Can developing countries pay for Climate Adaptation? Experimental Evidence through a Contingent Valuation Method (CV) in Nepal

Rastraraj Bhandari*

NYU Abu Dhabi, Class of 2019
rb3598@nyu.edu

Abstract

Despite the widespread consensus on the need of climate adaptation finance to support developing countries, funding for climate adaptation projects is limited. There is extensive debate and literature that suggests that adaptation finance will flow from developed countries. This paper, however, studies the willingness to pay (WTP) for adaptation from glacial flooding among university students in Nepal as a way to explore if residents of developing countries can fill the funding gap for climate adaptation. By eliciting WTP using a contingent valuation method, this paper shows that university students in Nepal exhibit a positive value for adaptation finance. Consistent with the literature on WTP, this study finds that gender and level of income have a significant influence on the WTP value while information treatment does not. While the positive WTP value among students of developing countries can be used to fill the financing gap for climate adaptation, it also highlights the urgency with which adaptation finance is required in vulnerable communities.

Keywords: adaptation, climate change, glacial flooding, Willingness to Pay (WTP)

1. Introduction

Climate change and the associated impacts on prevalent weather patterns and microclimates are a major threat to our coastal cities, food supply, ecosystem stability and water availability (Winden, Jamelske, and Tvinnereim 2018). The frequency and magnitude of natural hazards triggered by climate change have been increasing globally, leading to USD 1.5 trillion in economic damages from 2003 to 2013 (*Surge in Climate Change-Related Disasters Poses Growing Threat to Food Security* 2015), in addition to impacts to human and ecosystem health.

Limiting climate change will require increased international climate change cooperation and action towards a significant reduction in global greenhouse gas emissions (GHGs). At the same time, climate adaptation policies need to be prioritized particularly for developing countries of low-income brackets, as they experience the largest effects of climate change yet have limited institutional, financial and technological capacities to adapt to the manifold consequences (O'Garra and Mourato 2016). Until very recently, climate adaptation policies were sidelined in favor of climate change mitigation, which generally involves reduction of GHGs (Pielke et al. 2007; Tol 2005). But presently, there is widespread consensus that planning, regulation, infrastructure development, and development of climate forecast technology towards climate change adaptation are essential to help vulnerable populations and ecosystems become more resilient to climate-change impacts (O'Garra and Mourato 2016).

Climate adaptation, however, requires notable funding and resources (ibid.). There have been several global estimates of the costs of adaptation in developing countries (Stern 2007; Mearns and Norton 2010), with values ranging from $4-$37 bn/yr (Stern 2007) to $280-500 bn/yr by 2050 as shown by O'Garra and Mourato O'Garra and Mourato (2016). Adaptation finance is largely mobilized through the public sector, country-level pledges and the international community, via institutions such as the Asian Development Bank or the World Bank, or funds such as the Adaptation Fund, Global Environmental Fund (GEF), and the Green Climate Fund (GCF). Although significant policy efforts have been made to scale up adaptation finance, investment in the sector has not taken off and private sector financing is minimal, with only USD 22 billions

*Thesis submitted to the Division of Social Sciences at New York University– Abu Dhabi for the Economics Capstone Project in 2018–2019. I submit this Thesis for the Capstone project in Economics to the Division of Social Sciences at New York University Abu Dhabi. The Thesis provides sufficient information on data sources, data periods, and data manipulation and transformation to allow for a full replication of all results.

of tracked global investment being allocated to address climate change adaptation in 2016 (Micale, Tonkonogy, and Mazza 2018).

The question of who will pay for climate adaptation and how much they will pay has been debated over the years (Bowen and Rydge 2011; Khan and Roberts 2013; J. B. Smith et al. 2011). Although there are different aforementioned actors to finance climate adaptation, experts expect a substantial portion of this funding, particularly that required in developing countries, come from developed countries (Timperley 2021). In fact, the Glasgow Climate Pact adopted in November 2021 urges developed countries to at least double their collective provision of climate finance for adaptation to developing countries from 2019 levels by 2025 (*Glasgow Climate Pact, Draft decision -/CMA.3* 2021). This means that people from developed countries have a role to play in fulfilling this gap for climate adaptation. Winden, Jamelske, and Tvinnereim (2018) and Carlsson et al. (2012) also argue, through a developed country setting, that assessing public support for climate change, alongside the perceived value of taking action, can assist in filling such funding gaps. Within this debate, there has been a growing rhetoric among commentators, climate researchers, and government bodies that members of the general population have a high potential to voluntarily take action against climate change (Diederich and Goeschl 2014).

There have been a number of studies that examine willingness to pay (WTP) for climate change or climate mitigation activities (Akter and Bennett 2011; Carlsson et al. 2012; Winden, Jamelske, and Tvinnereim 2018). Johnson and Nemet (2010) provide a comprehensive literature review of the studies published through 2010 and find that the variables used to analyze WTP are largely similar, while the policy objectives and circumstances differ across studies (Winden, Jamelske, and Tvinnereim 2018). Most commonly, studies measure environmental and climate attitudes, awareness and belief on climate change, as well as socio-demographic variables such as income, education, gender, and age (ibid.). The average mean and median annual household WTP were $167 and $135, with a range of mean values between $22 and $437 across the 27 studies that were reviewed by Johnson and Nemet (2010). However, the studies were mostly on climate change mitigation, as opposed to climate adaptation, and tend to be U.S.-centric.

O'Garra and Mourato (2016) are a notable exception as they examine WTP for climate adaptation activities. They elicit the preference of individuals from the United Kingdom to pay for climate adaptation projects in developing countries. Results from their nationally representative survey indicate that UK residents are willing to contribute $30 per year towards developing country adaptation (ibid.). This is less than one third of the $100 - $140 per capita per year that the authors estimate would be needed to fulfill the $70 - $100 bn/yr recommended by the World Bank to fund climate adaptation in developing countries (ibid.). Both in looking at climate mitigation or adaptation, these studies are largely limited to the context of developed countries. The people in developing countries are often overlooked as potential funders for climate change activities in both the academic literature and international climate policy dialogues.

However, given the significant challenges on the political and private levels in channeling funds towards climate change adaptation alongside a low interest from individuals in developed countries (ibid.), alternatives to funding climate adaptation need to be explored by governments seeking to finance climate adaptation. This has never been more urgent given the impacts of climate change are worsening as shown by the 2021 Sixth Assessment Report from the Intergovernmental Panel on Climate Change, or IPCC (Masson-Delmotte et al. 2021). With an increasingly rising cost of climate change to the socio-economic welfare of developing countries, particularly in the aftermath of the COVID-19 pandemic where countries have constrained fiscal space, governments in developing countries have an opportunity to access public support domestically to fill the gap in adaptation finance.

To identify the potential to generate additional adaptation finance in developing countries, this study applies the contingent valuation (CV) method to data from surveys conducted among university students in Nepal to understand their willingness to incur costs for climate adaptation projects dedicate and /aimed to decrease risks of glacial flooding. The study particularly focuses on university students as young people will be among the segment of the population most affected by—and bear the majority of costs of—climate change (Winden, Jamelske, and Tvinnereim 2018, p. 452). An experiment with random variation in information was also conducted to examine and investigate if increased access to information results in an increased willingness to incur costs. This study is among the early attempts in the literature of environmental economics that seeks to identify WTP for adaptation projects among individuals of a developing country by collecting first-hand data. Through the findings, it challenges the current narrative that adaptation finance will mostly come from individuals of developed countries by showing that individuals in developing countries also demonstrate a high WTP.

Several results of interest are found. Nepali university students show higher levels of concern for climate change than those estimated for Chinese and American students by Winden, Jamelske, and Tvinnereim (ibid.). For Nepali university students, their WTP for climate adaptation via infrastructural provisions to decrease the flooding risk of the Tsho Rolpa Glacial Lake is on average 6.6 USD per annum with a WTP to income ratio of 0.76. Similar studies among U.S. and Chinese university students—but for a policy on climate change mitigation—suggest a WTP to income ratio of 0.5 and 1.9 respectively. Scaling the figures to the youth population of Nepal, this study suggests that youths in Nepal are willing to pay between $21.7 to $55 million a year for climate adaptation, which represents 14-18% of the annual estimated costs of climate change for Nepal. The study also explores the determinants of WTP and highlights how gender, income level, and distance from crisis influence the value of WTP, which is consistent with the findings of existing literature (Winden, Jamelske, and Tvinnereim 2018; Carlsson et al. 2012). Finally, the experiment suggests no significant increase in the willingness to pay for climate adaptation when more information about the adaptation project is provided, consistent with previous studies (O'Garra and Mourato 2016).

The rest of the paper proceeds as follows. Section 2 provides a general background on Contingent Valuation Methodology (CVM) which is used in this study. Section 3 provides an overview of glacial flooding and the rationale behind choosing the 'avoidance of glacial flooding as a climate adaptation mechanism' to calculate the marginal willingness to pay in this study. Section 4 explains the experimental design, including the survey sites, data collection and survey content. Section 5 summarizes the data and analyzes the findings of the study in depth. It pays particular attention to engaging the WTP value and its determinants with the existing literature. Finally, Section 6 provides some discussions on the implication of the positive WTP value for climate adaptation and concludes the paper.

2. Contingent Valuation Methodology (CVM)

It is challenging to quantify the benefits of taking climate action relative to perceived costs due to the difficulty in putting a price on non-market environmental goods and services, the type most affected by climate change (Keohane and Olmstead 2007). To circumvent the lack of data on price and quantity of environmental goods, economists have developed two strategies in estimating the value and risk of environmental amenities: the revealed preference approach and the stated preference method (ibid.). While the revealed preference approach indirectly observes behavior in related markets and uses that information to infer WTP, the stated preference method relies on asking people about their willingness to pay to protect a given environmental resource (ibid.). The revealed preference method uses information about real behavior as opposed to hypothetical choices, which makes it attractive and slightly favored by economists (ibid.). However, the stated preference method can sometimes be the only option due to lack of data on price and quantity (ibid.).

The most common stated preference approach is contingent valuation (CV): carefully structured surveys to obtain information on the research participants' willingness to pay, which is the method used in this paper. The major advantage of CV is its broad applicability. The existence value, for example, can only be estimated through CV, as it is purely internal rather than behavioral. An existence value is derived from "knowing" something exists, even if the individual doesn't use it or intend to use it. A CV method is most commonly used in natural resource damage assessment, to estimate lost passive use (or non-use) values from oil spills and other environmental harms (ibid.).

At the same time, it is important to note that the sources of bias can be very large in the CV approach, making them highly controversial (Diamond and Hausman 1994; Carlsson et al. 2012; Whitehead and Blomquist 2006). Firstly, some respondents might not provide a thoughtful response considering the survey will have no consequences. Secondly, which can be much worse, if respondents believe that the survey will have public policy consequences, they can have strategic incentives to misrepresent their true valuations. Nonetheless, specialists in CV have come up with a series of approaches to mitigate these and other potential sources of bias. As a result, a range of meta-analyses that have compiled results from multiple studies have concluded that CV methods and revealed preference approaches yield similar estimates of willingness to pay for environmental amenities (Keohane and Olmstead 2007). Thus, the values of these amenities can be assessed using either method. The most notable is the recommendations developed by the NOAA panel which were used in the design of this survey (Arrow et al. 1993).

In Nepal, there have been a limited number of contingent valuation studies. And the ones conducted on WTP are mostly on market goods such as the availability of improved water supply. A study by Katuwal and Bohara (2007) measured the WTP for improved

water supply using the stated preference method and compared it with the value obtained from the revealed preference method. Although just a working paper, the study suggests a mean WTP per month of NRS. 126.11 (USD 1) as compared to the current tariff of NRS. 60.11. The demand was estimated to be 40.84 Liters Per Capita per Day (LPCD) as compared to the current consumption of 33.19 LPCD. Using data from a survey of 1500 randomly sampled household in Kathmandu, Pattanayak et al. (2005) concluded that coping costs are almost twice as much as the current monthly bills paid to the water utility, but are significantly lower than the estimates of WTP for improved services (ibid.).

3. Context

Apart from being an aesthetic mountain range that brings an inflow of tourism, the Hindu Kush Himalayan Region contains the world's largest volume of glacier ice and perennial snow outside the Polar Regions (Kang et al. 2010). Nepal lies in the central core of the Himalayas as the mountains form the border between China and Nepal.

Presently, increased atmospheric warming and changing precipitation patterns are causing glaciers in the high Himalayas to retreat at an unprecedented scale. Alarmingly, there has been a 27% decline in glacial volume in the Himalayas in the past several decades (Ives, Shrestha, Mool, et al. 2010). Melting of the Himalayas can have lasting implications as the Himalayan ecosystem provides crucial ecosystem services to 1.9 billion people, more than any other mountain system (Wester et al. 2019). In addition, melting Himalayas can endanger downstream communities from adverse climate induced disasters (ibid.). For example, the resulting meltwater is rapidly accumulating to form glacial lakes, which absorb and transmit thermal energy to the glacier face, causing a positive-feedback loop and accelerating melting. Although these glacial lakes work as a dam to retain the meltwater—which could potentially be tapped to produce hydropower—some are vulnerable to bursting which can cause downstream flooding, often triggered by large avalanches or earthquakes. Such flooding is referred to as a Glacial Lake Outburst Flood, or GLOF.

There are 1,466 glacial lakes in Nepal, and scientists at the International Centre for Integrated Mountain Development (ICIMOD)—a leading research institution on Himalayan glaciers—note that about 21 of these lakes pose potential risks and six are at a high risk of an outburst (Ives, Shrestha, Mool, et al. 2010). The most infamous and vulnerable glacial lake is the Tsho Rolpa Glacial Lake, which is the subject of interest in this study's survey. Although the Tsho Rolpa lake has never burst in this region, the likelihood of a potential burst is high across the Himalayas—particularly in the Eastern Himalayas—in the distant future (Veh, Korup, and Walz 2020).

Tsho Rolpa is located in the Himalayas in central Nepal at an altitude of 4,546 meters (See Figure 1). It forms the headwaters of the Rolwaling River, a tributary of the major Tama Koshi River in the Dolakha district of Nepal. The economic elements exposed to a potential Tsho Rolpa Glacial Lake flood range from lives, property, development projects and infrastructure, livelihood support systems such as tourism and trade, and environmental resources such as forest, pasture/grazing land, and fisheries (Ives, Shrestha, Mool, et al. 2010). The economic and social damage—including the loss of lives—largely depends on the duration of the flood, the velocity of the flow, and the flooding level. A study by ICIMOD suggests that the tangible damage ranges from USD 2 million to 9 million, depending on the type of the flooding (ibid.). The same study also estimates that almost 650,000 people can be directly and indirectly affected by a potential flooding within 100 km of the glacial lake. Thulagi, another major glacial lake in Western Nepal, can affect around 2.2 million people who live within 100km of the lake (ibid.).

Although the Tsho Rolpa Glacial Lake has been of a major interest among the scientific community for decades, there seems to be very little study on the awareness and perception of the lake among the citizens who live in the region. In 2000, as scientists expressed concerns to the government about a potential GLOF event, an outlet was created which lowered the lake by 3 meters (Rana et al. 2000). Despite the mitigation efforts to reduce the level of the lake, there is still some fear of a potential GLOF among downstream communities (Dahal 2008). Furthermore, there is little information on the residents' understanding of the current situation on glacial flooding in the region alongside their risk perception.

This study explores the behaviors that can arise from thinking about potential impacts of a disaster triggered by natural hazards, in this case a GLOF event. In doing so, it aims to estimate how much people are willing to pay to protect themselves from a GLOF event. In addition, the study explores whether the threats posed by climate change shape people's economic valuation of the environment, and particularly their valuation of climate change adaptation projects.

4. Experimental Design

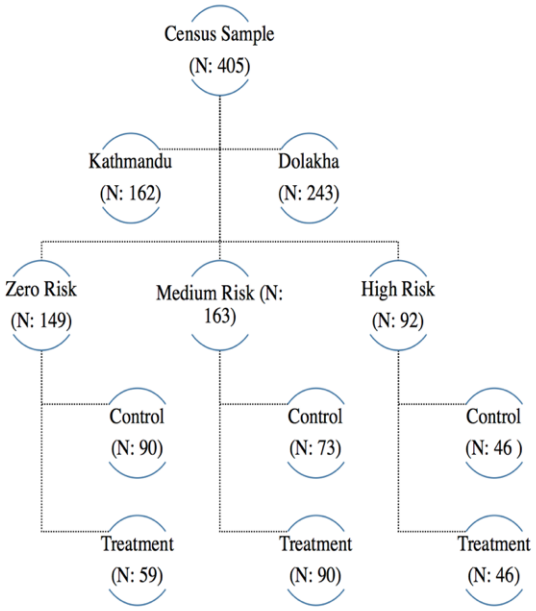
4.1. Survey Sites and Data Collection

Paper surveys[1] were administered among university students[2] in two different regions of Nepal. First, the surveys were conducted in Charikot, the capital district of Dolakha region where the Tsho Rolpa Glacial Lake is located. This location was selected as it is the biggest city that lies in the closest proximity of the lake and is the only city in the region with colleges. The same surveys were administered among top colleges in Kathmandu to understand the answers for the same questions. Kathmandu is the capital city that contains the most knowledgeable university students who are most likely to work for agencies of power in implementing future policies in the country. Therefore, a comparative study between the two regions seemed to be an interesting idea.

The surveys were taken over the 3 months between May and August in person. Only college students from three major colleges were considered for the survey in Charikot. From a total of around 700 students in these three colleges, 243 students were interviewed. In Kathmandu, two colleges were considered due to their prestige, ease in conducting research, and because they offered the same undergraduate programs offered by colleges in Charikot. From a total of around 2,500 students in these two colleges, 162 students were interviewed. All respondents are hence either enrolled in a Bachelors in Business Administration (BBA) or a Bachelors in Social Work (BSW) coursework. This leads to two limitations to our study. First, students studying other subjects could not be considered due to logistical limitations. Second, the survey provides an estimate from students who have had access to excellent education in their home areas. The results of this study therefore represent the sample of the population representing the best-case scenario.

Students were further classified into three different risk zones based on their geographical location and whether or not they have family or friends in the risk prone zone. If students had family and friends in the risk prone zone, they were classified to High-Risk. If students did not have family in the risk zone and belonged to Charikot, they were classified to the Medium-Risk category. The remaining students from Kathmandu with no family in the risk prone zone were classified to be in the No-Risk category.

Figure 1: Sample selection



Note: Figure showing the sample selection and study design

Figure 1: *Sample Selection*

4.2. Survey Design

The content of the survey was four-fold and explored socio-demographic characteristics, level of awareness and perception, and WTP for climate change adaptation. WTP for better road infrastructures in Charikot was also studied to understand how priorities to climate change fall in comparison to road infrastructures which have direct and higher short term benefits. During the time of survey, the major road that connected Charikot to the city was in very low standards with frequent road related accidents (*Rain, landslides affect road upgradation in Dolakha* 2017).

4.2.1. Personal Information

Students were asked to fill out some personal information to understand their demographic characteristics. Comparing the sample demographics to a national census was beyond the scope of this study. Questions ranged from their age, gender, location, number of people in their households, primary source of information about climate change, monthly income and whether

[1] See Appendix A and B.

[2] University students in this context refers to students pursuing their undergraduate studies. In Nepal, undergraduate studies are also offered by colleges that are affiliated to universities. In this case, interviews were taken at five separate colleges.

or not they have family members and friends who are involved in the environmental or tourism industry in any way.

4.2.2. Awareness Evaluation Exercise

A short awareness evaluation exercise was conducted to understand the level of awareness on glacial flooding and climate change. The Evaluation Exercise was a multiple choice questionnaire with the 10 questions divided into 2 categories.

First, general questions that pertained to their understanding of the causes and consequences of climate change and greenhouse gases were asked. Second, specific questions related to the Tsho Rolpa Glacial Lake were asked. Questions ranged from whether or not Tsho Rolpa is safe, whether or not there exists an emergency alarm system along the river banks, the number of people who can be affected by a potential glacial flooding and the government action in mitigating GLOF events in the region. Lastly, students were asked if they think Tsho Rolpa was never vulnerable to bursting and that potential GLOF events are only a planned hoax. The data was ranked in four quartiles and a 3 scale index was calculated according to the data scatter with 2 being the highest awareness and 0 the lowest.

4.2.3. Perception Evaluation Exercise

Students were asked thirteen questions to understand their personal opinion on climate change and in particular, glacial flooding. For every question, students could choose one among 4 options that said Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD).

Questions ranged from their perspective on the role of the government in solving climate change, their personal belief and interest in climate change as well as their priorities. Their answers to seven particular questions ranging from whether they think climate change is real and if they think it will affect their family or not were used to determine the Climate Perception Index. Respondents could receive a maximum of 3 and a minimum of 0 points for each of the 7 questions based on their answers. The data was ranked in four quartiles and a 3 scale index was calculated according to the data scatter with 2 being the highest perception and 0 the lowest. The CPI was calculated as awareness on climate change evaluates students on their knowledge of facts rather than how they feel about a particular social issue.

4.2.4. Willingness to Pay (WTP)

Students' Willingness to Pay (WTP) for potential action on climate change and their reasoning behind their answers was understood. Double bounded Contingent Valuation followed by an open-ended question is widely accepted as a highly reliable methodology in contingent valuation surveys (Arrow et al. 1993; Cooper, Hanemann, and Signorello 2002). However, logistical and time limitations limited the study to using a choice method followed by an open-ended question with surveys taken in a classroom setting. A pretest survey with open-ended questions was done with 40 respondents to understand the bounds of respondents' WTPs as recommended by Hoyos (2010). Accordingly, a lower bound of 0 and an upper bound of 1,000 was used in the exercise. The same bound was used for WTP for better road infrastructures. Students were simply asked to pick one of the options (e.g. <0, 0, 50, 100, 500, 1000, any other amount) in private.

4.2.5. Survey Versions and Treatment Effect

There were two versions of the survey to remain consistent with the experiment and explore the influence of different information treatments on WTP. Following the methodology of O'Garra and Mourato (2016), Survey A (n = 195) was designed to be persuasive and included stronger and more emotive wordings, with a detailed plan of action on the adaptation project[3]. Survey B (n = 209) was neutral and used the existing knowledge of the risks associated with glacial flooding to elicit WTP; a standard CV survey but with no detailed plan of action[4]. For the respondents of Survey B, the WTP exercise was conducted right after the Personal Information Section to ensure that the Awareness and Perception Evaluation Exercise would not increase the level of information on climate change. For respondents of Survey A, the WTP exercise was conducted last. The same level of information was provided for WTP for road infrastructures as it was not the main interest of this study. The two surveys were identical in all other aspects.

Overall, the information treatment had very little impact on the stated WTP value: mean of treated respondents, Survey A ($7.2; s.d. 10.5) was marginally but not significantly higher (p = 0.4189) than the mean of the control group, Survey B ($6.3; s.d. 11.6). Given the main interest of the paper is to estimate a WTP value and that the treatment had marginal effect on WTP, the results from both survey versions have been presented together for each risk zone except for in Table

[3]See Appendix A.
[4]see Appendix B.

6. Nonetheless, further analyses on the effect of treatment within and across risk zones has been provided in the section below.

5. Study Findings

5.1. Descriptive Statistics

In total, 420 students from 5 different colleges across two geographical regions were invited to participate in the survey. A total of 404 respondents completed the survey with a response rate of 96%. The majority of the respondents are classified under Medium-Risk Zone (40.3%) and No-Risk Zone (36.8%) with 22.8% responding to have friends or family along the river banks of the glacial lake classifying themselves in the High-Risk zone. Comparing the sample demographics to a national census would have been helpful but was beyond the scope of this study due to limitations in the census for our variables of interest. Key sample characteristics, according to different risk zones, are summarized in Table 1.

In general, 60.4% of the total sample was female with a particularly high rate of 66.9% in the Medium-Risk zone. This can be explained as although the out-migration from villages to cities among young males is common, young women are encouraged to stay at home[5]. This is also reflected in the programs offered by the colleges in Charikot, where all Medium-Risk students come from, as they do not offer studies in the natural sciences or the STEM field, which are often considered to be more suited to male students in the Nepali context.

Overall, the sample is majority Hindu (86.8%) and the employment rate is around 42% with an annual personal income of 866.5 USD. The income of students belonging to the No-Risk zone have incomes on average 29% higher than those of the total sample. This is explained as all of the No-Risk students study in Kathmandu where job opportunities as well as wages are higher than that in Charikot. On average, 23.5% of the students had friends or family involved in work related to the environment or climate change in any way, and 36.3% of the students had friends or friends involved in the tourism industry.

The average score for the sample on the Awareness Evaluation Exercise was 5.8 (out of 10), which is above average based on the criteria designed by the author[6]. Students have an average score of 6.0, 6.3, and 5.0 in the High, Medium and No-Risk zone respectively. Given students living in Medium and High-Risk zones can be affected by glacial flooding and have been exposed to awareness campaigns by different governmental and non-governmental organizations, it is understandable that students in the No-Risk Zone have a much lower awareness score on average. The average awareness index (2 being the best and 0 being the worst) is 0.9 implying that most students have an average awareness of glacial flooding and climate change. Given the lack of previous studies and the uniqueness of this questionnaire, it is difficult to benchmark the level of awareness being low or high compared to other developing countries.

The average score for perception evaluation exercise is 14.1, which falls in the average of the climate perception scale designed by the author[7]. The highest possible Climate Perception Score for a student is 21 and the lowest is 0. Students in the High-Risk zone have the highest perception of climate change (14.6), followed by students in the Medium-Risk zone (14.2) and finally students in the No-Risk zone (13.7). Given students in the High-Risk zone are the most vulnerable to climate change and the associated impacts, it is understandable for them to have the strongest perception of climate change and possible interventions.

Table 2 summarizes the students' response to questions in the Perception Evaluation Exercise. Only 60.5% of students expressed awareness of the glacial lake, 90.8% believed that climate change will affect them and their family with students of No-Risk zone the most concerned (93.2%.) 90.2% of students expressed a desire to learn more about climate change and how to be involved in solving the crisis.

A 2016 study published by the government of Nepal notes that around 91% of high-school students are aware of climate change (Statistics 2017). However, this number was based on whether or not respondents had heard of the term climate change, an insufficiently rigorous approach. These findings question the validity of the methodology of the government report and argue the level of awareness among students in Nepal to be much lower. When asked about the government re-

[5]While many young men travel to Kathmandu for higher studies, the rate of labor migration to gulf countries is also particularly high as shown by Malla and Rosenbaum (2017).

[6]Each question was worth 1 point and <= 5 being climate illiterate got an index score 0, 6 being climate neutral got an index score of 1, and 7 or higher being climate aware got an index score of 2.

[7]Questions 1, 3, 4, 5, 9, 11, 13 were used to calculate the perception index with students (see Appendix A). Each question received a maximum of 3 points if chosen Strongly Agree (similarly, Agree (2 points), Disagree (1 point), and Strongly Disagree (0 point)). Perception Score >- 16 have strong perception of climate change and have an index of 2, Perception Score 14, 15 have moderate perception to climate change and have an index of 1, and perception score less than 13 have a weak perception and have an index of 0.

search findings that suggest around 91% of high-school students are aware of climate change, only 25.1% agreed to the statement.

5.2. Willingness to Pay (WTP)

As noted in section 3.1, students were asked to indicate the amount they were interested in contributing towards climate change adaptation alongside road infrastructures. They were given 7 options (e.g. <0, 0, 50, 100, 500, 1000, any other amount) to choose from. The options were chosen in consideration of the household income per capita in Nepal and initial scoping conversations with faculty members in these colleges. In addition, an open-ended option was also included to mitigate any risks of restriction options for students. The average WTP value of the sample as classified under their risk zones are summarized below in Table 3.

The results indicate that 95.2% of students expressed a positive WTP value for climate adaptation projects. The number is much higher than that for other similar studies e.g. 54.3% for O'Garra and Mourato (2016). Further analysis of the data suggests that WTP value for climate adaptation is $8.3 for High-Risk zone, $8.5 for Medium-Risk zone and $3.5 for No-Risk zone. This is consistent with the idea that people in the No-Risk zone will value climate change adaptation less than people in Medium- and High- Risk zones. However, the results show that students from the Medium-Risk zone have higher WTP than those from the High-Risk zone. Following from Table 1, it is plausible that people in Medium-Risk zones have a higher value for WTP given they have a higher level of awareness than people in High-Risk zones; the analysis to this is presented in the section below.

Although this is not in the main interest of this paper, a meta-analysis on the recent WTP studies on environmental goods was conducted and suggests a lack of standard in evaluating what counts as high and what counts as low WTP[8]. Furthermore, given environmental goods and per capita income vary across countries, simply comparing the WTP and VSL values does not seem to be an accurate standard. To further this argument, Table 4 provides a comparison of these figures to those from a similar study conducted by Winden, Jamelske, and Tvinnereim (2018) for university students from China and the United States on climate mitigation projects.

90% of university students in Nepal believe climate change is happening whilst the number is 92% in China and only 76% in the US (ibid.). Overall, Jamelske, Barrett, and Boulter (2013) concludes that Chinese students have a uniform view on climate change as there is no debate nor denial on climate change coming from official Chinese government and media sources. A similar argument can be presented in the case of Nepal which in addition experiences first hand impacts of climate change. On the contrary, there is significant research in the United States to suggest that American views on climate change arise from a "partisan divide exacerbated by political debates and distorted media coverage." (Winden, Jamelske, and Tvinnereim 2018, p. 455) Similar trends are seen in concerns about climate change (91% Nepal; 53% China; 50% US) alongside environmental issues being the most important social issue (29.7% Nepal; 20% China; 9% US).

The average WTP to Income Ratio in Nepal (0.8), China (1.9) and the United States (0.5) suggests that WTP values in a developing country like Nepal is higher than the United States, which contradicts Greenstone and Jack (2015) assumptions. However, given the policy in study is climate mitigation in the United States and climate adaptation in Nepal, it is difficult to compare the two values and make a conclusion. Another comparison could be made with O'Garra and Mourato (2016), who show through a nationally representative survey that UK residents are willing to contribute $30 per year towards developing country adaptation. However, it is difficult to reach a comparative conclusion as UK residents are paying for climate adaptation in a different developing country location whilst Nepalese students are directly affected. Further, O'Garra and Mourato (ibid.) analyze a nationally representative sample whilst this study only surveyed university students.

Overall, results show that individuals irrespective of the different risk zones would be willing to pay about $6.6 per year, which is equivalent to 0.8% of their annual income to support climate adaptation projects to contain potential glacial flooding from the Tsho Rolpa Glacial Lake.

5.3. Regression analysis

Regression analyses were used to understand the influence of various socio-economic, awareness and perception related variables on WTP for climate adaptation. Particular focus was made on the influence of awareness on WTP. Results of the regressions are presented below in Table 5.

Consistent with other studies in the literature, this study shows that socioeconomic variables such as in-

[8]The author is currently working on another paper that performs a meta-analysis on previous WTP studies to highlight a lack of standard in evaluating what is low and high WTP.

come have a positive and significant effect on WTP (Carlsson et al. 2012; Duan, Yan-Li, and Yan 2014). An increase in a students' personal income by NRS. 100 ($0.9) on average significantly increases WTP by NRS. 2.7 ($0.03). Interestingly, female university students on average show significantly higher WTP than male students by around $2.2. This is consistent with the findings of Carlsson et al. (2012) and McCright (2010), who contribute to the literature that females are more knowledgeable and care more about the environment than males. The findings differ from Duan, Yan-Li, and Yan (2014) and Li et al. (2016) and Winden, Jamelske, and Tvinnereim (2018) who find that U.S. males show a significant and higher WTP than females, as well as Yang et al. (2014) and Kotchen, Boyle, and Leiserowitz (2013), who find no gender effect (Winden, Jamelske, and Tvinnereim 2018).

The study also utilizes various knowledge and perception related questions to create a perception index, which has a significant and positive effect on WTP. This idea is consistent with Carlsson et al. (2012) and Kotchen, Boyle, and Leiserowitz (2013) who show that respondents who believe that human beings affect climate change have a higher WTP. This study, however, moves further than Carlsson et al. (2012) and Kotchen, Boyle, and Leiserowitz (2013) by designing a singular index using questions that commonly have a positive impact on WTP. However, no significant and positive impact on perception is seen for an individual with a perception index 2 compared to an individual of perception index 1. This lack of discrepancy intuitively makes sense as there are other financial and socio-economic constraints to an individual that can limit them from an increasing WTP value.

A similar result is seen with awareness and knowledge about climate change. The results show that an increase in the awareness index of a student from 0 to 1 increases the WTP for climate adaptation with significance on average by NRS 419 ($3.8) keeping all else constant and with significance. This is consistent with the findings of Carlsson et al. (2012), Li et al. (2016), and Yang et al. (2014) who show that respondents who are more knowledgeable about climate change are willing to pay more. The relationship is not linearly upward sloping, however, as an increase in the awareness index of a student from 0 to 2 does not yield a significant rise of WTP for climate adaptation. One explanation to this can be the fact that there are other financial and socio-economic constraints that limit a potential increase in WTP. It is interesting to note that whilst awareness increases willingness to pay, it can only do so much. At the same time, the relationship between awareness and WTP is not significant when controlled for other explanatory variables.

Table 6 also provides insights on the influence of awareness on WTP across different risk zones. While students who have an awareness index of 1 have a significantly higher WTP for climate adaptation than students with an awareness index of 0 in the High-Risk and Medium-Risk zones, level of awareness has no influence on WTP in the No-Risk zone. Due to the absence of literature that studies WTP across risk zones, it is not possible to compare these findings with other studies. Nonetheless, it provides an interesting policy implication on who needs to be targeted and by what policy intervention to elicit higher WTP for climate adaptation. Perhaps awareness on glacial flooding will not elicit higher WTP for climate adaptation within the No-Risk zone, but the No-Risk community might face risks from alternative consequences of climate change such as rising sea levels. This provides an interesting policy implication on the need to personalize climate change awareness campaigns and inform communities on the risks pertinent to them in order to elicit higher WTP.

Although it was not in the main interest of this paper, it was interesting to note the insignificant effect of the information treatment in this study. This finding is consistent with that of O'Garra and Mourato (2016). Students with higher levels of awareness do not show higher WTP compared to students with lower levels of awareness when everyone is treated with a nuanced understanding and knowledge of the problem at hand. In fact, Table 6 shows that students with higher levels of awareness have a negative but insignificant influence on WTP for climate adaptation when they are treated with extra information. This might be because these students with a high level of awareness are aware of the risks in hand and can pick on the persuasive language which involves more emotions giving them an understanding that they were being treated to an effect. However, it is not possible to make such claims in certainty as the relationship is not significant. Neither is the p-value between risk zones for the control and treatment groups, High-Risk (p-value = 0.46); Medium-Risk (p-value = 0.55); No-Risk (p-value = 0.21).

6. Discussions and Conclusion

The primary focus of this study is to determine the WTP for climate adaptation among the university students of developing countries who will be at the forefront of climate change adaptation and interventions.. The study estimates an average WTP of $6.6 per person per year which suggests that there is significant support for funding climate adaptation projects in a developing country

like Nepal. By scaling this figure to the population of young people of approx. 5.4 million (aged between 16 - 25), youths are willing to pay between $21.7 to $55 million a year for climate change[9]. Although there are no accurate figures on the cost of adaptation for Nepal, the first Nationally Determined Contribution (NDC) of Nepal highlights the cost of climate change to be $270 - 360 million per year. To this end, the youths of Nepal are willing to pay 14-18% of the estimated costs of climate change, which represents a significant shift in the notion that people from developing countries are not willing to pay for climate action.

The results, however, should be interpreted with caution as the estimates are from a specific sample for a particular climate adaptation service, in this case protection against a GLOF, which might not necessarily represent the general population or be generalizable to climate adaptation as a whole. There are undoubtedly nuances across the variety of sectors that will be affected by climate change across Nepal, and people might have different WTP for protection against droughts, landslides or crop protection. Much care has been taken in making the sample nationally representative by the inclusion of three risk zones. However, youths of Kathmandu who are in the No-Risk zone might have a larger WTP, attributed by this study to their increased awareness on climate change. The results might be different if youths of a remote village were taken in the No-Risk zone instead of students from Kathmandu. Furthermore, due to data limitations, the full number of enrolled university students was not accessible during this study. Thus, the contribution to climate adaptation has been scaled to the entire youth population between the ages of 16 to 24, making the $21.7 - $55 million a year the best-case scenario for Nepal.

Nonetheless, this study provides new insights on the debate on who will pay for climate adaptation (Bowen and Rydge 2011; Khan and Roberts 2013; J. B. Smith et al. 2011) which has traditionally seen finance as coming from developed countries. Against the prevailing discourse that funding for climate adaptation has not taken off from private and public sectors, and that developing countries seem to be unwilling to fulfill the demand for climate adaptation, this study shows that individuals, particularly youths, from a less developed country like Nepal are willing to contribute to climate adaptation. Rather than placing the burden on Nepali youth as a potential funding source, the implications of such a positive WTP the positive WTP should highlight the urgency of the need to scale up adaptation finance among the international community.

References

Akter, Sonia and Jeff Bennett (2011). "Household perceptions of climate change and preferences for mitigation action: the case of the Carbon Pollution Reduction Scheme in Australia". In: *Climatic change* 109.3, pp. 417–436.

Arrow, Kenneth et al. (1993). "Report of the NOAA panel on contingent valuation". In: *Federal register* 58.10, pp. 4601–4614.

Atkinson, Giles et al. (2012). "'When to take "no" for an answer'? Using entreaties to reduce protests in contingent valuation studies". In: *Environmental and Resource Economics* 51.4, pp. 497–523.

Bowen, Alex and James Rydge (2011). "Climate-Change Policy in the United Kingdom"". In: 886.

Boyes, Eddie and Martin Stanisstreet (1993). "The 'Greenhouse Effect': children's perceptions of causes, consequences and cures". In: *International Journal of science education* 15.5, pp. 531–552.

CAI, Zhi-jian and Wei-wei ZHANG (2007). "On the Willingness to Pay for Water Quality Improvement of Yangtze River and Payment Mechanism in Nanjing Area [J]". In: *Ecological Economy* 2, pp. 116–119.

Carlsson, Fredrik et al. (2012). "Paying for mitigation: A multiple country study." In: *Land Economics* 2, pp. 326–340.

Cooper, Joseph C, Michael Hanemann, and Giovanni Signorello (2002). "One-and-one-half-bound dichotomous choice contingent valuation". In: *Review of Economics and Statistics* 84.4, pp. 742–750.

Dahal, Khila Raj (2008). *Hazard and Risk: Perception of Glacial Lake Outburst Flooding from Tsho Rolpa Lake, Nepal*. Michigan Technological University. URL: https://books.google.com/books?id=adrUtgAACAAJ.

Dawson, Vaille and Katherine Carson (2013). "Australian secondary school students' understanding of climate change". In: *Teaching Science* 59.3, pp. 9–14.

Diamond, Peter A and Jerry A Hausman (1994). "Contingent valuation: is some number better than no number?" In: *Journal of economic perspectives* 8.4, pp. 45–64.

Diederich, Johannes and Timo Goeschl (2014). "Willingness to pay for voluntary climate action and its determinants: Field-experimental evidence". In: *Environmental and Resource Economics* 57.3, pp. 405–429.

Duan, Hong-Xia, Lü Yan-Li, and Li Yan (2014). "Chinese public's willingness to pay for CO2 emissions reductions: A case study from four provinces/cities". In: *Advances in Climate Change Research* 5.2, pp. 100–110.

[9]The lower bound of the $21.7 to $55 million was reached by multiplying the WTP for climate adaptation for No-Risk Zone (0.3) whilst the higher bound was reached by multiplying the WTP for climate adaptation for High-Risk Zone (1.4) as seen in Table 4.

Duflo, Esther, Michael Kremer, and Jonathan Robinson (2011). "Nudging farmers to use fertilizer: Theory and experimental evidence from Kenya". In: *American economic review* 101.6, pp. 2350–90.

Glasgow Climate Pact, Draft decision -/CMA.3 (2021). URL: https://unfccc.int/sites/default/files/resource/cma2021_L16_adv.pdf.

Greenstone, Michael and B Kelsey Jack (2015). "Envirodevonomics: A research agenda for an emerging field". In: *Journal of Economic Literature* 53.1, pp. 5–42.

Hoyos Davidand Mariel, Petr (2010). "Contingent Valuation: Past, Present and Future". In: *Prague Economic Papers* 19.4, pp. 329–343.

Ives, Jack D, Rajendra B Shrestha, Pradeep K Mool, et al. (2010). *Formation of glacial lakes in the Hindu Kush-Himalayas and GLOF risk assessment*. International Centre for Integrated Mountain Development (ICIMOD) Kathmandu.

Jamelske, Eric, James Barrett, and James Boulter (2013). "Comparing climate change awareness, perceptions, and beliefs of college students in the United States and China". In: *Journal of Environmental Studies and Sciences* 3.3, pp. 269–278.

Johnson, Evan and Gregory Nemet (2010). "Willingness to Pay for Climate Policy: A Review of Estimates". In: *SSRN Electronic Journal*.

Kang, Shichang et al. (2010). "Review of climate and cryospheric change in the Tibetan Plateau". In: 5.1, p. 015101. DOI: 10.1088/1748-9326/5/1/015101. URL: https://doi.org/10.1088/1748-9326/5/1/015101.

Katuwal, Hari and Alok Bohara (2007). "Coping with unreliable water supplies and willingness to pay for improved water supplies in Kathmandu". In:

Keohane, Nathaniel O and Sheila M Olmstead (2007). *Markets and the Environment (Foundations of Contemporary Environmental Studies)*. Island Press.

Khan, Mizan R and J Timmons Roberts (2013). "Adaptation and international climate policy". In: *Wiley Interdisciplinary Reviews: Climate Change* 4.3, pp. 171–189.

Kilinc, Ahmet, Martin Stanisstreet, and Edward Boyes (2008). "Turkish Students' Ideas about Global Warming." In: *International Journal of Environmental and Science Education* 3.2, pp. 89–98.

Kotchen, Matthew J, Kevin J Boyle, and Anthony A Leiserowitz (2013). "Willingness-to-pay and policy-instrument choice for climate-change policy in the United States". In: *Energy Policy* 55, pp. 617–625.

Li, Yujie et al. (2016). "Willingness to pay for climate change mitigation: Evidence from China". In: *The Energy Journal* 37.China Special Issue.

Malla, Binayak and Mark S. Rosenbaum (2017). "Understanding Nepalese Labor Migration to Gulf Countries". In: *Journal of Poverty* 21.5, pp. 411–433.

Masson-Delmotte, V. et al. (2021). "Summary for Policymakers". In: *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, pp. 1–40.

McCright, Aaron M (2010). "The effects of gender on climate change knowledge and concern in the American public". In: *Population and Environment* 32.1, pp. 66–87.

Mearns, Robin and Andrew Norton (2010). *Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World*. World Bank.

Measham, Thomas G et al. (2011). "Adapting to climate change through local municipal planning: barriers and challenges". In: *Mitigation and adaptation strategies for global change* 16.8, pp. 889–909.

Micale, Valerio, Bella Tonkonogy, and Federico Mazza (2018). "Understanding and increasing finance for climate adaptation in developing countries". In: *Climate Policy Initiative*.

O'Garra, Tanya and Susana Mourato (2016). "Are we willing to give what it takes? Willingness to pay for climate change adaptation in developing countries". In: *Journal of Environmental Economics and Policy* 5.3, pp. 249–264.

Owolabi, Ademola B (2012). "Effect of organizational justice and organizational environment on turn-over intention of health workers in Ekiti state, Nigeria". In: *Research in world economy* 3.1, p. 28.

Pattanayak, Subhrendu K et al. (2005). "Coping with unreliable public water supplies: averting expenditures by households in Kathmandu, Nepal". In: *Water Resources Research* 41.2.

Peng, XZ and WH Tian (2003). "Study on willingness to pay about air pollution on economic loss in Shanghai". In: WORLD ECONOMIC FORUM.

Pielke, Roger et al. (2007). "Lifting the taboo on adaptation". In: *Nature* 445.7128, pp. 597–598.

Pruneau, Diane et al. (2001). "People's Ideas about Climate Change: A Source of Inspiration for the Creation of Educational Programs." In: *Canadian Journal of Environmental Education* 6, pp. 121–138.

Rain, landslides affect road upgradation in Dolakha (September 2017). URL: https://thehimalayantimes.com/nepal/rain-landslides-affect-road-upgradation-dolakha/.

Rajeev Gowda, MV, Jeffrey C Fox, and Robin D Magelky (1997). "Students' understanding of climate change: Insights for scientists and educators". In: *Bulletin of*

the American Meteorological Society 78.10, pp. 2232–2240.

Rana, Birbal et al. (December 2000). "Hazard assessment of the Tsho Rolpa Glacier Lake and ongoing remediation measures". In: *Journal of the Nepal Geological Society* 22, pp. 563–570. DOI: 10.3126/jngs.v22i0.32432.

Shepardson, Daniel P et al. (2011). "Students' conceptions about the greenhouse effect, global warming, and climate change". In: *Climatic Change* 104.3, pp. 481–507.

Smith, Joel B et al. (2011). "Development and climate change adaptation funding: coordination and integration". In: *Climate Policy* 11.3, pp. 987–1000.

Smith, Kirk et al. (2014). "Human health: impacts, adaptation, and co-benefits". In: *Climate Change 2014: impacts, adaptation, and vulnerability. Part A: global and sectoral aspects. Contribution of Working Group II to the fifth assessment report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, pp. 709–754.

Statistics, Central Bureau of (2017). *Nepal – National Climate Change Impact Survey 2016*. https://climate.mohp.gov.np/downloads/National_Climate_Change_Impact_Survey_Report_2016.pdf.

Stern, Nicholas (2007). *The Economics of Climate Change: The Stern Review*. Cambridge University Press.

Surge in Climate Change-Related Disasters Poses Growing Threat to Food Security (November 2015). URL: www.fao.org/news/story/en/item/345727/icode/.

Timperley, Jocelyn (October 2021). *The broken $100-billion promise of climate finance - and how to fix it*. URL: https://www.nature.com/articles/d41586-021-02846-3.

Tol, Richard S.J. (2005). "Adaptation and mitigation: trade-offs in substance and methods". In: *Environmental Science & Policy* 8.6, pp. 572–578.

Veh, Georg, Oliver Korup, and Ariane Walz (2020). "Hazard from Himalayan glacier lake outburst floods". In: *Proceedings of the National Academy of Sciences* 117.2, pp. 907–912. ISSN: 0027-8424. DOI: 10.1073/pnas.1914898117. eprint: https://www.pnas.org/content/117/2/907.full.pdf. URL: https://www.pnas.org/content/117/2/907.

Wang, Yan and Yi-Sheng Zhang (2009). "Air quality assessment by contingent valuation in Ji'nan, China". In: *Journal of Environmental Management* 90.2, pp. 1022–1029.

Wester, P. et al. (2019). *The Hindu Kush Himalaya Assessment: Mountains, Climate Change, Sustainability and People*. Springer International Publishing. ISBN: 9783319922881. URL: https://books.google.com/books?id=dI2CDwAAQBAJ.

Whitehead, John C and Glenn C Blomquist (2006). "The use of contingent valuation in benefit-cost analysis". In: *Handbook on contingent valuation*, pp. 92–115.

Winden, Matthew, Eric Jamelske, and Endre Tvinnereim (2018). "A contingent valuation study comparing citizen's willingness-to-pay for climate change Mitigation in China and the United States". In: *Environmental Economics and Policy Studies* 20.2, pp. 451–475.

Yang, Jie et al. (2014). "Public willingness to pay for CO2 mitigation and the determinants under climate change: A case study of Suzhou, China". In: *Journal of Environmental Management* 146, pp. 1–8.

Appendix

Table 1: *Summary statistics for respondents classified in three risk zones*

	High-Risk	Medium-Risk	No-Risk	Total
Number of University Students	92	163	149	404
Gender (% of Female)	57.6	66.9	55.1	60.4
Religion (% of Hindu Students)	90.5	87.7	83.6	86.8
Employment Rate (% of Employed)	46.7	31.9	48.3	41.3
Annual Income (USD)	869.6	633.2	1123.6	866.5
Friends or Family involved in work related to environment (%)	31.5	18.9	26.8	23.5
Friends or Family involved in work related to Tourism (%)	33.6	21.5	52.3	36.3
Awareness Evaluation Score (Out of 10)	6.0	6.3	5.0	5.8
Awareness Index (2 being best, 0 being worst)	1.0	1.2	0.6	0.9
Perception Evaluation Score (Out of 21)	14.6	14.2	13.7	14.1
Perception Index (2 being best, 0 being worst)	1.2	1.0	0.8	1.0

Note: Nepali University Students (n=404)

Table 2: *Perception Statistics of Sample (% of students saying yes)*

	High-Risk	Medium-Risk	No-Risk	Total Sample
Nepali University Students (n = 404)				
I think climate change is happening and that Nepal is vulnerable to the impacts of climate change.*	88.9	87.1	93.9	90
I have been made aware on the situation of Tsho Rolpha glacial lake by the government or others.	19.8	21	26.4	22.6
I have noticed a change in weather patterns and increase in extreme weather events in my surroundings and beyond.*	94.5	90.7	93.9	92.8
I have awareness of Tsho Rolpha Glacial Lake which was once believed to be highly vulnerable to bursting.*	66.7	67.9	48.3	60.5
I think Tsho Rolpha Glacial Lake Outburst Floor is a Hoax.	42.1	39.3	29.9	36.9
I think climate change will affect me and my family.*	91.3	88.3	93.2	90.8
There are too many social issues which are of primary importance compared to climate change.	72.8	75.9	62.2	70.3
I want to learn more about climate change and how I can be involved in solving this crisis.*	90.2	90.8	89.5	90.2
I think government is doing enough to combat climate change.	40.2	36.8	15.8	29.9
It is the government's and not the citizens responsibility to combat climate change.	43.9	54.3	26.9	41.9
The government should be awarded with international aid to combat climate change.*	61.5	49.1	54.2	53.9
I agree with the government research findings that 94% of students in Nepal know about climate change.*	27.2	22.2	26.9	25.1

Note: Table showing the perception statistics of the sample (% of students saying yes). The questions followed by an * were used in the calculations of the Climate Perception Index, details to which have been provided in footnote 4

Table 3: *Average WTP Values in USD for Climate Adaptation and Road Infrastructure by Risk Zones*

	High-Risk	Medium-Risk	No-Risk	Total
WTP: Climate Adaptation	8.3	8.5	3.5	6.6
Ratio of WTP Climate over Income	1.0	1.3	0.3	0.8
WTP: Road Infrastructure	8.1	8.9	3.5	6.8
Ratio of WTP Road over Income	0.9	1.4	0.3	0.8

Nepali University Students (n=404)

Table 4: *Comparisons of Findings with China and the United States*

	Nepal				China	United States
	High-Risk	Medium-Risk	No-Risk	Total	Total	Total
Project Type		Adaptation				Mitigation
Male (%)	42.4	33.1	44.9	40	44	49
Ratio of WTP Climate over Income	1.0	1.4	0.3	0.8	1.9	0.5
Perception of Climate Change	88.9	87.1	93.8	90	92	76
Concern about Climate Change	91.3	88.3	93.2	91	53	50
Environment: Most Important Social Issue	27.2	24.1	37.8	29.7	20	9

Similar representation of findings comparison to Widen et al. (2018)

Table 5: *Regression Results Predicting Level of Awareness on WTP for Climate Change*

	Willingness to Pay for Climate Change (wtp_climate)		
	(1)	(2)	(3)
Awareness Rankmg = 1	419.0***	243.2	227.9
	(152.4)	(156.7)	(154.5)
Awareness Ranking = 2	165.5	-79.47	-144.7
	(146.1)	(153.8)	(163.1)
Gender (Female = 0)		-248.4*	-247.2*
		(129.1)	(135.8)
Employment (Yes = 0)		-85.5	-126.0
		(144.2)	(153.4)
Location (Dolakha = 0)		-696.7***	-648.4
		(137.0)	(419.1)
Monthly Earning (Nrs.)		0.0257***	0.0271***
		(0.0096)	(0.0101)
1. Medium Risk Zone			-39.95
			-114.1
2. Zero Risk Zone			-232.5
			(406.4)
Perception Ranking = 1			270.9*
			(159.2)
Perception Ranking = 2			242.2
			(159.9)
Religion (Hinduism = 0)			34.21
			(147.9)
Survey Type (Control = 0)			-33.81
			(131.5)
Constant	581.9***	932.9***	870.1***
	(99.8)	(182.2)	(254.0)
Observations	399	384	370
R-squared	0.019	0.1	0.113

Note: Standard errors in parentheses ***p<0.01, **p<0.05, *p<0.1

Table 6: *Effect of Awareness on WTP value for Control vs Treatment*

	High Risk		Medium Risk		Zero Risk	
	Control	Treatment	Control	Treatment	Control	Treatment
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Willingness to Pay for Climate Change (wtp_climate)					
Awareness Ranking = 1	1,331**	-682	1,088**	147.9	23.69	-60.54
	(593.5)	(437.0)	(533.9)	(384.0)	(96.21)	(160.0)
Awareness Ranking = 2	314.3	-108.2	37.7	-52.08	70.33	181.1
	(508.2)	(467.4)	(498.3)	(367.9)	(94.32)	(185.0)
Constant	378.6	1,347***	694.1*	880.4***	340.2***	433.9***
	(393.7)	(318.5)	(404.8)	(288.9)	(49.14)	(91.35)
Observations	46	45	73	90	88	56
R-squared	0.112	0.063	0.084	0.004	0.007	0.026

Note: Standard errors in parentheses *** P<0.01, ** P<0.05, * P<0.1