



# Role of Women in the Mitigation of Climate Change Impact on Aquaculture in Chitwan, Nepal

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## Abstract

Gender roles in climate change mitigation within Nepal's aquaculture sector remains under researched. In this study, 40 women fish farmers from Chitwan district were interviewed from March to July 2021 to learn their roles and activities with respect to mitigation of climate change impact. It was found that women and men had different roles in climate impact mitigation. Women were more involved in drought than flood mitigation due to cultural norms. Further, more women from small-scale aquaculture were involved in mitigation activities than women from commercial aquaculture farms, which employed labourers and machines. Further support in terms of insurance, networking, and technical trainings are required through gender-transformative extension services.

**Key words:** Flood, drought, women fish farmers, mitigation, climate change

## Introduction

Aquaculture is one of the fastest growing sectors of food production in Nepal and it has contributed to about 4.22% of national agricultural gross domestic product (AGDP) and 1.59% of national gross domestic product in 2021 (CFPCC, 2022). Among different culture systems, carp polyculture is the most established culture system accounting for 90% of the total pond fish production in the country (Jha et al., 2018). Nepal is one of the most vulnerable countries to climate change (NAPA, 2010) and has

a number of issues, the most urgent of which is its susceptibility to climate-related catastrophes that might disrupt the entire value chain, from the pond to the plate. Flood and drought are two main impacts of climate change that has affected aquaculture. A single incidence of flood could wipe out the entire stock and affect farmers' investment (Asiedu, Adetola, & Kissi, 2017) while drought results in declining water levels and decreases fish productivity by 50-60% in several hectares of ponds located alongside of the Koshi river bank (Wagle, Gurung, Pradhan & Raymajhi, 2011).

Climate vulnerability is also influenced by social factors such as gender, caste, ethnicity, etc. (Jones & Boyd, 2011). Rural women in developing countries play a significant role in food production systems, accounting for 60-80% of production and selling products at markets (FAO, 2010). However, they generally do not have the same access to land, water, seeds, training and credit as men. As a consequence, in Nepal, women's involvement is greater in minor and subsistence food production while men are more involved in cash crops and commercial production of crops such as rice. Aquaculture contributes significantly to the creation of jobs at various stages of the value chain and women and men of various ages are involved in aquaculture activities. Women engage in a range of aquaculture activities in Nepal such as filling the pond, applying fertilizer, feeding, harvesting, and marketing (Gupta, 2022). About 1.5 lakh people work directly in this subsector, with men making up 68% of the workforce and women just 32% (Rijal & Jha, 2020). Although subsistence aquaculture has become primarily a women's responsibility, their role still remains unrecognized. Since there is a lack of adequate studies about women's participation and their contribution in the mitigation of climate change impact in aquaculture, the main objective of this study was to assess the role of women in mitigating the impact of climate change in aquaculture in Chitwan district, Nepal.

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## Materials and Methods

The study was conducted in Chitwan district which is one of the top ten fish production districts of Nepal. The district is centrally located, and has easy access to markets in major cities such as Kathmandu and Pokhara. Aquaculture is both small-scale (100-300 m<sup>2</sup>) and commercial (>300 m<sup>2</sup>). Out of total farmers interviewed, number of farmers in small scale is 18 and 22 in commercial aquaculture. In order to assess the role of women in mitigating the impact of climate change in aquaculture, 40 women fish farmers of different areas of Chitwan district were interviewed (Table 1).

The sample size was set at 2% of the total number of fish farmers in Chitwan district. The population of fish farmers was 2118, and the sample size was calculated to be 40. Choosing 2% of population in survey allows for a reasonable margin of error and is commonly accepted for initial assessments. Random selection of respondents was used to eliminate biases and reduce systematic errors. Half of the respondents were interviewed in person in March 2021 and telephonic interviews were conducted with the others in June 2021 due to travel restrictions following the spread of COVID 19 in the country.

Table 1. Number of respondents taken from four municipalities of Chitwan district

Municipality	Respondent (no.)
Rapti	16
Bharatpur	9
Khaireni	10
Ratnanagar	5

A cross-sectional semi-structured questionnaire was designed for the survey covering all activities related to four major categories: socio-demographic profile of fish farmers, impacts of climate change in aquaculture, mitigation practices adopted by fish farmers, and role of women in mitigating the impact of climate change in aquaculture. Descriptive statistics was used to analyse the data.

## Results and Discussion

Table 2 presents the characteristics of respondents' farms. The average size of selected farm was 0.6 ha ranging from 0.01 to 7 ha per household. The

number of ponds ranged from 1 to 13 and the farms had been in operation from 2 to 20 years.

With respect to the ethnicity, the highest percentage (77%) of respondents were Tharu followed by Brahmin (11%) and then Tamang (9%) and the lowest (3%) were Gurung. Tharu are a marginalized ethnic group in Nepal. They make up 6.6% of the total population (CBS, 2021). They are traditional fishers, capturing fish from rivers, swamps, lakes, and ponds to feed their families as fish is a major part of their diet. Nowadays, due to low and inconsistent catch from natural water bodies they have gradually shifted their livelihoods from fishing to farming. Producing fish in their own ponds improved their household income and nutritional status as well (Rai, Thilsted, Shrestha, Wahab, & Gupta, 2014).

With respect to land ownership of the respondents, women had the highest ownership (about 79%). This was due to a government rule which gives a 25-50% discount in the registration fee when the land is registered to women's name. This rule encouraged giving land rights to women and save registration fee. Men had only about 18% of ownership, while 3% was the combined ownership.

With respect to educational status, around 40% respondents were illiterate, 23% had primary education, 20% had secondary education and 6% each had intermediate, Bachelors' and Masters' level education. This indicated that there are few educated women involved in fish farming in Chitwan district.

Among the respondents, 55% of the respondents were commercial fish farmers and 45% were small-scale fish farmers. Semi-intensive carp polyculture is popular in Nepal and the majority of respondents (94%) in this study had adopted it; very few (6%) had adopted intensive aquaculture system. About 86% of the fish farmers adopted carp polyculture and remaining 14% adopted Pangas, Asian catfish, Carp and Tilapia culture.

Fig. 1 indicates percentage of fish farmers adopting different sources of water for fish farming. More than 40% of the fish farmers depend on irrigation canals and small motors. Since irrigation canal is seasonal and priority is given to paddy fields over fish ponds, most farmers who could afford motor and electricity have alternative sources of water supply. About 20% of small-scale fish farmers who could not afford the

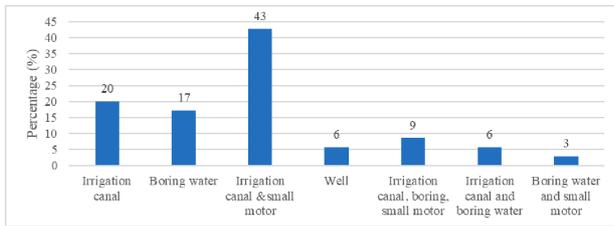


Fig. 1. Sources of water for fish farming

costs of a small motor and electricity used water supply from irrigation canal only. Around 17% of the commercial fish farmers used only boring water<sup>1</sup>. In case of emergencies, a combination of water sources is used, such as boring water and irrigation canals or small motors and irrigation canals; further, it is only considered an emergency, when water level has decreased considerably.

About 68% of the fish farmers experienced the problem of both flood and drought while 6% faced the problem of flood only and 26% faced the problem of drought only.

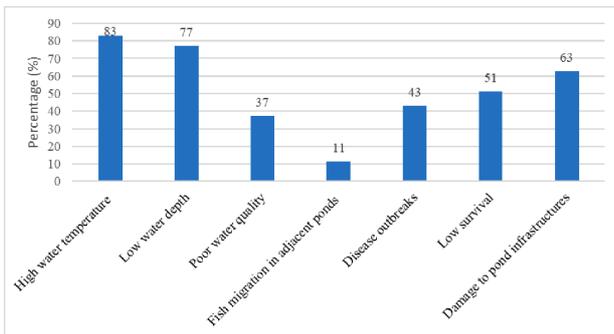


Fig. 2. Impacts of climate change in aquaculture

Fish farmers reported high-water temperature, low water depth, damage to pond dykes, low survival, disease outbreak, poor water quality, fish migration to adjacent ponds as impacts of climate change in aquaculture (Fig. 2). Around 37% faced the problem of poor water quality during both flood and drought. Farmers responded that water becomes more turbid during flood and during drought Dissolved Oxygen (DO) is depleted and fish mortality was also reported. About 51% farmers reported high fish mortality due to heat stress. About 11% faced the problem of fish migration to adjacent ponds during flood. Farmers realized that most of the surface feeder fish like Silver carp and

Bighead carp migrated to other ponds during floods; whereas bottom feeder like Common carp and Mrigal created holes in pond dykes to migrate, causing structural damage.

About 63% of farmers perceived that the damage to pond dykes occurred due to flooding. Therefore, the fish farmers complained about the problem of rising costs for continued operations for pond fish farming. The farmers also claim that due to damage from floods, they have to conduct regular maintenance of the pond every 1-2 years to make it deeper and the dyke stronger. Nearly 45% of fish farmers said there were more incidence of disease during the drought. The majority of farmers reported cases of asphyxiation during dry spells, argulus and tail/fin rot following dry spells and Epizootic ulcerative syndrome (EUS) during the winter months.

Women’s participation in mitigating the impact of flood in aquaculture is presented in Fig. 3. Out of total respondents, about 59% were involved in planting of banana plants and other trees around the pond and 60% actively participated in stocking other species like Rohu, Naini (for Chhadi culture), Common carp and Monosex Nile tilapia. Similarly, 43% women farmers were involved in early harvesting of fish. Whereas, few were involved in draining out excess water from the pond and fencing with a net around the pond. Women farmers mentioned that in case of pond and dyke maintenance, mainly men were involved. In case of small-scale aquaculture, mostly men from household were involved, sometimes with hired male labour. In case of commercial aquaculture, it is done using machines by hired male labour.

Fig. 4 presents women’s participation in mitigating the impact of drought in aquaculture. More than 50% of the women respondents were involved in planting banana plants, stocking fish at low density and 40 to 50% were involved in optimizing feed, stocking large seed and early harvesting. About 37% farmers were involved in adding freshwater in the pond and 36% in maintaining water level in the pond. Very few (11%) women used aerators and other about 29% used oxygen tablet (O<sub>2</sub> max) in case of emergency.

Overall, 28% of the women fish farmers were found to be involved in flood impact mitigation practices and 41% women farmers were involved in drought

<sup>1</sup> Boring water in Nepal is groundwater accessed by drilling a bore well into underground aquifers and pumped to the surface

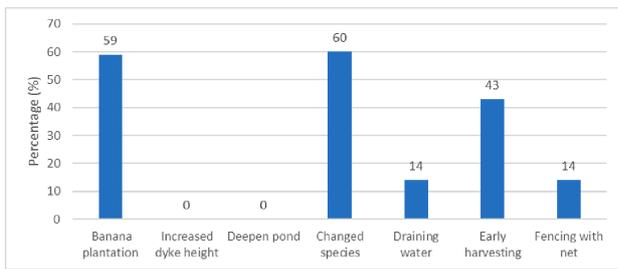


Fig. 3. Women's participation in measures to mitigate the impact of floods

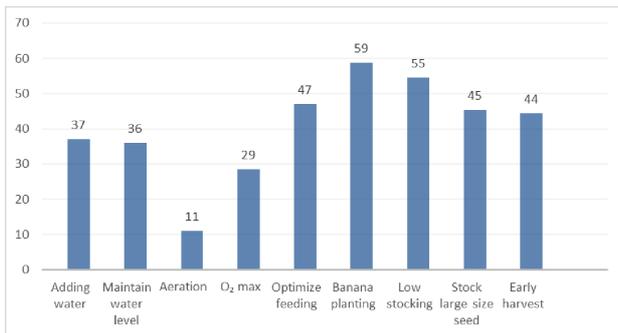


Fig. 4. Women's participation in measures to mitigate the impact of drought

impact mitigation. Between small-scale and commercial scale farmers, small-scale fish farmers had higher participation in both flood and drought impact mitigation practices.

In case of drought mitigation practices, 37% of the women fish farmers were involved in adding freshwater to the pond for cooling down the water temperature and for maintaining water level in the pond. Overall, 44% of the women fish farmers made an early harvest irrespective of the fish growth which was similar to findings reported by Adhikari et al. (2018) & Halim, Mondal, Salam, and Hossain (2017). In case of flood mitigation practices, very few (14%) women farmers were involved in fencing with net to prevent escape of fish from pond and draining out excess water from the pond. While women's involvement in deepening ponds and increasing dyke height was found to be almost nil, more

women (40 to 60%) were involved in changing cultured fish species, planting banana plants and early harvesting of fish.

In this study, women's involvement was found to be higher in small-scale aquaculture. This may be due to factors such as out-migration of men for employment which places women in charge of all domestic and agricultural tasks (Leduc, 2009; Mool et al., 2011). In case of small-scale aquaculture, men of the household were involved in deepening the ponds, draining out excess water, while in case of commercial aquaculture, these activities were done by machines (excavators) and hired labour (male). Increasing dyke height and deepening ponds are both physical activities that are traditionally done by men; while getting into deeper water is difficult for women aquaculturist because most of them cannot swim.

Since 45% of the respondents practiced small-scale aquaculture, they depended on canal water for water supply to fish ponds. Commercial farmers, on the other hand, mostly relied on ground water sources and had outlets to remove excess water. Therefore, they faced the problem of drought for short periods of time and it did not impact heavily on their aquaculture. Furthermore, 9% of respondents had support through insurance schemes and all of them were commercial fish farmers; while small-scale women farmers did not have insurance. Thus, from the above result, it is evident that small-scale farmers were more vulnerable to climate change. Similarly, according to Morton (2007), poor subsistence farmers depending on natural resources are most vulnerable to climate change.

In Nepal, cultural norms of modesty prohibit women and girls from swimming. Therefore, fewer women (28%) were involved in flood mitigation practices because they could not get into ponds with high-water levels to conduct activities like pond repair. However, more (41%) respondents were involved in drought mitigation practices because they could walk into shallow ponds and conduct

Table 2. Characteristics of respondents' farms

	Age of respondent (yr.)	Years under operation (yr.)	Total pond area (ha/household)	Number of pond (No./household)
Average±SD	41.1±8.2	10.7±4.5	0.6±1.6	3±2
Range	28-57	2-20	0.01-7	1-13

activities such as stocking, feeding, and harvesting.

Women's involvement in disaster mitigation is further hindered by several socio-economic and structural constraints, including policy-related and infrastructural issues that come in the way of enhancing women's role in aquaculture. These include low levels of literacy; limited access to resources, technology and markets; lack of government strategies; lack of women extension workers; and inadequate access to credit.

There is a clear gender-based division of labour in both flood and drought mitigation with women and men being involved in activities and roles that are gender "appropriate" within the context of Nepali culture. Men are involved in traditionally "masculine" activities such as digging, building, using equipment or technology as well as new techniques and tools. Women tend to be involved in activities such as planting, feeding, stocking and harvesting which could be considered an extension of their reproductive roles in the family. In aquaculture also, women fish farmers have been involved in traditionally feminine tasks such as planting, stocking fish, feeding and harvesting. However, in small-scale aquaculture farms run by the family, such gender norms do not seem to be relevant, since women take over men's roles in the absence of men who had migrated and were hence involved in most activities related to flood and drought mitigation.

Flood and drought are major climate-related impacts in aquaculture in Nepal. Women operating small-scale farms appear to have greater involvement in mitigation practices than their counterparts in commercial aquaculture. This is attributed to the manageable size and shallowness of ponds in small scale system, which allow easier integration of aquaculture related activities alongside domestic responsibilities. Women have no choice but to manage small scale farms which are also easily accessible for women with low financial status due to male migration in the families. Some of the strategies and technologies like aquaponics system, selection of stress resistant and resilient fish species, use of IoT devices to monitor water quality parameters during extreme events, rainwater harvesting, etc. should be promoted through gender-transformative extension services. The government needs to support and integrate farmers at every level from policy making, research and development, awareness campaigns, insurance programs and

trainings like water management techniques, sustainable aquaculture practices and disaster preparedness techniques.

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