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Local Residents' Perceptions of a Dam and Reservoir Project in the Teesta Basin, Darjeeling Himalayas, India

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We researched local residents' perceptions of a dam and reservoir construction project in the Teesta River catchment basin (Darjeeling Himalayas) within 1.5 years of its completion, using a questionnaire survey. Most survey participants expressed negative perceptions of the project, citing a declining quality of life (loss of jobs and loss of access to river sites that had been important for religious practices and livelihoods) and a sense of insecurity (risk of landslides). These results may help predict attitudes toward similar reservoir projects that are planned for the Teesta basin.

Keywords: *Local residents; dam; perception; Himalayas; India.*

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Introduction

Dam construction projects are often controversial (Shah and Kumar 2008; Moore et al 2010; Biswas 2012). The main participants in such debates are representatives of government, industry, financial institutions, nongovernmental organizations, and people affected by the dam (Nüsser 2003, 2014; Baghel and Nüsser 2010). Dam construction provides many socioeconomic benefits: water availability for domestic, industrial, and agricultural purposes; flood and drought protection; generation of hydroelectric power; and overall regional development. On the other hand, dams cause many losses to society and the environment, which often outweigh their benefits (Biswas 2012).

Although local communities realize the benefits arising from the creation of a dam and reservoir, they are afraid that their current lifestyle will change for the worse (Sirikaew and Seeboonruang 2013). Napier et al (1986) noted that people judge all phenomena by their personal benefits. Therefore, an individual's attitude toward a dam is conditioned by profits and losses resulting from its construction. When a community realizes tangible benefits from a dam and reservoir (eg flood protection, access to drinking and industrial water, and generation of tourism jobs), local residents' perceptions of such projects are favorable (eg Manatunge and Takesada 2013; Sisinggih et al 2013; Wiejaczka et al 2014), and occasionally a community that is initially hostile to a dam project eventually acclimates to living in its vicinity (Napier et al 1985) or perceives its favorable effect on livelihoods (Sunardi et al 2013).

A frequent reason for local opposition to dam construction is insufficient compensation and lack of prospects for improvement in living conditions (eg Chandy et al 2012; Akça et al 2013; Lee et al 2015). This problem is particularly acute for poor communities, which are not always able to efficiently negotiate satisfactory compensation. Lee et al (2015: 1) stated that "indigenous communities' rights and freedom to participate in the compensation process are important and should be an integral part of compensation policies for large development projects."

The Indian government aims to double India's electricity generation by constructing 292 dams throughout the Indian Himalaya in the next few decades (Government of India 2008). Erlewein and Nüsser (2011) stated that because of the expansion of hydropower development in northern India, which is taking place at an unprecedented pace, the Himalayas can be treated not only as a source of water but also power, as they supply the surrounding lowlands with hydroelectric energy. One of the most significant hydropower developments is the construction of a large number of different types of dams

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on the Teesta River, which drains Sikkim state and the Darjeeling Himalaya region in the state of West Bengal (Pandit and Grumbine 2012; Grumbine and Pandit 2013). According to Prasai and Surie (2013), these dam construction plans are controversial; serious concerns have been expressed by local communities, civil society organizations, academics, and environmentalists about their social and environmental effects. The Teesta basin has high biodiversity and is an integral part of the Indo-Myanmar biodiversity hotspot (one of 25 dry hotspots in the world). In the Teesta River valley, the quality of life of many indigenous communities depends on traditional natural resources (Chandy et al 2012; Prokop and Płoskonka 2012).

These considerations lead to the question of whether the construction of numerous dams in the Teesta River basin is likely to affect the livelihoods of local residents and whether they will perceive the construction as beneficial or detrimental. In the global literature on local residents' perceptions of dam projects, the population affected by the dam construction is usually analyzed as a whole, without considering its structure. However, individual members of such populations may have different attitudes toward the reservoir—or similar attitudes, but for completely different reasons—depending on their social status, sex, age, distance from the reservoir and dam, source of income, and other personal characteristics. Better understanding of such differences and their effect on local residents' perceptions of dam projects is necessary to develop solutions that minimize social losses resulting from dam construction. There have been no such examinations of newly constructed reservoirs in the Himalayas.

This study had the following objectives: (1) to analyze local residents' perceptions of one dam project in the Teesta basin a short time (1.5 years) after its completion and (2) to explore the reasons for people's attitudes toward the project and the way it has affected their lives.

Study area

The Teesta River flows from Himalayan glaciers in the upper catchment areas. At 414 km, it is the largest east-bank tributary of the Brahmaputra. Over 182 km of the Teesta's path through the Himalayas, the elevation of its basin descends from 8586 m above sea level (masl) at Kangchenjunga to 200 masl at the Himalayan margin. The rapid descent, high rainfall (between 1300 and 3300 mm for the upper and lower mountain part of the Teesta basin, respectively), its deeply incised valley makes it ideally suited for hydropower development (Prokop and Walanus 2017). Approximately 40 major dams have been planned for the river basin. Of these, 9 have been completed and 13 are under construction. Most projects are to be carried out by a government agency, the National Hydroelectric Power Corporation. If all the dams are constructed as proposed, the average density of dams in the Teesta basin will be one of the highest in the world (Pandit and Grumbine 2012).

In April 2013, the hydroelectric project Teesta Low Dam III, with a total capacity of 132 MW, was completed in the Darjeeling district of West Bengal state. The project was entrusted to the National Hydroelectric Power Corporation on 15 November 2000, with the main purpose of harnessing the hydropower potential of the Teesta River. The height of the dam is 32.5 m. The nearest dams constructed earlier are located 11 km downstream and 38 km upstream. Two additional dams are planned or already being built on the Teesta's largest tributaries in Sikkim, the Great Rangeet and the Rangpo.

The national highway linking West Bengal and Sikkim runs along the bottom of the Teesta Valley, with many small villages along the road. Roads between the river and the steep slopes allow local residents to use the water and forest resources. The 2 villages where we conducted our research are located along the reservoir 2.5 km (Baluwakhani) and 4 km (Geil Khola) upstream from the dam about 16 km east of Darjeeling town (Figure 1). The study villages are located within 100 m of the reservoir (before dam construction, their distance from the river was 20–120 m).

Research methods and study participants

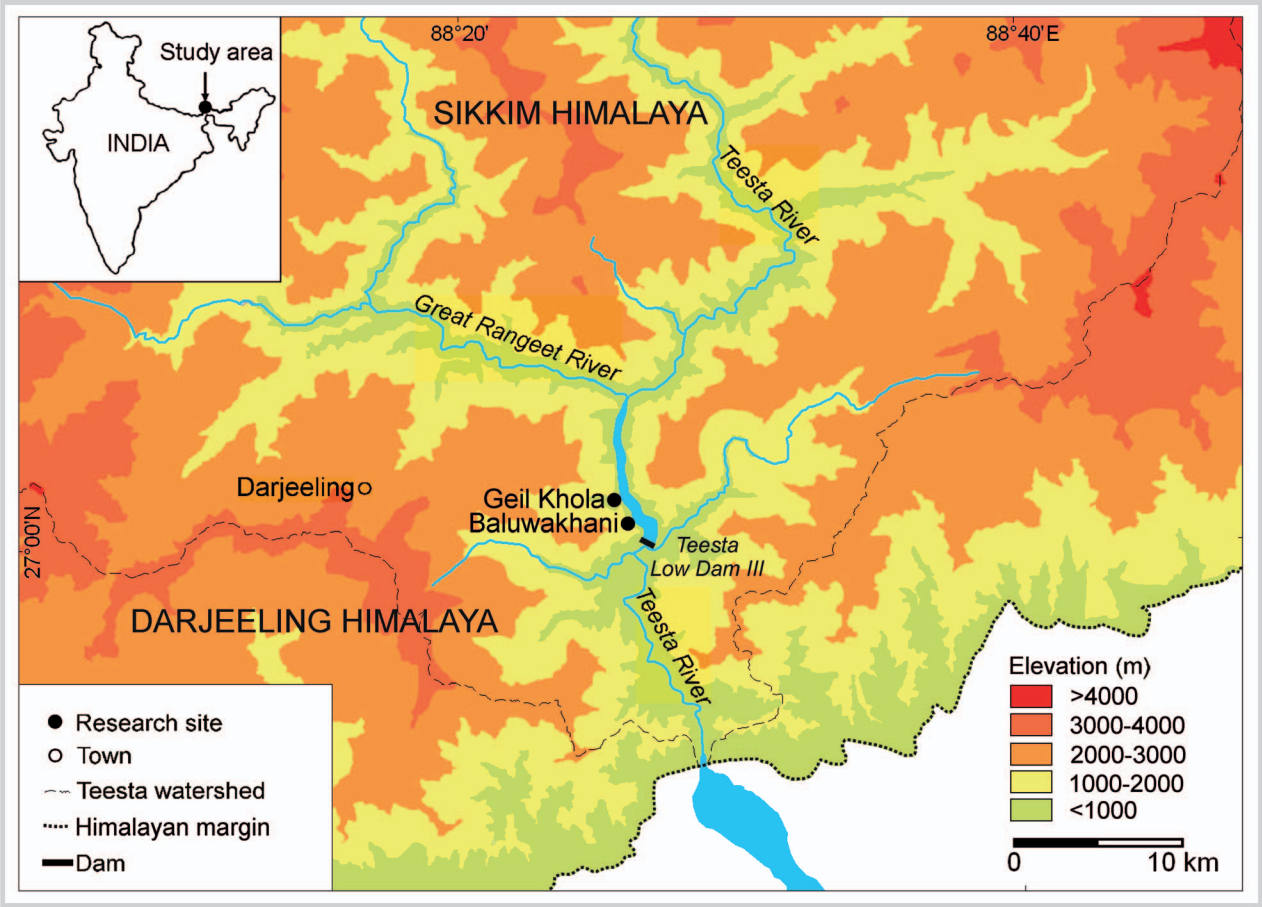
Data were collected through a diagnostic survey in the form of questionnaire-based interviews in December 2014, about 1.5 years after the dam and reservoir were built. The field survey allowed us to establish a total number of households in this area, which was 65 (39 in Baluwakhani and 26 in Geil Khola). In the course of the study, 21.5% of the owners of households either refused to take part in the interview or did not open the door. Finally we interviewed 51 respondents—one person per household—so the response rate of the studied households was 78.5%. It was therefore a representative group, which allowed the objective of the research to be met. Respondents were interviewed in the Nepali language.

The demographic characteristics and social information of the surveyed population revealed that the study group comprised 51.0% female members, which is slightly higher than the number of male participants. The age distribution was also distinctly varied among respondents of this study, with the largest group aged between 18 and 38 years old (slightly over a half). The educational background of the surveyed group was rather low, with a higher proportion of respondents who were illiterate or obtained primary education (Table 1).

The interviews included questions on demographic characteristics such as age, sex, and education, as well as 8 questions on participants' attitudes toward the dam. Of the latter, 5 were open-ended and 3 invited responses on a

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FIGURE 1 Map of the study area. (Map by authors)



5-point Likert scale (agree strongly, agree, no opinion, disagree, disagree strongly).These asked about participants' awareness of the purposes of the reservoir and where their knowledge originated, whether they thought the reservoir's creation was a good idea, whether they believed it was secure, its perceived costs and benefits for the local population, and the extent to which they had grown accustomed to living near it (Annex S1, *Supplemental material*, http://dx.doi.org/10.1659/MRD-JOURNAL-D-16-00124.S1).

We took into account Hibszer's (2013) finding that perceptions of an area, and acceptance of or resistance to changes to it, are significantly affected by a personal filter (characteristics such as gender, age, and education level), to a lesser extent a psycho-physiological filter (directly related to the sense of security), and a cultural filter (related to the individual's religion, culture, and tradition). Moreover, given that the construction of the reservoir in this community influenced people's earning opportunities, we took into account the impact that people's primary income source and, indirectly, their income class had on their perceptions of the reservoir.

Table 1. The study population by sex, age, and education.

Variable	Number	Percent of population
Sex		
Female	26	51.0
Male	25	49.0
Age		
18–38	26	51.0
39–59	17	33.3
≥60	8	15.7
Education level		
Grade 9–12 (secondary)	9	17.6
Grade 6–8 (middle)	13	25.5
Grade 1–5 (primary)	15	29.4
None	14	27.5

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Table 2. Perceptions of the Teesta Low Dam III project.

Question	% of answers				
	Agree strongly	Agree	No opinion	Disagree	Disagree strongly
Was the construction of the reservoir a good idea?	2.0	0.0	0.0	3.9	94.1
Did you get used to the fact that you live near the reservoir?	70.6	21.6	0.0	0.0	7.8
Do you feel safe living near the reservoir?	7.8	0.0	0.0	2.0	90.2
Would you like to move somewhere else because of the proximity of the reservoir?	3.9	68.8	0.0	13.7	13.7
Do you think that your neighbors are happy about the fact that they live near the reservoir?	3.9	0.0	3.9	2.0	90.2

People's attitudes toward anthropogenic changes in their environment are especially emotional and likely to result in opposition and conflict if their everyday existence, and particularly their ability to earn income, is directly related to those changes without any alternative available (Barber et al 2003; Piróg 2008). To identify any correlations between age, gender, education, source of income, and perceptions of the project, indices were attributed to the degrees of the ordinal scale used in the survey (Babbie 2012). Numerical codes ranging from −2 (disagree strongly) to +2 (agree strongly) were used. Negative code values corresponded to responses showing a significant or definite nonacceptance or negative perception, and positive values corresponded to a favorable perception of the project (see Tables 2, 3, and 4).

Results and discussion

Perceptions of the dam

A key factor determining local people's attitudes to a hydroengineering project is how they assess the nature and scale of possible personal benefits from the facility (Napier et al 1986). In our study, almost all the respondents declared that the reservoir had brought them no benefits. Nearly all spoke only of losses they had suffered as a result of the reservoir. For many

Table 3. Impact of education level and age on perceptions of the Teesta Low Dam III project. Numbers represent a range from −2 (disagree strongly) to +2 (agree strongly).

Question	Education level				Age			
	None	Grade 1–5 (primary)	Grade 6–8 (middle)	Grade 9–12 (secondary)	≤30	31–45	46–60	≥61
Was the construction of the reservoir a good idea?	−2.00	−1.93	−1.77	−2.00	−2.00	−1.88	−2.00	−1.33
Did you get used to the fact that you live near the reservoir?	1.62	1.47	1.54	1.22	1.20	1.53	1.50	1.83
Do you feel safe living near the reservoir?	−2.00	−1.73	−1.31	−1.56	−1.67	−1.76	−1.67	−1.33
Would you like to move somewhere else because of the proximity of the reservoir?	0.54	−0,07	0.31	1.11	0.87	0.06	0.17	0.00
Do you think that your neighbors are happy about the fact that they live near the reservoir?	−2.00	−1.73	−1.85	−1.89	−1.93	−1.88	−1.33	−1.67
Mean	−0.77	−0.80	−0.62	−0.62	−0.71	−0.79	−0.67	−0.50
Standard deviation[a)]	0.10				0.12			

[a)]A standard deviation equal or close to zero means the lack or weak influence of a specific personal characteristic (age, sex, education, etc) on the given answer. A standard deviation equal or close to 1 indicates a very large impact of the personal characteristic on the given response (rating on a scale from −2 to +2).

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Table 4. Impact of gender and source of income on perceptions of the Teesta Low Dam III project. Numbers represent a range from −2 (disagree strongly) to +2 (agree strongly).

Question	Gender		Source of income[a)]					
	Female	Male	A	B	C	D	E	F
Was the construction of the reservoir a good idea?	−2.00	−1.76	−1.91	−2.00	−1.91	−1.27	−1.27	−0.36
Did you get used to the fact that you live near the reservoir?	1.35	1.60	1.27	1.82	1.82	0.82	0.82	0.27
Do you feel safe living near the reservoir?	−1.65	−1.68	−1.64	−1.92	−2.00	−1.27	−0.55	−0.36
Would you like to move somewhere else because of the proximity of the reservoir?	0.38	0.32	0.18	0.64	0.27	0.18	0.18	0.18
Do you think that your neighbors are happy about the fact that they live near the reservoir?	−1.85	−1.64	−2.00	−2.00	−2.00	−1.27	−0.45	−0.36
Mean	−0.75	−0.63	−0.82	−0.69	−0.76	−0.56	−0.25	−0.13
Standard deviation	0.09		0.28					

[a)]A = construction; B = transportation; C = services (shop and restaurant owners); D = quarry day labor; E = other private sector; F = public sector.

respondents, the main loss was access to the river, which had been their source of income.

Before construction of the reservoir, the main local sources of income were extraction of stones, gravel, and sand from the riverbed, roadside shops and restaurants, and temporary jobs in road construction. It is worth emphasizing that extracting riverbed material was the main source of income for 35% of the respondents participating in the survey. These respondents declared that the construction of the reservoir deprived them of their jobs. For about four-fifths of the people in the villages, the main source of income had been running a roadside shop or working as a driver; these people were also affected, because the people working in the extraction of the riverbed material had been their customers.

Studies of communities affected by dam projects in other parts of the world also noticed that the majority of respondents do not see dam projects as having a positive effect on their livelihoods (eg Bird 2012; Usman 2012). However, some respondents point out positive effects such as road improvements and flood protection (Usman 2012; Wiejaczka et al 2014). The lack of noticeable benefits from Teesta Low Dam III for the studied respondents is therefore very worrying in the context of the quality of their livelihoods. Chandy et al (2012) found that in the case of the Teesta Valley communities, policy and investment mechanisms are needed to empower the villagers affected by the reservoirs so that they can engage in diverse livelihood activities.

In our survey 12% of respondents (mainly shop and restaurant owners) observed a decrease in their income, and 4% had to close their businesses (mainly shops) altogether after the reservoir was created. The owners of most of the shops, restaurants, and other businesses observed a decrease in the number of customers, which translated into a decrease of their income by 50% or more. For instance, an owner of a roadside restaurant said that before the creation of the reservoir he had had 20 to 30 customers per day, mainly workers extracting material from the riverbed and drivers transporting the material. After the reservoir was created and the extraction of riverbed material ceased, the number of customers fell to 5 to 10 per day. Another restaurant owner said that before the reservoir he had had 35 to 40 customers per day, but currently the numbers were about 50% lower. A shop owner said that before the reservoir she had earned about 500 Indian rupees (approximately US$ 8) or more per day. After the reservoir was built, she earned only about one-fifth that amount. A decline in customers and income due to the extraction of riverbed material being discontinued was also reported by providers of other services (such as tire repairing), although they did not specify the scale of the decline. Only 1 restaurant owner and 1 shop owner said that the creation of the reservoir had not affected their businesses. This is the opposite of the findings described by Atindana et al (2015) and Mudzengi (2012), who noted a higher job availability and diversity for people local community after dam construction. After the reservoir was created, the main source of income remained the same for 65% of the respondents. As mentioned above, the rest had depended on the extraction of material from the riverbed and were compelled to find different income sources. Of those people, about three-quarters found jobs as day laborers, for example, in road construction. The remaining households worked as wood collectors, shop owners, drivers, or watchmen. One respondent remarked that the income he had earned by extracting riverbed material was far higher than the income he currently earned from his shop, due to the competition from the many other shops in the area. A decline in local incomes after the construction of a dam, resulting from a change of livelihood, is a common occurrence (eg Wiejaczka et al 2014; Atindana et al 2015), although the opposite situation

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has also been observed (eg Mudzengi 2012; Parimalarenganayaki and Elango 2016).

Other personal losses reported by respondents included loss of a place for religious practices (for example, they could no longer cremate the bodies of the dead and throw the ashes into the river near where they lived but had to travel several kilometers upstream to Teesta Bazar). The negative impact of dams on cultural and religious sites and practices has also been documented for other regions—for example, loss of sacred grounds, unavailability of traditional food, and discontinuation of traditional festivals (Mettle 2011; Atindana et al 2015).

Most participants in our study said they had been informed, mainly by the National Hydroelectric Power Corporation, why the reservoir was being built and which institution would manage it; nevertheless, almost all disapproved of the reservoir (Table 2). They argued that no one could use the reservoir (eg for bathing, cleaning, or fishing) because access to it was forbidden. Since the creation of the reservoir, people use spring water for all their water needs. The springs are located on slopes above the villages, and the water is transported by small pipes. After dam construction, fishing has become a very rare activity.

Another important determinant of attitudes toward new hydrotechnical structure in the surroundings is whether they have an adverse effect on people's sense of security. Most respondents reported feeling insecure or fearful because of the reservoir's proximity, mostly about the possibility of landslides. This fear is exacerbated by the reservoir water level rising in the monsoon season and the possibility of collapse of the concrete reinforcements of the reservoir banks and the valley sides. Also of concern is the possibility that earthquakes may cause the concrete walls reinforcing the reservoir banks to collapse, leading to landslides. The local residents clearly remember an earthquake on 18 September 2011, before the creation of the reservoir, which caused houses to slide into the valley below.

Given these concerns, most respondents believed that not only they but also their neighbors were dissatisfied that the reservoir was built near their homes.

Despite their concerns about the dam, most respondents said that they had grown accustomed to it. Nevertheless, the majority expressed some desire to move away.

Two fundamental factors made such a move impossible, however. The respondents' statements implied that the land needed for the reservoir had been purchased by the construction company, and although the previous landowners had obtained compensation, they considered it insufficient. For instance, 1 respondent said that the amount he considered fair was 50 times the amount he had actually received. In the past he had been able to grow vegetables and fruit for his family's own needs, whereas at present he has to buy everything, creating an additional burden for the family budget. In addition, people found the compensation offered to them for leaving their homes to be insufficient to build a new home elsewhere, and as some of the respondents noted, they would have to leave their homes before receiving the compensation.

Insufficient compensation for communities affected by dam projects is particularly problematic for less wealthy people, who often have to completely change their way of life (Akça et al 2013). Cernea (1997) noted that "project budgets often do not distinguish between land acquisition, compensation costs and the costs of providing development opportunities to resettlers in their new sites" (p 14). The problem of deteriorating livelihood quality in communities affected by dam projects is emphasized in the World Commission on Dams report (2000). Furthermore, in the case of Teesta Low Dam III, people found the land offered to them by the dam construction company for their new homes (several kilometers downstream from the reservoir) unsuitable for establishing a residence. They said they could consider moving if they were offered land to settle on directly next to a highway or in a place with jobs or business prospects.

Two of the respondents declared that they would move out if and when all the other people in the village were also leaving their homes. More than half of the respondents envisaging the possibility of moving were able to specify, more or less precisely, their location of choice for the resettlement (eg where their family lived, downstream from the reservoir, next to a highway, or far from the river). More than one-fourth did not want to leave the place they lived in, for example, because they did not feel their living conditions had worsened since the reservoir was built or because they were afraid they would not fit in at the new location.

Influence of personal characteristics on perceptions of the dam

In this study, we attempted to identify the influence of personal characteristics such as age, education level (Table 3), gender, and income source (Table 4) on people's perceptions of the reservoir. These characteristics showed only a minor impact on perception of the project. The low standard deviation for each of these factors further highlighted the residents' unanimity in their unfavorable perception of the reservoir.

The factor with the relatively largest influence on perceptions of the project was source of income. The most skeptical respondents were those earning their living building roads, doing construction, or working as drivers and shop and restaurant owners —that is, those with the lowest and most uncertain earnings. The least critical were people working in the public sector, who were relatively well off.

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All of them thought building the dam was a bad idea and were of the opinion that their neighbors share this view. The harshest in their evaluation were drivers, road/building constructors and people working in the trade industry. All of them said they did not feel safe living near the reservoir. However, the local population became used to the reservoir, in particular respondents working as shop owners and drivers. No links were observed between the source of income and willingness to move to a different location.

Age had little influence on people's perceptions of the project. Older respondents were slightly less willing to move to a different location because of the dam and said they felt a little more secure and accustomed to living near it. Education level also had a small influence on perceptions of the project. However, there is difference in perception of the project between particular levels of education. The level of education had the strongest impact on the sense of security. Illiterate respondents felt least secure; the higher their level of education, the safer people felt. Education also had an impact on people's willingness to move to a different location because of the dam project—more educated people were clearly more willing to move. All respondents, regardless of their education level, were similarly skeptical both in their own assessment of the validity of the project and in their opinion on whether their neighbors were happy with it. No correlation was observed between education and the extent to which respondents said they had become accustomed to living close to the reservoir. Gender had such a negligible impact that we can consider this factor irrelevant in shaping attitudes toward the dam. Wiejaczka et al (2014) found that the distance of their homes from the reservoir was the most important factor influencing perceptions of a reservoir. Generally, the greater the distance of the household from the reservoir, the more positive the perception. Other determinants (age, education, and gender) have slighter influence on the perception of the dam project (Wiejaczka et al 2014).

Conclusions

Our study of perceptions of the Teesta Low Dam III demonstrated that the local community has a negative opinion of the proximity of the reservoir to their homes. Residents perceived the reservoir to have resulted in losses, mainly resulting from the loss of river access, which had provided livelihoods (extracting riverbed material, fishing) and facilitated their daily functioning (cleaning, bathing, religious practices). These losses reduced their sense of security and quality of life and were the main reasons for their hostility to the dam and reservoir, despite the relatively small surface of the flooded area and the absence of large-scale resettlement.

The personal characteristic with the largest influence on perceptions of the project was the source of income.

The findings of our research are potentially relevant to several other reservoir projects planned in the Teesta basin. The results of our survey of 2 communities affected by the dam may help predict possible responses to future dam projects. The attitudes of local residents toward changes made by the government in their environment are an important factor influencing the development of local businesses in the future.

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Supplemental material

ANNEX S1 Survey questions.

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