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Assessing How Environmental Impact Assessment Shapes the Management of Selected Irrigation Schemes in Baringo County

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Abstract

Globally, irrigation schemes offer numerous benefits, which includes improvement of livelihoods of rural farmers, enhancing food security and promoting agricultural productivity. However, irrigation schemes can also have negative environmental and social effects that need careful consideration and management regarding the use of Environmental Impact Assessment (EIA). EIA is a process used to identify, predict, evaluate, and mitigate the potential negative environmental and social effects of proposed developments including irrigation schemes. This study sought to assess to evaluate the efficacy of EIA process in managing selected irrigation schemes funded by Baringo County government, Kenya. A descriptive survey research design was used to collect both qualitative and quantitative data. Purposive random sampling was used to select all the 10 irrigation schemes and stratified sampling technique was used to select 192 respondents who were beneficiaries in all irrigation schemes. 10 irrigation scheme managers, 4 County irrigation engineers, and 4 environmental experts were selected purposively. Questionnaires were administered to all 192 respondents and, 18 key informant interviews were conducted with the 10 irrigation managers and 4 County irrigation engineers. The study established that there exists a positive significant correlation between stakeholder awareness and management of irrigation schemes ($r = 0.423$, $p < 0.05$). The study further established that there exists a positive significant relationship between efficacy of EIA and management of irrigation schemes ($r = 0.598$, $p < 0.05$). Taken together, the study shows that stakeholder awareness and understanding of EIA contribute positively to the effective management of irrigation schemes. Similarly, the EIA process has a direct and positive effect on the management of irrigation schemes. Therefore, it is recommended that the County Government ensures the EIA process is not only regulatory-compliant but also participatory, inclusive, and evidence-based. Furthermore, stakeholder and public involvement must be made more meaningful by incorporating community feedback into project planning and implementation.

Keywords: EIA; Irrigation schemes; climate change; Baringo County

Introduction

Irrigation has long been regarded as a viable alternative for improving and sustaining rural livelihoods through increased farming production (Bélanger & Pilling, 2019). Globally, the human population is currently growing resulting in increased pressure on natural resources such as soil, water, and energy supplies. Irrigated agriculture accounts for 40% of global food production, and is practiced in ASALs areas (Rosa, 2020). ASALs areas are known for their extreme temperatures affecting plant growth and hence, irrigation can help to alleviate heat and water stress on crops, reducing climate variability and extremes. Most African countries have not realized their full potential of irrigation schemes because of poor irrigation management, lack of proper public participation from the beneficiaries and insecurity of land ownership (Bjornlund et al., 2020).

A study conducted in Australia noted that government funded projects especially irrigation schemes, operated either by the community or jointly by other partners are poorly managed compared to the traditional schemes (Pittock et al., 2020). This is because of lack of ownership feeling by the local community toward schemes that were planned, implemented, and operated by the government without consultation of the beneficiaries. Benjamin (2021) also noted that there is little or no consultation with the beneficiaries on irrigation projects' identification, feasibility study, and design. This therefore forms a knowledge gap

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about the challenges that are faced by the government donor irrigation projects. Therefore, there is need to try ways to attain balance between development and environmental protection among the government donor projects. This will eventually reduce time and costs of implementing a project.
According to Streimikiene *et al.,* (2021), it is preferable to develop and promote instruments that effectively meet local environmental sustainability expectations and demands. Environmental Impact Assessment (EIA), one of several 'environmental assessment' methods described by Shammi *et al.,* (2022) as having sustainability as their underlying objective, despite not having originated in this context, is one of these promising existing instruments.

Environmental Impact Assessment (EIA) is defined as a process of considering the potential environmental consequences of a proposed action during the planning, design, decision-making, and implementation phases of that action (Enríquez-de-Salamanca, 2021). USA formally introduced EIA in 1969 and has since then spread to different countries in different forms. The factors that determine the effects of EIA vary for different countries depending on the level of public involvement and on whether EIA it should be done or not. EIA has quickly grown, and it now plays a crucial role in the environmental protection of many industrialized and developing countries (George et al., 2020).
The approach used for EIA differs from one country to another. In the United States, the law states that public projects that majorly have negative effects on the environment should undergo EIA (Abdulkadir, 2021). The author further illustrated that EIA process involves the evaluation of impacts, as well as an exploration of possible approaches for mitigation measures. Canada prioritizes environmental safety and sustainable development under the Canadian Environmental Assessment Act. Irrigation schemes in Canada undergo thorough environmental and social reviews by evaluating possible alternatives and cumulative effects while involving the public (López-Felices et al., 2020). This ensures that irrigation schemes minimize negative impacts and encourage sustainable resource use.
In China, the EIA systems have been operational since the year 2000. The existing Environmental Impact Assessment regulation has undergone additional changes including accommodation of policies and plans captured in the Strategic Environmental Assessment (SEA) (Wirojanagud, 2020). The author recommends that enforcement of EIA in legislation, public participation, and capacity building should be conducted. In Africa, EIA was adopted by many countries as a result of many initiatives such as the African Ministerial Conference on Environment and the Pan-African initiative for Capacity Development and linkages for EIA which officiated the use of EIA through African environment ministers (Ofoezie *et al.,* 2022).
While irrigation schemes offer numerous benefits, they can also have negative environmental effects that need careful consideration. The construction of dams, canals, and water abstraction weirs along rivers for irrigation purposes can lead to changes in hydrological patterns, water scarcity downstream, soil erosion, and impacts on aquatic ecosystems (Miedviedieva and Dyniak 2021). Mateo-Albou *et al.,* (2024) noted that increased use of agrochemicals and improper water management practices in irrigated agricultural lands can also result in water pollution and degradation of soil quality. If left unchecked, the problem will worsen and will manifest most visibly as a decrease in yield, lack of food, conflicts over natural resources, human and crop diseases, conflicts with wildlife, and land degradation. This will also harm the performance of irrigation schemes by endangering their long-term productivity.
In Kenya, EIA is provided for under Article 69 (i) (f) of the Constitution of Kenya, 2010 which states that, 'the state shall establish systems of environmental impact assessment, environmental audit and monitoring of the environment; and Section 58 of Environmental Management and Coordination Act (EMCA), 1999. This has been done to mitigate the adverse social and environmental impacts of development projects including irrigation schemes. Irrigation schemes in the country are required to undergo EIA and obtain environmental licenses to ensure compliance with environmental standards. As a result of insufficient

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information to the public on the impacts to the environment, Kenya has put in place a wide range of policy and legislative frameworks to address major causes of environmental degradation (Kiremu *et al.,* 2022). The EIA process in Kenya plays a vital role in identifying environmental risks, reducing resource use conflicts by encouraging community participation, minimizing adverse environmental effects, and laying the foundation for environmentally sound initiatives (Omenge *et al.,* 2020).

Baringo County is located in the former Rift Valley region of Kenya. Most of the areas within the County have a semi-arid type of climatic regime and for this reason, it is highly dependent on irrigation to increase crop production and improve food security. Baringo County has also been affected by banditry, cattle rustling and, conflicts of natural resources. This has hindered the County government from delivering its services such as developing irrigation schemes and also improving pasture fields in the affected areas Baringo County Integrated Development Plan (CIDP, 2012).

The most common irrigation schemes in Baringo County are small-scale and medium-scale schemes primarily located along the County's rivers and lakes. As per CIDP (2012), the irrigated acreage in the County was 1580 acres (640 ha) but the potential hectares to be exploited is 65000ha of land. In the future, a vast area of land will be opened up through irrigation to enhance food security and also reduce poverty within the County. Therefore, proper mitigation measures to negative environmental impacts of irrigation projects need to be put in place to prevent future deterioration of soil fertility and water quality.

Equipping the irrigation scheme requires financial resources that have been done through an expanded National Irrigation Authority programs. Some areas with potential for irrigation schemes in the County have been equipped while others have stalled as a result of inadequate funding (CIDP-Baringo County, 2018-2022). Most irrigation schemes in the County are supported by the County Government of Baringo and owned and managed by the Community. CIDP-Baringo County (2023-2027) states that the irrigation schemes should undertake Environmental Impact Assessments as stipulated by Kenya's primary environmental law-EMCA, 1999 to prevent adverse environmental and social effects. Baringo County government have invested a sum of 200 million in the irrigation schemes within the County with an aim of increasing land under irrigation and improving food security (Baringo County Government, 2023; National Irrigation Authority, 2024). Despite these huge investments, the results of these irrigation schemes are generally far below expectations of the County's objectives. The factors responsible for poor irrigation performance in these irrigation schemes are organizational, water, environmental and production, soil and plant health issues which have caused the problems, condensed and summarized as water shortage, waterlogging, saline-sodic and fertility stress. These stresses account for the declining trends in agricultural production (Department of Water, Sanitation and Irrigation, 2023). Therefore, it is precisely in this context, that the study sought to assess the effects of EIA in managing irrigation schemes funded by Baringo County Government. For this reason, there was need to determine how the threats faced by irrigation schemes can be better examined through EIA for the sustainability of these irrigation schemes by assessment, analysis, and mitigation measures adoption to curtail certain problems faced by irrigation that are detrimental to the environment. This is because knowing and comprehending the obstacles encountered, alternative solutions to the problems are accurately proposed and viable mitigation measures are prepared.

The present study will be of great help to the Baringo County government and its residents as it will inform the county government on the effective management of irrigation projects by using EIA. The study will provide information for solving conflicts and give a lasting solution in the effective distribution of water resources to irrigation schemes. To donor organizations and development partners, the findings would highlight areas of weakness in project implementation and take over for adjustment, ensuring that the intended goals are attained.

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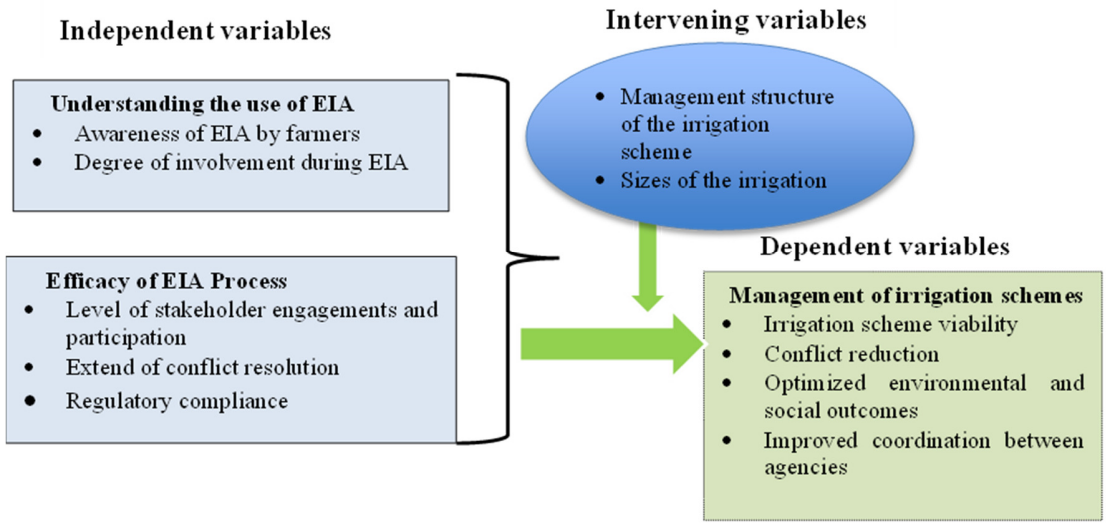

Figure1: Conceptual framework of the study

Materials and methods

Research Design

A descriptive survey research method was used to collect both qualitative and quantitative data from community members and government officials. This research design was preferred because information about the opinions, attitudes, perceptions, and experiences of individuals were gathered by use of questionnaires and interviews on irrigation schemes as stated by (Kothari, 2014).

Study Area

The study was undertaken within Baringo County, which is located in former Rift Valley province, Kenya. The County boarders Elgeyo Marakwet County and West Pokot to the west, Nakuru County to the South, Samburu and Laikipia County to the East, Kericho to the west, and Turkana to the North. Baringo County is mostly agro-based growing cash crops such as pyrethrum, macadamia, cotton, and coffee. Other crops include - onion, tomatoes, finger millet, cassava, sorghum, sweet and Irish potatoes, beans, maize and pigeon peas. Livestock products include: mutton, beef, honey, hides, and skin. The area was chosen for the study because of the underlying challenges faced by irrigation schemes funded by Baringo County Government. Further, the area has a history of conflicts raising from land tenure issues.

Target Population

According to the reports for the Department of Water and Irrigation schemes, (2023), there are 10 irrigation schemes funded by Baringo County government. The target population of the study was 387 drawn from 10 irrigation schemes funded by Baringo County government. This was comprised of 369 beneficiaries, 10 irrigation scheme managers ,4 County irrigation engineers and 4 environmental experts from these 10 irrigation schemes funded by Baringo County Government as shown in Table 1.

Table 1 The target population

Electoral Ward	Beneficiaries	Irrigation managers	Total (Target population
Marigat	148	4	152
Mochongoi	83	2	85
Mukutani	92	2	94
Barwesa	37	1	38
Mogotio	9	1	10
Total	**369**	**10**	**379**

Source: Modified from the Department of Water and Irrigation schemes, (2023)

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Sample and Sampling Procedures

The study adopted stratified and purposive sampling techniques. All the 10 irrigation schemes funded by the County Government of Baringo and the 10 managers were selected purposively. The total number of beneficiaries within the 10 selected irrigation schemes were 369 farmers (Department of Water & Irrigation, 2023). The study utilized Yamane (1967) formula of to obtain the sample size as follows;

$$n = \frac{N}{[1 + N(e)^2]}$$

Where:

n = Sample size of household farmers
N = Population size of farmers
e =the level of significance
1=Unite (constant value)

Total number of beneficiaries = 369 farmers
Sample size = 369/ $(1+369(0.05)^2)$
n=192 farmers
The sample of 192 respondents was proportionately distributed among the 10 selected irrigation schemes.

Data Collection Instruments

The study utilized both primary and secondary data sources that were collected using a structured questionnaire and an interview guide.

Questionnaires

Data from the beneficiaries of the irrigation schemes was obtained through a close-ended questionnaires. The questionnaires were self-administered to the 192 respondents.

Key informant interview schedule

Key informant interview schedule was also used. The interview schedule was adopted in collecting data from 4 sub-counties irrigation engineers from the representatives' sub-counties (Baringo North, Baringo Central, Baringo South and Mogotio), 10 selected irrigation managers and 4 randomly selected environmental experts in Department of Environment, Water and irrigation.

Ethical Considerations

Before conducting the study, the researcher obtained all the necessary permits such as a clearance letter from the Board of Graduate Studies of the University of Kabianga, and a research permit from the National Commission of Science Technology and Innovation. During the study, the researcher ensured that rights, needs, values and desires of the respondents were respected by seeking formal approval and consent of the respondents before the onset of data collection. All opinions and ideas shared by the respondents were treated with the utmost confidentiality and only used for the purpose of this study.

Results and Discussion

Dominant crops grown by the respondents

The study sought to determine the dominant crops grown by the respondents within the selected irrigation schemes of Baringo County as shown in Table 2

Table 2 Dominant crops grown

Crops	Frequency	Percent
Maize	129	67.2
Tomatoes	34	17.7
Beans	11	5.7
Onions	8	4.2
Watermelons	6	3.1
Pawpaws	4	2.1
Total	**192**	**100.0**

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The findings presented in Table 2 indicate that maize is the most dominant crop grown in the study area, as reported by 129 respondents (67.2%). This is followed by tomatoes, with 34 respondents (17.7%), while beans and onions were grown by 5.7% and 4.2% of the respondents, respectively. Watermelons and paw paws emerged as the least cultivated crops, reported by 3.1% and 2.1% of the respondents, respectively.

These results suggest that maize production is the principal agricultural activity among farmers in the region, likely due to market access for seed production, its role as a staple food and its adaptability to local climatic conditions. The cultivation of tomatoes and other horticultural crops, though less prevalent, reflects a degree of diversification in farming practices, which may be influenced by factors such as water availability, market access, and soil suitability. Understanding these patterns is crucial in informing policy and interventions aimed at enhancing food security and optimizing land use in irrigation-dependent communities.

The study sought to determine the size of farm within the project area in Table 2.

Table 2 Size of farm within the project area

Farm size	Frequency	Percent
1-5 Acres	140	72.9
5-10 Acres	34	17.7
10-15 Acres	17	8.9
15 Acres and above	1	0.5
Total	**192**	**100.0**

The results in Table 2 indicate that the majority of respondents (140 individuals, 72.9%) operate on relatively small farms ranging between 1 and 5 acres. A further 17.7% of the respondents reported owning farms between 5 and 10 acres, while 8.9% cultivate between 10 and 15 acres. Only one respondent (0.5%) reported a farm size exceeding 15 acres.

These findings suggest that smallholder farming dominates agricultural activity in the study area, a trend that mirrors the broader national and regional patterns observed in rural Kenya. According to Bjornlund et al. (2020), smallholder irrigation systems in sub-Saharan Africa often operate on limited land sizes, which can constrain productivity and hinder the adoption of advanced irrigation and farming technologies.

The predominance of smaller farms also implies that land fragmentation remains a key challenge, affecting economies of scale and reducing the efficiency of both resource utilization and farm management practices. Moreover, the low incidence of larger farm holdings may be symptomatic of limited access to land, financial capital, and agricultural extension services, which are essential for expanding farm size and increasing productivity.

Stakeholder awareness and understanding of EIA

We also sought to evaluate the effect of stakeholders' awareness of EIA on the management of the selected irrigation schemes funded by Baringo County

Awareness of EIA

The figure 2 shows stakeholders' awareness on EIA

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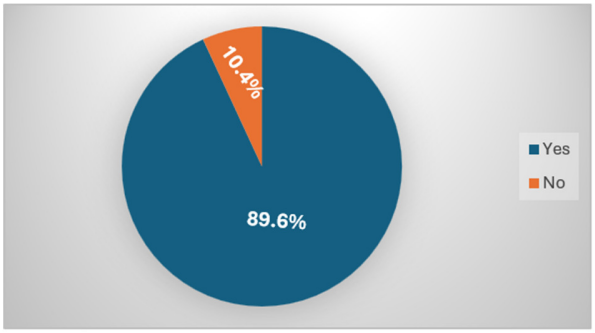

Knowledge about Environmental Impact Assessment (EIA)

The study inquired whether the respondents were aware of EIA before the study. The majority of them, 172(89.6%), indicated that they knew about it and 20(10.4%) respondents were not aware of it. This implies that most of the respondents were aware of the environmental impact assessment in the region. These findings indicate that the majority of the farmers were aware of the EIA process. This implies that the respondents were in a position to understand the operations of the irrigation schemes and EIA meaning the information they provided were relied upon.

Familiarity with the Process of Environmental Impact Assessment (EIA)

The study examined the extent to which respondents were familiar with the process of Environmental Impact Assessment (EIA). This was essential in determining the level of awareness and capacity of stakeholders to participate in environmental governance, particularly in relation to irrigation schemes. The findings is summarized in Table 3.

Table 3 Familiarity with the process of Environmental Impact Assessment (EIA)

Response Category	Frequency (n = 192)	Percentage (%)
Very familiar	82	42.7%
Somewhat familiar	97	50.5%
Not familiar	13	6.8%

The results reveal that a majority of respondents (93.2%) reported being either very familiar (42.7%) or somewhat familiar (50.5%) with the Environmental Impact Assessment (EIA) process. Only a small proportion, 13 individuals (6.8%), indicated that they were not familiar with the process at all.

These findings suggest that EIA awareness and knowledge levels are relatively high among stakeholders in the irrigation schemes within the study area. This is an encouraging indicator for effective environmental governance, as familiarity with the EIA process enhances public participation, oversight, and accountability in environmental decision-making.

According to Glasson et al. (2021), stakeholder awareness and engagement are critical elements for successful EIA implementation. Familiarity with the EIA process allows communities to critically evaluate development proposals, voice concerns, and advocate for sustainable practices. Furthermore, high familiarity levels indicate successful efforts by government agencies, NGOs, or project implementers to sensitize communities on the importance of EIA in managing environmental and social risks.

However, the presence of a small segment (6.8%) that is not familiar with EIA points to the need for continuous capacity-building and inclusive outreach strategies, especially targeting marginalized or less-educated groups, to ensure

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that no segment of the population was excluded from critical environmental processes.

The study through inputs from the key informants that a general awareness of EIA was a crucial tool in managing environmental impacts related to irrigation schemes. However, awareness levels varied. Some informants, particularly those from local management committees, demonstrated a higher awareness of the legal and procedural aspects of EIA. In contrast, community members and lower-level staff showed limited understanding, with some equating EIA to simple environmental clean-up efforts rather than a comprehensive assessment process.

Understanding of the Purpose of Conducting Environmental Impact Assessment (EIA) for Irrigation Schemes.

To evaluate stakeholders' depth of knowledge and conceptual grasp of the Environmental Impact Assessment (EIA) process, the study assessed their understanding of the purpose of conducting EIA in the context of irrigation schemes. The results is presented in Table 4.

Table 4 The purpose of conducting Environmental Impact Assessment (EIA) for irrigation schemes

Response Category	Frequency (n = 192)	Percentage (%)
Yes, I understand it well	98	51.0%
Yes, but I have some doubts	85	44.3%
No, I don't understand it well	8	4.2%
No, I have no idea about it	1	0.5%
Mean		1.50
Standard Deviation		0.69

The findings indicate that a significant proportion of respondents (95.3%) reported some level of understanding of the purpose of conducting an EIA for irrigation schemes. Specifically, 51% (98 respondents) stated that they understand it well, while 44.3% (85 respondents) acknowledged having an understanding but with some doubts. On the other hand, only 4.7% (9 respondents in total) admitted to having little or no understanding of the purpose of EIA.

The mean score of 1.50 (on a scale where lower values indicate higher understanding) and a standard deviation of 0.69 further reflect a concentrated response pattern, confirming a high degree of awareness among the majority of stakeholders.

These results suggest that environmental awareness campaigns, stakeholder sensitization efforts, or previous exposure to EIA processes may have contributed to building a strong foundational understanding among community members and other stakeholders involved in irrigation initiatives. This aligns with Glasson et al. (2021) and Caro-González et al. (2021), who argue that stakeholder understanding of EIA processes is a cornerstone for meaningful participation and successful implementation of environmental safeguards.

However, the existence of a small segment that lacks sufficient understanding underscores the need for continued environmental education and inclusive training, especially tailored for farmers, local administrators, and community groups involved in irrigation project planning and execution. Without such efforts, this gap in understanding may hinder effective participation and limit the community's ability to monitor and hold developers accountable for environmental protection.

The interviews revealed that while many respondents recognized the importance of EIA, the level of understanding about how it should be conducted and integrated into the management of irrigation schemes varied. A significant proportion of respondents had limited technical knowledge about the steps involved in conducting an EIA. Only a few, particularly those with government or NGO backgrounds, could articulate the purpose of

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EIA in minimizing negative environmental impacts and promoting sustainable irrigation practices.

Perception on the Importance of Environmental Impact Assessment (EIA) in Ensuring Success of Irrigation Schemes

The study sought to evaluate the perception of stakeholders regarding the role of Environmental Impact Assessment (EIA) in the success of irrigation schemes. The results, as summarized in Table 5 highlight respondents' views on the relevance of EIA in the sustainable development of irrigation projects.

Table 5 Perception on the importance of Environmental Impact Assessment (EIA) in ensuring success of irrigation schemes

Perception Category	Frequency (n = 192)	Percentage (%)
Very Important	116	60.4%
Moderately Important	75	39.1%
Slightly Important	1	0.5%

The findings reveal that a vast majority of respondents (99.5%) consider Environmental Impact Assessment to be important in ensuring the success of irrigation schemes. Specifically, 60.4% (116 respondents) rated EIA as very important, while 39.1% (75 respondents) considered it moderately important. Only one respondent (0.5%) regarded it as slightly important, reflecting near-unanimous support for the relevance of EIA in irrigation development.

These results underscore a widespread recognition among stakeholders of the preventive and precautionary role of EIA in minimizing adverse environmental and social impacts. This aligns with the findings of Lambrecht (2022) and Bjornlund et al. (2020), who emphasize the critical role of EIA in fostering long-term sustainability, stakeholder inclusivity, and project legitimacy in water resource infrastructure such as irrigation schemes. The high perception score may also reflect prior experience or exposure to environmental consequences resulting from poorly planned irrigation projects, thus reinforcing the perceived necessity of incorporating environmental safeguards through EIA processes

The study found that a majority of the respondents, 116(60.4%), felt that EIA is very important for ensuring the success of irrigation scheme development, 75(39.1%) respondents indicated that it was moderately important and 1(0.5%) respondent indicated that it was slightly important. The findings imply that most respondents were of the view that EIA process is very important, which is in line with the view of Brown and Green (2020) who established that EIA process is important in achieving a satisfactory balance between comprehensiveness and effectiveness of a project. Findings from the interviews revealed that the degree of involvement in the EIA process was inconsistent across the stakeholders. Respondents involved in the planning and management of irrigation schemes expressed greater participation in EIA processes, including consultations and decision-making. However, grassroots-level participants, including local farmers, expressed their feeling of being excluded from meaningful involvement in the process. Many noted that their input were either not sought or not adequately incorporated into final decision-making in EIA process. Suggesting a need for more inclusive participatory practices.

The findings indicate that while there is a general awareness of EIA, the depth of understanding and involvement varies significantly across different stakeholder groups. This variation could affect the effective implementation of EIA in managing the environmental impacts of irrigation schemes in Baringo County

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Efficacy of EIA process and the management of the selected irrigation schemes

The third objective of the study sought to evaluate the efficacy of Environmental Impact Assessment process on the management of the selected irrigation schemes funded by Baringo County.

Stakeholders' perceptions of the efficacy the Environmental Impact Assessment

The study assessed stakeholders' perceptions of the efficacy of the Environmental Impact Assessment (EIA) process in managing the selected irrigation schemes. A key indicator of this perception was the level of importance respondents attached to conducting EIA prior to the implementation of irrigation projects.

Table 6 Importance of conducting Environmental Impact Assessment (EIA) before initiating irrigation schemes

Response	Frequency (n = 192)	Percentage (%)
Very Important	147	76.6%
Moderately Important	18	9.4%
Slightly Important	21	10.9%
Not Important at All	6	3.1%

The results in Table 6 indicate that a significant majority of respondents (76.6%) regard the EIA process as very important before the commencement of irrigation schemes. An additional 9.4% consider it moderately important, while 10.9% and 3.1% view it as slightly important and not important at all, respectively.

These findings suggest a strong awareness among stakeholders regarding the preventive and planning functions of EIA. The high percentage of respondents who support pre-implementation EIA points to a general consensus that it plays a critical role in anticipating and mitigating environmental and social risks associated with irrigation schemes. This aligns with findings from Glasson et al. (2021) where they emphasized that the effectiveness of irrigation scheme management significantly improves when EIA should be conducted before project rollout. It enhances foresight, compliance with environmental regulations, and stakeholder participation, all of which are essential for sustainable irrigation development.

Involvement of Stakeholders in the EIA Process

The study also sought to assess perceptions on the importance of involving stakeholders in the Environmental Impact Assessment (EIA) process in the context of irrigation schemes. Table 7 presents respondents' views on whether stakeholder involvement contributes to better decision-making in the planning and management of these schemes.

Table 7 Involvement of stakeholders in EIA process.

Question	Yes	No	Not sure	Mean	SD
Do you believe involving stakeholders in the EIA process for irrigation schemes would improve decision-making?	186 (96.9%)	5 (2.6%)	1(0.5%)	1.04	0.21

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As shown in Table 7, an overwhelming 96.9% of the respondents agreed that involving stakeholders in the EIA process improves decision-making for irrigation schemes. Only 2.6% responded negatively, while 0.5% were unsure. The mean score of 1.04 with a very low standard deviation of 0.21 further demonstrates a strong consensus among the participants.

These findings underscore the value that stakeholders place on inclusive and participatory approaches in environmental governance. According to Roos et al. (2020) and Kaku et al. (2022), stakeholder involvement enhances transparency, ensures local knowledge integrated into project planning, and fosters ownership, which are essential for the sustainability of irrigation initiatives.

Moreover, active participation helps to identify site-specific concerns that may not be apparent to external experts. This aligns with the best practices outlined by Glasson et al. (2021), who advocate for participatory EIA frameworks, particularly in rural and agriculturally intensive regions, to ensure equitable and environmentally sound outcomes.

The findings of the interview schedule revealed that stakeholder engagement is crucial to the success of the EIA process. Several respondents noted that while stakeholders invited to participate in the EIA process, the level of engagement varied. Key decision-makers, such as government officials and irrigation scheme managers, were well represented, but local farmers and community members reported feeling marginalized. Many felt that their contributions were limited to formal meetings, with little follow-up on how their input influenced the final decisions. This led to a perception that the EIA process was top-down, rather than a truly participatory process.

Importance of Involving the Public in the EIA Process

The study further sought to examine respondents' perceptions regarding the importance of public involvement in the Environmental Impact Assessment (EIA) process, especially in relation to the planning and implementation of irrigation schemes. The findings is presented in Table 8

Table 8 Importance of involving the public in the EIA process for irrigation schemes.

Question	Very Important	Moderately important	Slightly important	Not important at all
How important do you think it is to involve the public in the EIA process for irrigation schemes?	148(77.1%)	39(20.3%)	5(2.6%)	0(0%)

Most of the respondents indicated that it was very important to involve the public in the EIA process for irrigation schemes by a mean of 1.18 and a standard deviation of 0.42. On the other hand, 39(20.3%) respondents stated that it was moderately important and 5(2.6%) respondents indicated that it was slightly important. Therefore, these findings imply that most farmers considered the involvement of the public in EIA process as very important. The findings are supported by George et al. (2020) study on assessing the importance of public involvement in the Environmental Impact Assessment (EIA) in farm project in Nigeria established that engaging stakeholders such as governmental organizations, relevant government agencies, local government, professionals, and the local population was critical in farm projects.

Contribution of EIA in Resolving Conflicts Related to Irrigation Schemes

To assess stakeholder perspectives on the role of the Environmental Impact Assessment (EIA) process in conflict resolution, the study examined the perceived extent to which EIA contributes to resolving disputes associated with irrigation schemes. The findings is presented in Table 9.

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Table 9 The contribution of EIA in resolving conflicts related to irrigation schemes

Question	Significantly	Moderately	Slightly
How do you anticipate EIA could contribute to resolving conflicts related to irrigation schemes?	106(55.2%)	79(41.1%)	7(3.6%)

As shown in Table 9 , a majority of respondents, 55.2%, believe that the EIA process contributes significantly to conflict resolution in the context of irrigation schemes. Another 41.1% indicated that it contributes moderately, while only 3.6% viewed its contribution as slight.

These results highlight a strong belief in the potential of the EIA process to act as a platform for mediating and mitigating conflicts related to land use, water allocation, environmental degradation, and social equity. The findings align with Kaku et al. (2022) and Kabera & Mutavu (2023), who argue that when EIA is executed, stakeholder engagement will facilitated transparent dialogue, reducing misunderstandings, and helps prevent disputes from escalating.

Furthermore, as Bjornlund et al. (2020) and Lee and Wong (2023) note, the EIA process when inclusive and participatory can proactively identify potential conflict triggers and recommend mitigation strategies, particularly in resource-sensitive projects like irrigation development.

Regarding conflict resolution, the respondents of the interview schedule emphasized that EIA should play a vital role in addressing potential disputes arising from irrigation scheme management. However, the findings showed that conflicts between local communities, irrigation scheme managers, and environmental bodies were not always adequately resolved through the EIA process. In some cases, the lack of meaningful stakeholder engagement led to disputes regarding water use, land allocation, and environmental degradation. Key informants suggested that integrating conflict resolution mechanisms into the EIA process could enhance its overall efficacy, ensuring that all parties' concerns' are addressed early in the planning phase.

Effectiveness of EIA Reports in Addressing Environmental and Social Effects

The study sought to evaluate perceptions regarding the effectiveness of Environmental Impact Assessment (EIA) reports in identifying and addressing potential environmental and social impacts of irrigation schemes. The findings is presented in Table 10.

Table 10 Preparation of EIA reports for irrigation schemes and their effectiveness in identifying and addressing potential environmental and social effects of irrigation schemes

Effectiveness Level	Frequency (n = 192)
Very effective	87 (45.3%)
Moderately effective	100 (52.1%)
Slightly effective	5 (2.6%)
Not effective at all	0 (0%)

The results show that 97.4% of the respondent's view EIA reports as either very effective (45.3%) or moderately effective (52.1%) in addressing environmental and social issues tied to irrigation scheme. Only 2.6% considered the reports as slightly effective, and notably, none of the respondents found them completely ineffective.

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These findings reflect a strong confidence in the practical utility of EIA reports in identifying project-related risks and recommending mitigation measures. This supports the observations by Glasson et al. (2021) and Caro-González et al. (2021), who argue that comprehensive and well-implemented EIA reports are instrumental in ensuring sustainable project outcomes, particularly in sectors like agriculture where environmental and social stakes are high.

Moreover, Roos et al. (2020) emphasize that the effectiveness of EIA depends significantly on how rigorously the assessment was conducted, and the extent of stakeholder engagement. The positive perception reported here likely reflects both an increasing awareness of EIA processes among local stakeholders and an appreciation for their contribution to proactive risk management.

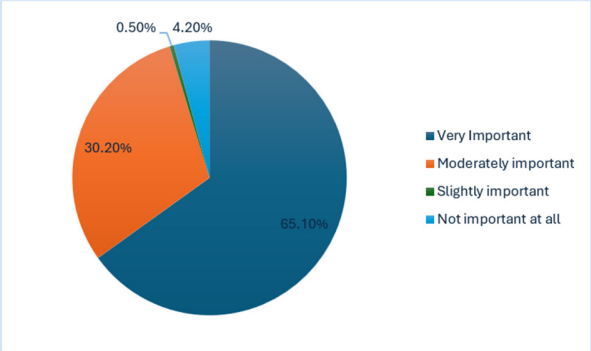

Figure 3 Compliance with regulations

The researcher sought to inquire how important the respondents believed it is for irrigation schemes to comply with regulatory requirements and found that most of the respondents, 125(65.1%), believed this was very important giving a mean of 1.43 and a standard deviation of 0.71. The findings showed that 58(30.2%) respondents indicated that it was moderately important, 1(0.5%) respondent indicated that it was slightly important, and 8(4.2%) respondents indicated that it was not important all for irrigation schemes to comply with regulatory requirements. Thus, most respondents believed that it was necessary for the irrigation schemes to comply with regulatory requirements. The findings concur to those of Smith et al. (2022) and Ho et al., (2020) which emphasized the need for compliance of EIA process.

The researcher also interviewed 14 key informant members on the regulatory compliance aspect of the EIA process, which was acknowledged by respondents as being critical, though challenges were reported. While most irrigation schemes followed the basic guidelines set forth by the National Environment Management Authority (NEMA), informants noted gaps in the consistent enforcement of these regulations. Several participants mentioned instances where EIA reports were approved without thorough on-ground assessments, reducing the overall effectiveness of regulatory oversight. Furthermore, some key informants believed that regulatory compliance was more of a formality, with less emphasis on monitoring and implementation after the approval phase.

Conclusion

The study found that majority of the respondents (76.6%) believed that it was very important to conduct EIA before initiating irrigation schemes in complying with regulatory requirements. Most of the respondents (96.9%) believed that involving both stakeholders and public in the EIA process for irrigation schemes would improve decision-making. Majority of (96.3%) believed that EIA contributes to resolving conflicts either significantly or moderately in relation to irrigation schemes. The study findings then established that there exists a positive significant relationship between efficacy of EIA and management of irrigation schemes ($r = 0.598$, $p < 0.05$). The study concludes that the efficacy of the EIA process has a direct and positive effect on the management of irrigation schemes. Participants emphasized the need to conduct EIA prior to project initiation and highlighted the critical role of stakeholder and public involvement in the EIA process. Additionally, EIA is perceived as a key tool in identifying potential risks and in resolving environmental and social conflicts. These findings underscore the value of a rigorous and participatory EIA process as a strategic

mechanism for enhancing regulatory compliance, improving decision-making, and supporting sustainable irrigation development.

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