An assessment of willingness to pay to avoid climate change induced flood
Rohini Prasad Devkota, Tek Narayan Maraseni and Geoff Cockfield

ABSTRACT

Flood risk analysis provides a rational for the appraisal of policy options for the decision makers. In this paper, by employing referendum method and face to face questionnaire surveys for 210 households in West Rapti River in Nepal, the willingness to pays (WTPs) to avoid four climate change-induced flood scenarios were assessed. Differences on WTPs among age, sex and education groups were analysed, and correlation between WTPs and different types of incomes and flood related damage costs were tested. The WTP was lowest for age group below 35 and it was highest for the age group 35–44. Females suffered more from flood than males and hence their average annual WTP was higher than male’s average. Similarly, the average WTP was higher for literate than illiterate people in all flood scenarios. The average annual WTPs were statistically significantly ($p < 0.05$) positively correlated with annual total income, farm income, livestock income and flood-related damage costs. The level of WTPs estimated in this study would be helpful for formulating flood-related policy and plan, prioritising investment and implementation of the programmes.

INTRODUCTION

Climate is changing and impacting the world (Nguyen et al. 2013). The global average temperature has risen by about 0.74°C for the period of 1906–2005 and the warming rate over the last 50 years is nearly twice that for the previous 50 years (Trenberth et al. 2007). Climate change is one of the major contributing factors to water related vulnerability (UNISDR 2009; Mercer 2010) as it accelerates the intensity of rain which increases flood hazards. Flood affects the water infrastructure such as hydropower, drainage and irrigation systems (Braun et al. 2013; Devkota et al. 2013) as well as agricultural land and its productivity (Tversky & Kahneman 1974) and settlements near the river embankments. The climate change projection in Nepal shows that: (1) the intensity of rainfall will increase, particularly in tropical and high-latitude areas where mean annual precipitation has been increasing over the past decades; and (2) the number of heavy rainfall events will increase during the monsoon period (Baidya et al. 2008). Similarly, annual rainfall shows the positive trend for whole country as well as for Western Nepal, the research site for this study.

Because of the fragile geographical position, poverty and the lack of resources, the adverse impacts of flood are more significant in developing countries like Nepal, making a weak economy even weaker (Stern 2006; Manton et al. 2010). Particularly, the Mid-Western regions of Nepal where the West Rapti River (WRR) basin lies are experiencing greater than expected floods that has resulted in immense damage to lives and properties and serious losses in production every year (Marahatta et al. 2009). Flood management in such a river basin is a challenging task. For the effective management of flood, government needs in-kind and cash support from local people, which is also crucial in developing the feeling of ownership over infrastructure developed for flood control. In this context, the overarching aim of this study is to assess the willingness to pays (WTPs) of WRR basin’s residents to avoid four climate change-induced flood scenarios. This study also analyses the

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correlation between WTPs and income from different sources and flood-related damage costs in the study area. As such, application of WTP for flood mitigation activity is the novel concept. Moreover, its novelty is further enhanced by the use of labour-day (man-day), rather than cash, as a means of payment. In a developing country like Nepal, where about 35% of people are under the poverty (CBS 2012) and the opportunity cost of labour is very low due to lower employment rates, labour-day approach provides a better approximation.

Water management or flood management is usually a non-market service because the benefits cannot be easily guaranteed for, or confined to, an individual or family. Hence, most flood mitigation actions require some form of collective action. For example, a government is considering an improvement in a river bank then an estimation of the WTP for flood control would help government planners and policy-makers choose the best liked option amongst flood control options because it provides an estimation of relative value to those affected. Among the various techniques for estimating WTP, the contingent valuation (CV) method and choice experiment techniques measure demand by examining an individual’s stated preference for goods or services relative to other goods and services (Laurens 2012). CV methods construct hypothetical situations and ask people what choices they would make if they were in those circumstances (Lu & Shon 2012) and it is assessed by determining if WTP varies in reasonable ways (Lera-López et al. 2012). Climate change will have differential impacts across a population, revealing varying sensitivities and capacities to cope with change. The benefits of individual adaptation are also often temporally diffuse and challenging because of the up-front investment required for implementation (Franic et al. 2012).

Flood prevention measures can be described in terms of structural measures which include internal (pumping during rains, sewage management) and external (dikes/dams) flooding measures and non-structural measures such as early warning systems (Raaijmakers et al. 2008; Bradford et al. 2012). Hence, affected people can value and compare the options based on perceived flood impacts where WTP varies among the respondents. The WTP for flood and environmental risk reduction may depend on factors such as resource constraints, personality (individual attributes), current risk levels, and acceptability of risks (Zhai et al. 2006). It is true that when flood-prone land is purchased for an evacuation project flood damage no longer occurs, however the avoided damages are already reflected in the depressed land price (ICIMOD 2007). Further, WTP is constrained by household income and the disutility from flood risks measured through higher or lower flood damage costs and risk aversion according to people’s attitude to flood protection (Lera-López et al. 2012).

The perceptions on floods are expected to vary, given an individual’s subjective view of the realised flood risk level and average annual flood damage. It is also expected to vary by age, sex, income and education levels. Preferences are likely to be heterogeneous towards risk reductions as a result of the economic interests in the floodplain area which may influence people’s attitudes to flood risk, income and damage cost. There are no obvious means to assess revealed preferences but stated preference methods could be difficult to apply in the developing world (Bates et al. 2008; Biel et al. 2011) due to lack of education and poverty. This study would assess WTPs of flood mitigation from the local people and therefore would help to develop flood mitigation policies and projects for the different tiers of government.

**METHODOLOGY**

A brief description of the study area

This study was carried out in the WRR basin. Political boundaries covered by the study are the Banke and Dang districts of Nepal. The study area covers an area of 6,500 km$^2$ (Figure 1). The WRR basin is considered one of the important river basins of the country from a socio-economic point of view as it supports large farming communities, although people living in this basin are poor. There are 39 Village Development Committees (VDCs) and two municipalities in the Dang District, whereas there are 46 VDCs and one municipality in the Banke district. Out of them only four VDCs with 720 households are affected by floods (DDC 2007; CBS 2012). In this research, a total of 210 households (over 29% of the total population) were randomly selected for interview. The heads of the
households or the persons who were looking after the household economy were interviewed. The ages of the respondents ranged from 21 to 65 (the age groups of the respondents were <35 (22%), 35–44 (28%), 45–55 (23%) and >55 (27%) respectively) years. The number of the respondents in each age group was more or less equal whereas 45.3% were female and more than half were illiterate.

Methods

CV approaches are perhaps the most promising approach for the estimation of the WTP of local people in flood prone areas for different flood mitigation activities under different flood scenarios; however, it has not been previously attempted in the case of floods in developing countries. The CV method has suffered from some methodological issues and criticisms (Ojeda et al. 2008) but those issues are overcome by following the comprehensive set of guidelines developed by the National Oceanic and Atmospheric Administration (NOAA) Panel (Hanemann 1996) and accepted within the US legal system and by the World Bank (Hanemann 1996; Carson et al. 2008). Moreover, in developing countries, where most people are under- or unemployed and thus their income levels are very low, using ‘man-day’ as a unit of WTP is a promising approach. In this study, the NOAA Panel guidelines (as discussed below) were strictly followed and WTP for mitigating floods under different flood scenarios were estimated with the use of man-day as a measure of WTP.

The scenario development: the following background of different flood scenarios were presented to each of the respondents. You have been experiencing flood for a long time. You know better than us the cause of floods which could be due to: climate change; unmanaged land use practices; lack of embankment protection; deforestation, etc. You are well aware that the erratic rainfall caused devastating floods in the past years resulting in a huge loss of public and private properties including agricultural land, livestock, houses, bridges, etc. in the WRR basin. You might still remember the worst event in 2006. At that time at least 22 people disappeared, thousands of villagers were displaced and 10 villages were submerged in the plain areas. You may still remember the flood event in 2008, in which 870 people from 142 households were forced to leave their houses from Holiya VDC. In 2010, 16,000 people from
2,600 households were forced to leave their houses and farmlands from the Banke and Dang districts and live as refugees. I assume that you may want to live and work in a flood risk free environment.

Therefore, you know better than us about the impact of floods to your properties and livelihoods. You may want a sustainable solution to protect your properties from floods and sustain your livelihood. Considering your circumstances, four hypothetical flood scenarios are developed to investigate your perception and WTP for each scenario – please note, the four flood scenarios were: (1) current flood scenario; (2) flood scenario for 2030; (3) flood scenario for 2070; and (4) flood scenario for 2100. However, in order to avoid confusion, respondents were not informed about years and they were simply briefed for the four flood scenarios. Please remember your WTP for different flood mitigation scenarios that could be useful for developing and implementing flood mitigation policy to your government and other stakeholders.

**Scenarios 1–4**

The Government of Nepal would like to manage the flood problem in this river basin. This will help to stop: (1) the risk of death to people; (2) the loss of private properties such as houses, agricultural and forest lands, livestock, etc.; and (3) the loss of public lands and infrastructures. By developing flood controlling mechanism, the Nepalese Government would like to guarantee the protection of all private and public goods. You know how much you are suffering better than us. Now let us see four highly likely flood scenarios (in terms of depth of water and its logging time) at your locality.

**Scenario development**

Four flood scenarios were proposed: the current flood scenario; a flood scenario for 2030; a flood scenario for 2070; and a flood scenario for 2100. However, in order to avoid confusion, no mention was made of years and respondents were simply briefed as to the four flood scenarios. All flood scenarios were shown on a map and also on a laptop. During the survey, information of various flood prone area, depth and its frequencies were presented for different scenarios. Through this process, respondents were quickly able to calculate their damage costs under different flood scenarios and elicit their WTP accordingly.

**Pre-testing of questionnaire and its final setting**

In order to elicit the WTP of respondents, a bidding game method was used. During the reconnaissance survey the wording of questions was pre-tested and refined using words/language which was locally appropriate to the group of people being surveyed.

The wording of the question was as follows: Would you vote in favour of reducing your annual loss due to flood in terms of labour days each year to protect life and properties?

Yes No

If ‘yes’, what will be the highest amount/labour days you would pay per year?

If ‘no’, why do you say ‘no’? What is the least amount/labour days you would pay?

**Respondents’ characteristics**

In order to triangulate the validity of the WTPs, WTPs were cross-checked with the estimated (by respondents) damage costs of flood to agricultural crops and livestock, and impacts on their total income. Correlations were estimated between key attributes and WTPs and appropriate statistical tests were conducted to see whether there were any statistically significant differences in WTPs associated with gender, education, age, location (depth of waterlogged), income and damage cost classes.
RESULTS AND DISCUSSION

WTP of respondents by age, gender and education level at different flood scenarios

Socio-economic factors such as age, gender, education level, income level and flood damage cost influence the level of WTP. The mean WTP of respondents, by these factors, is analysed and their statistical significance is tested.

The results of this study indicate that people of different age groups have different WTP (Table 1). For all flood scenarios analysed, mean WTP was highest in the 35–44 year old age group and was lowest in the age group below 35. Mean WTP between different age groups were statistically significantly different \( (p < 0.05) \) in all four flood scenarios. As expected, the WTP of all age groups increased with flood severity (from scenarios 1–4). For example, the average WTP to mitigate a scenario 1 flood for the age group 35–44 was 4.57 man-days/year (1 man-day = Rs300, US$1 = Nepalese currency Rs82) and increased by 110% to 9.61 man-days/year to mitigate the scenario 4 flood.

It is interesting to note that WTP was found to be lowest in people below 35 years of age and highest in the 35–45 age group. The respondents who were below 35 years of age accounted for 17% of the total respondents; their overall response might have been because the people of this age group did not have good jobs and were planning to migrate either to nearby cities or move to India for employment. Young people living in this area feel that they face a critical lack of basic needs due to flood and its impacts. For example, there are several cases where children were not able to go to school because of flooding. A 29-year-old female respondent who was interviewed reported that her children, along with those of her neighbours, were unable to go to school because they could not cross the flooded stream near their school. This is serious for families who aspire for better lives and better futures for their children, but is unable to ensure that they can get the education he/she needs because of flooding. People in the ‘under 35 years’ age group wanted to escape from this pathetic situation.

People in the 35–45 year age group might be more settled and so see less possibility for migrating to other places. Further, most of them might see the possibility of making their places better through undertaking appropriate flood mitigation measures. The high value of standard deviations, on the other hand, indicates that there was differing perception even in this group. However, since the WTP values of the different groups were relatively close, we can conclude that their general perspective on flood risk management was similar.

Similarly, average WTP was found to differ between the male and female survey respondents for all four scenarios (Table 2). In all four scenarios, the mean WTP of

### Table 1 | WTP by age for four different flood scenarios

<table>
<thead>
<tr>
<th>Age group</th>
<th>Mean/Std. Deviation</th>
<th>WTP (man-days/yr) for scenario 1</th>
<th>WTP (man-days/yr) for scenario 2</th>
<th>WTP (man-days/yr) for scenario 3</th>
<th>WTP (man-days/yr) for scenario 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 35 (N = 46)</td>
<td>Mean</td>
<td>3.80</td>
<td>5.59</td>
<td>7.19</td>
<td>9.29</td>
</tr>
<tr>
<td>Std. deviation</td>
<td>1.56</td>
<td>2.16</td>
<td>2.68</td>
<td>3.25</td>
<td></td>
</tr>
<tr>
<td>35–44 (N = 59)</td>
<td>Mean</td>
<td>4.57</td>
<td>6.18</td>
<td>7.87</td>
<td>9.61</td>
</tr>
<tr>
<td>Std. deviation</td>
<td>1.67</td>
<td>2.21</td>
<td>2.75</td>
<td>3.44</td>
<td></td>
</tr>
<tr>
<td>45–55 (N = 48)</td>
<td>Mean</td>
<td>4.38</td>
<td>6.09</td>
<td>7.72</td>
<td>9.54</td>
</tr>
<tr>
<td>Std. deviation</td>
<td>1.78</td>
<td>2.80</td>
<td>2.96</td>
<td>3.56</td>
<td></td>
</tr>
<tr>
<td>&gt; 55 (N = 57)</td>
<td>Mean</td>
<td>4.28</td>
<td>5.59</td>
<td>7.54</td>
<td>9.44</td>
</tr>
<tr>
<td>Std. deviation</td>
<td>1.62</td>
<td>2.16</td>
<td>3.04</td>
<td>3.31</td>
<td></td>
</tr>
<tr>
<td>F-value</td>
<td>4.85</td>
<td>6.92</td>
<td>5.39</td>
<td>4.56</td>
<td></td>
</tr>
<tr>
<td>Significance</td>
<td>0.009</td>
<td>0.001</td>
<td>0.005</td>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>Total (N = 210)</td>
<td>Mean</td>
<td>4.23</td>
<td>5.94</td>
<td>7.56</td>
<td>9.46</td>
</tr>
<tr>
<td>Std. deviation</td>
<td>1.67</td>
<td>2.44</td>
<td>2.85</td>
<td>3.36</td>
<td></td>
</tr>
</tbody>
</table>

Note: Scenario 1 – Current flood situation, Scenario 2 – Potential flood level for 2030, Scenario 3 – Potential flood level for 2070 and Scenario 4 – Potential flood level for 2100.
male and female groups were statistically significantly different \((p < 0.05)\), indicating that the women were more serious about responding to future flood scenarios than the men.

Results of this study showed that WTP in scenario 1 was greater for males than for females, while WTP was higher for females for all other scenarios. It can be taken that males are, generally, more concerned for the present than the future. However, the differences in WTP values were not so great that we can draw any outright conclusions about this. Since females involved in the study spent more time on household work where they are involved in cooking, fetching water, collecting firewood and grass for animals, it can be surmised that females are more concerned about the impacts of climate change. This may be the reason for the sharp rise in the value of WTP from current case (scenario 1) to the case of 2030 (scenario 2). In Nepalese society, females are still considered to have less knowledge; hence, it is encouraging to know that the female population is also willing to pay more to reduce suffering due to flood hazards, now and in the future when such events may be aggravated by climate change.

While the proportion of literate and illiterate respondents was almost the same, average annual WTP varied with education level with literate people willing to contribute more compared to illiterate people (Table 3). Higher levels of WTP amongst literate people was expected (Maraseni et al. 2008), as they were better able to calculate the long term benefits of their small investments and were more serious about responding to the risk of flooding.

It was found that more than 50% of people living in the study area were illiterate. Of the total number of literate respondents, less than 40% had above secondary level education. WTP was found to be significantly higher in literate people in all cases indicating that literate people may be more likely to be able to assess flood risk and potential damages, as well as the long term benefit of small investments in flood management. These findings are similar to those of Maraseni et al. (2008), in which they reported that WTP was strongly influenced by education,

### Table 2 | WTP by gender for four different flood scenarios

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean/Std. Deviation</th>
<th>WTP (man-days/yr) for scenario 1</th>
<th>WTP (man-days/yr) for scenario 2</th>
<th>WTP (man-days/yr) for scenario 3</th>
<th>WTP (man-days/yr) for scenario 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male ((N = 117))</td>
<td>Mean 4.29</td>
<td>5.85</td>
<td>7.50</td>
<td>9.45</td>
<td>1.67</td>
</tr>
<tr>
<td>Female ((N = 93))</td>
<td>Mean 4.15</td>
<td>6.06</td>
<td>7.63</td>
<td>9.46</td>
<td>1.67</td>
</tr>
<tr>
<td>F-value</td>
<td>0.009</td>
<td>0.001</td>
<td>0.005</td>
<td>0.012</td>
<td>Significance</td>
</tr>
</tbody>
</table>

Note: Scenario 1 – Current flood situation, Scenario 2 – Potential flood level for 2030, Scenario 3 – Potential flood level for 2070 and Scenario 4 – Potential flood level for 2100.

### Table 3 | WTP by literate and illiterate people at different flood scenarios

<table>
<thead>
<tr>
<th>Literacy</th>
<th>WTP (man-days/yr) for scenario 1</th>
<th>WTP (man-days/yr) for scenario 2</th>
<th>WTP (man-days/yr) for scenario 3</th>
<th>WTP (man-days/yr) for scenario 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literate ((N = 106))</td>
<td>Mean 4.30</td>
<td>6.02</td>
<td>7.75</td>
<td>9.68</td>
</tr>
<tr>
<td>Illiterate ((N = 104))</td>
<td>Mean 4.15</td>
<td>5.87</td>
<td>7.37</td>
<td>9.24</td>
</tr>
<tr>
<td>Total ((N = 210))</td>
<td>Mean 4.23</td>
<td>5.94</td>
<td>7.56</td>
<td>9.46</td>
</tr>
<tr>
<td>F-value</td>
<td>0.009</td>
<td>0.001</td>
<td>0.005</td>
<td>0.012</td>
</tr>
</tbody>
</table>

Note: Scenario 1 – Current flood situation, Scenario 2 – Potential flood level for 2030, Scenario 3 – Potential flood level for 2070 and Scenario 4 – Potential flood level for 2100.
environmental awareness and household income. It demonstrates the need for awareness-raising campaigns targeting illiterate people including the younger generation, women and marginalised people.

**Correlation between WTP and farm and livestock incomes**

Agricultural land is highly impacted by floods. Therefore, it is expected that the higher the level of income from livestock and farming, the greater will be the WTP. As a result, there should be a positive correlation between WTP and these types of income. Results indicate that, for all four flood scenarios, the average annual WTP was positively correlated with both farm income and livestock income (Table 4) and all correlations were statistically significant ($p < 0.05$).

Relatively poor correlation (0.28) was found between WTP and livestock income as compared with farm income (0.61). This may be because, if people know in advance that a flood is coming, they release (set free) their livestock; the implication being that there is less chance of losing livestock assets with floods. However, on many occasions, livestock losses have occurred where flooding occurs without warning (e.g. in the middle of the night) and the people's first priority is to escape. In the case of agriculture, floods have two major impacts: (i) in the short term, farmers lose agricultural produce from the land; and (ii) in the longer term, they may lose their land altogether or the land is degraded for agricultural activities. This could explain why people in the study area are willing to pay more for flood management activities that protect their farm land from floods than those that protect livestock.

Natural disasters, including flood disasters, may increase in terms of frequency and severity in the future as a result of climate change. WTP can be used as an explanatory variable to know the perceptions of the local people for flood risk management to reduce economic losses of the area. It is, however, affected by the geographical condition and socio-economic characteristics. For example, people with high levels of income were willing to pay more. Therefore, an assessment of WTPs of people with different income groups living in different flood prone areas could be an effective way to evaluate the probable involvement of local people and to inform decisions around responsibilities for future flood risk management.

WTPs of high income groups are obviously higher than low income groups. Therefore, a comprehensive WTP study in such areas is crucial for all levels of flood stakeholders. Such study could be more meaningful if the whole catchment is divided into different flood-prone zones.

**Correlation between average annual damage and WTP at various flood scenarios**

The correlation between WTP and flood related damage costs incurred was calculated to validate whether respondents' WTP for the four different flood scenarios are real and logical (Table 5). For all scenarios, average annual damage costs were found to be highly positively correlated with average annual WTP (Pearson's correlation $r = 0.59$–$0.71$; $p = 0.00$).

The correlations between WTPs and farm and livestock incomes and damage costs have been decreased from scenario 1 to scenario 4. People may have a very clear idea about the impact of current flood on livestock and farm incomes and damage cost. However, as they go from scenarios 1–4, they may not accurately estimate the impact of floods on these incomes and cost. Therefore, as they go from scenarios 1–4, the correlation between incomes and WTP may decrease.

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**Table 4** Correlation between income and WTP at various flood scenarios ($N = 210$)

<table>
<thead>
<tr>
<th>Income sources</th>
<th>WTP for scenario 1</th>
<th>WTP for scenario 2</th>
<th>WTP for scenario 3</th>
<th>WTP for scenario 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm income</td>
<td>Pearson correlation</td>
<td>0.61</td>
<td>0.65</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td>Significance</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Livestock income</td>
<td>Pearson correlation</td>
<td>0.28</td>
<td>0.13</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>Significance</td>
<td>0.000</td>
<td>0.071</td>
<td>0.015</td>
</tr>
</tbody>
</table>

Note: Scenario 1 – Current flood situation, Scenario 2 – Potential flood level for 2030, Scenario 3 – Potential flood level for 2070 and Scenario 4 – Potential flood level for 2100.
Other studies have found that WTP increases with increases in flood damage (Botzen & Van 2009). However, the damage cost could vary on both spatial and temporal scales. Floods in a place with high value property and at the time of harvesting crops would incur more damage. Therefore, WTP estimates derived from perceived impacts of all potential costs are very useful for developing flood mitigating policy, programs and projects (Blocker & Rochford 1986; Morss et al. 2005). So far, while offering WTP values, people are usually asked to consider the physical property losses only, and not the health and psychological costs of flooding. A comprehensive WTP study which considers all those direct and indirect costs could be very useful.

The results of this study are encouraging in the sense that the level of WTP for devising strategies on flood management under climate change conditions was found to increase consistently over time, from the current scenario to future scenarios of 2100, irrespective of age, gender or literacy. As stated by Solomon & Johnson (2009) and confirmed in this study, valuing climate protection through WTP is a valuable approach to flood and climate risk reduction.

### CONCLUSION

This study has examined the WTP for various flood scenarios using a survey of 210 households living in the WRR Basin in Nepal. Differences on WTPs by different attributes were analysed, and correlation between WTPs and agriculture and livestock incomes and flood related damage costs were tested. (1) The average annual WTP of the 35–44 year old age group was higher than that of other age groups; (2) women were found to be more willing to pay than males; and (3) literate people were found to be more willing to pay than illiterate people. Similarly, income levels and the extent of flood damage costs influenced WTP at various flood scenarios. The average annual WTPs were significantly positively correlated with annual farm income, livestock income and flood-related damage costs. The cross-validation of WTPs against different attributes showed that the WTPs in terms of man-day are logical, practical and real. Therefore, in developing countries, where the unemployment rate is very high and the opportunity cost of people is very low in some seasons, the man-day approach seems promising and is therefore recommended to be widely adopted. WTPs of people living in different flood-prone zones within a catchment could be different. Due to limited time and resources, this study could not assess this aspect. Although the damage costs might have covered this aspect, a study considering this factor could provide more stratified insight in this matter.

This finding provides a rational basis for the appraisal of policy options and resources allocation. This finding supports moves to promote public–private partnerships for reducing flood risks through the participatory approach. Similarly, this assessment is likely to be one of several sources of evidence that decision makers may employ while making difficult and often highly contested long term planning and flood risk management decisions. Moreover, the framework of this empirical study could be applicable for a similar study in some other catchments in Nepal and other developing countries.

### REFERENCES


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**Table 5** | Correlation between average annual damage and WTP at various flood scenarios (N = 210)

<table>
<thead>
<tr>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
<th>Scenario 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson correlation</td>
<td>0.67</td>
<td>0.71</td>
<td>0.67</td>
</tr>
<tr>
<td>Significance</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Note: Scenario 1 – Current flood situation, Scenario 2 – Potential flood level for 2030, Scenario 3 – Potential flood level for 2070 and Scenario 4 – Potential flood level for 2100.


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