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SMALL DAMS AND SOCIAL EMPOWERMENT: A CASE STUDY OF POTOHAR, PAKISTAN

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ABSTRACT
Small dams are vital infrastructures that can be used to address water scarcity issues, promote sustainable agriculture practices and improve rural livelihoods. In Pakistan, where agriculture is the main source of livelihood for the majority of the population, the construction of small dams has been identified as a means of providing irrigation water to farmlands and improving the socio-economic status of rural communities. This paper focuses on the impact of small dams on social empowerment in the Potohar region of Pakistan. Locale of the study was Potohar Plateau of Pakistan which includes Attock, Chakwal, Jhelum and Rawalpindi. Data were collected from the encroachment areas of ten dams. Data of beneficiaries and non-beneficiaries were collected through a structured tool. Data shoes the participation of farmer with different education groups, type of their family, marital status, cultivated land, and social empowerment. Data represents that participant reported four different levels of social empowerment, in which higher level of empowerment was reported by 65.0 percent. In addition, data shows that social empowerment is not dependent with the utilization of dam water. And regression analysis between respondent's and social empowerment shows p values 0.485, and that is less than value of alpha. So, we conclude that social empowerment is found in the areas under study but that is not linked with small dam utilization. And study further suggest to explore the key indicators of social empowerment in Potohar.
Keywords: small dams, social empowerment, Potohar plateau, Pakistan, Attock, Jhelum, Rawalpindi, Chakwal

INTRODUCTION
Pakistan relies heavily on the Indus River and its tributaries, which receive 84% of their total inflow in just three monsoonal months, with the remaining 16% coming in the following nine months. Due to climate variability, wet seasons are becoming wetter, while dry seasons are becoming drier. Additionally, the current reservoirs are losing capacity at a rate of 0.2 million acre-feet per year, with 500,000 tons of sediment being deposited daily in the Terbela reservoir alone. To address this depletion, new reservoirs are needed to transfer water from wet to dry seasons and years. The lack of adequate storage has led to the loss of over 90 million acre-feet of water during floods in 2010, 2012, and 2014, causing severe damage to infrastructure, crops, livestock, and human life. Large dams can help mitigate these losses by storing water during wet years and releasing it in subsequent years (Qureshi & Ashraf, 2019).

Small dams offer various benefits, including groundwater recharge, provision of water for domestic and municipal use, erosion control, proximity to point of use, aquaculture development, and recreation. However, they have limitations such as losing 50% of impoundments to evaporation due to their high surface area to volume ratio. Additionally, they experience seepage and percolation losses of around 20% of their volume, compared to 5% in large dams. Their limited storage capacity prevents seasonal or annual carryover, and there are safety concerns regarding managing overflow

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during extreme weather events. The cost of water in small dams is also 4-7 times higher than in large dams, as per studies conducted by Keller (2000) and Sakthivadivel (1997).

Small dams are proving to be a crucial factor in ensuring the sustainability of groundwater and agriculture. Appropriate planning and management of these structures can help in promoting sustainable agriculture in Pakistan. They are also contributing significantly towards the economy, environment, local climate, recreation, and crop production. Moreover, small dams have the potential to produce electricity at a local level. Hence, considering the overall positive impact on the environment, there is a need to encourage the construction of small dams (Ejaz, et al., 2012).

A recent study that examined 94 studies from around the world (Mbaka & Mwaniki, 2015) found that small dams have both positive and negative impacts on the richness and density of aquatic macroinvertebrates, and the effects depend on the type of impoundment. Although the study was valuable, it did not consider the cumulative downstream effects of small dams, which this research aims to address (Mantel, Rivers-Moore, & Ramulifho, 2017). The development of large projects such as dams often leads to changes in the social lives and structures of the communities affected by them. While these changes affect individuals differently (Williams & Schirmer, 2012), they can generally be categorized into seven sub-groups: impacts on health and social well-being, liveability, economic and material well-being, culture, family and community, institutions, legality, politics and equity, and gender relations (Vanclay, 2003; Malek et al., 2017).

A number of studies have been conducted in Punjab Province to evaluate the impact of small dams that have been built. The Aga Khan Rural Support Program (2000) investigated the effects of 13 small irrigation schemes in Baltistan, Gilgat, and Chitral. The projects had internal rates of return ranging from 13 to 56%, and cost-benefit ratios ranging from 1.23 to 3.63. A total of 35% of new land was brought under cultivation, and the value of land was significantly increased. The availability of water also led to an increase in livestock raising, and tree cultivation was initiated, which is expected to improve soil structure and fertility. However, the workload of women was increased due to the expansion of agriculture, and the cropping pattern shifted from traditional crops to high-value market crops such as fruits and vegetables (Wajid et al., 2013).

Munawar, Zakir, and Muhammad (2004) conducted a study to investigate the effects of small-scale irrigation on agricultural productivity and poverty levels among farmers in marginal areas of Punjab, Pakistan. The study collected data from nine tehsils of Potohar Plateau during the period of 2002-03. The findings revealed that poverty levels were higher in rainfed areas as compared to irrigated areas. Poverty headcounts were 26% in irrigated and irrigated plus rain-fed areas and 37% in the rainfed areas. The majority of the annual income of the poor came from agriculture, while non-poor farmers generated most of their income from business. Additionally, the poor spent a significant portion of their expenditure on food. The study showed that the productivity and profitability of agriculture were lower for poor farmers than non-poor farmers, while the cost of production was higher for poor farmers. However, the study found that small-scale irrigation schemes could lead to an increase in crop production, which could ultimately reduce poverty in the study area.

The Potohar plateau is made up of highland areas with a low percentage of flat terrain, which causes rainwater to runoff because of the steep slopes. Although having a total cultivated area of only about 1.0 Mha, Potohar contributes 10% of all agricultural operations and GDP. This ratio demonstrates *Potohar's* agricultural potential (Ashraf, Khlwn, & Ashraf, 2007). *Potohar's* agricultural activities are hampered by a water deficit. Rainfall is necessary for agriculture, fisheries, and animal maintenance. The monsoon season, from July to September, and the winter season, from December to March, are when it rains in Potohar. At Potohar, the average annual total rainfall ranges from 900 to 1900 mm (Pakistan Meteorological Department, 2005). Regarding the yearly water loss from surface runoff in (Monsoon). Farmers aim to reduce crop input to reduce the chance of loss and choose to adopt off-farm sources of income due to these uncertainties (Pakistan Meteorological Department, 2005).

Little dams in Potohar are mostly used for irrigation, but they also affect ground water levels, drinking water supplies, the growth of fisheries, the availability of recreational opportunities, and flood control. Large dams were seen as dependable supplies before 1970 for managing water resources for electricity, irrigation, and other human uses. Yet, modest dams are starting to take the place of massive dams in light of growing criticism of those structures.

The empowerment of rural people to lead better lives is the ultimate goal of rural and agricultural development. Social empowerment and cultural change are two ways to gauge the social and economic impact of small dams. The fundamental idea behind rural development is the phenomenon of empowerment. Individuals and organized groups can strengthen their power and autonomy through the process of empowerment to attain the results they need and want (Eyben, 2011). The most vulnerable sections in society, such as the poor, women, and marginalized communities, are seen to benefit from social empowerment because when the local populace participates in development, it becomes more tenable. Present study focused to explore relationship between respondent's type (beneficiary and non-beneficiary) and social empowerment of study population.

METHODOLOGY

The researcher chooses an explanatory study methodology to determine how tiny dams affect local communities, particularly farmers, in terms of social empowerment. Explanatory study uses the limited knowledge that is available to investigate why something occurs. It can assist you in deepening your understanding of a certain subject, figuring out how or why a specific phenomenon is occurring, and making predictions about the future. Explanatory research can alternatively be defined as a "cause and effect" approach that looks for previously unrecognized patterns and trends in current data. It is therefore frequently seen as a form of causal study (George, 2021).

The present study primarily used a quantitative deductive research approach, although case studies and personal narratives were also gathered to provide further context for the topic. Deductive techniques to the research process that try to support or refute preexisting theories are what define quantitative research.

For the purpose of gathering data, interview schedules with standardized questions were established. The tool was modified following the pilot testing under similar circumstances. A pilot test also aids in the removal and addition of questions in accordance with the field's actual circumstances. For this study, simple random sampling was used. Beneficiary farmers were chosen by simple random sample from the catchment areas of each of the ten dams on the Potohar Plateau.

The study focuses on the tiny dams and the catchment populations' socioeconomic empowerment. To fix the mistake in the filled interview schedules, field data editing and desk editing were done after data collection. A code plan or codebook was created to prepare a data entry file after data alteration.

Statistical Package for Social Sciences (SPSS) software was used for data entry and analysis. Comprehensive attempts were made to fix data entry mistakes and establish linkages between variables after data entry. In addition, SPSS was employed for more sophisticated analysis. The two primary components of data analysis are descriptive and inferential. To determine the relationship between research variables and determine the effect of small dams on social empowerment and other planned study variables, advanced statistical tests were used.

RESULTS AND DISCUSSIONS

Table No. 1 Sample Distribution by District

District	Frequency	Percent
Rawalpindi	80	14.8
Attock	120	22.2
Chakwal	240	44.4
Jhelum	100	18.5
Total	540	100.0

The distribution of respondents according to districts is seen in the data in the above table. According to percentages, 14.8 percent of respondents were from Rawalpindi, 22.2 percent came from Attock, 44.4 percent from Chakwal, and 18.5 percent came from Jhelum.

Table No. 2 Type of Respondent

Category	Frequency	Percent
Beneficiary	272	50.4
Non-Beneficiary	268	49.6
Total	540	100.0

The involvement of the study sample is shown in the above table by type. Both individuals who use small dam water and those who do not have access to dam water are considered beneficiaries. The data shows that 50.4 percent of the respondents in the current survey used dam water for irrigation, while the remaining respondents did not use this service that the government is providing for the general people.

Table No. 3 Education of Respondents

Education	Frequency	Percent
Illiterate	48	8.9
Primary	95	17.6
Secondary	124	23.0
Matriculation	178	33.0
Intermediate	62	11.5
Bachelors	29	5.4
Masters	4	.7
Total	540	100.0

Most social science studies use education as a demographic indicator to assess the effectiveness of their research. In the current study, 8.9% of farmers lack a high school diploma, compared to 17.6% of farmers with a primary diploma. 23.0 percent of respondents reported using a secondary source, while 30.0 percent of farmers are matriculated. Additionally, 5.4 percent had a bachelor's degree, 11.5 percent completed an intermediate, and 0.7 percent completed a master's.

Table No. 4 Family Type and Marital Status

Category	Frequency	Percent
Family Type		
Nuclear	126	23.3
Joint	365	67.6
Joint extended	49	9.1
Total	540	100.0
Marital Status		
Unmarried	39	7.2
Married	477	88.3
Widow/widower	22	4.1
Divorced	2	.4
Total	540	100.0

The two demographic factors for farmers—family type and marital status—are shown in the above table. According to family type data, just 23.3% of farmers are still living in nuclear families, while 67.6% are joint families. This illustrates how common joint families are in Potohar. According to respondents' marital status, 7.2% of farmers had never been married. Farmers who are married

make up 88.3% of the workforce. In the current study, a small number of divorced and widowed instances were also documented.

Table No. 5 Cultivated Land

Category	Frequency	Percent
<10	43	8.0
11-20	80	14.8
21-30	68	12.6
31-40	57	10.6
41-50	51	9.4
51-60	33	6.1
61 and above	208	38.5
Total	540	100.0

Farmers who have cultivated land are among the respondents, and the diversity in holding land size was also taken into account. According to data, 8.0% of study participants have fewer than 10 Kanals of farmed land. In 14.8% of cases, the area under cultivation ranged from 11 to 20 Kanals. 12.6% of farmers reported having cultivated land in the category of 21–30 Kanals, 10.6% in the category of 31–40 *Kanals*, and 9.4% in the category of 41–50 *Kanals*.

Table No. 6 Social Empowerment

Categories	Frequency	Percent
Low Level	4	.7
Medium Level	90	16.7
High Level	95	17.6
Higher Level	351	65.0
Total	540	100.0

The social empowerment of Potohar locals was one of the study's main goals. The data on social empowerment of research participants are shown in the above table. In 0.7% of cases, there was a low level of social empowerment. 16.7% of research participants reported having a medium level of social empowerment, whereas 17.6% reported having a high level. In the end, 65.0 percent of Potohar farmers were found to have a higher level of empowerment.

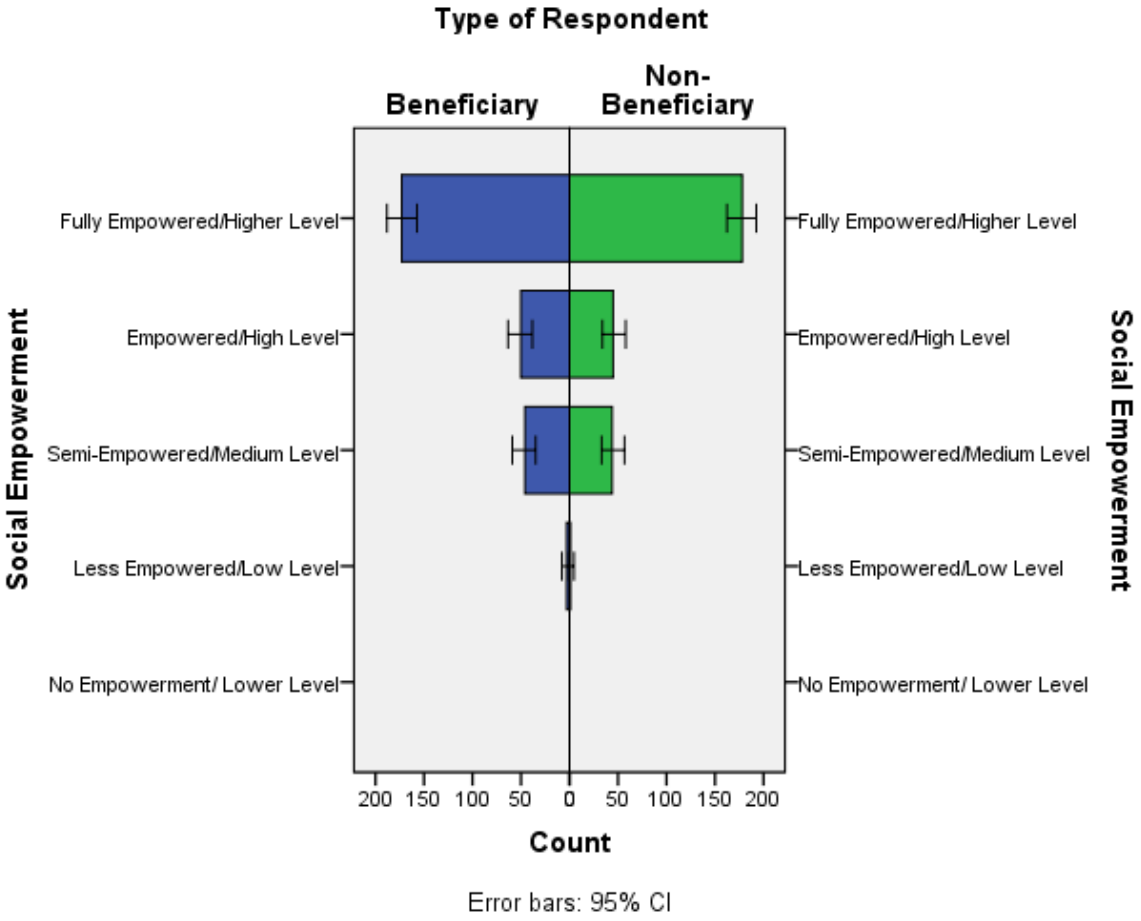
Table No. Social Empowerment * Type of Respondent

Social Empowerment		Type of Respondent		Total
		Beneficiary	Non-Beneficiary	
Low Level	% within Social Empowerment	75.0	25.0	100.0
	% within Type of Respondent	1.1	.4	.7
Medium Level	% within Social Empowerment	51.1	48.9	100.0
	% within Type of Respondent	16.9	16.4	16.7
High Level	% within Social Empowerment	52.6	47.4	100.0
	% within Type of Respondent	18.4	16.8	17.6
Higher Level	% within Social Empowerment	49.3	50.7	100.0
	% within Type of Respondent	63.6	66.4	65.0
Total	% within Social Empowerment	50.4	49.6	100.0
	% within Type of Respondent	100.0	100.0	100.0

The same categories are used here as well to ensure consistency in the outcomes. The distribution of responses in the area of social empowerment shows that beneficiaries favoured low

levels of social empowerment 75.0 percent of the time, while non-beneficiaries reported this category at 25.0 percent. The beneficiary percentile in the medium level category of social empowerment is 51.1 percent, whereas the non-beneficiary percentile is 48.9 percent. In cases of high levels of development, beneficiary responses were recorded at 52.6%, while non-beneficiary responses were at 47.7%.

Beneficiaries respond with 49.3 percent, compared to 50.7 percent of non-beneficiaries at higher levels of social empowerment. Distribution of responses by respondent type reveals that beneficiaries reported a low degree of social empowerment at 1.1 percent, a medium level at 16.9 percent, a high level at 18.4 percent, and a higher level at 63.6 percent. 66.4 percent of those who were not beneficiaries favoured greater social empowerment.



Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Interval by Interval	Pearson's R	.030	.043	.699	.485[c]
Ordinal by Ordinal	Spearman Correlation	.029	.043	.682	.495[c]
N of Valid Cases		540			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.

Generally, the final three levels of social empowerment, the response distribution is not very much different in both type of respondents. However, the replies from non-beneficiaries are observed

to differ by 50.0 percent in the first category of social empowerment. The difference in opinion between non-beneficiaries and beneficiaries in the higher category of social empowerment was 2.8%.

Social Empowerment[a]
ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	.307	1	.307	.488	.485[b]
	Residual	338.158	538	.629		
	Total	338.465	539			

a. Dependent Variable: Social Empowerment
b. Predictors: (Constant), Type of Respondent

Is there a discernible relationship between social empowerment and the predictor variable? Results from the aforementioned ANOVA table indicate that a significant value is bigger than.05, which supports our conclusion that the predictor has no discernible influence on the dependent variable. Also, the data shows that the SS value is positive. This indicates that the predictor has a favorable effect on social empowerment, however it is extremely minimal.

$y = 0.0477x + 4.3972$ $R^2 = 0.0009$

Regress model further explain the results of ANOVA table. In which the value of the slop is 0.0477 (positive integer) but the change occurred to this value is very nominal. Yet, we can say the relationship is positive but not influential.

Literature on the effects of minor dams on rural development, including social and economic outcomes, is expanding. Little dams may not have the impact that is anticipated, according to several studies. The current study, in particular, showed no conclusive link between small dams and rural development or social empowerment. Similar findings were made by Adhikari and Yadav (2019) in Nepal, who discovered that while tiny dams improved water supply, there was no appreciable increase in rural livelihoods or a decrease in poverty.

The social empowerment of the local populations was not significantly impacted by small dams, according to a study by Khan et al. (2017) that looked at the effect of small dams on rural lives in Pakistan. The study found that while the social and cultural facets of rural development remained essentially unaltered, the advantages of the tiny dams were primarily restricted to irrigation and water supply for agriculture. Similar to this, a study conducted in India by Shah et al. (2020) that looked at the effects of small dams on rural development found no evidence of a connection between small dams and social empowerment. According to the study, the benefits of tiny dams were primarily restricted to irrigation and water availability for agriculture, and as a result, they had little effect on the social and economic well-being of the local community.

In rural areas, a lot of small farmers rely on agricultural sales as their primary source of income to support their family. Numerous low-income families rely heavily on agricultural products for their daily needs. Sadly, many underdeveloped areas lack the optimum soil conditions, seed availability, and other elements necessary for productive farming, which contributes to poverty in the developing world. Agricultural development encourages favorable farming circumstances so that crops may be planted, harvested, and processed efficiently, which can ultimately decrease poverty and save lives (Terzo, 2022).

The goal of the component for water use and development of irrigated agriculture is to raise the income of agricultural households and businesses, make project ownership easier for all parties involved, guarantee the sustainability of O&M investments in the command area, reduce "elite capture" and asset inequities, and realize the reservoir's irrigation potential. This element will comprise irrigated agriculture, increased external inputs, and agricultural intensification. It is necessary to pay the necessary attention and take appropriate safety precautions for the safe use of agrochemicals, integrated pest management, and correct irrigation water management and drainage.

The notions of social cohesion and social capital are also affected, according to respondents, by a considerable change in social life in the research area. Everyone present agreed that local disputes were widespread prior to the dam's construction. As a result of the dam's completion,

farmers' needs for irrigation are now sufficiently covered, and such incidences have decreased. Also, people had the chance to get to know one another while working together to build the dam, improving their social connections. A community's common resources and ideals, on the other hand, have improved social cohesiveness in the research region. The interviewees emphasized that because locals trust one another more and cooperate more readily, joint projects are more effective. They pursue achieving mutual benefits, which is the foundation of these new forms of communal actions. For instance, neighbors from different countries work together to build irrigation channels. This approach is helpful for generating social capital among the villages. Farmers' bonds have grown stronger, enabling the emergence of behaviors that go beyond the level of the individual and boost cohesiveness and solidarity within rural communities (Hosayni, et al., 2017).

Past research has shown that social capital, norms, and networks facilitate collective action, increasing disadvantaged people's access to resources and job prospects. The bondages, tight ties, trust, and other social capital that the poor frequently have are high. The only thing missing is tangible resource scarcity (Narayan, 1999; Woolcock & Narayan 2000; Grootaert & van Bastelaer, 2002). They are also voiceless and powerless (Narayan, 2005). Moreover, empowerment strategies can improve governance, which in turn improves growth prospects. Empowerment is a component of development agendas that can more successfully encourage growth that benefits the disadvantaged. This entails lowering inequalities through enhancing the skills of the poor through education, access to R&D facilities, access to land, financial capital, and markets, as well as by educating them on how to use natural resources wisely both now and in the future. Successes in local empowerment initiatives have occasionally increased impetus for regional and national reforms (Grootaert, 2005).

Understanding how women's empowerment promotes technological uptake and the distribution of benefits from its use, notably in the case of irrigation, is another area that needs improvement. For instance, the adoption of irrigation systems could result from an increase in women's decision-making power over decisions affecting productivity and income. On the other hand, the lack of power women has over productive assets like land, their limited participation in household and community decision-making, and their heavy workloads frequently lead to lower adoption of irrigation, limited participation in irrigation governance, or fewer benefits from irrigation (Theis et al. 2018; Imburgia 2019; Lefore et al. 2019). These various experiences highlight the significance of comprehending the complex and contextual connection between irrigation and the empowerment of women.

CONCLUSION

Study reveals the participation of farmers of four districts of Potohar Pleatue including Rawalpindi, Attock, Chakwal and Jhelum. Participation of beneficiaries were 50.4 percent and non-beneficiaries were 49.6 percent. Education level varies from illiterate to masters' category with different percentiles. Data of social empowerment shows that 65.0 percent respondents reported higher level of social empowerment followed by 17.6 percent high social empowerment is recorded in present study. Further analysis of the data reveals that social empowerment is not dependent on small dam intervention in selected areas of the study and that is concluded after running the regression analysis on the data. Many of the previous also represents the similar finding that shows that small dams have no significant impact the social empowerment of the catchment population of small dams. Study further recommends to conduct research on such indicators that is responsible for social empowerment of the population of Potohar of Pakistan.

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