# Exploring the Farmers' Perspectives and Challenges Regarding the Construction of Mirani Dam and Irrigation System: A Comprehensive Analysis of Mirani Dam, Pakistan

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***Abstract***

*This research's main objective was to investigate farmers' perceptions and constraints regarding the Mirani dam's Right and Left Bank Canals in District Kech Balochistan, Pakistan. The study revealed that farmers' perceptions were categorized into two main groups: socioeconomic and environmental perceptions. According to the study's results, most respondents (100%) believed that the availability of on-farm and off-farm employment opportunities had increased. Additionally, nearly all farmers stated there had been improvements in marketing facilities, income, and consumption levels. However, some respondents expressed doubts about the dam's primary purpose and impact on the local environment. All respondents cited the lack of a warbands system and a water user association as major issues regarding constraints. Other significant challenges identified by the farmers included water losses during conveyance and application, the existence of Kacha water courses, and the absence of agricultural extension services. Water logging, salinity, improper maintenance of the central canal, and irrigation water theft were also highlighted as severe constraints affecting agricultural productivity in the study area. These findings shed light on the complex dynamics surrounding the region's water management and agricultural development.*

**Keywords:** Agricultural Productivity, Irrigation Management, Food Security, Poverty.

## Introduction

Water, a precious natural resource akin to wood, coal, and gold, stands out from other resources due to its diverse range of economic and technical uses and its profound social, cultural, and symbolic importance. While people may be able to survive without other resources, water is essential for agriculture, serving as the lifeblood and foundation of life itself. It is no wonder that water carries significant religious and spiritual significance across the globe, often at the forefront of creation stories. In areas where water is scarce, developing and managing water resources play a crucial role in ensuring sustainable agriculture. The importance of water in this context cannot be overstated, as highlighted by researchers such as Ashraf et al. (2007) and Azizi et al. (2009).

Pakistan is facing a dire shortage of high-quality irrigation water, with canal water and groundwater being the primary sources for agriculture. However, the reliance on groundwater is

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increasing rapidly due to the lack of canal water. Unfortunately, groundwater is not only expensive for small farmers to access, but it is also unsuitable for agricultural purposes due to its poor quality. Additionally, the wastewater from both pre-urban and urban areas is being used for irrigation without proper treatment. Despite the availability of decentralized treatment technology, there are still obstacles to its widespread adoption. These challenges include the limited availability of water and suitable land and a lack of knowledge, financing, and appropriate infrastructure. Furthermore, the rigid official standards and designs also hinder the acceptance of decentralized approaches to water treatment in Pakistan (Parkinson & Taylor, 2001).

Salinity levels in agricultural fields are on the rise due to the poor quality of underground water. Farmers in pre-urban areas are turning to wastewater for irrigation in response to the scarcity of canal water and contamination of underground sources. This alternative source is a mixture of organic and inorganic matter and chemical compounds. For centuries, irrigation has played a crucial role in the development of societies, transforming once-barren lands into highly productive crop zones. In urban and pre-urban areas, poor farmers have long been practicing wastewater irrigation as a necessity rather than a choice. This unplanned action has been a traditional practice for these farmers, as noted by Mustafa (2002).

The importance of irrigation in agrarian communities cannot be overstated. It is crucial in human capital development to generate direct and indirect benefits. Directly, irrigation boosts productivity, ensures food security, and stabilizes income. Indirectly, it impacts agricultural labor migration to urban areas. Moreover, effective irrigation systems can stimulate economic growth, alleviate poverty, and manage the flow of labor from rural to urban regions.

The Mirani Dam is a vital water source for irrigation, providing water to over 33,200 acres of agricultural land in District Kech, Balochistan (Government of Balochistan, 2018). The dam has a storage capacity of 302,000 acre-feet, with an annual irrigation supply of 240,000 acre-feet (WAPDA, 2020). The Mirani Dam irrigation system benefits over 10,000 farming families, with an average farm size of 3-4 acres (Khan et al., 2019). Agricultural production in the Mirani Dam command area has increased by 25% since the dam's construction, with major crops including wheat, cotton, and watermelon (Baloch et al., 2020). Despite these benefits, farmers in the region still face significant challenges, including water scarcity, poor irrigation infrastructure, and limited access to credit and markets (Ahmed et al., 2019).

Perception is fundamental to how humans interact with the world around them, forming the basis of all theoretical knowledge. Perception has always been important in philosophy and science, as it shapes our understanding of the world. In the context of agriculture, farmers have a range of perceptions and constraints related to their irrigation systems. These constraints include factors such as employment levels, marketing facilities, consumption levels, income levels, health status, and the impact of damming the river flow. Additionally, changes in cropping patterns, adequacy of water supply, and the use of dams to supply water to specific areas all shape farmers' perceptions and constraints regarding irrigation. Some of the key constraints faced by farmers in relation to irrigation include inadequate water supply, the absence of agricultural extension and research workers, the lack of a structured water distribution system, and the prevalence of water logging and salinity issues. Other challenges include water losses during transportation and application, the use of unlined or earthen water courses, insufficient infrastructure, and the issue of water theft. Given the importance of understanding these perceptions and constraints in integrated irrigation systems, a study was conducted in the Mirani dam command area, specifically focusing on the Right and Left Bank Canals in district Kech, Balochistan, Pakistan.

### Scope of Research

This study focuses on exploring the perspectives and challenges of farmers regarding the construction of the Mirani Dam and irrigation system in District Kech, Balochistan, Pakistan. The research scope is limited to the farmers' experiences, perceptions, and challenges related to the project and does not include an evaluation of the project's technical or economic feasibility.

### Rationale of the Research

The construction of large-scale infrastructure projects like the Mirani Dam and irrigation systems can significantly impact local communities, particularly farmers. However, the perspectives and experiences of these stakeholders are often overlooked in the planning and implementation of such projects. This research aims to fill this knowledge gap by comprehensively analyzing the farmers' perspectives and challenges regarding the Mirani Dam and irrigation system.

### Research Problems

1. What are farmers' perspectives regarding the construction of the Mirani Dam and irrigation system?
2. What challenges do farmers face about the project?
3. How do farmers perceive the project's impact on their agricultural productivity and livelihoods?

### Objectives of Research

1. To explore farmers' perspectives regarding the construction of the Mirani Dam and irrigation system.
2. To identify the challenges farmers face in the project.
3. To analyze the project's impact on farmers' agricultural productivity and livelihoods.

## Theoretical Framework

This study is grounded in the sustainable livelihoods framework, which emphasizes the importance of considering the multiple dimensions of rural livelihoods, including economic, social, and environmental factors (DFID, 1999). The framework is also informed by social exchange theory, highlighting the importance of reciprocity and fairness in stakeholder relationships (Emerson, 1976).

### Significance of Research

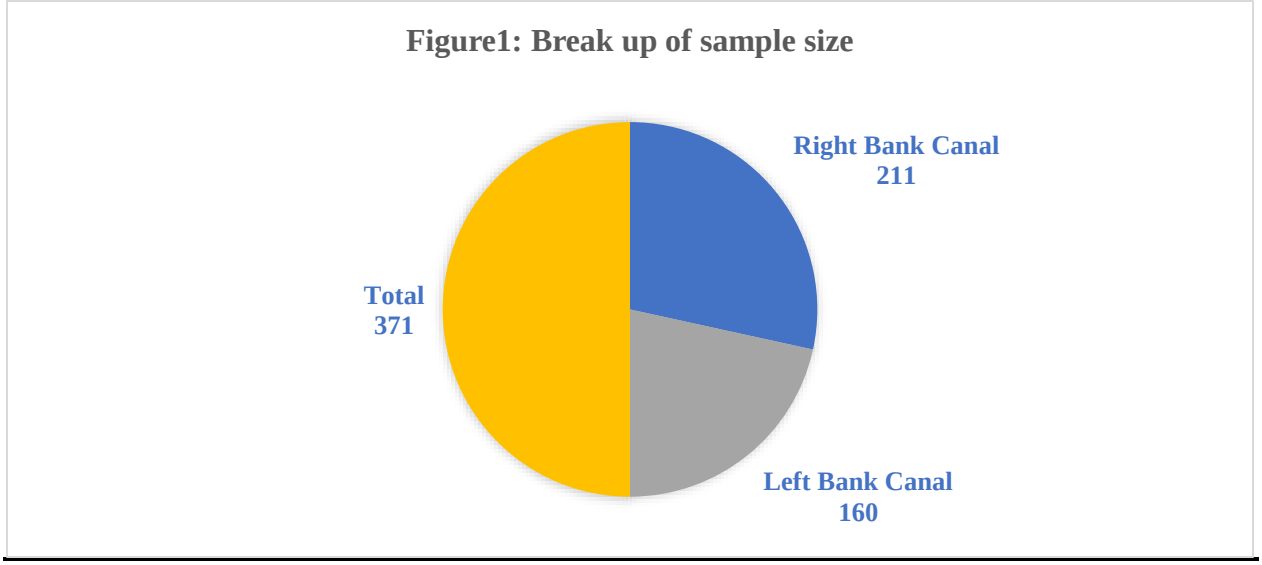
This study contributes to the existing literature on the impacts of large-scale infrastructure projects on local communities, particularly farmers. The findings of this research can inform policy and practice related to the planning and implementation of similar projects, ensuring that the perspectives and experiences of local stakeholders are considered.

## Methodology

### Study Area

The study was conducted in the catchment area of the Mirani Dam irrigation system, specifically focusing on the Right and Left Bank Canals. This area is situated in tehsil Dasht, District Kech, Balochistan, Pakistan.

**Figure 1: Sample Size and Sampling Procedure**




The study identified respondents through the use of a random sampling approach. Three hundred seventy-one farmers were selected using a simple random sampling method, with 211 farmers chosen from the Right Bank Canal and 160 farmers from the Left Bank Canal. The primary data of these selected farmers was collected through a questionnaire administered by trained study assistants.

## Data Analysis

The data collected for this inquiry was analyzed using quantitative methods with the help of Excel and SPSS software, which are widely known for their use in socioeconomic analysis. Following the analysis, farmers were asked to share their views and limitations regarding the influence of various factors on access to irrigated land within the two irrigation systems in the Mirani dam command area. To gain insights into the farmers' perspectives and limitations concerning the construction and operation of Miran's irrigation system, a descriptive statistical approach (mean) was employed in analyzing the data.

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## Result and Discussion

### Sample households' perceptions of the construction of Mirani Dam and the irrigation system

In the study area, the availability of irrigation water plays a crucial role in land cultivation and agricultural productivity. As a result, many farmers are exploring ways to enhance their access to water resources. Table 1 presents farmers' viewpoints regarding the Mirani Dam's construction and its impact on the irrigation system. These perspectives are categorized into two main groups: socioeconomic and environmental. The socioeconomic perceptions encompass various aspects such as employment opportunities, access to marketing facilities, consumption patterns, income levels, health conditions, impact on river flow due to dam construction, changes in cropping patterns, environmental alterations triggered by the dam, availability of sufficient irrigation water, and the use of the dam for supplying water to Gwadar.

On the other hand, the environmental perceptions focus on the effects of the dam on river flow. The table provides a breakdown of the frequency and percentage of each perception, drawing references from previous research studies. This comprehensive analysis offers valuable insights into the opinions and concerns of farmers in the study area regarding the Mirani dam construction and its implications for the irrigation system.

The findings of this study are consistent with several theoretical frameworks or justifications that explain the complex relationships between infrastructure development, agricultural productivity, and rural livelihoods.

### Modernization Theory

Modernization theory posits that constructing large-scale infrastructure projects, such as dams and irrigation systems, can increase agricultural productivity and economic growth (Rostow, 1960). However, this study's findings suggest that the benefits of the Mirani Dam and irrigation system have not been evenly distributed among farmers, with some experiencing increased productivity and others facing challenges related to water scarcity and poor irrigation infrastructure.

### Dependency Theory

Dependency theory argues that constructing large-scale infrastructure projects in developing countries can perpetuate dependence on external capital and technology rather than promoting self-sustaining development (Frank, 1966). This study's findings support this theory, as the Mirani Dam and irrigation system were constructed with external funding and technical assistance, and farmers in the region continue to rely on these external inputs to maintain their agricultural productivity.

### Sustainable Livelihoods Framework

The sustainable livelihoods framework emphasizes the importance of considering the multiple dimensions of rural livelihoods, including economic, social, and environmental factors (DFID, 1999). This study's findings highlight the need for a more holistic approach to infrastructure development that considers the diverse needs and perspectives of farmers and other stakeholders in the region.

### Social Exchange Theory

Social exchange theory posits that individuals and groups exchange resources and services based on perceptions of reciprocity and fairness (Emerson, 1976). This study's findings suggest that farmers in the region have mixed perceptions of the Mirani Dam and irrigation system, with some feeling that they have benefited from the project and others feeling that they have been

disadvantaged. These findings highlight the need for more effective communication and consultation between project implementers and local stakeholders.

These theoretical frameworks provide a deeper understanding of the complex issues surrounding the Mirani Dam and irrigation system and highlight the need for more nuanced and context-specific approaches to infrastructure development and support for rural livelihoods.

**Table 1: Perception of Sample Household on Mirani dam construction and irrigation system**

| Particulars | Frequency | %age | Rank |
|---|---|---|---|
| Socioeconomic | | | |
| Employment level increased | 371 | 100 | 1 |
| Marketing Facilities increased | 362 | 97.6 | 3 |
| The Consumption level increased | 362 | 97.6 | 3 |
| Income level increased | 361 | 97.3 | 4 |
| Health status changed | 242 | 65 | 7 |
| Dam for supplying water to Gwadar | 85 | 23 | 9 |
| Dam stopped the river flow | 67 | 18 | 10 |
| Environmental | | | |
| Change in Cropping pattern | 369 | 99.5 | 2 |
| Adequate of Irrigation Water Supply | 311 | 83.8 | 5 |
| Average Temperature decreased | 275 | 74 | 6 |
| Humidity increased | 96 | 26 | 8 |

*Source:* Survey, 2016-17

## Socio-economic Perception

The respondents were individually interviewed to understand their views on marketing facilities. A majority of the farmers, about 97.6 percent, agreed that there has been a noticeable improvement in marketing facilities within the study area. Despite this positive trend, they mentioned that they regularly faced no difficulties in selling their products in the local market, especially fodder crops. Thanks to the accessibility provided by the National Highway and the Mekran Coastal Highway, farmers can easily transport their produce to the National Market in Karachi and other regions across the country.

The survey included questions about respondents' perceptions of their income and consumption levels, revealing that 97.3 percent believed their income had increased and 97.6 percent believed their consumption level had increased. The construction of the Mirani irrigation system had a profound impact on the social life and lifestyle of the region's residents. With more water available for irrigation, there was an expansion of cultivated land and higher production of crops. This led to an increase in income and consumption levels among the residents in the area.

The households in the study area were surveyed about the secondary impacts of the Mirani dam and irrigation system (including the Right and Left Bank canals) on health services. The household responses indicated a favorable perception, with many reporting an increase in their ability to allocate funds towards healthcare expenses compared to the previous year. Even though there has been no apparent increase in government-provided healthcare facilities such as hospitals, clinics, or medical professionals in the study area, the rise in household income has enabled individuals to seek medical care at private institutions.

A significant portion of the survey respondents, approximately 23 percent, expressed skepticism regarding the primary purpose of the Mirani dam, suggesting that it was not constructed solely for irrigation purposes. Concerns were raised about the potential use of the dam as a water storage facility catering to the needs of the Gwadar seaport and its surrounding industrial and residential areas. Reference to specific documents indicated a planned provision of 1.5 million gallons per day from both the Mirani and Akra Kaur dams to support the water requirements of Gwadar. Contrary to specific reports, the government has put forth various proposals to address future water demands, as outlined in the Gwadar Master Plan, which includes an allocation of 45 cusecs of water from the Mirani Dam to Gwadar. These findings align with previous research by IUCN (2007); in response to water shortage issues, the Public Health Engineering Department (PHE), in collaboration with the Balochistan government, resorted to hiring private water tankers to transport water from the Mirani Dam to Gwadar.

Additionally, nearly 18 percent of respondents highlighted the Mirani dam construction's significant impact on the Dasht River's flow, which was crucial for sustaining their traditional agrarian livelihoods and the occasional occurrence of flash floods. The obstruction of the river flow has led to challenges in accessing underground water, forcing individuals to drill deeper for tube wells. This disruption has particularly affected the downstream population, affecting their means of living as documented by various studies. Furthermore, downstream communities have faced difficulties in various aspects, including livelihood, water supply, healthcare, road infrastructure, education, and electricity supply, due to the altered river flow brought about by the Mirani dam construction.

## Environmental Perception

The respondents had a favorable perception of the cropping pattern in the study area, attributing its improvement to the construction of the Mirani Dam and its Right and Left bank canal irrigation system. A vast majority (99.5 percent) of respondents believed that cropping patterns had significantly increased, leading to important implications for agricultural growth and the livelihood of farmers in the region. Additionally, the respondents noted a substantial environmental impact caused by the dam, with 83 percent stating that it had reduced the average temperature in the study area. Moreover, respondents expressed satisfaction with the irrigation water supply post-construction, with 83 percent reporting sufficient water for crop production. They pointed to the benefits of the Mirani Dam and its canals, noting that every living being in the area, including humans and animals, had access to water. Interestingly, 26 percent of respondents also observed a significant increase in humidity in the study area, particularly affecting those living upstream and downstream of the dam.

### Challenges encountered by the agricultural community due to the construction of Mirani Dam and the Irrigation System (Right & Left Bank Canal)

The importance of irrigation in the research region has grown significantly, serving as a crucial source of income for many families. Research indicates that irrigation can significantly boost impoverished individuals' earnings. Various households in the area faced a multitude of challenges related to irrigation, with significant issues including a lack of sufficient irrigation water, the absence of trained Agriculture Extension and Research workers, a lack of a structured warbands system, the need for a Water User Association, water logging and salinity issues, unlined/earthen water courses, inadequate infrastructure, difficulties in operating and maintaining the central canal,

and instances of water theft. Table 2 displays the frequency and percentage of these identified problems.

**Table 2: Issues / Constraints faced by the farming community on Mirani Dam construction and its Irrigation System (RBC & LBC)**

| S.No | Constraint | Frequency | %age | Rank |
|---|---|---|---|---|
| 1 | Nonexistence of warabandi system | 371 | 100 | 1 |
| 2 | Nonexistence of water user Association | 371 | 100 | 1 |
| 3 | Unlined/earthen water courses | 344 | 92.7 | 2 |
| 4 | Water losses during conveyance in Canal | 305 | 82 | 3 |
| 5 | Water losses during Field application | 301 | 81 | 4 |
| 6 | Water losses create water logging | 290 | 78 | 5 |
| 7 | Absence of Agriculture Extension& Research Department | 200 | 53.9 | 6 |
| 8 | Inadequate Infrastructure | 165 | 44 | 7 |
| 9 | Operation and Maintenance of Main Canal | 150 | 40 | 8 |
| 10 | Inadequate Irrigation water supply | 147 | 39.6 | 9 |
| 11 | Water theft | 105 | 28 | 10 |

*Source:* Survey 2016-17

Table 2 indicates that all respondents agree that there is a lack of a warband system in the study area, leading to challenges in water distribution for landowners. The unequal distribution of irrigation water among farmers in the region highlights the necessity for implementing a warband system to ensure fair access to water resources. Furthermore, the absence of a water user association in the Mirani Dam Right and Left Bank Canal command area exacerbates farmers' difficulties in obtaining sufficient irrigation water for their crops. The inadequate management of irrigation water and poor maintenance of earthen water courses contribute to water losses through seepage and leakage, as 82% of respondents reported. This problem is exacerbated by the prevalence of Kacha water courses, prone to seepage and leakage, resulting in more than 20% water loss during conveyance and field application. These findings align with previous research by Soomro (2018), who identified leaks from nukes, vegetation obstruction, silt deposition, un-compacted banks, lack of maintenance, and rodent-induced holes as key factors contributing to conveyance losses. Overall, the evidence presented in Table 2 underscores the urgent need to implement a warbands system and establish a water user association to address the water distribution challenges farmers face in the study area. Additionally, efforts to improve watercourse maintenance and reduce conveyance losses are necessary to ensure sustainable irrigation practices and enhance regional agricultural productivity.

The findings from Table 2 indicated that nearly 93 percent of participants recognized the presence of kacha water courses as a significant issue in the study area. Respondents noted that most of the water courses were unlined, leading to leakage from cracks, holes made by rodents, and seepage. These factors accounted for 44 percent of water losses from the water courses. In line with previous research by Arshad (2009), it was found that the average water loss from lined water courses was 43.5 percent, with lining reducing water losses by 22.5 percent. Furthermore, a small percentage of respondents (7.3 percent) reported that the Balochistan Agriculture Extension Department had recently lined their water courses but were still incomplete, lacking necessary structures like Lucca and road culverts and surface cleaning. Development work on other water courses near the Mirani

dam command area was also underway, although progress was slow due to delays by the contractor.

The issue of absenteeism within the Department of Agricultural Extension and Research persists in the research/study region. A survey revealed that 53.9 percent of respondents noted the absence of Extension workers and research staff in the study area since the construction of the Mirani Dam Right and Left Bank Canal. On the other hand, 46.1 percent stated that they had encountered these workers in the command area sporadically, primarily during monitoring activities related to the construction of watercourses.

The respondents in the study area were surveyed about water losses leading to water logging and salinity, as depicted in Table 2. A 78 percent of participants identified this issue as highly concerning in the study areas, attributing it primarily to insufficient understanding of water management practices, seepage from earthen water courses, and the absence of a water user association and warbands system in the region. This aligns closely with the findings reported by Qureshi (2008) in his research.

According to a recent survey, 44% of participants reported that electricity is accessible in about two-thirds of the villages, leaving the remaining villages without this basic necessity. Infrastructure was highlighted as a significant concern in the study area, with electricity, link roads, and storage facilities being identified as significant areas needing improvement. In addition to these findings, farmers were questioned about the maintenance of the central canal during the field survey. Nearly half (48%) of respondents expressed dissatisfaction with the upkeep of the central canal in the study area. The main canal is plagued with issues such as weed overgrowth, silt accumulation, and debris, leading to sluggish water flow in many regions. This lack of proper maintenance hinders the efficient distribution of water resources in the area.

The participants in the research area highlighted insufficient irrigation water availability as an issue and expressed dissatisfaction with the current water distribution. According to Table 2, 39.5 (M, Ahmed, Usman, & Shabbir)% of farmers reported not receiving water adequately.

In Table 2, it was found that 40% of landowners observed incidents of irrigation water theft occurring on both the right and left bank canals. A study by Ebrahim (2019) revealed that water thieves could siphon off a substantial amount of water, estimated to be between 1200 to 2800 cusecs, from the region between Punjab and Qasimwala.

## Conclusion

The construction of the Mirani Dam and irrigation system in District Kech, Balochistan, Pakistan, has significant implications for the local farming community. This study aimed to explore farmers' perspectives and challenges regarding the project. The findings indicate that while the project has improved irrigation facilities and increased agricultural productivity, farmers face numerous challenges, including inadequate water supply, inefficient irrigation systems, and limited access to credit and markets.

### Suggestions

To address the challenges faced by farmers and ensure the long-term sustainability of the Mirani Dam and irrigation system, the following suggestions are proposed**:**

*1. Improved Water Management:* The government should establish a robust water management system to ensure equitable water distribution among farmers**.**

*2. Irrigation System Upgrades:* The existing irrigation system should be upgraded to reduce water losses and improve efficiency.

*3. Farmer Training and Capacity Building:* Training programs should enhance farmers' knowledge and skills in water management, crop selection, and farming practices.
*4. Credit and Market Access:* The government and private sector should collaborate to provide farmers access to credit facilities and markets for their produce**.**
*5. Regular Maintenance and Monitoring:* The dam and irrigation system should be maintained to prevent damage and ensure optimal performance.
*6. Community Engagement and Participation:* Farmers and local communities should be actively engaged in decision-making to ensure that their concerns and needs are addressed.
*7. Environmental Impact Assessment:* A comprehensive environmental impact assessment should be conducted to identify potential environmental risks and develop strategies for mitigation.
By implementing these suggestions, the government and stakeholders can ensure that the Mirani Dam and irrigation system benefit the local farming community and contribute to the sustainable development of District Kech, Balochistan**.**

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