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Research Paper

Analyses of community willingness-to-pay and the influencing factors towards restoration of River Malaba floodplains

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Abstract

The high productivity of soils along River Malaba floodplains and various functions (like, transport and recreation) increase the desire for humankind settlement adjacent to floodplain corridors. However, human life and property have unceasingly been destroyed by floods. Strategies have been established to deal with floods but the problem still exists. This study employed the double-bound dichotomous choice contingent valuation method to quantify the community willingness-to-pay (WTP) and associated influencing factors for restoration of River Malaba floodplains. Reconnaissance surveys, focus group discussions, key informant interviews, observations study, and household questionnaires from 498 out of the targeted 550 respondents were employed in data collection. Among the adaptation strategies at household and community level, the post-flood strategies were more efficient than those practiced before- and during-floods. Among the suggested structural and non-structural strategies, "embankment/river training structures" and "flood forecasting and early warning" were highly preferred, respectively. The results revealed that 55% of the households expressed WTP an individual amount between Uganda shillings (UGX) 5,000 (United States Dollar, US$ 1.35) to UGX 500,000 (US$ 135.14), with a monthly average of UGX 97,080 (US$ 26.24). Total monthly amount would be UGX 38,249,500 (US$ 10,333.70) considering the 498 households. Among the factors analysed, age, gender, marital status, education level, occupation, household income, business affected, lost property due to floods, flooding a major problem had significant (p<0.01) positive impact on WTP. This study findings are pertinent in supporting stakeholders' decision regarding predictive planning of flood adaptation strategies in the study area.

Key words: Floodplain, contingent valuation, willingness-to-pay, regression model, River Malaba sub-catchment.

Research highlights

- The study quantified willingness-to-pay for River Malaba floodplain restoration.
- 498 respondents out the targeted 550 were used in the study.
- 55% of the households expressed WTP towards the restoration program.
- Households were WTP a monthly average of UGX 86,148 (US$ 23.28).
- Several demographic, social-economic and institutional factors influenced WTP.

1. Introduction

The high productivity of soils along river floodplains and various functions (such as, transport and recreation) increase the desire for humankind to settle adjacent to floodplain corridors. However, human life and property are normally destroyed due to flooding (Di Baldassarre et al., 2013). Because of the fairly flat topography in River Malaba sub-catchment in Uganda (East Africa), the districts of Butaleja and Tororo have been affected by disastrous floods. Within the same sub-catchment, rain-induced landslides coupled with flash floods have often occurred in the highland districts of Manafwa and Bududa (Mayega et al., 2015; Ministry of Water and Environment, 2018a). These events particularly floods, have resulted in devastating effects including loss of lives, destruction of property, infrastructures, and displacement of human-beings (Ministry of Water and Environment, 2018b, 2014). Recent studies showed that rainfall over the River Malaba sub-catchment and the surrounding areas was characterized by increasing trend during the September-October-November season (Onyutha et al., 2020) and multi-decadal variability in both seasonal and annual time scales (Mubialiwo et al., 2020). Due to increasing rainfall over the region where River Malaba is located, landslides over the period 2010–2019 have been more frequent than those which occurred from 1960 to 2009 (Onyutha et al., 2020). If the positive trend in rainfall over the sub-catchment and surrounding areas is to continue into the future, the local population may experience more floods of varying magnitudes. Given that recurrent floods can hinder sustainable development especially in the developing world, there is a need to develop sustainable adaptation strategies (Rakib et al., 2017; Thomas and López, 2015). Adaptation is the process of making transformation in the human systems in response to real or predictable climatic events and/or their related impacts, aimed at reducing the harm or exploitation of beneficial opportunities (City of Vancouver, 2020; Levina and Tirpak, 2006). Formulation of adaptation strategies exclusively based on modelling may result in increased risks rendering the society more susceptible to infrequent but extremely impacting disasters (Ciullo et al., 2017). Therefore, there is a need to understand the community perception of flooding and possible adaptation strategies (Bomuhangi et al., 2016; Sung et al., 2018). This enables developing flood adaptation strategies, with the society assigned the leadership role in the entire process (Nyasimi et al., 2016; Rizvi et al., 2016). Baan and Klijn (2004) emphasised that effective management of floods requires investigation of both technical and economic aspects which guide decision-making on the establishment of feasible flood protection strategies. Besides, Brémond et al. (2013) further noted that management of flooding impacts requires restoration of the floodplains by allocating more room for the water. This necessitates economic and environmental evaluation to guide in decision-making (Brémond et al., 2013).

Despite the possible predictability of these rain-induced floods as they occur repeatedly, communities in the present study area (River Malaba sub-catchment) have continued to suffer the consequences. This could be attributed to inappropriate adaptation mechanisms being employed (Mayega et al., 2015). Recently, to lessen the impacts consequent to occurrence of floods, the community support in monetary form and/or generosity (physical effort), has become crucial. This has been through the use of flood management mechanisms that rely on the community willingness-to-pay (WTP) as evidenced in several studies (Arnal et al., 2016; Entorf and Jensen, 2020; Gravitiani and Suryanto, 2017; Maghsood et al., 2019; Reeser, 2016; Thistlethwaite et al., 2020). Adopting flood management mechanisms that depend on WTP, can boost community involvement, particularly in Uganda where implementation of adaptation strategies to rain-induced disasters remains a challenge (Ampaire et al., 2017). In addition, the WTP approach is vital in countries like Uganda, where there is a contest of low capacity at district and community levels to engage in adaptation planning (Echeverría et al., 2016). Government involvement is normally dependent upon the community efforts towards solving the existing problem (Kreibich et al., 2011; Nguyen and Robinson, 2015). This can be in form of community WTP towards supporting the government programs. The WTP tells the maximum value (e.g., amount of money) an individual is willing to offer for a service or good (Martín-Fernndez et al., 2010).

The contingent valuation (CV) method (Boyle, 2017; Cummings et al., 1986; Mitchell and Carson, 1989) tends to be preferred to other methods in establishing the community WTP contingent on provision of some imaginary service or good, for instance, in flood management (Wright, 2012). In Uganda, the CV method has been applied in several studies (Angella et al., 2014; Banga et al., 2011; Hansen et al., 2013; Kakuru et al., 2013; Kikulwe and Asindu, 2020; Wright, 2012). The community WTP for restoration of the floodplains, hence reducing the flood risk, is determined by the anticipated damage, perception of flood risk, and attitude (Botzen et al., 2013; Khan et al., 2014). Mainly, a person compares the fringe benefits of getting protection against a risk with the marginal cost of investment to avoid the risk. This is entirely dependent on individual economic limitations. By the time of conducting this study, there were no studies that applied the CV technique to determine community WTP towards restoring River Malaba floodplains, moreover with identification of the influencing factors. Therefore, by using the shadow price, this study aimed at determining the community WTP for restoration of River Malaba floodplain based on the CV technique. Demographics, socio-economic, institutional factors and their influences on community WTP towards the program were analysed.

2. The contingent valuation (CV) method

Several valuation methods exist including the Contingent Valuation (CV) (Boyle, 2017; Cummings et al., 1986; Mitchell and Carson, 1989), experimental auction (Vickrey, 1961), and conjoint analysis (Balderjahn, 1994; Green and Rao, 1971; Green and Srinivasan, 1990, 1978). Some of these methods (like the conjoint analysis) are found to offer high inducements for strategic behaviour on the part of survey respondents, hence overestimating the community WTP (Carson, 2000; Danso et al., 2017). On the other hand, the CV method is applied to obtain information that may not be attained using the economic market-based instruments (Fujita et al., 2005; Ginsburgh, 2017; Khan et al., 2014). The CV method is an easy, flexible non-market valuation technique that has attracted an extensive application in cost-benefit analysis and environmental impact assessment in many countries (Venkatachalam, 2004). For example, Navrud et al. (2012) established that the application of CV method focusing on determining the WTP in generosity can eliminate the challenges associated with applying the method in developing countries (like Vietnam). Ghanbarpour et al. (2014) applied the CV technique to evaluate the community's WTP for flood insurance and structural flood control mechanisms in the Neka River Basin in Northern Iran, and with much confidence, applauded the method. In addition, the CV method has been used to approximate the environmental costs resulting from extreme floods in the Evros River basin, Greece (Markantonis et al., 2013). The method has similarly been applied to determine the United States community WTP for the reduction of greenhouse gas emission from the Glen Canyon Dam operations (Jones et al., 2017), and to support policy making in solid waste management in Ikaria, Greece (Gaglias et al., 2016). With the CV technique, Zhao et al. (2013) estimated the WTP for the protection of the Zhangjiabang Creek river ecosystem in China. Maghsood et al. (2019) also used the CV method to assess the community acceptability of flood management strategies under climate change in Talar River in northern Iran. Gravitiani and Suryanto (2017) further applied the CV approach to value the economic impact of flood mitigation in the Central Java, Indonesia. Besides, Wright, (2012) applied the CV method to analyse the society WTP for the operation and maintenance of an improved water source in the villages of Kigisu and Rubona in Uganda. Banga et al. (2011) used the CV method to establish the determinants of community WTP for an improvement in solid waste-collection services in Kampala, Uganda. Using the CV method, Chia et al. (2020) assessed the farmers' knowledge and WTP for insect-based feeds in Kenya. Angella et al. (2014) evaluated the farmers WTP for irrigation water at Doho rice irrigation scheme in Uganda. This scheme is located close to the study area. In the present study, the CV technique was applied to determine to community WTP for the restoration of the floodplains of River Malaba. Floodplain restoration encompasses several adaptation strategies that can minimise the the impacts of flooding such as loss of lives, destruction of houses, schools, hospitals, bridges, roads, and agriculture.

3. Material and methods

3.1 Study area

River Malaba sub-catchment (Fig. 1), has an approximate drainage area of 3,500 km^2. The sub-catchment is part of the Mpologoma catchment under the Kyoga Water Management Zone (KWMZ), stretching between latitudes 0º19'0N and 1º07'N, and longitudes 33º37'E and 34º37'E. The sub-catchment drainage area is transboundary, shared between Uganda (approximately 69% or 2,395 km^2) and Kenya (about 31% or 1,100 km^2). The rainfall over the area occurs in two seasons with the first and more intense from March to May, while the second and highly variable occurs between October and December. The area receives an average annual rainfall of approximately 1,375 mm but the districts of Bududa and Manafwa receive slightly higher rains, on average 1,800 mm per annum. The climate may be influenced by the presence of great lakes (like Lake Victoria, Lake Kyoga) and the mountain Elgon slope breezes that tend to affect the afternoon convection (Camberlin, 2009). This results in high variability of weather elements particularly rainfall (Ministry of Water and Environment, 2018a). The sub-catchment experiences frequent floods in the low-lying area of Tororo and Butaleja, while the highlands of Mount Elgon in Manafwa and Bududa are vulnerable to landslides (Mayega et al., 2015; Ministry of Water and Environment, 2018a). These events result in vast public consequences and substantial effects such as displacement of people, loss of lives and destruction of property including roads, bridges, schools and hospitals (Mayega et al., 2015; Osuret et al., 2016). These events could be attributed to the high population (with the growth rate of 3.2%), which puts pressure on water and land resources (Ministry of Water and Environment, 2018a). For instance, the massive deforestation exposes the soil so that it can be simply soaked and carried away. The major land use in the sub-catchment is agriculture, largely depending on rainfall. The regions downstream of Mount Elgon forested area comprises of agricultural and grassland, fallow land, and isolated woodlots. Land use changes in the sub-catchment ecosystem have unpleasantly altered the river Malaba hydrological flow patterns (Jiang et al., 2014). Petric Plinthosols and Gleysols are the core soils types. There other categories including Lixic ferrasols, Acric ferrasls and Nitisols (Barasa et al., 2017; Kitutu et al., 2009). The basin is occupied mainly by the indigenous Bagishu in the districts of Bududa and Manafwa, mostly Banyole in Buteleja, and the Basamia in Busia. Over 53% of the community practice subsistence agriculture, which is their main source of income (Uganda Bureau of Statistics, 2018). The lowest lying areas in River Malaba sub-catchment are the flood prone zones of Butaleja and Tororo where terrain barely surpasses 4%. The elevation difference between the highest and the lowest point is very high (up to about 3366 m).

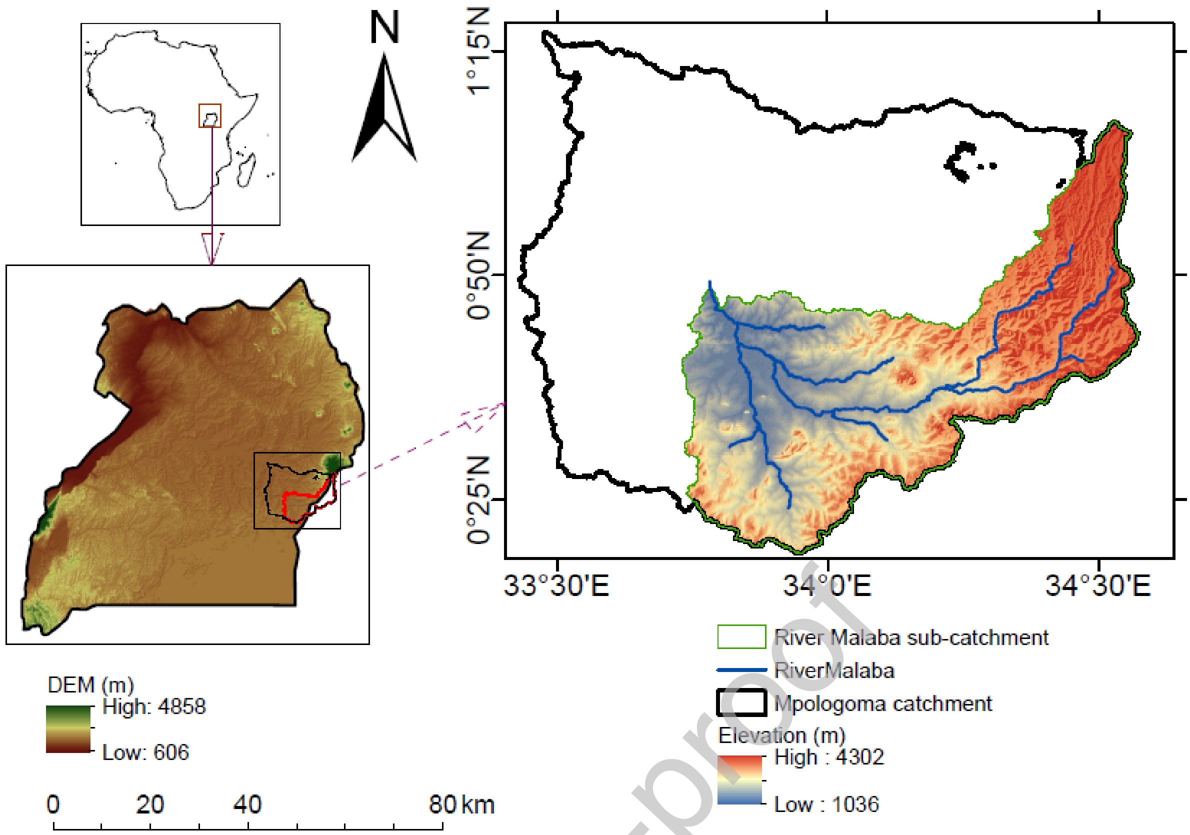

Fig. 1 Location of the study area. The background map is the Digital Elevation Model (DEM) acquired via http://srtm.csi.cgiar.org/ (accessed: 12 February, 2021). Hill shade effect was applied to the background map.

3.2 Data collections approaches

This data aided understanding of the society insights regarding the level of flooding and associated impacts. Information regarding the current and preferred flood adaptation measures was acquired. Community WTP and the underlying factors were explored. Several approaches, including reconnaissance surveys, household surveys, focus group discussions (FGDs), key informant interviews (KIIs) and observations study were used.

3.2.1 Reconnaissance surveys

Reconnaissance surveys were conducted for two weeks (27 October to 7 November, 2020) to achieve the all-purpose community perception regarding flooding. Both male and female were interviewed separately to achieve unbiased perception. The surveys were conducted by asking the households to define flooding events and related impacts that occurred in recent past 5 to 10 years. The limitation of 5 to 10 years was vital not to miss-inform the research as the local community may not clearly recall long ago information. However, in situations where responds had clear records of long-ago incidents, the study considered extending beyond the 10 years back in time. The flood adaptation strategies that have been in existence were as well generated. This information guided the development of both qualitative and quantitative survey questionnaires (Mathers et al., 2007). To guarantee high quality data, the survey was carried out by educated and well-trained field assistants from Kyambogo University and Busitema University. Baseline data about the study area was obtained and used in determining the sample size. The survey also utilised secondary data such as internet articles, government and agencies reports (e.g., Uganda bureau of statistics (2020; 2018), Ministry of Water and Environment (2018a). Information such as socio-economic, demography of the society was obtained and used in WTP analyses.

3.2.2 Sample size and household survey

Sampling enabled the selection of a representative number of individuals from a large population (Alvi, 2016). Several methods for determining the sample size exist including (1) the use of census for a small population (up to 200), (2) using a sample size of similar studies, (3) applying values in published tables, and (4) use of formulae to estimate sample size to a certain level of precision, confidence and variability (Glenn, 1992; Singh and Masuku, 2014). With the large and unknown population variability in proportion over the study area, the sample size used was obtained using the Cochran's sample size formula (Cochran, 1977, 1963) in equation (1). The Cochran formula computes an ideal sample size given the desired level of precision or margin error e such that;

$$N = \frac{Z^2}{e^2} pq \quad (1)$$

where N is the sample size, Z is the standard normal distribution indicating the degree of confidence level of p. In the present study, a confidence level of 95% (Z =1.96) was adopted. The term p is the estimated proportion of the entire population. Finally, q is $(1-p)$, and e is the margin of error (level of precision). The Z of 1.96 assumes that approximately 95% of the sample will have a true value within the specified range of accuracy under a normal distribution (Singh and Masuku, 2014). Considering maximum variability and/or heterogeneity of the population in the study area, the value of p equal to 50% was assumed. e determines the level of accuracy of the sample size, the range in which the true value of the population is estimated to fall (Singh and Masuku, 2014). In this study, e of ±0.042 was adopted. The studies by Charan and Biswas (2013) and Naing et al. (2016) applied a value of 0.05 to determine the sample sizes. Considering the above parameter values, the computed sample size was 550. The use of Cochran's formula has been embraced by several studies (Feizollahi et al., 2014; Kroonenberg and Verbeek, 2018; Lehmann et al., 2013; Makwinja et al., 2019). In Uganda, some of the studies that applied the Cochran formula include Wafana et al. (2019), Wasswa et al. (2015), Odongo et al. (2014).

As the study intended to capture attention of the local community comprised of mostly illiterates, the face-to-face interview method was adopted (Mathers et al., 2007). Mainly, households close and normally affected by climate-induced floods were considered. However, consideration was also made for those households that are indirectly affected (households in highland area). The sampling procedure ensured that household were at least

150 m apart to reduce the self-styled *herd attitude effect*, where individuals' particular behaviours are influenced by their neighbours. This arrangement further improved the diversity of the samples regarding flooding impacts. Household questionnaires were developed using information from the reconnaissance survey. Through a dry run of the survey on a small representative set of the targeted respondents, questionnaires were pre-tested and checked to identify and correct potential response errors which guaranteed their strength and dependability. The questions were designed not to cause any ethnical, political, social or environmental uncertainty that could otherwise jeopardise the research. Though the questionnaires were designed in English, an official language in Uganda, during the process of interview, translation into words or language locally suitable to the respondents was done. The survey gathered information such as (i) socio-economic activities in the area, (ii) existing mitigation and adaptation strategies including their rankings and (iii) community Willingness and ability to pay for adaptation strategies, etc.

3.2.3 Focus group discussions (FGDs)

Ten FGDs having not more than 12 participants for effective management (Nyumba et al., 2018), were used to gather data from a community. FGDs targeted the highly flood susceptible regions. FGDs helped to address particular concerns related to flooding; build community consensus about flood adaptation strategies; to cross-check information with a specific category of people having concrete knowledge on flooding events and existing adaptation strategies; and to obtain reactions to hypothetical and/or intended actions. FGDs focused on farmers, women groups, youth groups, schools, local government leaders and non-government organisations. Generated information included history of major past flooding events, the highly flooded areas and frequently affected sectors, existing pre-flood, during and after flood adaptation strategies, and monetary value of land and animals.

3.2.4 Key informant interviews (KIIs)

KIIs were conducted at districts and local levels targeting leaders, politician, civil servants and NGO working on projects related to management of rain-induced floods. Their selection was based on experience and expertise. Kumar (1989), urges that KIIs yield information of doubtful meaning and low trustworthiness, as key informants are not cautiously nominated, interview guides not prior prepared, and responses are poorly captured. However, in this study, participants to KIIs were carefully chosen to guarantee the proper representation of conveyed community ideas (McKenna and Main, 2013). The generated information included traditional methods to predict rains and floods, previous disastrous flood events, trend of flood events, adaptation strategies and their effectiveness, prospective plans to restore the floodplains, community involvement in flood management.

3.2.5 Direct observations study

Direct observations enabled the collection of qualitative data and to develop an in-depth understanding of rain-induced floods. It yielded information on the current flooding challenges. The study was based on looking, listening, asking questions and keeping detailed field notes. Useful information on the history of land use land cover, major flood events, current flood problems and existing flood adaptation strategies considered in the study area were acquired. This method provided information that could not be obtained by the other methods that largely depend on self-report (Morgan et al., 2017)

3.3 Flood adaptation strategies

Using the techniques described in section 3.2, flood adaptation strategies that have been in existence were generated, mainly using the reconnaissance surveys. These included those locally developed by the community and those initiated by the government and other agencies. Through the household surveys, respondents were asked to score or rank the adaptation strategies in order of preference on a Likert scale of 1 to 5. In this study, values of 1 and 5 were used to denote the least efficient/preferred and very effectively/applicable, respectively. For guidance in the ranking of the strategies, respondents were presented with inundation maps of the study area. Likert scale (Likert, 1932) was initially developed by Rensis Likert and has had numerous application including modification in the field of social science and attitude research projects (Croasmun and Ostrom, 2011; Joshi et al., 2015), particularly to measure the perception of the respondents. Based on the overall score of each adaptation strategy, ranking was made from the most desired to the least desired using the Weighted Average Index WAI (equation (2)) in order to analyse the respondents' level of agreement (Miah, 1993) as done by Simotwo et al. (2018), Thapa-Parajuli et al. (2018), and Ndamani and Watanabe (2016). WAI was generated by multiplying the total number of declarations in each category with its corresponding weight and dividing it by the total number of responses.

$$WAI = \frac{F_1W_1 + F_2W_2 + F_3W_3 + F_4W_4 + F_5W_5}{N} \tag{2}$$

where W = the weight applied to different response classes, i = score (1 = least preferred, 2 = less preferred, 3 = moderately preferably, 4 = very preferred, 5 =most preferred); F_i = frequency of responses for a particular response class i; N = total number of respondents/responses. WAI has previously been successfully applied for different studies in different countries (Chowdhury and Khairun, 2014; Zeleke and Assefa, 2017; Zhen and Zoebisch, 2006)

3.4 Theoretical model for WTP

To determine the community WTP, the CV method was applied. The CV technique was applied to generate information that may not be attained using the economic market-based instruments (Fujita et al., 2005; Ginsburgh, 2017; Khan et al., 2014). Personal understanding, mindset, and preference concerning rain-induced flooding together with the associated non-market values were determined mainly using the household questionnaires. To assess the effect of flooding on the community well-being, respondents were asked for their WTP (Mitchell and Carson, 1989) towards the restoration of River Malaba floodplains. Restoration of the floodplains involves a series of adaptation strategies including structural to non-structural. The change in risk of being pretentious by the rain-induced floods was measured using money as the standard. This was defined as either positive or negative payment assuming the anticipated value constant under various risk levels (Khan et al., 2014). Depending on the knowledge level of the targeted respondents, comprehending the hazards of being affected by rain-induced floods may be challenging (Khan et al., 2014). This could be further aggravated by differing risk levels across individual and communities (Loomis, 1990). However, in the present study, by sampling in various risk zones differences in risk-alertness levels were identified. Subsequently, risk awareness regarding flooding and associated impacts was carried out during the reconnaissance survey. This eliminated the reasoning burden associated with understanding and interpreting probabilistic illustrations of the flooding risk particularly when it came to large groups of illiterate communities (Khan et al., 2014). The danger of communities being affected by the rain-induced floods was categorised as exogenous (extrinsic), for those whose factors are outside the community controls and endogenous, for which the community can get involved to reduce the possibility of unwanted events from occurring or reduce the cost of the events (Brouwer et al., 2009). The extent of damage a person is exposed to, determines the incentive to pay to reduce the risk (Khan et al., 2014). Generally, a person compares the fringe benefits of getting protection against the risk with the marginal cost of investment to avoid the risk. This is entirely dependent on individual economic limitations.

Using the regression model in equation (3), the WTP was estimated as a function of several factors including comprehending the risk magnitude, which depends on the exogenous (extrinsic) factors, self-defence, individual income and person evasion from the risk (Bateman et al., 2005).

$$WTP_i\left(X_i, \varepsilon_i\right) = X_i\beta + \varepsilon_i \tag{3}$$

where WTP_i is a dummy variable (having 1 for positive WTP and 0 for negative WTP), X_i is the vectors of descriptive variable, β are the matching vectors of the assessed parameter and ε_i is the subjective or marginal error which is considered to be normally distributed with a mean of zero and variance σ^2. The key assumption made was that, the WTP for floodplain restoration are consistent with differences in extrinsic risk grades across individual households. It was anticipated that the individual WTP towards the floodplain restoration would base on alertness and experience (Priest et al., 2011; Reeser, 2016; Thistlethwaite et al., 2020). Diversity amongst individual preferences towards adaptation strategies was assumed to be influenced by several factors ranging from demographic, socio-economic and institutional (Table 1). These influenced individual mindset and perception towards the flooding hazard hence, their WTP for restoration program. In the regression model, a dummy variable for each category was coded for variables with more than 2 categories e.g., education, occupation, type of house.

Table 1 Explanatory variables applied in the regression model

Variable	Definition of descriptive variable	Categorisation of the variable
G	Gender	Dummy variable [male =1 and female =0]
HAG	Household head age	Continuous variable
MS	Marriage status	Dummy variable [married =1, single = 0]
EL	Education level	Categorical variable [never went to school = 0, primary = 1, secondary = 2, tertiary (certificate/Diploma) = 3, University (Bachelors) = 4]
HHS	Household size	Continuous variable
OP	Occupation	Categorical variable [agricultural farming = 0, government job = 1, private firm (employed)= 2, small business (small shop) = 3]
TH	Type of house	Categorical variable [permanent = 0, semi-permanent = 1, mud house = 2]
HHI	Household income	Continuous variable
BR	Born respondent	Dummy variable [Yes = 1, No = 0]
FFL	Frequency of floods	Categorical variable [rainy season = 0, every year = 1, once in 5 years = 2]
BAFL	Business affected by floods	Dummy variable [Yes = 1, No = 0]
LPFL	Lost property due to floods	Dummy variable [Yes = 1, No = 0]
TP	Trend of production	Categorical variable [increased = 0, Decreased = 1, No change = 2]
RFES	One responsible for flood early warning system	Categorical variable [Government = 0, NGO = 1, charity group = 2, community = 3]
CGIP	Have confidence in government	Dummy variable [Yes = 1, No = 0]
FMP	Is flooding a major problem	Dummy variable [Yes = 1, No = 0]
CAC	Can Flooding be controlled	Dummy variable [Yes = 1, No = 0]

3.5 Statistical evaluation

The starting question was to appreciate the insights of community WTP in principle for floodplain restoration without necessarily stating anything regarding money. The response obtained determined the proceeding question. The study ensured that respondents provided as honest responses as possible bearing in mind other personal demands that rely on their limited income (Khan et al., 2014). Responses from the first question were considered as affirmative or negative, objection/protest or honest zero. Below are the WTP questions presented to respondents:

Question. 1: *Assume the government of Uganda initiates a program dubbed* ***"Restoration of River Malaba Floodplains****", intended to minimise the impacts of flooding such as loss of lives, destruction of houses, agricultural and forest land, damage of roads and bridges. However, the program requires large amounts of money, and unfortunately, the government has limited funds due to other pressing demands. Therefore, suppose you are approached and requested to contributed towards the program, in principle, would you be WTP?*
Yes/No (If Yes, answer question 2; If no, proceed to question 3)
Question. 2: *If yes, what are some of the reasons for your WTP?*
Question. 3: *If No, why are you not WTP?*

Following the response (yes or No) of WTP obtained from question 1, respondents with yes were asked for their WTP follow-up price bids to which they answered either yes or no. Several follow-up price bids were presented (5000, 10000, …, 500000 UGX). These follow-up bids were pre-tested prior to their usage in the WTP exercise through a dry run assessment on a trail representative sample of the intended respondents. This study adopted four starting bids of 10000, 100000, 350000 and 450000 UGX, which respectively correspond to 2.7, 27.0, 94.6 and 121.6 United States Dollars (US$) at an exchange rate of approximately 3700 UGX = 1 US$ according to Bank of Uganda as of 25 February 2021. The initial bids were randomly presented to avoid a fixed stating bid bias. Depending on the respondent's answer of either affirmative or negative to the starting bid, the follow-up bid presented was higher or lower, respectively (Ikeuchi et al., 2013). The study adopted the double-bound dichotomous choice (DBDC) CV approach instead of the single-bound dichotomous choice (SBDC). While SBDC approach considers a one-off choice, for the DBDC, the WTP relies on a series of variables X_i in equation (4). This as well comprises of the follow-up bid amount and hidden factors incorporated in the error parameter ε_i. The WTP of the second follow-up bid was computed using equation (5) subsequent to the first WTP bid.

$$WTP_i = X_i\beta + \varepsilon_i \tag{4}$$

$$WTP_i^2 = (1-\varphi)WTP_i + \varphi B^s + \sigma \tag{5}$$

where φ is the parameter reflecting on the first bid B^s and σ is a change parameter. Respondents were asked two different questions, (1) do you admit the first bid price B^s, and (2) do you admit the follow-up bid price B^f? (Khan et al., 2014). Accordingly, four possible WTP intervals were generated using the DBDC CV approach (Haab and McConnell, 2002).

$WTP \geq B^2$	agree to both first bid B^s, and follow-up bid B^f (yes-yes responses, YY)
$B^s \leq WTP < B^f$	agree to first bid B^s, and reject follow-up bid B^f (yes-no responses, YN)
$B^f \leq WTP < B^s$	agree to follow-up bid B^f, and reject start bid B^s (no-yes responses, NY)
$WTP < B^2$	reject both first bid B^s, and follow-up bid B^f (no-no responses, NN)

YY = 1 for YY answer and zero (0) otherwise, YN = 1 for YN answer, NY =1 for NY answer, and NN = 1 for NN answer and 0 otherwise.

The maximum likelihood function is used to approximate the direct slope coefficient β and standard error σ. By defining $\varnothing_{\varepsilon/\varepsilon_2}$ as the standardised bivariate normal cumulative distribution function with zero mean, unit variance σ and correlation coefficient ρ, the j^{th} contribution to the bivariate probit probability function takes the form of (Haab and McConnell, 2002).

$$L_j\left(\frac{WTP_i}{\beta^i}\right) = \varnothing_{\varepsilon/\varepsilon_2}\left\{d_{1j}\left(\frac{B^s - WTP_1}{\sigma_1}\right), d_{2j}\left(\frac{B^f - WTP_2}{\sigma_2}\right), d_{1j}d_{2j}\rho\right\} \quad (6)$$

where $WTP_{1j} = 1$ if the reply to the first question is yes, and 0 otherwise, $WTP_{2j} = 1$ if the answer to the second question is yes, an 0 otherwise, $d_{1j} = 2WTP_{1j} - 1$ and $d_{2j} = 2WTP_{2j} - 1$ (Haab and McConnell, 2002).

The average WTP can be determined as $E(WTP) = X_i\hat{\beta}$, where $\hat{\beta}$ is the vector parameter estimate. To take into consideration the DBDC CV design, parameters were estimated by applying the “doubleb” command in STATA suggested by Lopez-Feldman (2010). The “doubleb” command integrates both the starting and follow-up bids and considers the initial and follow-up response (Lopez-Feldman, 2012). Several studies (Budhathoki et al., 2019; Galárraga et al., 2014; Jiang et al., 2019; Mekonnen et al., 2019; Ostermann et al., 2015; Pakhtigian and Jeuland, 2019; Tien et al., 2020) have embraced the use of “doubleb” command in STATA in difference areas across the world.

4. Results

4.1 Characteristics of the household survey respondents

The demographic and socio-economic characteristic with descriptive statistics such as parameter name, mean, minimum and maximum are included in Supplementary Material Table M1. The planned sample size of respondents was 550 households. Nevertheless, 498 questionnaires (representing a 91% valid response rate) were administered. The remaining 52 chose not to participate in the research. The average age of respondents was 40 years with a range of 18 to 95 years, which indicates validity of the findings. The study conducted by Danso et al. (2017) in Kampala reported an average age of 39 years, while Angella et al. (2014) reported an average age of 42. During the field observations, the gender disparity was very small, despite the community practicing patrilineal system. For instance, there were 47.8% were male, and 52.2% females. This implies that the findings represent the views for both male and female. Banga et al. (2011) reported gender balance of 33.8% male, and 66.2% female in Kampala, Uganda. Wright (2012) reported 49% male respondents and 51% female in Mubende, Uganda.

The smallest household had 1 member while the largest family was composed of 40 members. The average size of families was 9.7 which is remarkably higher than the national average of 9.0 (Uganda bureau of statistics, 2020). Majority of the respondents were married registering a 97.2%, while only 2.8% were single (either unmarried, divorced, widowed or separated). A large number of the households had mud-houses (65.5%), while 26.7% had semi-permanent houses and only 7.8% had permanent houses. Interaction with the community revealed that they prefer mud-houses, mainly because those made out of bricks develop cracks (and/or collapse) due to settlements resulting from high water tables. A large number of respondents (59.4%) never went to school, only 21.3% had primary education, while 16.5% possessed secondary education. This shows that majority of the community lack basic education and so could not read and write. The low literacy level in the study area is partly attributed to the involvement of children in rice growing, the major economic activity in the area. Besides there is the huge difference between rural and urban setting regarding education facilities (Tromp and Datzberger, 2021). During field interactions, most of the respondents (the illiterates ones) could not comprehend flooding, its associated impacts and how to mitigate and/or implement proper adaptation strategies. Contrary, the Uganda bureau of statistics (2020) reported an average literacy level of 73% in Uganda, much higher than that in the study area.

The study found that 82.7% of the respondents depend on agricultural farming as the main source of income. The other occupations reported in the study were small business (small shop) (5.2%), government job (3%) and private firm (0.3). 8.8% of the respondents are unemployed. While about 81% earn a monthly income between 5,000 to 1,000,000 UGX, nearly 90% have a monthly expenditure in the same range. This implies that some households spend more than their earnings. Those spending more than their earnings stated borrowing the extra money from either financial institution like Savings and Credit Co-operative Societies (SACCOs), micro finance or friends. Others reported selling some of their property like land, animals to pay debts. 65.5% of the respondents were born in the study area, while 34.5% migrated from other areas. Majority (89.5%) migrated to the study area for marriage, while only 4.1% migrated because of disasters (e.g., floods) in their previous places.

4.2 Community perception of flooding in the area

Table 2 shows the community perception of flooding in the study area. For brevity, the tables with respondents' perception on causes of floods, impact of floods on different elements, effectiveness of flood alerting mechanisms, and preference of the flood forecasting mechanisms are provided in the Supplementary Material Tables M2 to M5. As seen from Table 2, 94.2% of the respondents have ever experienced floods, while only 5.8% reported to have never experienced flooding. Of those who experienced floods, 56.1%, stated that floods occur every rainy season, while 43.3% experience floods every year. The 56.1% were mainly residing along the river banks and/or in low-laying areas. Only 6% reported experiencing floods once in 5 years.

Table 2 Community perception of flooding in the study area

Variable	Category	Value	Percent
Do you experience floods in this area	Yes	469	94.2
	No	29	5.8
How frequent are the floods	Every rainy season	263	56.1
	Every year	203	43.3
	Once in 5 years	3	6
What is the average depth of water logging	0 to 2 m	410	87.4
	>2 m	59	12.6
Has your business been affected by floods	Yes	463	98.7
	No	6	1.3
Have you ever lost property due to floods	Yes	456	97.2
	No	13	2.8
Do you cultivate in previously flooded land	Yes	454	96.8
	No	15	3.2
What is the trend of production when you cultivate in previously flooded land	Increased	54	11.9
	Decreased	390	85.9
	No change	10	2.2
In case of a flood, which settlement option do you take	Stay in same place	361	77
	Migrate	108	23
Are you aware of any flood early warning system	Yes	307	65.5
	No	162	34.5
Do you utilise any flood prediction mechanism	Yes	360	76.8
	No	109	23.2
Do you have confidence in the government to implement flood management project	Yes	75	16.0
	No	394	84.0
Is flooding a major problem to you	Yes	440	93.9
	No	29	6.1
Can Flooding in this area be controlled	Yes	458	97.7
	No	11	2.3

While around 97% reported cultivating in the previously flooded area, about 86% of the households experienced a decrease in production, and only 12% reported an increase. FGDs revealed that decrease in production was due to soil erosion which washes away the fertile soils. Majority (84.0%) of the respondents did not have confidence in the government on the implementation of a flood management project. The community lost trust in the government because of the previously failed projects in the area coupled with high corruption. 77% of the respondents stayed in the same risky places during floods, mainly to protect their remaining property from theft. Only 23% migrated to safe places like schools, hospitals, and relatives' homes. The study further revealed that majority (93.9%) of the respondents considered flooding as a major problem. However, 97.7% of the respondents believe flooding in the area can be controlled with God's intervention. 65.5% of the respondents were aware of the flood early warning system. The other respondents (34.5%) did not have any knowledge about the flood early warning system in their areas. However, there was only one flood early warning system (siren) in the entire study area located in Butaleja district which was been non-operational since 2017 due to damaged cables. Besides, interaction with respondents revealed that by the time sound comes from the siren, the biggest part of the area is flooded. This was attributed to the inappropriate location of the sensors.

The respondents' perception on the causes of floods were explored as shown in Supplementary Material Table M2. The causes were mainly generated during the reconnaissance surveys. Respondents scored them on a Likert scale of 1 to 5; with 1 (very small cause) and 5 (very high cause). The final score based on the WAI yielded "prolonged rainfall" as the main cause of flooding (WAI = 4.87), followed by "changes in the rainfall pattern" (WAI = 3.93). Respondents believed that "deforestation" was least influential in causing flooding, ranking it last (WAI = 1.69). It is noticeable that the first two causes (prolonged rainfall and changes in rainfall pattern) cannot be controlled by human. Similarly, respondents were asked of the perception on the impact of floods on different elements (Supplementary Material Table M3). Generally, all the elements were significantly affected. However, respondents considered "farm and agricultural land" as the highly impacted element by floods (WAI = 4.78), followed by "roads, hospital and schools" (WAI = 4.58). While "domestic animals and poultry, households and settlement, and sources of drinking water" did not rank among the first two, these were equally impacted by floods (WAI>3.0).

Regarding efficiency of flood alerting mechanisms, "shouting out to neighbours" ranked the most effective (WAI = 4.35), followed by "door-to-door knocking" (WAI =3.48), while "alarm/siren at the monitoring point" came third (WAI = 3.33) (Supplementary Material Table M4). It sounded surprising why the quite difficult and time intensive mechanisms ("shouting out to neighbours" and "door-to-door knocking"), were considered most effective. However, respondents expressed that these were the cheap mechanisms that they could afford. The siren was not ranked most effective because it has been non-functional since 2017. Besides, interaction with respondents revealed that by the time sound comes from the siren, the biggest part of the area is flooded. This is attributed to the inappropriate location of the sensors. On the other hand, "radio stations, mobile phone text messages, television and newspapers" exhibited WAI <3.0, implying they were less-to-least effective early warning mechanisms. This was related to lack or inadequate access to the three mechanism by the communities as most respondents reported absence of radios and televisions in their homes. Five commonly flood forecasting mechanisms were generated from the reconnaissance survey. Overall, respondents highly preferred the "observation of the rainfall duration" (WAI = 4.57), followed by "observing amount of rains in the mount Elgon area "(WAI = 4.41), while "sound from the early warning system/siren" was ranked third (WAI = 3.39) (Supplementary Material Table M5). "Too much heat" and "analysing magnitude of thunderstorms" had WAI<3.0, hence, considered less preferred.

4.3 Flood adaptation strategies

Several adaptation strategies have been in place for pre-flood, during-flood and post-flood management. These strategies were being practiced at household and community levels, as generated during the reconnaissance survey. Communities were asked to state their perception of preference and applicability of the different strategies. Still for succinctness, this section includes only the explanation of different strategies, while the tables are included in the Supplementary Material Tables M6 to M11. It is noticeable that "relocation of personal property/materials" was the most applicable pre-flood strategy at household level. All the pre-flood strategies have WAI with in a range of 3.0, having a close difference between them (Supplementary Material Tables M6). This implies that all of them have a moderate application. Similarly, during-flood, all strategies have WAI with in a range of 3.0, with a close difference between them (except "shout-out to neighbours and escape from flooding area") (Supplementary Material Tables M7). However, all post-flood strategies have WAI above 4.0, indicating that all of them were highly applicable in the area (Supplementary Material Tables M8). Regarding strategies at community level, all the pre-flood measures were less effective (2.0≤WAI<3.0) (Supplementary Material Tables 9), while those practiced during-flood were moderately preferred (3.0≤WAI<4.0) (Supplementary Material Tables M10). However, two of the post-flood strategies were highly preferred (WAI>4.0), while the other two were moderately preferred (3.0≤WAI<4.0) (Supplementary Material Tables M11). Respondents were also asked to give the suitability and/or preference of various structural and non-structural strategies that could be employed to deal with floods aside from the current strategies being practiced at community and household levels. The perceived preference/suitability of structural and non-structural strategies are presented in Tables 3 and 4, respectively.

Table 3 Suitability of structural adaptation strategies for flood management

Adaptation strategy	MP	VP	MdP	LP	LSP	WAI	Rank
Embankment/river training structure to prevent flood spread	69.7	16.0	9.2	3.7	1.3	4.49	I
Reservoir/flow regulating structure e.g., weirs and barrages, dam	65.6	15.6	10.5	3.9	4.4	4.34	II
Gabion wall to protect river	60.3	17.3	10.5	6.6	5.3	4.21	III
Bamboo mesh/mat with sand filled bag to prevent flood spread	53.9	21.5	13.6	8.6	2.4	4.16	IV
Bio-dyke (bio engineering) – e.g., plant water resistant trees along river	55.7	18.6	7.7	15.8	2.2	4.10	V

MP is Most preferred, VP is very preferred, MdP is Moderately preferred, LP is less preferred and LSP is Least preferred

From Table 3, "embankment/river training structures to prevent flood spread" was the most preferred structural strategy (WAI = 4.49). It was followed by "reservoir/flow regulating structure e.g., weirs and barrages, dam" (WAI = 4.34), while "gabion wall to protect river" came third (WAI = 4.21). "Bamboo mesh/mat with sand filled bag to prevent flood spread" and "Bio-dyke (bio engineering) e.g., plant water resistant trees along river" had WAI of 4.16 and 4.10, respectively. It is noticeable that all the structural strategies had WAI>4 (>80%), with a minimal difference between them, implying that all the five strategies were highly preferred in flood management.

Among the non-structural strategies (Table 4), "flood forecasting and warning" ranked the most preferred (WAI = 4.18), followed by "household level preparation /management like elevated houses" (WAI = 3.79). Contrary to structural strategies, the non-structural measures had WAI<4.0 (except "flood forecasting and warning"). This implies that five of the strategies were moderately preferred (3.0≤WAI<4.0), while only one was highly preferred (WAI>4.0).

Table 4 Suitability of non-structural adaptation strategies for flood management

Adaptation strategy	MP	VP	MdP	LP	LSP	WAI	Rank
Flood forecasting and warning	58.3	18.6	11.7	6.0	5.5	4.18	I
Household level preparation /management like elevated houses	43.3	21.3	15.4	11.0	8.9	3.79	II
Watershed management	50.5	11.7	11.9	17.2	8.7	3.78	III
Controlling flood level around the house & food storage (trench)	42.0	21.3	17.0	11.2	8.5	3.77	IV
Land use management to avoid damage from flood	39.0	22.0	19.0	11.9	8.0	3.72	V
Modification of the farming practices	41.3	18.6	17.9	13.5	8.7	3.70	VI

4.4 Evaluation of the community willingness to pay

Table 5 shows the household WTP responses for the program of restoring River Malaba floodplains. Restoration encompasses a series of adaptation strategies as described in section 4.3. The responses were categorised as affirmative, genuine zero and protest. The distribution of the WTP responses was done for respondents who disclosed their household monthly income and those who did not disclose. Based on the reasons provided by respondents as to why they were not willing to pay for the program, a genuine zero was distinguished from a protest. For responses where the reason for not willing to pay was given as "I don't have money for the program, other expenditures are high" a genuine zero was assigned. Other responses were categorised as protests.

Table 5 Willingness to pay (WTP) responses for the program

	Reported Household monthly Income		
WTP	Yes	No	Total
Affirmative	272(0.55)	2(0.29)	274 (0.55)
Genuine Zero	172(0.35)	5(0.71)	177(0.36)

Protest	47(0.10)	0(0.00)	47(0.09)
Total	491(1.00)	7(1.00)	498(1.00)

From Table 5, 55% of the respondents were affirmative, while 36% presented a genuine zero. Only 9% of the respondents protested the idea of paying towards the program of restoring the River Malaba floodplain. However, Chia et al. (2020) achieved a response rate of 94% WTP for insect-based feeds in Kenya, Maghsood et al. (2019) reported an average WTP of 35% towards flood management strategies in Talar River Basin, northern Iran. Gaglias et al. (2016) reported 65% WTP to create a fund for financing social and environmental programs in Ikaria, Greece. In Uganda, Ojok et al. (2012) reported 48.1% WTP for improved municipal solid waste management service in Kampala, while Banga et al. (2011) on the other hand reported 79.8% WTP for a waste-collection service in Kampala.

Analysis of the WTP amounts was based on the respondents who had earlier-on disclosed their monthly incomes. Table 6 shows the statistical analysis of various WTP amounts.

Table 6 Breakdown of the WTP amount in UGX

WTP parameter	Mean	Median	Mode	Minimum	Maximum	Sum
Per month	97,080	50,000	10,000	5,000	500,000	38,249,500

3700 UGX is equivalent to 1 US$ (approximated based on the Bank of Uganda rate on 25 February 2021). UGX denotes Uganda Shilling and US$ stands for United States Dollar.

Computation of the median was based on the presence extreme higher values in the responses, hence, making median more suitable than the mean value. The collected dataset on WTP amount was positively skewed (Cs =0.88) resulting in a smaller median value than the mean. This is a clear signal that the mean is sensitive to any score in the distribution and is prone to huge shifts from the true central value when the sample contains extreme scores (Sykes et al., 2016; Zheng et al., 2016). In addition, the mode value was used to show the most frequently occurring value in the data series. In this study, the average (mean) monthly WTP amount was 97,080 UGX, while the median was 50,000 UGX, and mode 10,000 UGX. The maximum and minimum monthly WTP amounts were 500,000 UGX, and 5,000 UGX, respectively. The respondent’s WTP amount is further presented in Fig. 2 with a linear trend line fitted on the probability of responses.

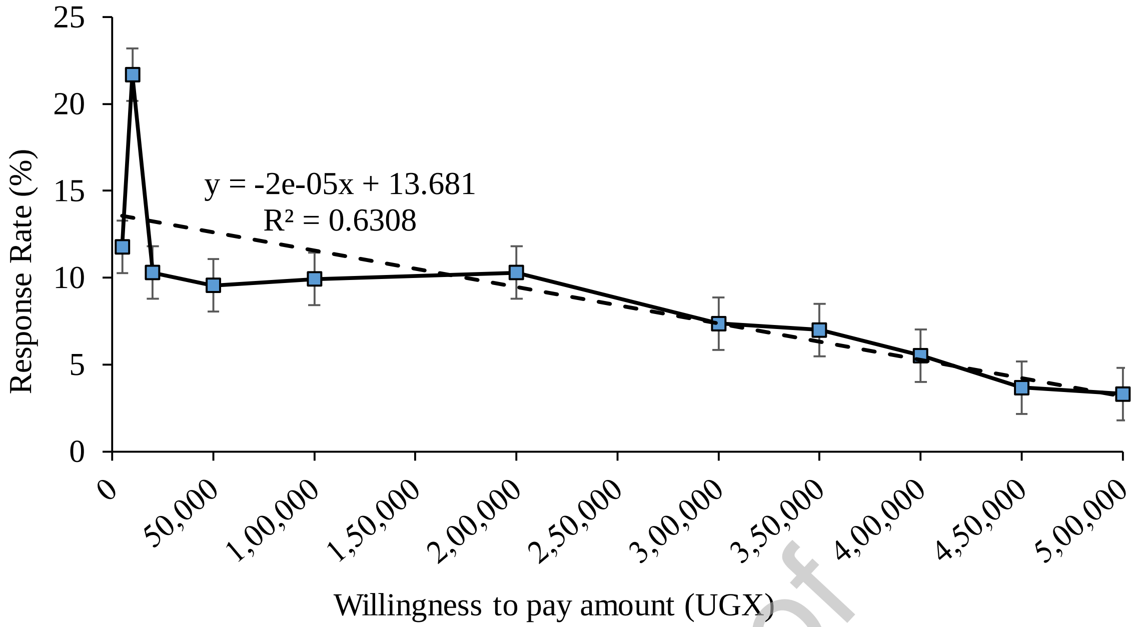

Fig. 2 Analysis of the WTP amount in UGX

It is noticeable from the linear regression model on Fig. 2 (y = -2e-05x + 13.681), that the response rate decreased with increasing WTP amount. The value of the regression model coefficient R^2 was obtained as 0.6308, which implies that the WTP amount influenced 63.1% changes in the response rate. It is further noticeable that the response rate varied from one WTP amount to another. The response rate increased from 11.8% to 21.7%, with an increase in WTP amount from UGX 5,000 (US$ 1.35) to UGX 10,000 (US$ 2.70). The highest response was at the WTP amount of UGX 10,000 (US$ 2.70), while the lowest was observed at UGX 500,000 (US$ 135.14). Largely the results reveal that the community were willing to contribute towards the program for restoring River Malaba floodplain area. The individual monthly WTP amounts ranged from UGX 5,000 (US$ 1.35) to UGX 500,000 (US$ 135.14), with a monthly average of UGX 97,080 (US$ 26.24). Total monthly amount was UGX 38,249,500 (US$ 10,337.70) considering the 498 households.

Respondents gave various reasons for their choices of either affirmative or negative WTP responses as shown in Table 7. From Table 7, 54.6% were willing to pay towards the program, while 45.4% opposed. 36.2% of the respondents were WTP with anticipation that the program would result in management of floods hence, minimising the impacts on human and surrounding environment. 30.9% of the respondents agreed to pay with a hope that program's implementation would guarantee more protection of the residents living along the river banks. 16% of the respondents were WTP expressed that the program would mitigate rain-induced floods, while 16.8% voiced that the contributed money would help the authorities during budget constraints times. However, of the 45.4% respondents who were not WTP, 27.3% did not have money due to other high expenses. 3.5% stated that it was the government responsibility to restore the river floodplains, while a small percentage (0.6%) expressed that those affected by floods should pay for the program. On the other hand, 4.5%

of the respondents were not WTP because flooding from the river is a minor challenge to them, while about 60.7% explained that they could not pay for the program because they have no trust in the government programs. A small number (of about 3%) believed that floods in the area are beyond any human control effort and should only be left to God.

Table 7 Reasons for affirmative and negative WTP responses towards the River Malaba floodplain restoration program

Item	Category	Number	Percent	Mean ± STD Error	Min-Max
WTP	Affirmative	272	54.6	0.55± 0.022	0-1
	Negative	226	45.4		
Reasons for WTP	Manage floods to minimise impacts	271	36.2	0.38± 0.021	1-5
	Mitigate rain-induced floods	120	16.0		
	Contribute money to authorities	126	16.8		
	Protect residents along river banks	231	30.9		
Reasons for not WTP	Flooding is a minor problem to me	29	4.5	0.09± 0.009	1-5
	I don't have money	177	27.3		
	Uganda government should pay	23	3.5		
	Those affected should pay	4	0.6		
	No confidence in government	394	60.7		
	Flooding is beyond any one's control effort (be left to God)	22	3.4		

4.5 Factors influencing the community willingness to pay

The factors categorised under demographic, socio-economic and descriptive statistics were verified for multicollinearity to establish if there was no high correlation prior to their use in the regression model. The analysis revealed a weak correlation between most of the explanatory variables, hence making them suitable for use in the regression model. However, some variables such as "frequency of floods once in 5 years", and "no change in production trend" exhibited collinearity. These were excluded from the regression model. Table 8 presents results of the probability of a respondent being willing to pay for the restoration of River Malaba floodplains. The value of R-square demonstrates how better the data fits in the regression model, and it varies between 0 and 1.0, with the value of 1.0 denoting a perfect match, while higher values indicate a better fit (Barnnett et al., 1998). From the analysis of the Wald chi-squared test, the null hypothesis was rejected with R^2 = 0.531, p = 0.000. Therefore, the variables coefficients included in the regression model were statistically different from zero. Almost 50% of the variables had significant influences on community WTP (Table 8). The respective variable influences are described in section 5.

Table 8 Analysis of the effect of explanatory variables in the regression model

Variable	Coefficient (*β*)	Std. error (σ)
Gender	0.1794***	0.5233
Age	0.0031***	0.0013
Marital Status	0.4335***	0.1817
Education (Never went to school)	-0.2237 [ns]	0.3177
Education (Primary)	0.015**	0.3111
Education (Secondary)	0.145**	0.3104
Education (Tertiary)	0.1527***	0.3264
Household size	-0.0057 [ns]	0.0043
Occupation (agriculture)	0.0283***	0.1526
Occupation (government)	0.2568*	0.3846
Occupation (small business)	0.0969*	0.1704
Type of house (semi-permanent)	0.1331 [ns]	0.0925
Type of house (Mud)	0.0705 [ns]	0.0830
Household income	0.2388**	0.0838
Respondent born in study area	0.0749 [ns]	0.0515
Flood frequency (rainy season)	0.0085 [ns]	0.2654
Flood frequency (every year)	0.0312 [ns]	0.2646
Business affected by floods	0.2622***	0.0564
Loss of property in floods	0.1507***	0.0496
Production trend (increase)	0.0589 [ns]	0.1685
Production trend (decrease)	0.0855 [ns]	0.0656
Responsible for early warning (government)	0.1614 [ns]	0.1660
Responsible for early warning (NGO)	0.1275 [ns]	0.2067
Responsible for early warning (charity)	0.141 [ns]	0.2056
Responsible for early warning (community)	0.1222 [ns]	0.3071
Confidence in government	-0.3268***	0.0628
Flooding a major problem	0.2251***	0.5510
Can flood be controlled	-0.124 [ns]	0.1902
Constant	-0.709**	0.5296

***, ** and * denote significance at 1%, 5% and 10% level, respectively, while [ns] indicates none significance at the three levels (1%, 5% and 10%). “Std. error” stands for standard error.

5. Discussion

During the reconnaissance surveys, it was observed that flooding is a major problem in the River Malaba sub-catchment. For instance, interaction with some of the households revealed the following: “…after the worst flood (locally known as Somalia flood) of 1997, the number of flooding events had reduced until 2010, when the frequency started increasing to date, with at least 3 to 4 flooding events annually…” During the FGDs and KIIs, some of the respondents expressed that the increasing bends along the river, cultivation near the river banks some of the key factors to the rising number of flooding damages in the area. This conforms to the findings by Mayega *et al*. (2015), who attributed most disasters in Uganda to human factors. Similarly, in other areas across the worlds, several studies have reported the influence of human factors in causing rain-induced disasters like floods. For instance, the current poor urban planning practise and insufficient to absence of environmental set-ups have aggravated Nigeria's flooding (Echendu, 2020). In Dire Dawa city, Ethiopia, apart from the natural factors, anthropogenic effects have resulted in flash floods (Erena and Worku, 2018). Besides, in China, Lyu *et al*. (2018) noted that human factors including degradation of rivers and lakes and construction of three dams are among the significant factors influencing the occurrence of flooding. During field observations, water crossing roads (making them impassable), standing waters in compounds and gardens even after 5 days of rainfall were key indicators of flooding. On average, the flood water height was 2 m as measured from the marks on some of the features like houses and school structures. However, in other areas, it went up to 4 m.

At the household and community levels, the post-flood adaptation strategies were found to be more efficient than those practiced before- and during-floods. Regarding the suggested structural and non-structural strategies, "embankment/river training structures to prevent flood spread" and "flood forecasting and early warning" were highly preferred, respectively. The above implies that the community preferred strategies that are to be implemented by someone else (e.g. government, NGO, charity organisations) than themselves. This signifies lack of responsibility, commitment and ownership by the community to take a leading role in the entire process. This conduct could be attributed to absence of material, monetary and logistical facilitation in addition to lack of community awareness (Nguimalet, 2018). Therefore, education/sensitisation of the community on the benefits of performing a key role in developing and implementing flood adaptation strategies is vital (Rizvi et al., 2016). Besides authorities need to extend social and material requirements to community levels, and improving society sense of belonging (Simon et al., 2020).

10% of the respondents protested WTP towards the program despite them disclosing their monthly incomes. During the survey, most of these stated that "they do not have confidence in the implementation of this project by the government due to corruption exhibited on the previous projects". Graphically (Fig. 2), a decreasing trend is noticeable in the response rate from the highest (21.7%) to lowest (3.3%). This is because, as the WTP amount increases, the response rate decreases. The study by Jofre-bonet and Kamara (2018) also reported a reduced WTP response (percentage) at higher WTP amount for health insurance in Sierra Leone. Therefore, the respondents in this study acted in a way that is consistent with the ideal situation. The increase in response rate from 11.8% to 21.7%, with an increase in WTP amount from UGX 5,000 (US$ 1.35) to UGX 10,000 (US$ 2.70) could sound abstruse. In a normal situation, the response rate would be expected to decrease as the WTP amount increases. However, a low response rate at UGX 5,000 than UGX 10,000 was because respondents expressed that contributing only UGX 5,000 could not raise enough money to support the program, hence opting for a higher amount. According to Carson and Groves (2011) some respondents may opt to go for higher WTP amount to ensure that the program serves the intended purpose than merely choosing WTP values below anticipated cost. With a total monthly amount would be UGX 38,249,500 (US$ 10,337.70) for the sample size of 498, assuming that all factors remain constant and all households in the study area were willing to pay towards the restoration program, a reasonable sum of money can be generated.

The different regression coefficients *(β)* and standard errors (σ) are presented in Table 8. Six independent variables (education, occupation, type of house, flood frequency, production trend and responsibility for early warning) were categorical and therefore, a dummy variable for each category was coded. Gender had a positive regression coefficient at 1% significance level. This implied that males are more likely to pay for the program than females. This sounds true because in Uganda there is customary marriage which gives more powers to males on financial decisions (Banga et al., 2011; Wright, 2012). Although reported on a different sector, results of the present study are in treaty with the findings from Banga et al., (2011). The studies by Twerefou (2014) in Ghana and Eridadi et al. (2021) in Ethiopia reported similar results. The respondents' age had a significant positive influence on their WTP for the restoration program. This inferred that respondents' WTP increases as they attain an old age. Similar results can be found in previous studies e.g., Eridadi et al. (2021) in Ethiopia and Jiang et al. (2019) in China. However, the present study findings contradicted with those of Banga et al. (2011) in Uganda, Eskandari-Damaneh et al. (2020) in Iran and in a transnational study by Funahashi et al., (2020) who reported negative impact of age on community WTP. Respondents who never went to school exhibited a negative attitude toward the program. However, respondents' education level from primary upwards had a significant positive influence on their WTP for the restoration of River Malaba floodplains. The highest education class (tertiary) of respondents were willing to contribute more compared to their counterparts in lower education categories. The studies by Nguyen and Robinson (2015), Zhao et al. (2013), and Banga et al. (2011) reported that respondents with higher education yielded relatively higher WTP in China, Vietnam, and Uganda, respectively. This indicates the need to improve education standards in the study area which could possibly help community attain additional acquaintance of the benefits of floodplains restoration.

The respondent's marital status had a significant positive influence on their WTP. It was statistically significant at 1% significance level. This revealed that married respondents were more likely to pay for the restoration program as they are obliged to meet their family expenditures compared with their counterparts (the singles). The present study findings were similar to those of Eridadi et al. (2021). However, the study by Acey et al. (2019) reported that married people were less likely to pay for water utility in Kenya. Although statistically insignificant, respondents who were born in the area were likely to pay towards the program. This implied that being a born of an area enables an individual to comprehend the various challenges within the community.

The three variables of respondents' occupation (agriculture, government and small business) had significant positive influences on their WTP. These results indicate that having a source of income could increase an individual's potential to contribute towards the restoration of floodplains. Previous study by Eridadi et al. (2021) reported positive impact (though insignificant) of occupation on community WTP towards improving water services in Sebeta town, Ethiopia. The relationship between the probability of respondents WTP and the continuous variable "household income" was positive. The regression coefficient was significantly positive at 5% significance level. This indicated that respondents with high income value were more willing to pay towards restoring the floodplains compared to lower income earners. These results agree with several other studies (Eridadi et al., 2021; Eskandari-Damaneh et al., 2020; Jones et al., 2017; Kikulwe and Asindu, 2020; Maghsood et al., 2019; Makwinja et al., 2019; Twerefou, 2014) that reported significant positive impact of income on WTP. Therefore, empowering the community economically could potentially motivate them to always contribute towards government programs. Socio-economic variables of "effect on business", "loss of property due to floods" and "flooding being a major problem" had a significant positive impact on the community WTP for the program. They were all statistically significant at 1% significance level. This implied that respondents had hope that by contributing towards the program would enable the government handle the flooding problem hence, minimising on the future losses due to floods. Some of the socio-economic variables such as "production trend", "responsibility for early warning" exhibited positive (but insignificant) impacts on WTP.

The institutional variable "confidence in government" had a significant negative impact on WTP. It was statistically significant at 1% significance level. Confidence refers to the amount of trust that respondents have in government institutions and actions towards managing floods and associated impacts. During the study, it was pointed out by some respondents that those with authority such as chairpersons, treasurers on the management committees were corrupt. Other respondents stated that some of the committees created to manage floods were donor-driven and their interests to restore floodplains were tagged on the monetary paybacks than the will of the community. Generally, various independent variables of gender, age, marital status, education, occupation, income, effect on business, loss of property in floods, confidence in governance and flood as a major problem will have an influence (mostly significant) on the community WTP towards restoring River Malaba floodplains provided other variables are kept constant.

6. Conclusions

Based on the study findings it was discovered that the charge that was established for floodplain restoration could be significant and could be efficiently used in flood management in the sub-catchment. It was realised that a fixed value of the estimated WTP amount can be applied across the entire community towards restoration of the floodplains. However, in most cases, findings may not be used as obtained at the assessment time due to budget constraints that may materialise during the implementation stage (Khan et al., 2014; Venkatachalam, 2004). Among the adaptation strategies at household and community levels, the post-flood strategies have been more efficient than those practiced before- and during-floods. Among the suggested structural and non-structural strategies, “embankment/river training structures to prevent flood spread” and “flood forecasting and warning” were the most preferred, respectively. The study revealed that the community possessed limited knowledge on the benefits of restoring the floodplains and preferred strategies that are implemented by someone else e.g., government. Therefore, there is need to educate the community on the benefits of performing a key role in developing and implementing adaptation strategies. Besides, government should provide logistical facilitations instead of waiting for as hoc interventions at the time of disasters.

A number of demographics, socio-economic and institutional factors exhibited varying influences on the community WTP. Largely, demographic variables (e.g., gender, age, marital status, and education level) had significant positive influence on the community WTP. Similarly, socio-economic factors such as “occupation”, “household income”, “business affected” and “loss of property in floods” showed significant positive influence on the community WTP. However, the institutional factor (confidence in government), had a significant negative impact with WTP. Some factors such as type of house, flood frequency, trend in production, exhibited positive but insignificant impact on WTP. This study findings present policy implications to the government. Planning and implementation of strategies aimed at managing floods and related disasters in the present study area and equally affected parts of the world need to take into consideration a thorough study of similar nature for an informed decision-making. Better understanding the benefits of managing floods, estimated WTP amount and the influencing factors could facilitate informed predictive planning of flood mitigation and adaptation strategies.

A few limitations to the present study are recommendations for future research studies are noteworthy mentioning. WTP being a new concept to community in the study area, it was challenging to obtain data especially explaining the benefits of the study to the affected communities and interesting them to participate in the survey. This affected the amount of information collected. Therefore, it is recommended that government and other authorities sensitise the community on the benefits of the WTP approach and promote future research studies in similar areas and sectors. This study focused on analysing the community WTP for the restoration of River Malaba floodplains. It is recommended that future research be conducted on equally other important rain-induced disasters in the area. For instance, research focusing on investigating how much the community would be willing to pay for drought and landslides resilience programs. Future research should as well consider other areas which are equally prone to rain-induced disasters such as the Rwenzori region in western Uganda and other regions in Africa.

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Authorship contributions: Ambrose Mubialiwo presently a Ph.D. candidate at the Africa Centre of Excellence for Water Management, Addis Ababa University, Ethiopia planned the research, collected and analysed the data, and drafted the manuscript and made required revisions. Adane Abebe and Charles Onyutha were both greatly involved at each stage including research scoping, reviewing the study tools, and manuscript reviewing. Adane Abebe and Charles Onyutha were advisors to Ambrose Mubialiwo during the process of this study.

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