

SOCIO-HYDROLOGICAL STUDY OF WATER USERS' PERCEPTIONS ON THE MANAGEMENT OF IRRIGATION SCHEMES AT TOMAS IRRIGATION PROJECT, KANO, NIGERIA

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ABSTRACT

Classical irrigation management entails the coordination of water source and infrastructures to equitably, efficiently and sustainably share water among farmers. Although human unlawful actions are reportedly linked to the poor performance of irrigation schemes, these activities are typically ignored in the analysis of irrigation water management as perceived as non-quantifiable. To overcome this notion, the concept of socio-hydrology was proposed and aimed at exploring, modelling and coupling the interactions and feedbacks between the impact of humans and various water management sectors (including irrigation schemes). The research aim was to get insights into how human actions impacted water systems, and how water systems could, in turn, affect humans in terms of their well-being and decisions. Before embarking on socio-hydrological study, a preliminary study needs to be conducted to historically ascertain the inherent relationships between stakeholders and water systems. Herein, we report water users' perceptions on the management of Tomas Irrigation Project, Kano, Nigeria and the data was generated using structured questionnaire, site visit and analyse using descriptive statistics and percentage. The study revealed that majority of the farmers have no confidence on water managers' competence as 46%, 43%, 11% and 0% of the farmers scored managers as poor, fair, good and very good respectively. Conversely, water managers accused irrigators to lack enthusiasm and provided evidence of unlawful water usage. 32% of the farmers are illegally abstracting water using pumps as their farm plots were initially considered non-irrigable. In average, 42% of the users do not participate in the maintenance of the infrastructures. Although the scheme was designed to supply water through gravity, only 29% of the farmers received water using gravity while 39% obtained water using pumps and 32% using both pumps and gravity. About 50% of the farmers do not receive the required amount of water, and 29% complain bitterly about the current water allocation method. This study, therefore, recommended the need for sensitization and awareness campaigns to enlighten water users to understand that their participation in the management, operation and maintenance of Tomas Irrigation Project is not an option but a necessity.

Keywords: Irrigation schemes, Socio-hydrology, Users' perception, Water management, Water users

1 INTRODUCTION

Irrigation scheme is a system made up of water source, infrastructures, allocation rules and human activities that entangled water sharing among farmers. Irrigation practice has long existed particularly in water-scarce regions where the annual rainfall is not sufficient for crop production. Irrigation schemes have no doubt contributed tremendously toward increasing food and fiber production in order to meet the demand of the ever-increasing world population [1]. The primary reason for irrigation schemes is not only to supplement water available for the crop but also to grow crops that are not feasible during the rainy season [2]. Thus, considering the rate at which the demand for food increases, irrigation schemes should be managed and operated efficiently to make the best use of the limited water resources. To achieve effective irrigation project management, it is essential to adopt periodic appraisals to assess the level of its functionality over time [3]. One of the approaches for checking how successful an irrigation system is being operated is by routine assessment of various

system components. The aim is to evaluate some performance metrics such as efficiencies, adequacy, equity, resilience, sustainability, vulnerability and infrastructures to ascertain the level of system functionality. For example, assessing the performance of water allocation is to evaluate water conveyance networks to determine some associated problems and suggest possible solutions to obtain reliable discharges [1]. The proffered suggestions and recommendations can then be adopted for subsequent actions by the managers, users and other water-related organizations. Routine assessment is, therefore, a prerequisite to routine maintenance in order to achieve an effective and sustainable irrigation scheme management and operation.

Irrigation scheme is a system made up of many sub-systems coupled together to efficiently, equitably and sustainably supply water to farmers using a prescribed operating rule. Therefore, a failure of a given subsystem or component may subsequently affect the overall system performance. Moreover, irrigation schemes are operated and managed by human beings, where human behaviour-related issues could further complicate the problems. According to Zakari et al. [4], freshwater is increasingly becoming scarce worldwide not only due to natural causes (e.g. droughts) but also human-causes (water wastage behaviour and imprudent management strategies) which increases demand. Despite these, conventional irrigation system performance assessments focuses mainly on one or two sub-systems at a time, such as water quality, conveyance systems, reservoir, water allocation or infrastructures [1, 5]. Furthermore, the effects of stakeholders (managers, users, neighbouring community and other water-related organizations) are typically ignored. These highlighted problems could lead to faulty or scanty information to the relevant authority in identifying the actual location, causes and effects of the prevailing problems. These, among other reasons, instigate the need for a holistic assessment, taking human-behaviour into consideration, to ensure effective utilization of the limited water resources [6]. Unlike traditional irrigation system performance assessment which largely focused on water or physical infrastructures, this paper presented the insights gained from a preliminary study on the water users perceptions. The study assessed and analyzed water users' views and perceptions on the management of an irrigation scheme, and the outcomes are to serve as baseline data for future human-water interaction study as expounded in the concept of socio-hydrology [7].

Socio-hydrology is a newly introduced interdisciplinary field of study which encompasses many disciplines, including hydrology, sociology, ecology, philosophy, anthropology, engineering and economics [7]. Socio-hydrology aimed at identifying the dynamics, complexities, interactions, co-evolutions and feedbacks between the coupled human and various water systems including irrigation schemes [6]. Usually, the socio-hydrological study begins by exploring the historical dynamics of human-water interactions and then couple the driving variables that act as the missing links between the human and water subsystems [8, 9]. Traditionally, hydrologic studies seek to assist water management decision-making without considering the human impacts quantitatively. It is now realised that data generated from physical hydrologic science alone have limitations in diagnosing the resulting water management problems [10]. With the aim to promote and encourage researches in the field of socio-hydrology, the International Association of Hydrological Sciences (IAHS) launched a hydrological decade 2013–2022 with the theme “*Panta Rhei – everything flows: Change in Hydrology and Society*” [6, 7, 9]. The main aim of *Panta Rhei* is to reach an improved understanding and interpretation of the processes governing the water management sectors (such as irrigation schemes etc.) in connection with rapidly changing human societies [11].

Since the introduction of socio-hydrology, several pioneered models have been developed that explore human-water dynamics in various facets of water systems to get insights on how water management problems co-evolve alongside human influences [12]. Such complex interactions and feedbacks between human and water subsystems are very crucial in water management but remain inadequately understood and ignored in the conventional hydrology [7, 13]. Although concern for the nature alongside economic productions have been historically embodied in water management laws [14], diverse human ethical issues have not been explicitly incorporated [15, 16, 17, 18, 19]. For example, success of irrigated agriculture is not only related to the water availability and vast arable land but also effective water management and maintenance of infrastructures through farmers' participation [20, 21]. Since the focus of water management is increasingly shifting from command and control to a more decentralize and user-oriented approaches, stakeholder engagement is no longer an option but a

necessity in any sound water governance [22]. In line with this, ethically oriented irrigation management culture needs to be created by incorporating the diverse stakeholders' norms of values (behaviour) into irrigation management. This is to explore, comprehend, conceptualize, model, simulate and assess the various alternatives or scenarios of the impacts of human behaviour on irrigation management performance to inform policy-makers.

Before embarking on any socio-hydrological study, a preliminary study needs to be conducted to historically ascertain the inherent relationships between stakeholders and water systems. This paper presents the insights gained from a baseline socio-hydrological assessment of the Tomas Irrigation Project (TIP), Kano, Nigeria. The study assessed and analyzed water users' views and perceptions on the management of the TIP. The main aim was to identify the actual source, causes and effects of problems affecting TIP, thereby informing relevant authorities for subsequent action. The findings could also serve as baseline information for further socio-hydrological studies in the area.

2 MATERIALS AND METHODS

2.1 Location of the Study Area

The study was conducted at Tomas Irrigation Project (TIP), Kano, Nigeria during the 2019/2020 irrigation season. TIP is located along Kano – Daura road at Longitude $8^{\circ}31'08''$ – $8^{\circ}34'21''$ E, Latitude of $12^{\circ}18'57''$ N – $12^{\circ}19'31''$ N and altitude 453 m above sea level [23]

2.2 Water Users' Perceptions about the Management of Tomas Irrigation Project

Water users' perceptions were collected using questionnaires and information was also generated using a site visit to observe some prevailing physical conditions. A set of questions was prepared and the water stakeholders were asked to select or state their view on each of them. A total number of 123 questionnaires were administered, 41 each to the stakeholders situated at upstream, midstream and downstream of the TIP. The questionnaires were characterized into three (3) targeting the perceptions of the water users' on: i) Problems affecting the project, ii) Participation in the management, operation and maintenance of the project, iii) Water managers' competence, expertise and performance.

2.3 Results Analysis

The data generated was analyzed using descriptive statistics (i.e. the proportions of the water users that opted to choose or select one option over the others for each of the questions).

3 RESULTS AND DISCUSSIONS

3.1 Problems Affecting Tomas Irrigation Project

Based on the information generated using the questionnaire and site visit, numerous problems are currently affecting the Tomas Irrigation Project (TIP). For example, about 32% of the irrigators have been found to illegally abstract water by pumping as their farm plots were initially considered non-irrigable. Besides, although the TIP was designed to supply water use of gravity, only 29% of the farmers received water using the gravity. While 32% and 39% of the farmers obtained water using both gravity and pumps and by pumping only respectively. About 50% of the farmers do not receive the required amount of water particularly those situated downstream of the irrigation project. Some of the major reasons for this problem is that a significant number of upstream and midstream water users were found to either over-irrigate or abstract the water unlawfully. A larger proportion of the water conveyance infrastructures were also found to be silted and infested by weeds as observed during the site visit. Moreover, more than 29% of the farmers expressed unhappiness with the water allocation method currently used. The water allocation method used at TIP is the so-called '*continues flow allocation method*' which has no restriction mechanisms. Therefore, water users have access to water throughout the season, and this led those at upstream and midstream to over-irrigate their farm plots and hence low discharges at the downstream distributary and field channels.

There are an increased number of distributary canals that were silted-up. This is the result of slacked maintenance activities as lamented by the farmers who unanimously stressed that 3 years ago, the situation was not as bad as it is at time of the survey (December, 2019). This highlighted the danger

of abandoning irrigation infrastructures and if such poor maintenance culture is not brought to an end with immediate effect, it may lead to abandoning the whole scheme. It is, therefore, observed that the business-as-usual method of water management at TIP need to be changed with new approaches that encourage participation of all the actors.

3.2 Participation in the Management, Operation and Maintenance of Tomas Irrigation Project

A sequence of enquiries was conducted from which farmers' views on the factors affecting their willingness to participate in the management, operation and maintenance of the irrigation project was assessed. Fundamentally, the most common problem stressed by the farmers was that of water supply (on-farm delivery in terms of adequacy and reliability) and maintenance of irrigation infrastructures. In addition to that, very few water users' acknowledged that they have problems with deciding when to, and how much to irrigate which are known as the determinants of efficiency [2]. On average, 42% of the users do not participate in the maintenance of the infrastructures. This agrees with the proclamation by Pete [24], that most farmers in Nigeria have no culture of maintenance particularly in the public irrigation schemes. Similar to what Haruna [19] obtained at Kano River Irrigation Project (KRIP), about 55% of water users of TIP hold the opinion that irrigation scheme management, operation and maintenance is an exclusive responsibility of the government. Majority of the irrigators were mainly worried about their farm output, income and quality of life. More than 70% of the farmers at TIP perceived that their responsibility is to procure farm input before the commencement of farming activities, and this should be within their financial capability while the government is responsible for the operation and maintenance of the irrigation project.

One of the shocking findings is that water users perceived that government funds are limitless such that government is capable of sponsoring and making everything at their disposal free of charge. Based on this, water users hold the belief that government can create an enabling environment through policy alterations and resolutions that prescribed and force current and future administrations to sponsor programs of activities, including management of irrigation schemes and providing farm input at a subsidized price. However, some farmers perceived that Water Users Associations (WUAs) are self-organized and co-operative associations of irrigators who willingly wish to undertake water management activities to assist water managers who are being paid by the government. In addition to interface between the individual or group of irrigators and the government officials in resolving conflicts, dialogues and policy alterations. This group of farmers were found to pay more attention to their farming activities and seldom participate in the management, operation and maintenance of the TIP. These, among other reasons, further deteriorated both water management and physical conditions of TIP. Site visit revealed that a larger proportion of farmers, particularly those at downstream, had to abandon farming activities, which is similar to what has been observed at Watari Irrigation Project (WIP) more than a decade ago [2, 5, 25].

Generally, water users perceived that irrigation schemes are to serve as water shortfall (drought) relief that provides not only water for supplementary irrigation, but also other support services. Base on this, farmers complained bitterly about why irrigation agency personnel who are employed and paid by the government, are forcefully shifting system management and maintenance responsibilities to them. This instigated the need to educate and enlighten water users to understand that sustainable irrigation management is not one party concern. Such sensitization intervention can inculcate the concept of '*participatory*' in the water users' minds. This can guide water users to see themselves as the custodians and have a collective responsibility to manage the irrigation scheme jointly with public agencies, private institutions, national and international organisations, civil societies, and religious and traditional leaders.

Following are some of the proposed fundamental aspects that every water user need to understand:

- a) That irrigation agency staff and other non-governmental officials are there to educate, guide and support them to attain maximum farm production and hence, to improve their financial status and quality of life.

- b) That the prescribed laws and regulations enacted to govern irrigation schemes are there to ensure the sustainable system operation and resolve disputes and conflicts among water users and between water users and agency staff and other neighbouring community.
- c) That cooperative functions including participation in the management, operation and maintenance of the irrigation infrastructures is not an option but a necessity in order to achieve effective and efficient irrigation management.
- d) That collection of irrigation water fees is not an act of extorting money from the farmers unnecessarily but to be used for the maintenance of the system.
- e) That researchers, non-governmental organizations (such as UN and World Bank projects), civil society, religious and traditional rulers and extension support services are all there to foster profit-oriented agricultural production.

3.3 *Water managers' competence, expertise and performance*

Majority of the water users lost confidence in water managers' competency as 46%, 43%, 11% and 0% of the users scored managers as poor, fair, good and very good respectively. One of the questions asked whether the water managers work with farmers on the field to guide or advise them, to which more than 90% of the farmers responded 'No' and added that they seldom see water managers and operators on the field unless when they are busy working on their personal farm plots. In addition, all the respondents stated that they do not receive any training, directives or awareness on how and/or when to apply water to their crops. When the farmers were asked to assess the level of water managers' and operators' performance on the scale of poor to very good, 54%, 42%, 4% and 0% of the farmers scored water managers as poor, fair, good and very good respectively. Water users' perception of the water managers' and operators' performance was terrible as more than half of the users scored them poor.

About 39% of the users also questioned the technical advice they receive from the irrigation experts and doubted much on the expertise of irrigation agency staff. About 63% of the farmers perceive that water managers are not doing their primary duty and proclaimed that water managers are more effective when it comes to the collection of water charges. They also complained on the delayed response to their needs by the irrigation authority personnel. These, among other complaints from water users highlighted the need to undertake an in-depth socio-hydrological study in the area to establish the actual problems thereby proposing solutions for equitable, efficient and sustainable sharing of water among farmers.

4 CONCLUSIONS

A baseline study on the water users' perceptions of the current state of water management at Tomas Irrigation Project (TIP) was conducted during the 2019/2020 irrigation season. The study revealed poor water management, infrastructural decay and stakeholders' conflict as the major problems affecting the TIP. Some of the underlying issues that led to these problems include poor sensitization programs to facilitate farmers' involvement in the management of TIP. This can be achieved through sensitization and awareness campaigns using workshops and seminars to train farmers on how to resolve conflicts, efficient use of limited water resources and to facilitate water users' involvement in irrigation management activities such as agency-farmer joint management. It is, therefore, recommended that the business-as-usual methods of water management at TIP need to be changed with new ones that encourage a more stakeholders' participation. An insight on how to handle these problems can be gained when an in-depth socio-hydrological study is conducted in the TIP, thereby proposing solutions for equitable, efficient and sustainable sharing of water among farmers.

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