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Causes for drying up of Bhairab River in Bangladesh

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ABSTRACT

Bhairab River is an important river in the moribund delta area of Bangladesh although it is drying up gradually. The study was conducted for a period of four months at six selected drying up points of the Bhairab River, viz. Notun Khoyertola, Puratan Koshba Kazipara, Nodagram, Santola, Nurnagar and Bijoy Nagar Villages in Jashore district to identify the causes for drying up of the Bhairab River so that the flow of the river can be continued and kept alive by taking necessary steps. Data were collected through questionnaire interviews and Focus Group Discussion (FGD). The data analysis revealed that both of human made causes and natural causes were responsible for river dry. It was found that 47%, 78%, 64%, 64% and 73% respondents supported the installation of dam, establishment of bridge, excessive irrigation in agricultural land, use of chemicals, pesticides, industrial effluents etc. and irresponsible management of fishing, respectively as human made causes for drying up of the Bhairab River. Data analysis also showed that 65%, 62%, 60%, 67% and 80% participants favored climate change, siltation, rainfall pattern, temperature and drought, respectively as natural causes for drying up of the Bhairab River. From the study, establishment of dam was observed predominant among human made causes and drought was found strongest among natural causes. The result also revealed 159 and 150 positive approval with respect to human made causes and natural causes, respectively as causes for the river dry, which indicated that the human made causes were relatively more responsible than natural causes for drying up of the Bhairab River. Therefore, it is very essential to take necessary steps through individual and government participation and public awareness to improve the present condition of the Bhairab River.

Key Words: *Causes, Dry, Bhairab River and Bangladesh*

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I. Introduction

River is a long watercourse that flow down a slope along a bed between banks. It originates from a 'source' and culminates to a sea or lake at its 'mouth'. Along its length, it may be joined by smaller rivers called 'tributaries'. A river and its tributaries form a 'river system'. Land surfaces are never

perfectly flat. As a result, the runoff water after precipitation tends to flow downward by the shortest and steepest course in depressions formed by the intersection of slopes. Runoff water of sufficient volume and velocity join to form a stream by the erosion of underlying earth and rock. Traditionally, river systems have been classified according to their stage of development as 'young', 'mature', or 'old'. Most of the rivers of Bangladesh are at their old stage and enter into the Bay of Bengal. Bangladesh have predominantly four major river systems - the Brahmaputra-Yamuna, the Ganges-Padma, the Surma-Meghna and the Chittagong region river system. However, Brahmaputra is the 22nd longest (2,850 km) and the Ganges is the 30th longest (2,510 km) river in the world. Preparing a complete list of the rivers of Bangladesh is more or less tough as often a single river possesses different names at different places (Banglapedia, 2015).

Bhairab River is a river in West Bengal, India and south-western Bangladesh. It is a distributary of the Ganges (Rob, 2012). It passes through Khulna, dividing the city into two parts. Bhairab River originates from the Tengamari border of Meherpur District and passes through Jashore town (Geology of the Khulna City, 2010). The river is approximately 160 kilometers (100 mi) long and 91 meters (300 ft.) wide. Its average depth is 1.2 to 1.5 meters (4 to 5 ft.) with minimal water flow. It has plenty of silts (Hossain, 1994). This river is very important in the history of Bangladesh. The ancient business of Bangla is circulated around this river. It was also important in the Moghal Period, at that time the landlord of the Jashore was Protapaditto. But after that, the river is losing its charm gradually and takes the recent view. The main part of this river is in Jashore. Bhairab River has two main branches, the Ichamati (Khulna-Ichamati) and the Kobadak. Part of the Khulna-Ichamati is in India and partly in the Satkhira district of Bangladesh, and so it forms the boundary between the two countries between Bangladesh and India. The towns of Khulna and Jashore are situated on the bank of the river (Geology of the Khulna City, 2010). The Bhairab is considered to be of older origin its parent river the Jalangi. It takes off from that river at a point, a few miles north of Karimpur (in West Bengal). After a tortuous course towards the south, it turns to the east. It forms the boundary line between Meherpur P.S. (Bangladesh) and Karimpur (India) for a short distance. Then turning south enters Meherpur P.S. and flows past Meherpur town to the south. Finally, it loses itself in the Mathabhanga close to the east of Kapashdanga. Its intake from the Jalangi having silted up, this river has been practically dead for long. The Rupsa River is formed from the Bhairab and the Atrai River and flows into the Pasur River (Chowdhury, 2012).

In the moribund delta area, Bhairab River is an important river. At present, the mainstream is not navigable beyond Bagherpara Upazila of Jashore district. In the monsoon, the Ganges feeds it, but in the dry season, it becomes dry. Its lower course remains navigable throughout the year and is influenced by tides. Meherpur, Chuadanga, Barobazar, Kotchandpur, Chaugachha, Jashore, Daulatpur, Bagerhat and Khulna are some of the important places located on the banks of the Bhairab (Chowdhury, 2012). Bangladesh has a tropical monsoon climate characterized by marked seasonal variations. Abundant rainfall during the monsoon (July-October) is followed by a cool winter period (November-February), then a hot, dry summer (March-June). Seventy to eighty percent of the annual rainfall occurs in the monsoon season (Banglapedia, 2015).

Several industries and match factories of Rupsa industrial area, Khulna are polluting the Rupsa River with their wastes. The Khulna Newsprint Mill, Hardboard Mills, Goalpara Thermal Power Station, Jute and Iron Industries of Khalishpur are depositing all their wastes into the Bhairab River. The Khulna Newsprint Mill discharges about 4500 cubic meters of wastewater per hour in the Bhairab River, in which suspended undissolved solid materials are present. Almost every year the two major rivers change their courses. The surface flows bring about 3 million tons of sediments every year in the country. While it is seen that the process of siltation and erosion is a natural phenomenon in the rivers of Bangladesh, there is evidence of serious problems with many rivers becoming dead, dislocating many navigation routes. Moreover, relatively rapid changes in landforms due to erosion and sedimentation have been occurring for long; the physical evidence of such changing conditions is apparent in eroding riverbanks, areas of new deposition and consequent changes in the environment (Banglapedia, 2015). Bhairab River is drying gradually. It is very important to identify the causes for drying up of this river so that the flow of the river can be continued and kept alive by taking necessary steps. Therefore, the present study was conducted to find out the natural and human-made causes as well as ascertain the most intensified cause of drying up of the Bhairab River.

II. Materials and Methods

Study area and duration

The Bhairab River of Jashore region was selected for the present study. The Bhairab River is famous for its rich reserve of aquatic life. A large number of people live in the North-South bank, whose livelihoods and daily activities are related to the river. Jashore Sadar Upazila was selected as the study area. There are several drying up points of the Bhairab River in Jashore Sadar Upazila. Among them, six important primary drying up points of river areas were selected, namely: 1) Notun Khoyertola, 2) Puratan Koshba Kazipara, 3) Nodagram, 4) Santola, 5) Nurnagar and 6) Bijoy Nagar Villages of Jashore District (Figure 01). The data were collected for a period of four months from September to December, 2017 in the study area.

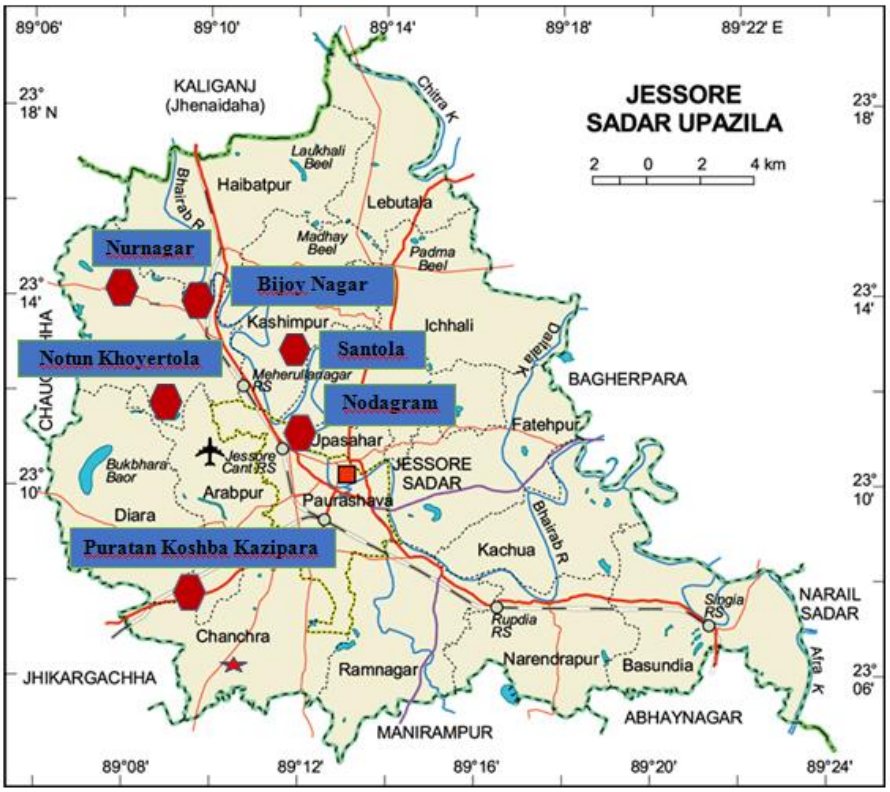

Figure 01. Study area (Shapes indicating the location of drying up villages of the Bhairab River).

Data collection

The data were collected from randomly selected 45 participants in six different villages. Most of the participants were fishermen because a large number of fishers were known to be engaged in fish catching in the Bhairab River. Moreover, farmers, local inhabitants, fishing community members and others related to river were also involved in data collection. Data were collected through questionnaire interviews and focus group discussions with these participants. A structured questionnaire was prepared based on the objectives of the study before data collection. Cross-check interviews with key-informants were also conducted to clarify or verify the information.

Data processing and analysis

The collected data were summarized and scrutinized before the actual tabulation. The processed data were transferred to a spreadsheet from which classified tables were prepared to reveal the finding of the study. Then the data were tabulated into the computer. Preliminary data sheets were compared with computer spreadsheets to ensure the accuracy of the data entry. After data entry, the data were analyzed with computer program Microsoft Excel Software and then presented graphically.

III. Results and Discussion

Human made causes

Installation of dam: In the present study, 47% respondents (male- 52% and female- 42%) responded in favor of the installation of dam for drying up of the Bhairab River; 24% (male- 24%% and female-

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25%) gave a negative opinion and rest 29% (male- 24% and female- 33%) had no opinion in terms of installation of dam as the cause for river dry (Figure 02). Misra (2010) worked on River Yamuna and identified one of the most polluted rivers of India. The barrages formed on the river were playing a major role in escalating the river pollution. Normally no water was allowed to flow downstream of the Himalayan segment (Tejewala barrage) especially in the summer and winter seasons. Freshwater input to estuaries might be greatly altered by the river-barragesand prevent saltwater intrusion. Moreover, a new type of salt plug formation in the multi-channel Pasur River Estuary (PRE) was discovered to cause by decreasing river discharges resulting from an upstream barrage (Shaha and Cho, 2016). That means the installation of dam might cause river dry.

Establishment of bridge: The present study showed that 78% respondents (male 86% and female 71%) supported the establishment of bridge for drying river, 11% (male 10% and female 12%) denied and rest 11% (male 4% and female 17%) didn't give any opinion regarding bridge as the cause of drying up of river (Figure 02). Sengupta (2006) studied on heavy metals at Nizamuddin bridge in the Yamuna River and found the presence of Cadmium, Nickel, Iron, Zinc and Chromium at Nizamuddin bridge, whereas the maximum concentration of Aldrin of 213.41 µg/L, Dieldrin of 50.85 µg/L and Endosulfan of 4591.08 µg/L at Nizamuddin bridge. Islam et al. (2017) assessed on the environmental impact of Lebukhali bridge construction project over the river of Paira, Bangladesh and found that there were no significantly sensitive ecological, physicochemical, socio-cultural impacts in the area. The environmental impact value was estimated +2 (Positive two), which showed the acceptance of this project. That means establishment of bridge might perform river dry.

Excessive irrigation in agricultural land: According to the present survey, 64% participators (male - 81% and female 50%) supported, whereas, denied participants were 29% (male 14% and female 42%) as well as 7 % (male 5% and female 8%) didn't give any opinion in terms of excessive irrigation in agricultural land for drying up of river (Figure 02). Many perennial watercourses converted into temporary flow due to the effects of water extraction for human use or as a result of changes in land use (Steward et al., 2012). Besides, the TajMahal situated on the bank of Yamuna River had been reduced to a pale and stinking drain due to its irregular available water treatment facilities. During dry weather, the flow of Yamuna River consisted almost entirely of polluted effluents which resulted in the death of thousands of fishes over the TajMahal area along the water body (Verma, 2002). River dry might be executed due to excessive irrigation in agricultural land.

Use of chemicals, pesticides, industrial effluents etc.: From the questionnaire interview, 64% respondents (male- 71% and female- 58%) gave positive opinion in favor of using of chemicals, pesticides, industrial effluents for drying up of the Bhairab River; 31% (male- 24% and female- 38%) gave negative opinion and rest 5% (male- 5% and female- 4%) had no opinion (Figure 02). The Karnafuli River received huge amount of untreated effluents from various industries. So the environment of the River Karnafuli was getting polluted. The Yamuna had been reduced to a small stream due to drainage of industrial effluents, sewage, dirt and other toxic substances (Misra, 2010). The exceeded level of bioaccumulation of some heavy metals (Ahmed et al., 2012) was found in a freshwater fish Ayre (Hamilton, 1822) collected from Rajfulbaria of Dhaleshwari river due to solid residue from the iron ore processing at the headwaters of the Doce River basin (Pires et al., 2003). These might decrease the water flow of river. River dry might be performed due to use of chemicals, pesticides, industrial effluents etc.

Irresponsible management of fishing: In the present study, it was found that 73% respondents (male- 71% and female- 75%) gave positive opinion in favor of using of chemicals, pesticides, industrial effluents for drying river; 9% (male- 5% and female- 12%) gave negative opinion and other 18% (male- 24% and female- 13%) had no opinion in terms of irresponsible management of fishing as the cause for drying up of the river (Figure 02). The lack of proper drainage systems, adequate sanitation facilities and waste management facilities increased the vulnerability of those communities during hazards (Alam et al., 2016). Human disturbances such as the irrigation and storage of water in reservoirs did not play a decisive role, they accelerated the degradation (Liu et al., 2006). Moreover, other irresponsible management of fishing such as excessive fishing from rivers, catching brood fish and fry, reducing the biodiversity of rivers might lead to the drying of the Bhairab River. River dry might be performed due to irresponsible management of fishing.

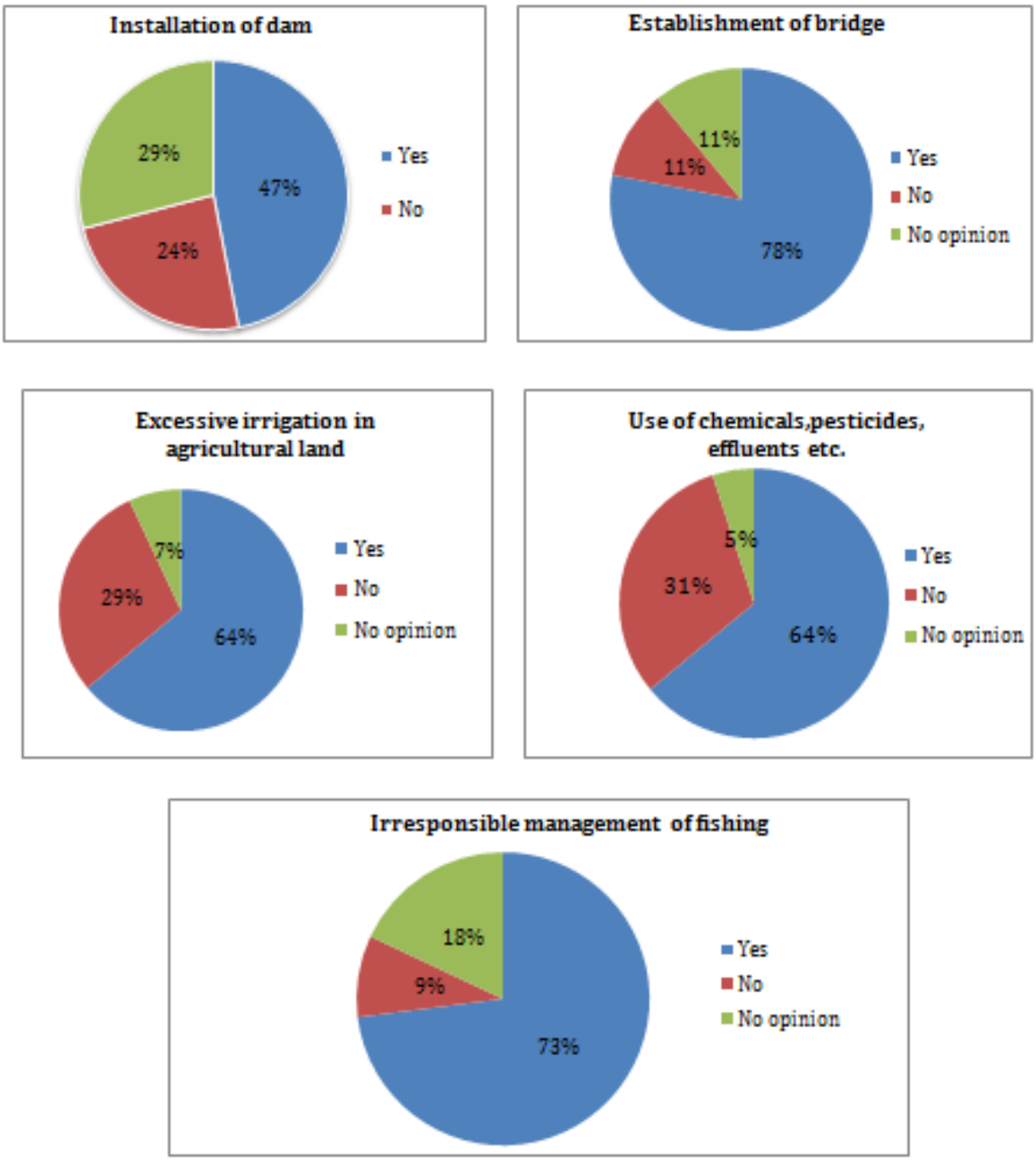

Figure 02. Human made causes for drying up of Bhairab River responded by the participants of the study area.

Ascertaining the intensity among different human made causes for drying the river: The evaluations of different human made causes were analyzed and 'Establishment of bridge' was considered the strongest cause for drying up of the Bhairab River according to the respondents. Moreover, the respondents identified the 'Irresponsible management of fishing', 'Excessive use of agricultural land' and use of chemicals, pesticides as the sequentially potential causes for drying up of the river. On the other hand, more than half of the respondents refused 'Installation of dam' as the powerful cause for drying up of Bhairab River (Figure 03).

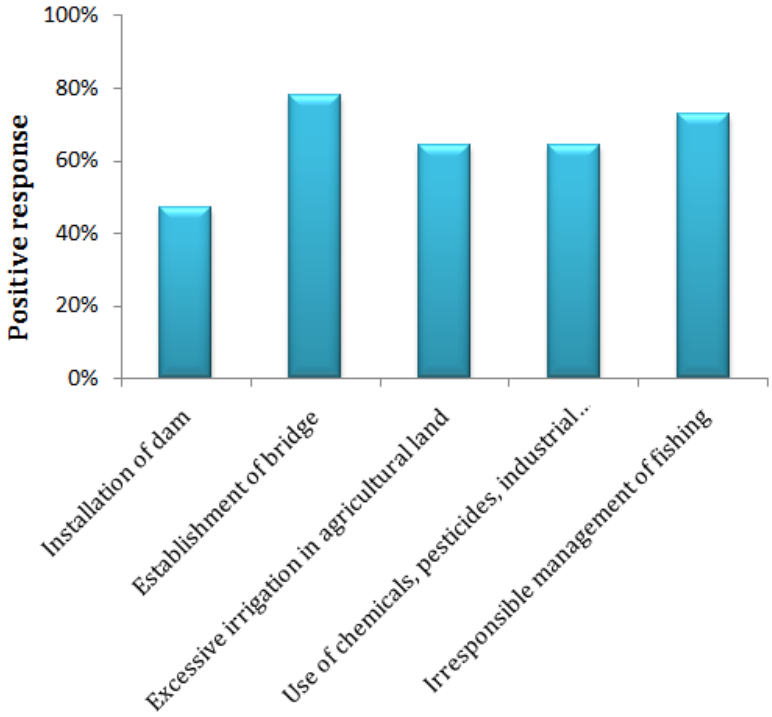

Figure 03. Intensity of human made causes for drying up of Bhairab River based on the positive response of the participants.

Natural causes

Climate change: In the study area, the present study showed that 65% respondents (male- 76% and female- 54%) supported the climate change for drying river, 24% (male- 14% and female- 33%) refused and the rest 11% (male- 10% and female- 13%) had no opinion in respect of climate change as the cause for drying up of the Bhairab River (Figure 04). Many perennial watercourses turned into temporary flow regimes due to the effects of climate (Steward et al., 2012). The Global Climate Risk Index (CRI) identified Bangladesh as being among the top ten most vulnerable countries and ranked fifth in terms of death toll, losses and number of extreme events in the ten years between 1993–2012 (Kreft and Eckstein, 2014). In recent years, the magnitude and recurrence of climate-induced disasters such as floods, cyclones, droughts, river erosion, salt-water intrusion and its biological effects had increased significantly (Roy, 2011 and Minar et al., 2013).The hydrological cycle of the basin of the Yellow River had changed greatly due to climate change impact (Liu and Zheng, 2002). That means climate change might perform river dry.

Siltation: The present study investigated that 62% respondents (male- 62% and female- 62%) responded in favor of the siltation for drying up of the Bhairab River; 25% (male- 29% and female- 21%) gave negative opinion and rest 13% (male- 9% and female- 17%) had no opinion in terms of siltation as the cause for river dry (Figure 04). Naden et al. (2003) found mean concentrations of suspended solids in the UK Yorkshire Rivers varying between approximately 1 and 100 mg l-1. River dry might be executed due to siltation.

Rainfall pattern: The present study showed that 60% respondents (male- 57% and female- 63%) supported the rainfall pattern for drying up of the river, 16% (male- 29% and female- 4%) denied and other 24% (male- 14% and female- 33%) had no opinion in terms of rainfall pattern as the cause for river dry (Figure 04). A temporary riverbed could be dried for much of the time and might only be aquatic for a brief period after a flood or a period of heavy rainfall (Datry et al., 2011). River dry might be caused due to rainfall pattern.

Temperature: In the present study, 67% participants (male- 67% and female- 67%) responded in favor of the temperature for drying up of the Bhairab River, 18% (male- 9%and female- 25%) gave a negative opinion and rest 15% (male- 24% and female- 8%) had no opinion in terms of temperature as the cause for river dry (Figure 04). Steward et al. (2012) found that extreme temperatures were subjected to flow disturbances that deposited and scoured bed sediments in dry riverbeds as well as

could also be exposed to intense solar radiation. Sumon (2013) found that temperature regulated the metabolic activity of fishes and other aquatic organisms and most of the rivers were supersaturated with CO2, CH4 and N2O during the study period (Qu et al., 2017). River dry could be performed due to temperature.

Drought: During the present study, 80% respondents (male- 86% and female- 75%) supported drought for drying up of Bhairab River, 13% (male- 5% and female- 21%) disavowed and remaining 7% (male- 9% and female- 4%) had no opinion in terms of drought as the cause for river dry (Figure 04). Dry riverbeds were defined as the channels of temporary rivers during the dry phase that could be exposed during periods of drought (Kassas and Imam, 1954; Steward et al., 2012). Scientists also anticipated that the drought occurrence would be worsened as a result of climate change and sea-level rise (Dodman and Satterthwaite, 2008). Hence, the drought might be the result of other natural causes related to river dry. So ultimately drought could also cause river dry.

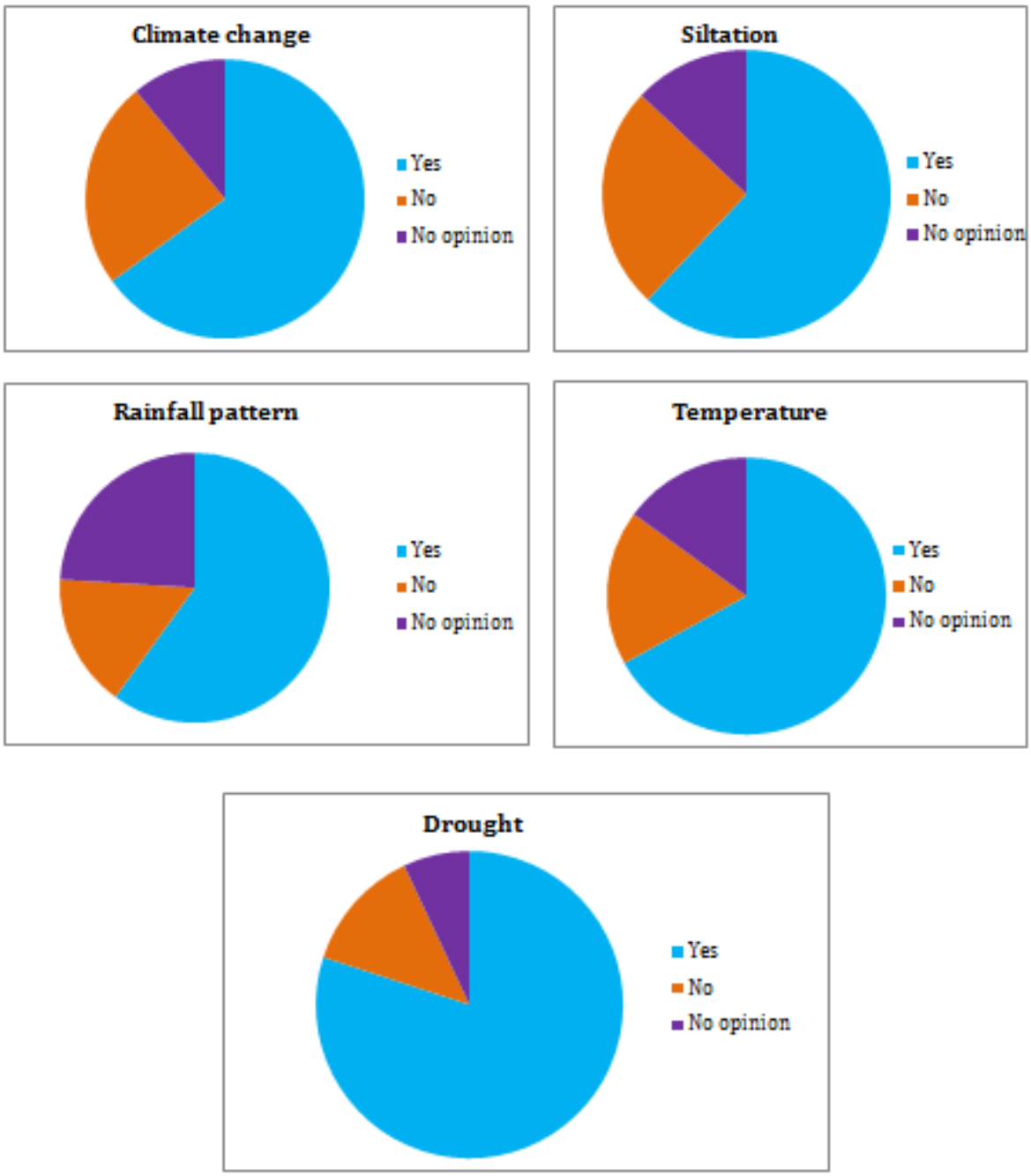

Figure 04. Natural causes for drying up of Bhairab River responded by the participants of the study area.

Determining the Intensity among different natural causes

The evaluations of various natural causes were analyzed and 'Drought' was assessed the strongest cause for drying up of the Bhairab River according to the respondents. Moreover, the respondents identified the 'Temperature', 'Climate Change' and 'Siltation' as the successive dynamic causes for drying up of the river. Other side, more than half of the respondents disavowed 'Rainfall pattern' as the potential cause for drying up of the Bhairab River (Figure 05).

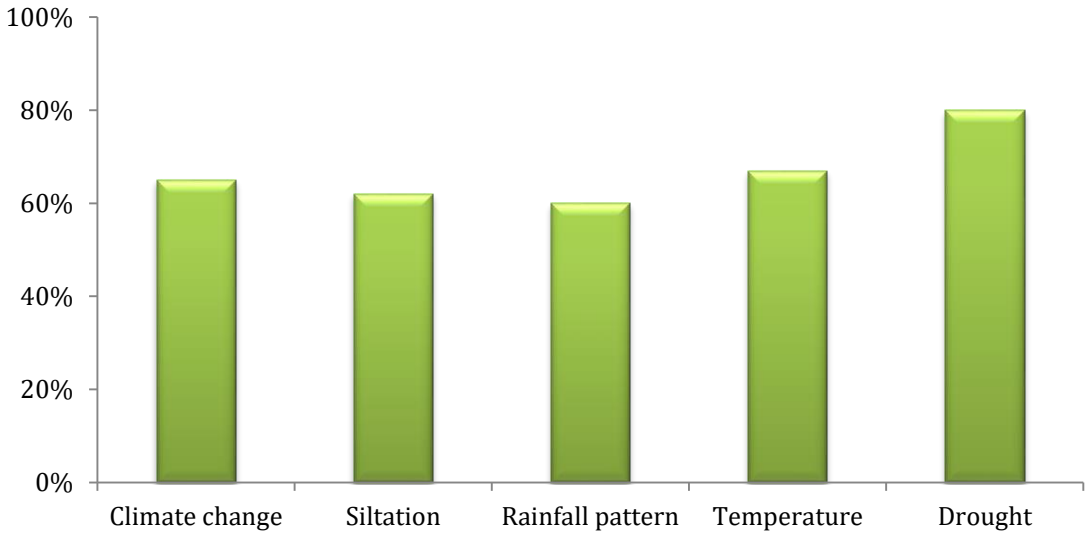

Figure 05. Intensity of natural causes for drying up of Bhairab River based on the positive response of the participants.

Supremacy between human made causes and natural causes for drying up of the Bhairab River through their comparison

Overall analysis of the research revealed 159 positive approval and only 47 negative approval in terms of human made causes for drying Bhairab River. On the contrary, there were 31 no-opinion in respect to these causes. On the other hand, in case of natural causes for drying the river, 150 positive approval and only 43 negative approval were transpired, Whereas, there were 32 no-opinion on these causes (Figure 06). Considering this comparison of predominance, it might be said that human made causes were relatively more responsible for drying up of the Bhairab River.

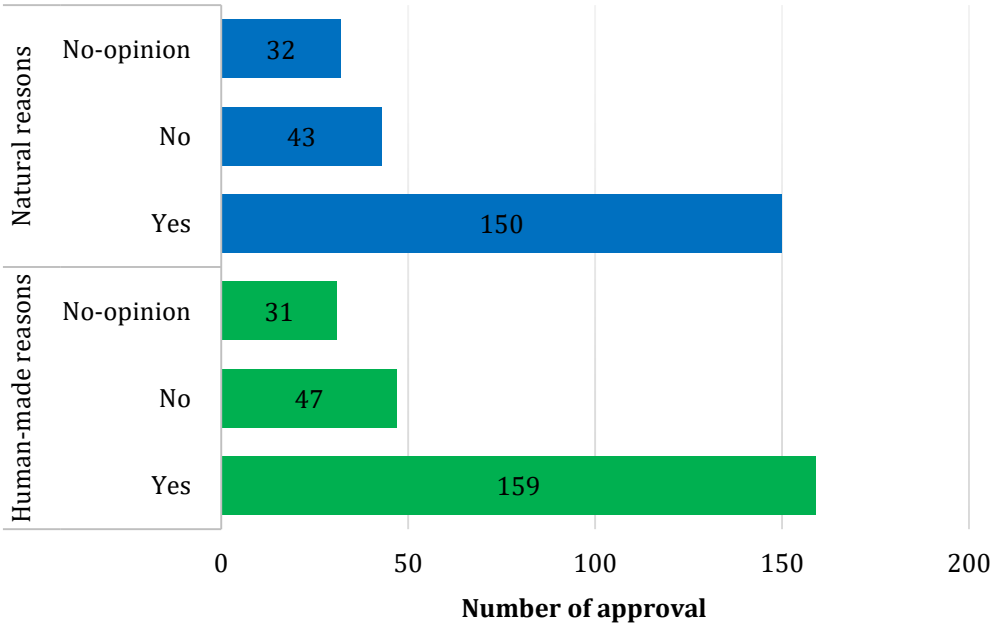

Figure 06. Comparison of the predominance between human made causes and natural causes for drying up of Bhairab River.

IV. Conclusion and Recommendations

Bhairab River is in great threat due to human activities such as the establishment of bridge, use of chemicals, pesticides and industrial effluents and irresponsible management of fishing etc. as well as natural causes such as climate change, drought, temperature, rainfall pattern etc. As a result, drying up of the Bhairab River is increasing drastically. The complete drying up in many parts of the river Bhairab is a common scenario during the lean season, which is not only nationally but also internationally detrimental to fish populations and overall ecological ecosystem because drying up of river is a global issue as well concern for upcoming moment. Considering opinion from participants, it can be recommended that human made causes are more responsible for drying up of the Bhairab River. Therefore, it is essential to take steps for institutional support, government participation and implementation of regulations, international support with routine research work, public awareness to improve the present condition of the Bhairab River or save the river from drying up. Thus, safe and sound aquatic environment can be made for upcoming period.

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