Water Application on Farmland in the Area.

Method of Water Application on Farmland	Irrigation Area			Total
	Koza	Sabke	Daberan	
Via Pipes	12	53	71	136
Via Channel	5	19	19	43
Using Containers/can	39	43	70	152
Others	1	0	2	3
Total	57	115	162	334

Source: Field Work, 2024

Above table (3) indicates that 136 of the respondents apply water to their farms using pipes and 43 of the respondents apply water to their farms via constructed open channels from the source. The high numbers of respondents 152 apply water on their farm using watering cans only 3 of the respondents uses other methods for applying water in their farm land for irrigation. This implies majority of the respondents use containers and other watering cans for applying water in their farm land for irrigation practices.

Research Question 3
What are the problems associated with managing irrigation water?

Table 4: Limiting Factors Facing Various Irrigation Water Management Practices in the Area

Limiting Factors	Irrigation Area			Total
	Koza	Sabke	Daberan	
Inadequate Machines	.9%	1.2%	2.4%	4.5%
Unreliable Supply	2.1%	.6%	14.7%	17.4%
Improper Channels	1.2%	.3%	0.0%	1.5%
Inadequate Implements and Modern Techniques	6.0%	15.0%	19.8%	40.7%
Lack of Knowledge	.3%	2.1%	9.9%	12.3%
No Response	6.6%	15.0%	1.8%	23.4%
Poor Management	0.0%	.3%	0.0%	.3%
Total	17.1%	34.4%	48.5%	100%

Source: Field Work, 2024

Table (4) above reveals that 4.5% of the respondents are facing challenges of machines inadequacy, where by many farmers use one single machine to water their farms in rotation. 17.4% of the respondents are facing problems in terms of reliability of water supply by irrigation water management practices. Inadequate channels are another limiting factor facing irrigation water management in the area, 1.5% of the respondents are having problems with water channelling from the dam, where by some farmers are sharing single channel from dam to their farms. 40.7% of the respondents are having the problem of inadequate implement of

modern technique where by resorting to local method of water application using bucket and wheel-barrow. 12.3% of the respondent's lack knowledge to manage the water for irrigation. 0.3% indicated a poor management of water for irrigation. in the study area. About 23.4% of the respondents are silence on the response for limiting factors facing irrigation management This implies that improper water management can have a serious negative implication in socioeconomic development of the dry areas.

Discussion

From the major finding of the research, sources of irrigation water were identified as Dam, besides stream, open well, ditch and borehole in the area. However, the use of containers and other watering Cans were identified as the methods of water application on the farmland in indigenous methods of storing water in all he irrigation area. Inadequate irrigation facilities such as fond, dumps, sprinkler, inadequate knowledge and skills of crops water regulation, and erosion and siltation were identified as the major problem of water management in the areas.

Conclusion

In conclusion, water management practices do have biophysical gains of which communities can benefit from specifically in water generation for irrigation purposes. From the findings it revealed that sources of irrigation water were Dam, Stream, Open Wells, Ditch, and Borehole. Dam is the major source of irrigation water in the areas, with borehole been the lowest because of it cost effective. It is also indicated that the methods of water application on farmland for irrigation were done by the use of watering Containers and other watering cans.

Recommendations

i. There is need for government and NGO'S to fully intervene with regard to usage frame work of the Dams.
ii. There should be more water management practices and proper means of enlighten farmers and feed them with information on new improved water management practice, and they should be fully involved in decision making regarding the water management of the areas.
iii. The authorities should be organizing sensitizations and workshop to farmers on proper utilization of water and irrigation facilities so as to conserve irrigation water and consequently avoid water losses.

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