

RESEARCH PAPER

Examining stakeholders' views and opinions for river conservation in India: a case study from Pune, Maharashtra

Nishikant Gupta* and Ishaan Kochhar

International Centre for Integrated Mountain Development (ICIMOD), Post Box # 3226, Kathmandu, Nepal

ABSTRACT

Rivers are threatened by numerous stressors, and the projected impacts of climate change warrants strategies for their protection. Incorporating stakeholders' views and opinions in conservation policies can assist with their sustainability and success. The rivers of the district of Pune in Maharashtra, India face severe threats despite being a lifeline for some local communities. An online survey conducted between 2016 and 2017 to assess the views and opinions of the residents of the city regarding their rivers resulted in 160 responses, where 98% of the respondents mentioned that the rivers need protection. Pollution (47%) and management issues (25%) were identified as the dominant adverse issues, and legislative support (31%) a potential protective measure. Overall, 73% of the respondents felt that protecting their rivers could possibly assist with water shortages (in varying degrees). Additionally, an examination of Global Surface Water Explorer datasets (1984-2015) revealed that over a span of 32 years, new surface waterbodies had appeared, and significant ones had disappeared from the city. The authors recommend adaptive strategies to assist these ailing rivers.

KEYWORDS: Freshwater, Maharashtra, remote sensing, Sahyadri, Western Ghats.

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Introduction

Rivers have a multitude of functions however, face numerous stressors (Gupta et al., 2015). The projected variation in temperature and precipitation could place additional pressure on these vital resources (Shrestha et al., 2015). The participation of local stakeholders in policy formulation discussion is beginning to be addressed, as their views and opinions is often crucial for a programme's success (Gupta et al., 2016). Long-term, field-based monitoring of rivers is often a challenge for concerned agencies due to budget and time constraints, and remote sensing is being utilized as a valuable knowledge tool to gather data at regional/sub-regional level (Sawaya, 2017). The district of Pune in the Indian State of Maharashtra includes the Mula-Mutha watershed. It is in the rain shadow zone of the Western Ghats and is dominated by a semi-arid climate with monsoonal rainfall. Despite the historical dependence of some residents on the watershed, the watershed now suffers from pollution and encroachment (Borthakur et al., 2016) due to low awareness, low sewage treatment capacity, and scarcity of protective tools (Kamble et al., 2012).

Materials and Methods

Web-based survey

A web-based survey was conducted between 2016 and 2017 to understand the views and opinions of the residents of Pune city regarding their rivers and its conservation needs (see Appendix 1 for the survey questions). A pilot survey was run among randomly selected respondents (N=25) to highlight any problems with the survey's completion. Each response was reviewed to ensure that respondents did not submit multiple responses (Gupta et al., 2016), and strict confidentiality of responses was maintained. The survey was promoted widely on a variety of websites, forums, groups and social media (Facebook/Twitter) nonetheless, the authors acknowledge some potential for bias towards those with greater IT literacy. The authors are currently conducting face-to-face interviews throughout the district to supplement these initial findings (Gupta et al., 2016).

Mapping surface water dynamics

The changes in surface waterbodies were analyzed from 1984-2015 using Global Surface Water Explorer (<https://global-surface-water.appspot.com/download>) to

Table 1. List of classes observed in the transition product of Global Surface Water Explorer, along with their description.

Surface water category	Description
Permanent	Unchanging permanent water surfaces
New Permanent	Conversion of a no water place into a permanent water place
Lost Permanent	Conversion of a permanent water place into a no water place
Seasonal	Unchanging seasonal water surfaces
New Seasonal	Conversion of a no water place into a seasonal water place
Lost Seasonal	Unchanging seasonal water surfaces
Seasonal to Permanent	Conversion of seasonal water into permanent water
Permanent to Seasonal	Conversion of permanent water into seasonal water
Ephemeral Permanent	No water places replaced by permanent water that subsequently disappeared within the observation period
Ephemeral Seasonal	Ephemeral seasonal water, (i.e. no water places replaced by seasonal water that subsequently disappeared within the observation period)

show different facets of their spatial and temporal distribution over the last 32 years (Pekel et al., 2016) (See Table 1 for a description of the classes of transition products).

Results

Web-based survey

Of the 160 responses obtained, 47% belonged to the age group 25-34 years, followed by 35-44 years (16%) (Fig. 1A). Fifty-three percent of the respondents were male, and 47% female (Fig. 1B). Post-graduation was the highest level of education obtained (60%), followed by under-graduation (25%) (Fig. 1C). Forty-five percent of the respondents were professionals, followed by unemployed (20%) (Fig. 1D).

Of the total number of respondents (N=160), 82% agreed that there is a water shortage in the city. Ninety-nine percent of the respondents mentioned that the city's rivers need to be protected to potentially assist with water shortages (34%) and to restore the ecological balance (34%) (Fig. 2). Pollution (47%) and management issues (25%) were identified as the dominant culprits plaguing the rivers (Fig. 2). Legislative support (31%) was identified as a major protective measure, followed by regular cleanliness drives and awareness and education (25% each) (Fig. 2). Respondents stated that protecting the city's rivers could assist with the water shortage as it could increase water availability after purification (62%) and support groundwater recharge (24%) (Fig. 3D). Fifty-three percent of the respondents mentioned that fish were the most stressed species followed by aquatic birds (18%)

(Fig. 3A) primarily due to water pollution (73%) and drying up of supporting streams (19%) (Fig. 3).

Mapping surface water dynamics

The surface water changes revealed that over a span of 32 years new waterbodies, i.e. new seasonal (~10,000 km²) and new permanent (~6,600 km²) had appeared, indicating the possibility of new reservoirs in the northeastern part of the district. The disappearance of permanent (~132 km²) and seasonal (~3,955 km²) waterbodies were also observed mainly in the southern region (see Fig. 4 and 5).

Discussion

Although only 160 responses were obtained through the online survey, these represent diversity in terms of views and opinions and are in line with published scientific literature on river conservation. The observed surface water changes did not detect the stability of the waterbodies hence, is being tested using long-term water history described by temporal profiles. This will hopefully assist in identifying land replaced by permanent water that subsequently disappears, and land replaced by seasonal water that subsequently disappears during the period of water presence. Based on the current findings (and unpublished data from ongoing field research in Pune district), there is an urgent need for actions to assist the rivers and dependent communities. It is important to strengthen field and spatial-temporal data by conducting periodic assessments of changes in overall river ecology – capacity building of identified research agencies/institutions can assist with this data collection. At the local stakeholder level, education and awareness training (based on the available information) will be key towards

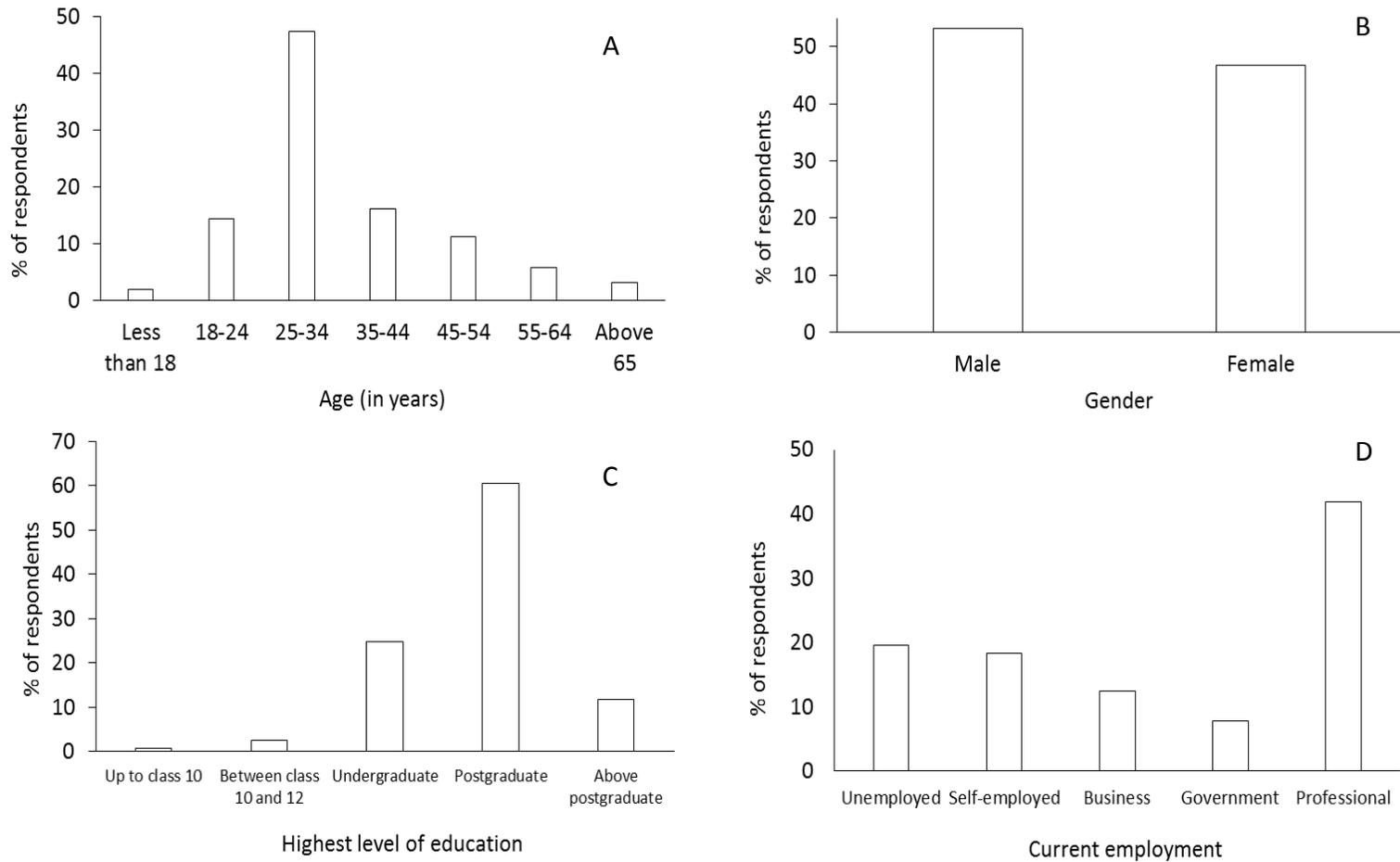


Figure 1. Distribution of responses to Pune's rivers survey questions (A. age, B. gender, C. highest level of education, D. current employment)

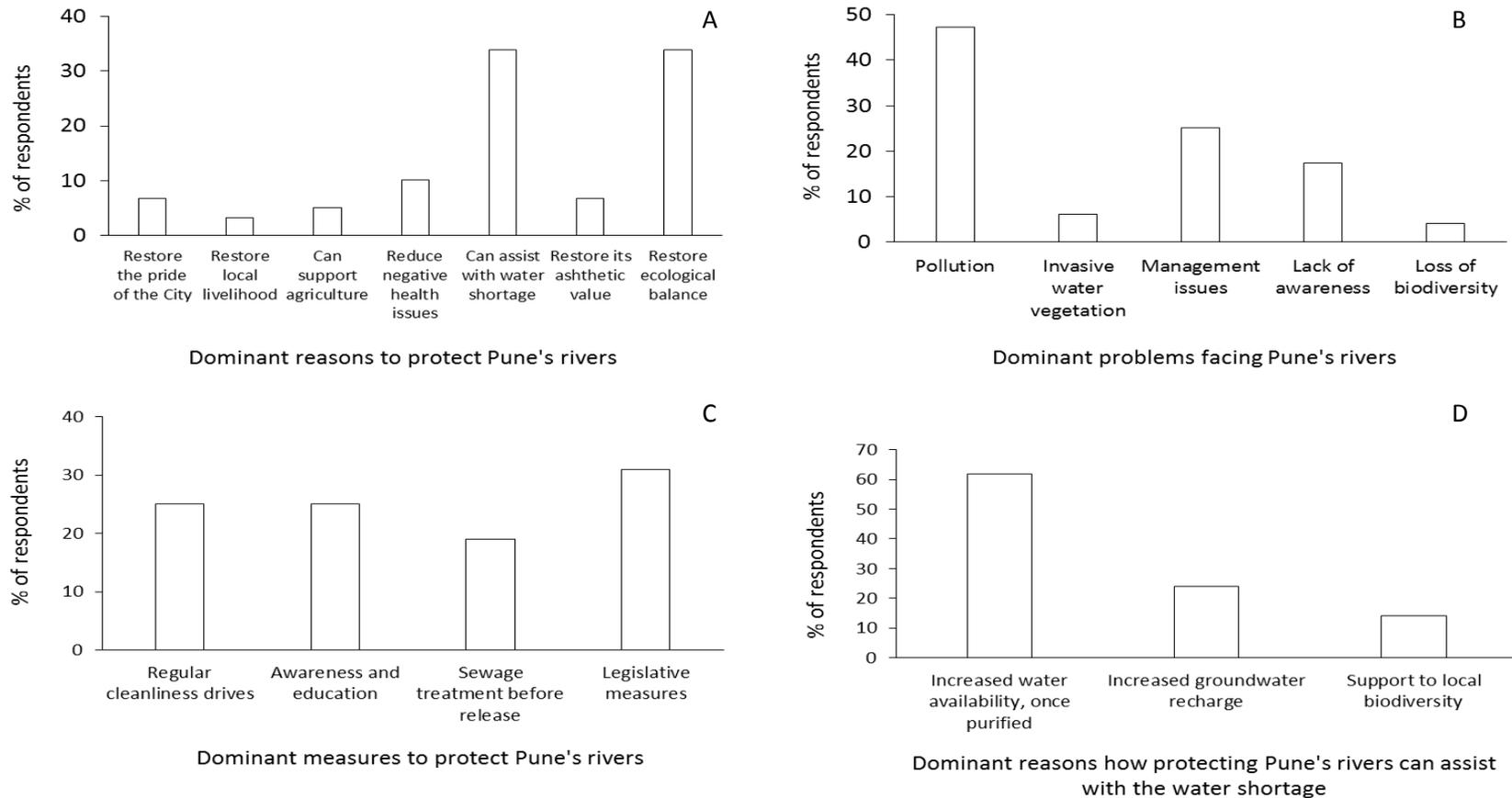


Figure 2. Distribution of dominant responses in relation to Pune's rivers (A. reasons for protection, B. problems, C. measures for protection, D. how protecting Pune's rivers can assist with the water shortage).

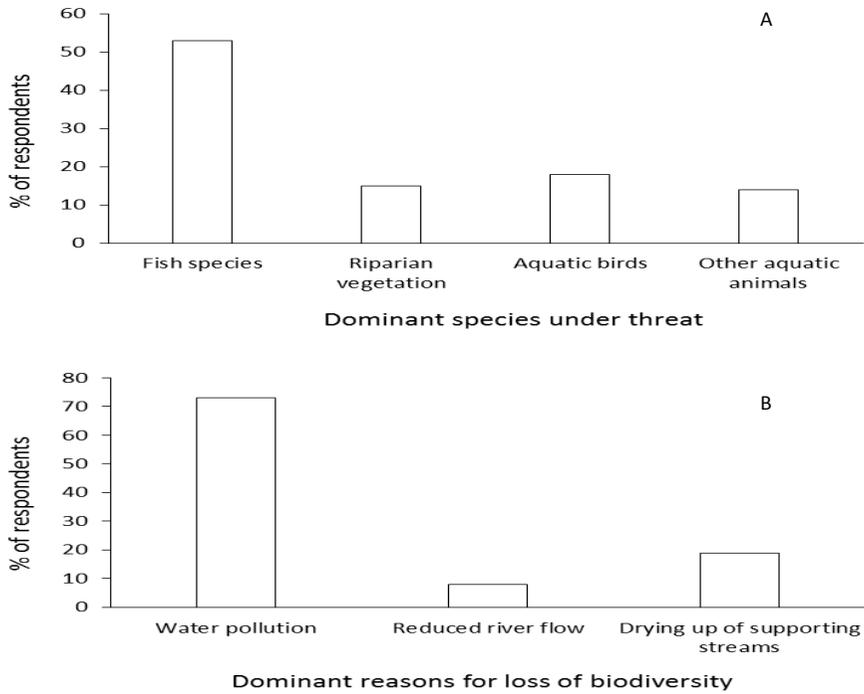


Figure 3. Distribution of dominant responses in relation to Pune’s rivers (A. species under threat, B. reasons for loss of biodiversity).

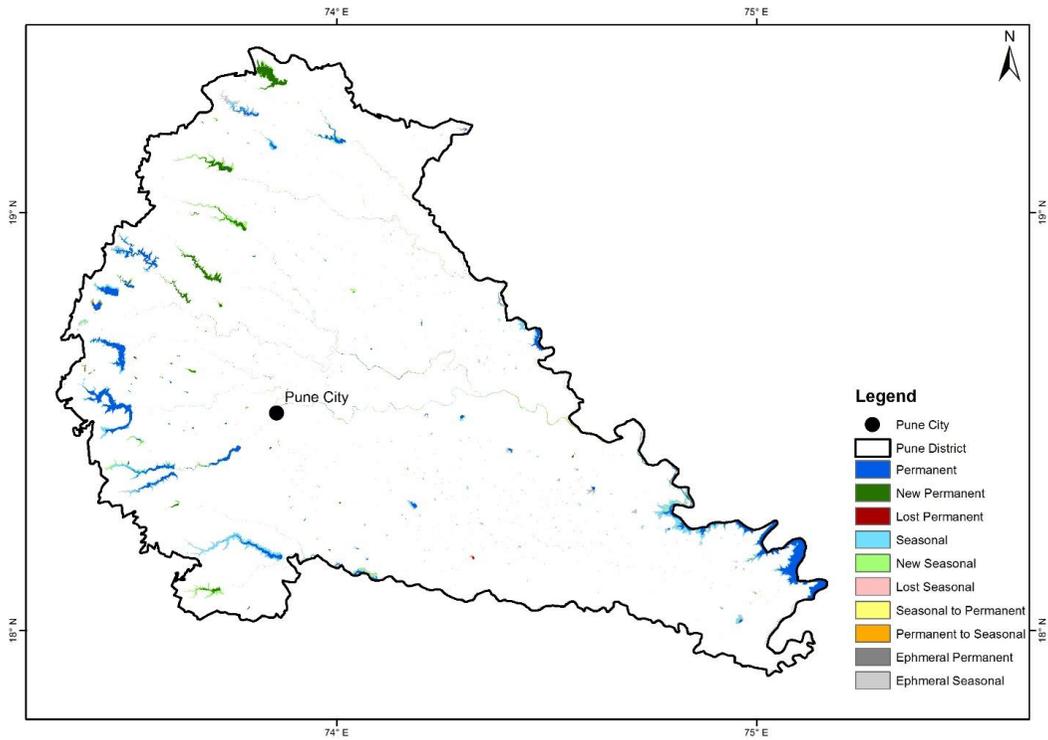


Figure 4. Map of the district of Pune showing spatial and temporal changes in the surface water bodies from 1984-2015.

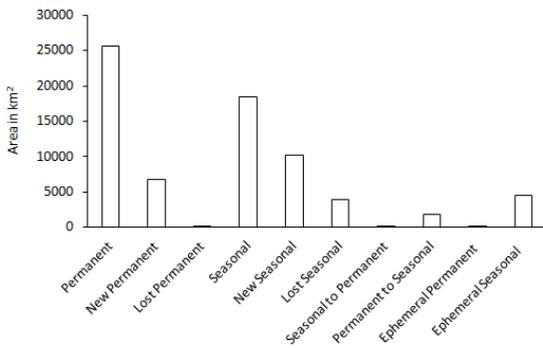


Figure 5. Surface water transitions from 1984-2015 in the district of Pune.

supporting cleanliness drives and reducing pollution. Water resources management policies/legislations should be harmonized in the local context. Local organizations need to promote among communities the benefits of maintaining embankments and protecting river reaches. There is a need to strengthen the existing institutional capacities to regularly assess and forecast the water demand, allowing the development of technical guidance/support tools. There is a requirement to promote sustainable use of available water, and it is essential to inform the local communities of water storage techniques in view of the current status of water availability in the city.

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Appendix 1

Pune's rivers survey

This questionnaire aims to understand the views and opinions of the residents of Pune regarding the city's rivers. The findings of this survey will assist in addressing the knowledge gaps and in pinpointing conservation methods to be applied for the protection of the rivers here.

- 1) What is your age?
- 2) What is your gender?
- 3) What is your highest level of education?
- 4) What is your current employment?
- 5) Is there a water shortage in Pune?
- 6) Do Pune's rivers need to be protected?
- 7) Please explain your answer to the above.
- 8) What are the major problems facing Pune's rivers?
- 9) What major measures can be applied to protect Pune's rivers?
- 10) Can saving Pune's rivers help with the water shortage in the city?
- 11) Please explain your answer to the above.
- 12) Which river plant or animal species are in trouble as well?
- 13) Please explain your answer to the above.
- 14) Any additional comments or suggestions?