

Article

## Mega Hydropower Projects and Sustainable Development of Pakistan

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### ABSTRACT

This research paper aims to contribute to discussing the impact of mega hydro projects on sustainable development in Pakistan. It is essential to carefully consider the long-term impact of these projects on social, economic, and environmental factors to ensure that they contribute to sustainable development and the population's well-being. Data was collected through a combination of primary and secondary sources; primary sources were field observations, while secondary sources were government reports, academic articles, and other relevant literature. While the project has the potential to generate clean energy and contribute to economic development, it also has negative impacts on the environment and local communities. To contribute to sustainable development of Pakistan, while minimizing its potential negative impact on the environment, social well-being, and economic growth of the region. The study recommendations aim to ensure that the Sukhi Kinari Dam contributes to sustainable development in Pakistan while minimizing its potential negative impact on the environment, social well-being, and economic growth of the region.

**Keywords:** Sukhi Kinari Dam; Mega Hydropower Project; Policy Framework; Sustainable Development

### 1. Introduction

Pakistan is a developing country that faces a growing demand for energy, economic development, and infrastructure [1]. In this context, mega hydro projects such as the Sukhi Kinari Dam have been proposed as a solution to these challenges. However, it is important to examine the potential impact of such projects on sustainable development in the country [2]. Sustainable development [3] seeks to address the current needs while ensuring that future generations can fulfill their requirements without compromise. Therefore, it's necessary to consider the long-term social, economic, and environmental impact of these projects [4].

The purpose of this research paper is to examine the impact of the Sukhi Kinari Dam on sustainable development in Pakistan. The paper provided an overview of sustainable development and its goals, as well as a literature review of previous research on the impact of hydroelectric projects on sustainable development. The paper also includes a methodology section outlining the research design and data analysis techniques used to collect and analyze data on the Sukhi Kinari Dam project. The findings of the research

paper will provide insight into the impact of the Sukhi Kinari Dam project on sustainable development in Pakistan. The paper discussed the positive impacts of the project, such as energy generation, economic growth, the generation of jobs, and the adverse effects, such as those on the environment and society.

### 2. Literature Review

A definition of sustainable development is that it involves achieving present needs while safeguarding the capability of future generations to fulfill their requirements [5]. Hydroelectric projects are often proposed as a solution to the growing demand for energy, economic development, and infrastructure in developing countries like Pakistan [6]. However, the potential impact of these projects on sustainable development is a topic of debate among scholars and policymakers. Earlier studies have demonstrated that hydroelectric projects can bring about both favourable and adverse effects on the sustainability of development. On the positive side, hydroelectric projects can generate clean energy, reduce reliance on fossil fuels, and provide economic benefits such as job creation and increased revenue for the government [7]. For example, a study by Mazhar et al. [8] found that the Tarbela Dam, another hydroelectric project in

Pakistan, contributed significantly to economic development and poverty reduction in the area. However, hydroelectric projects can also have negative impacts on sustainable development. For example, the construction of dams can displace local communities, destroy wildlife habitats, and alter the natural flow of rivers, which can have downstream ecological impacts. Additionally, the operation of dams can lead to changes in water quality and quantity, which can affect the livelihoods of people who depend on the river for irrigation or fishing. A study by Afzal et al. [9] found that the construction of the Gomal Zam Dam in Pakistan had negative impacts on the environment and local communities. The Sukhi Kinari Dam, a mega hydro project under construction in Pakistan, is expected to have a significant impact on sustainable development in the country. Previous research on the project has focused on its potential impact on energy generation and economic development. For example, a study by Khan et al. [10] found that the project could generate significant energy and contribute to economic development in the region. However, there is limited research on the potential negative impacts of the Sukhi Kinari Dam project on sustainable development, particularly on environmental and social factors [11]. Therefore, further research is needed to understand the potential trade-offs between the positive and negative impacts of the project on sustainable development in Pakistan. This research paper aims to contribute to this discussion by examining the impact of the Sukhi Kinari Dam on sustainable development in Pakistan, with a focus on its environmental and social impacts.

### 3. Methodology

The impact of a Mega hydro project on sustainable development in Pakistan can be accessed through a case study of the Sukhi Kinari Dam. A comprehensive literature review of existing research and literature on the topic of Mega hydro projects and sustainable development in Pakistan was conducted. It provides a foundation for the study and helps identify gaps in knowledge that the study addressed. Data was collected through a combination of primary and secondary sources using a mixed method of study [12]. Primary sources were field observations, while secondary sources were government reports, academic articles, and other relevant literature.

#### 3.1. Data Collection

Data was collected on the following aspects:

**Environmental impact:** The impact of the Sukhi Kinari Dam on the environment was assessed; it includes the impact on the local ecology, water quality, and air quality.

**Social impact:** The social impact of the dam was assessed; it included the impact on local communities, including their livelihoods and access to resources.

**Economic impact:** The economic impact of the dam was assessed; it includes the impact on the local economy, including job creation and income generation.

**Infrastructure and technology:** The infrastructure and technology used in the construction and operation of the dam were assessed, including its safety and sustainability.

#### 3.2. Data Analysis

The data was gathered and underwent scrutiny through suitable quantitative and qualitative techniques, encompassing statistical analysis, content analysis, and thematic analysis. The study's conclusions, which include the advantages and disadvantages of the Sukhi Kinari Dam for Pakistan's sustainable development, were addressed and presented. Based on the findings of the study, conclusions were drawn and recommendations were

made for improving the sustainability of Mega hydro projects in Pakistan. Overall, this methodology provided a comprehensive assessment of the impact of Mega hydro projects on sustainable development in Pakistan, using the Sukhi Kinari Dam as a case study.

## 4. Regulatory and Policy Framework

The regulatory and policy framework for mega hydro projects in Pakistan is complex and involves several key institutions and legal frameworks. The regulatory framework is intended to ensure that mega hydro projects are developed in a way that promotes sustainable development and protects the environment, social well-being, and economic growth of the country. One of the key regulatory institutions for mega hydro projects in Pakistan is the Water and Power Development Authority (WAPDA) [13]. WAPDA is responsible for the planning, design, construction, and operation of hydroelectric power projects in Pakistan. WAPDA is also responsible for ensuring that mega hydro projects comply with relevant laws and regulations, including the Pakistan Environmental Protection Act 1997 [14]. The Pakistan Environmental Protection Agency (EPA) is another key regulatory institution for mega hydro projects in Pakistan. The EPA is responsible for reviewing and approving environmental impact assessments (EIAs) for mega hydro projects. The EPA is also responsible for monitoring compliance with environmental regulations and taking enforcement action when necessary [15].

In addition to these institutions, several key legal frameworks govern mega hydro projects in Pakistan. The Pakistan Environmental Protection Act 1997 sets out the legal requirements for environmental impact assessments and environmental protection in Pakistan [16, 17]. The National Energy Policy 2013 provides a policy framework for the development of renewable energy, including hydroelectric power, in Pakistan [18]. Several international agreements and standards govern mega hydro projects in Pakistan. These include the World Commission on Dams Guidelines on Dam Safety and the United Nations Framework Convention on Climate Change [19].

Despite the existence of these regulatory and policy frameworks; there have been concerns about their effectiveness in ensuring environmental, social, and economic sustainability in mega hydro projects in Pakistan. For example, there have been concerns about the adequacy of environmental impact assessments for mega hydro projects, and about the displacement of local communities and the impact on downstream water supply. The regulatory and policy framework for mega hydro projects in Pakistan involves several key institutions and legal frameworks. While these frameworks are intended to ensure sustainable development and protect the environment, social well-being, and economic growth of the country, there have been concerns about their effectiveness in practice. To ensure that mega hydro projects like the Sukhi Kinari Dam contribute to sustainable development in Pakistan, it is important to monitor and evaluate the implementation of these regulatory and policy frameworks and make improvements as necessary.

## 5. Finding

The development findings of the impact of the Sukhi Kinari Dam on sustainable development in Pakistan are mixed. While the project has the potential to generate clean energy and contribute to economic development, it also has negative impacts on the environment and local communities. On the positive side, the Sukhi Kinari Dam is expected to generate 884 MW of clean energy, which can help reduce Pakistan's reliance on fossil fuels and mitigate the impacts of climate change [20]. The project is also

expected to create jobs and contribute to economic development in the region, particularly in the construction and operation of the dam. However, the Sukhi Kinari Dam also has negative impacts on the environment and local communities. The construction of the dam has already resulted in the displacement of some people, who were relocated to nearby areas. This has disrupted their traditional way of life and livelihoods, and they may face challenges in accessing basic services like healthcare and education. The dam has also caused the loss of forest land and is expected to impact the biodiversity of the area. Furthermore, the operation of the dam can have negative impacts on downstream communities and the river ecosystem. The dam will alter the natural flow of the Kunhar River, which may affect the water quality and quantity downstream, impacting the livelihoods of people who depend on the river for irrigation and fishing.

To mitigate these negative impacts, it is important to implement measures that promote sustainable development. For example, compensation and resettlement programs can be implemented to ensure that affected communities are adequately compensated and can access basic services. Environmental safeguards and monitoring systems [21] can be put in place to minimize the impact on biodiversity and the ecosystem. Additionally, community-based approaches can be used to ensure that local communities are involved in decision-making processes and can benefit from the project. The Sukhi Kinari Dam has the potential to contribute to sustainable development in Pakistan by generating clean energy and contributing to economic development. However, the negative impacts of the project on the environment and local communities cannot be ignored. It is important to implement measures to mitigate [22] these impacts and ensure that the project contributes to sustainable development in the long term.

## 6. Recommendations

Based on the analysis of the impact of the Sukhi Kinari Dam on sustainable development in Pakistan, the following recommendations are suggested:

- The project developers should take measures to minimize the environmental impact of the dam, including minimizing the loss of biodiversity, reducing greenhouse gas emissions, and preventing soil erosion. The implementation of these measures should be monitored regularly to ensure their effectiveness.
- A comprehensive social impact assessment should be conducted to evaluate the potential impact of the dam on local communities, including the impact on their livelihoods, cultural heritage, and social structures. The assessment should be conducted in a participatory manner, involving local communities and stakeholders.
- The project developers should engage with local communities and stakeholders throughout the project lifecycle, to ensure that their concerns and interests are taken into account. This should include providing information [23] about the project, consulting with local communities, and ensuring their participation in decision-making processes.
- Adequate compensation and resettlement should be provided to those affected by the project, including those displaced from their homes or livelihoods. The compensation should be fair and transparent, and based on a comprehensive assessment of the impact of the project on affected individuals and communities.
- The project developers should prioritize the employment of local people in the construction and operation of the dam, and provide training and capacity-building opportunities to local

communities to enable them to participate in the project's development and management.

- The government of Pakistan should also invest in the development of alternative energy sources, such as solar and wind energy.

## 7. Conclusion

The impact of the Mega Hydropower Project on the sustainable development of Pakistan is a subject of paramount importance and complexity. Our comprehensive analysis, employing a range of qualitative methods, has unveiled a nuanced picture of a colossal endeavor. The project offers substantial potential for economic growth, job creation, and meeting the country's energy needs. It can pave the way for reduced reliance on fossil fuels and contribute to a more sustainable energy mix. However, this potential must be carefully managed to ensure that it doesn't come at the cost of significant environmental degradation or adverse social consequences. The recommendations above aim to ensure that the Sukhi Kinari Dam contributes to sustainable development in Pakistan while minimizing its potential negative impact on the environment, social well-being, and economic growth of the region. Implementation of these recommendations will require collaboration between project developers, government institutions, local communities, and other stakeholders, with transparency, participation, and accountability.

**Data availability statement:** The whole data of this research is included in this article.

**Declaration of competing interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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