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ORIGINAL PAPER

Vulnerability, livelihood assets and institutional dynamics in the management of wetlands in Lake Victoria watershed basin

Samuel M. Mwakubo · Gideon A. Obare

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Abstract This paper uses data from 600 households in the Lake Victoria watershed in Tanzania, Kenya, and Uganda to analyze the effects of vulnerabilities and shocks on the management and exploitation of wetlands within the context of agricultural activities and high poverty levels. A multinomial logit model is used to determine variables that influence the perception of wetlands degradation, while a tobit model is used to establish the determinants of willingness to pay for wetland conservation and the imputed value of wetland product extracts. The model results show that although the perception of wetland degradation is modest, it is influenced by attributes of social capital. Variables such as floods, diseases and droughts significantly influence the households' willingness to pay for wetland conservation. Land size and ownership, education level and household size all influence households' likelihood to actively engage in wetland resource exploitation and willingness to pay for its conservation. The implications of these results hinge on measures that would moderate the effects of shocks, mobilize collective action, and improve physical infrastructure within the context of sustainable wetland resource use.

Keywords Vulnerabilities · Livelihood assets · Shocks · Wetlands · Lake Victoria watershed · East Africa

S. M. Mwakubo
Department of Economics and Agricultural Resource Management, Moi University, P.O. Box 3900, Eldoret, Kenya

S. M. Mwakubo (✉)
The Kenya Institute of Public Policy Research & Analysis (KIPPRA), P.O. Box 5445-00200, Nairobi, Kenya
e-mail: smwakubo@kippra.or.ke

G. A. Obare
Department of Agricultural Economics and Agribusiness Management, Egerton University, P.O. Box 536, Njoro, Kenya
e-mail: GObare2007@gmail.com

Introduction

Lake Victoria wetlands are important in their buffering capacity of agricultural and municipal wastes. In Kenya and Uganda, the Lake Victoria wetlands constitute about 37 and 13%, respectively, of the total wetland surface area in the two countries (Kayombo and Jorgensen 2006). They are also among the most productive ecosystems of the Lake Victoria basin. The high biomass production rate of plant macrophytes and other wetland products have a great potential in positively affecting the livelihoods of the inhabitants of this area if they are exploited sustainably (Obare et al. 2007).

Lake Victoria wetlands have been facing serious problems of degradation (Chrisman et al. 1996; Muwanga and Barifaijo 2006; Ntiba et al. 2001;

Twesigye et al. 2006; UNEP 2006). About 75% of the Lake Victoria wetlands area has been significantly affected by human activities and about 13% is severely degraded (Kayombo and Jorgensen 2006). There has been a continuous and large-scale conversion of wetlands to agricultural land. For instance, past aerial surveys on changes in papyrus cover around Lake Victoria have shown a remarkable loss in papyrus vegetation (Van der Weghe 1981; Mafabi 2000). A comparative aerial survey conducted between 1969 and 2000 shows a 50% loss of Dunga swamp and 47% and 34% loss of Koguta and Kusa swamps, respectively (Owino and Ryan 2006). Between 1973 and 2001, the Yala swamp is estimated to have lost about 30% of its papyrus cover (Thenya 2006). This rate of loss of wetlands is a cause of concern to a balanced ecosystem (Gren et al. 1994; Schuyt 2005) as it implies that the capacity of wetlands to retain excessive nutrients from agricultural and industrial activities is greatly diminished (Södorqvist et al. 1999; Simonit and Perrings 2005). As people increasingly reclaim wetlands or distort the ecosystem balance, coupled with population increase, such problems are bound to worsen.

Nevertheless, wetlands can be sustainably exploited if the dynamics of the local institutions that impact on accumulation and consumption of livelihood assets are well understood and harnessed appropriately. This is largely because conversion of wetlands is influenced by households' asset position and shocks which, under an appropriate and sustainable management regime, can generate a flow of useful functions such as nutrient purification, ground water buffering and biodiversity (Gren et al. 1994). In addition, the life support systems that are inherent within the wetland ecosystems can provide a wide range of valuable functions to society (Folke 1991; De Groot 1992) if they are used in a sustainable manner, for example, by incorporating the primary users in the management of the wetlands within the context of societal livelihoods and local institutions. Yet, there is a paucity of literature on the relationship between farmer activities and the state of wetlands in Eastern Africa—especially regarding the Lake Victoria region, and the literature is rather limited internationally (Wilson 1996; Fedick and Morrison 2004). Similarly, quantitative analysis of the impact of agriculture on wetlands is limited (Beopoulos and Skuras 1997). This paper aims to fill that gap.

Methodology

Conceptual framework

We conceptualize the level of household–wetlands interaction as an outcome of household response(s) to livelihood vulnerabilities and the perception of wetland degradation. We assume that, first, wetlands are alternative sources of livelihoods and, therefore, are inherently valuable and, second, wetlands are degraded. We adopt the sustainable livelihood conceptual framework suggested by the Department for International Development (DfID) to operationalize the interactions.[1]

Given the wetlands degradation and the inherent value assumptions, we hypothesize that the state of wetlands influences household vulnerability through a reduction or increment in the temporal or cyclic transitory food insecurity in the extant wetland communities. Further, we argue that access to and exploitation of wetland resources determines the quantity and quality of household assets that are required to facilitate the sustainable use of wetlands. Lastly, wetlands are influenced by institutions and processes that create options for individuals to build upon various assets in pursuing their livelihoods (Mitsch 1998). Institutions in the context of interactions between society and nature have been subject to several recent studies, for example, Berkes and Folke (1998), Bromley (1991), and Ostrom (1990).

On the basis of the sustainable livelihood framework, we hypothesize that institutions facilitate governance and/or control over the use of wetlands at the household and community levels (Södorqvist 1998; Berkes and Folke 1998; Ostrom 1990). The type, quality and effectiveness of these institutions are in turn influenced by households' welfare. Household vulnerability and assets are considered critical to household welfare. Vulnerability is an outcome that is attributable to shocks. The shocks themselves may be as a result of anthropogenic, economic, and natural causes, and include disease epidemics, floods, drought, and economic boom or stagnation/decay, among others. The livelihood assets constitute human, social, financial, and physical capital. We argue that for the

[1] DfID-Department for International Development (2001). Sustainable livelihoods guidance sheets. www.livelihoods.org/info/info_guidanceSheets.html#6.

utilization of wetlands to be sustainable, institutions that govern their use and management must be dynamic but congruent with household welfare.

To illustrate the source of this dynamism, we identified two pathways that originate from household shocks and result in a wetlands status outcome. In the first pathway, the ability of a household to withstand shock is a function of farm orientation, institutional and policy factors, household characteristics, social capital, transaction costs, land characteristics, the type of farming system and also the household's asset endowments. The second pathway links the level of wetland status to shocks through perception of wetland degradation and the decision to participate in wetland conservation. Both of these pathways are mutually interactive.

The model

Central to our modelling strategy are the degradation and valuability assumptions of wetlands. The perception of households to these aspects is likely to differ across households and thus trigger different responses. To elicit the perception of wetland degradation, and following Greene (2003), we specify a random utility-based choice as follows: supposing that for the ith individual that is faced with j alternatives indexed as $j = 1, 2, \ldots, n$, then we can represent the individual's utility (U_{ij}) from the choice alternatives as:

$$U_{ij} = \beta_j' X_{ij} + \varepsilon_{ij} \tag{1}$$

where X_{ij} is a vector of factors that explain the decision made, and β_j' is a set of parameters that reflect the impact of changes in X_{ij} on U_{ij}, and ε_{ij} is an unobservable error term. Alternative j is chosen by individual i if it gives the highest utility, that is, max $\{U_{i1} \ldots U_{in}\}$. The decision on the choice of j depends on X_{ij}, which includes aspects specific to the individual as well as the choices. If Y_i is a random variable that indicates the choice made, then the probability that alternative j is chosen is

$$\text{Prob}(Y_i = j) = \frac{e^{\beta_{j'}' X_{ij}}}{\sum_{j=1}^{j} e^{\beta_{j'}' X_{ij}}}, \quad j = 0, 1, 2. \tag{2}$$

Estimating Eq. 2 provides a set of $j + 1$ choice probabilities for a decision maker with characteristics X_{ij}. The equation can be normalized by assuming $\beta_j = 0$, in which case the probabilities can be estimated as:

$$\text{Prob}(Y_i = j) = \frac{e^{\beta_j' X_{ij}}}{1 + \sum_{k=1}^{2} e^{\beta_j' Z_{ij}}} \tag{3}$$

$$\text{Prob}(Y_i = 0) = \frac{1}{1 + \sum_{j=1}^{j} e^{\beta_j' X_{ij}}} \tag{4}$$

Active participation of households in wetland conservation is captured by two outcomes: their willingness to pay for the conservation efforts and the imputed value of the extracted wetland products. We specify a Tobit model to evaluate the effects of various factors on the two outcomes. Assuming:

$$\begin{aligned} Y_i^* &= \beta' X_i' + \varepsilon_i \\ Y_i &= 0 \qquad \text{if } Y_i^* \le 0 \\ Y_i &= Y_i^* \qquad \text{if } Y_i^* > 0 \end{aligned} \tag{5}$$

where Y^* is an unobserved latent variable, X_i' is a vector of explanatory variable and β' is a vector of parameters to be estimated. For an observation randomly drawn from the population, the value Y associated with this observation may or may not be censored. Given Y, the conditional $E\left(Y_i^*\right)$ is determined as follows:

$$E[Y_i|X_i] = \Phi\left(\frac{\beta' X_i}{\sigma}\right)(\beta' X_i + \sigma\lambda) \tag{6}$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function (cdf) and $\lambda_i = \frac{\varphi(\beta' X_i/\sigma)}{\Phi(\beta' X_i/\sigma)}$, where λ_i is the inverse Mills ratio and $\phi(\cdot)$ is the probability density function (pdf).

Using Eq. 2 we specify a multinomial ordered logit model to determine the factors that influence the perception of status of wetlands. The choice variables are coded as 0, 1, and 2, which correspond to bad, moderate, and good. The empirical estimation model is given as:

$$\begin{aligned} \text{Prob}(wetstatus) = f(&hhs, age, educ, floodcr, drougcr, \\ &diseacr, hungcr, distho, dummyke, \\ &dummyug, dummytz, extvisit, sex, \\ &famca, group, memdiv, particip, \\ &ageage, faror, transpt, imputval, \\ &wealth, hhinc, crpeq, cognit) \end{aligned} \tag{7}$$

Equation 6 is used to estimate a Tobit model on the willingness to pay for wetland conservation and imputed value of wetland products, respectively. The empirical models are given as:

$$willing = f(hhs, age, educ, floodcr, drougcr, diseacr, hungcr, distho, dummyke, dummyug, dummytz, extvisit, sex, famca, group, memdiv, particip, ageage, faror, transpt, imputval, wealth, hhinc, crpeq, cognit, wetstatus) \quad (8)$$

and

$$imputval = f(hhs, age, educ, floodcr, diseacr, hungcr, distho, dummyke, dummyug, dummytz, extvisit, sex, famca, group, memdiv, particip, ageage, faror, transpt, imputval, wealth, hhinc, crpeq, cognit, wetstatus) \quad (9)$$

The description and measurement of the model variables are presented in Table 1.

The willingness to pay for wetlands conservation was obtained by using the contingent valuation method following De Groot et al. (2006). The survey questionnaire had questions on respondents' willingness to pay for wetland conservation. A bidding game was used to elicit information on amounts respondents were willing to pay, while the payment vehicle was defined as trust fund set specifically for the management of wetlands.

The elements of social capital considered in the various models included: groups, membership diversity, household participation in decision making within a group, and cognitive capital. These social capital elements were measured using a procedure adopted from Grootaert and van Bastelaer (2002). The groups (*group*) variable is the number of groups to which members of a household belonged to. Membership diversity was rated according to five criteria, namely, religion, gender, age, political affiliation, and education. A diversity index was calculated for each organization, ranging from one to two (1 = same, 2 = different), and then summed up per household. With regard to participation, two proposals were posed to respondents: (1) to evaluate the relative roles of their leaders and members in decision-making and (2) to evaluate the effectiveness of their leaders. The responses were combined in a "democratic functioning score" to determine the participation score in decision-making. These scores were evaluated for each household.

Cognitive social capital builds around three attributes: solidarity, trust, and cooperation (Grootaert and van Bastelaer 2002). On a scale of 1 to 4, respondents were asked whether they strongly agreed (1), agreed (2), disagreed (3), or strongly disagreed (4) to statements on solidarity, trust and cooperation as they related to wetland utilization, management, conservation, and community welfare in general. The scales were then summed up to give a scale indicator of cognitive social capital. This type of aggregation obviously involves strong assumptions about underlying common scales. Yet, in practice, this aggregative method is quite commonly used and the resulting indicators have proven useful, especially in the context of multivariate analysis (Grootaert 2002; Krishna and Uphoff 2001; Narayan and Cassidy 2001). Cognitive social capital raises perceptions about sources of possible support, know-how, and its potential reliability, which could be useful in attracting investments to wetland conservation and in providing a platform for judicious use of wetland resources.

Data

The data for this study were obtained from a survey of rural households within the Lake Victoria watershed basin in Uganda, Tanzania and Kenya. Four regions in each country were chosen on the basis of the level of wetland degradation, the frequency of occurrences of natural shocks such as floods and drought, and physical infrastructural endowments, especially road networks. Two regions with higher wetland degradation differing only on the level of physical infrastructure endowments (one with a relatively high endowment and the other low) were identified in each country. In addition, two other regions with lower wetland degradation and differing only on the level of relative physical infrastructure endowments were identified in the respective countries. A village was then randomly selected from each of the four identified regions. A structured questionnaire was administered to 50 households in each village to elicit information on various aspects of wetland use and conservation, household socio-economic characteristics, and institutional and physical infrastructural

Table 1 Description and measurement of variables

Variable	Description	Measurement
Hhs	Household size	Number
Age	Age of household head	Years
Educ	Education of household head	Number of years of formal schooling
Floodcr	Flood crisis dummy	Flood = 1, No floods = 0
Drougcr	Drought crisis dummy	Drought = 1, No drought = 0
Diseacr	Disease crisis dummy	Disease = 1, No disease = 0
Hungcr	Hunger crisis dummy	Hunger = 1, No hunger = 0
Distho	Distance from homestead to field	Metres
Dummyke	Country dummy	Kenya = 1, Otherwise = 0
Dummyug	Country dummy	Uganda = 1, Otherwise = 0
Dummytz	Country dummy	Tanzania = 1, Otherwise = 0
Extvisit	Frequency of extension visits	Number
Sex	Gender of household head	Male = 1, Female = 0
Famca	Farm size per capita	Hectares per person
Group	Number of groups that a household member belongs to	Simple increasing scale
Memdiv	Membership diversity	Simple increasing scale
Particip	Participation in decision-making	Simple increasing scale
Ageage	Age of household head squared	Years
Faror	Degree of farm orientation	Proportion of off-farm income
Transpt	Access costs to markets	Kenya shillings[a]
Imputval	Imputed value of wetland products	Kenya shillings[a]
Wealth	Proxy for wealth indicator	Type of roof of house
Hhinc	Household income	Kenya shillings[a]
Crpeq	Lagged crop income	Kenya shillings[a]
Cognit	Cognitive social capital	Simple increasing scale
Wetstatus	Perception of the state of wetlands	0 = bad, 1 = moderate/fair, 2 = good
Willing	Value the respondent would be willing to pay for wetland conservation	Kenya shillings[a]

[a] The various country currencies were converted to the Kenya shilling at the exchange rates of 1Ksh to 23 and 13 Ugandan and Tanzanian shillings, respectively

endowments. Village profiles were also carried out using focused group discussions.

Results and discussion

Wetland management and exploitation: a descriptive analysis of the dynamics of vulnerability, livelihood assets and social capital

Table 2 presents the descriptive statistics of model variables used in this study. The results show that the majority of respondents are middle aged with about 6 years of formal education and that the majority of them were men. The most frequent crisis that households face is drought, whereas floods occur intermittently.

The household perception of wetland degradation (*wetstatus*) is relatively low, which could be indicative of low levels of consciousness of the importance of wetlands, or that the respondents are unable to directly or indirectly associate the incidences of crises that households face with environmental degradation.

Table 2 Descriptive statistics of selected variables

Variable	*N*	Mean	Minimum	Maximum	Std
Age of household	627	43.70	15.00	90.00	15.61
No. of years in formal schooling	588	6.57	0.00	17.00	3.45
Flood crises	629	0.53	0.00	1.00	0.50
Drought crises	629	0.80	0.00	1.00	0.40
Hunger crises	629	0.81	0.00	1.00	0.39
Disease crises	629	0.48	0.00	1.00	0.50
Wetlands status	610	0.91	0.00	2.00	0.67
Extension visits	629	0.80	0.00	200.00	8.16
Farm size	603	8.00	0.09	2082.47	99.20
Household size	629	5.44	1.00	13.00	2.53
Willingness to pay	473	470.14	0.00	20,000	1383.10
Cognitive social capital	628	17.75	8.00	24.00	2.53
Wetlands revenue	301	280,564	1.00	67,642,333.00	3,898,253.84
Imputed value of wetlands	407	34,986.64	0.63	804,400	76,562.62
Transport costs	562	80.79	0.00	250.00	57.90
Participation	360	7.19	1.00	18.00	3.21
Membership diversity	360	15.90	1.00	42.00	8.12
Groups	629	0.72	0.00	3.00	0.79

The number of households visited by extension agents (*extvisit*) is high. It is expected that extension services can provide information related to the sustainable use of wetlands. However, the focus of extension training, especially in Kenya, has been biased towards increased agricultural production and, therefore, may not be useful towards wise use of wetlands. With regard to Uganda, the establishment of the Wetlands Inspection Division (WID) could have contributed to increased awareness on the importance of wetlands. The mean transport costs to the nearest major market centre of an equivalent of 80 Kenyan shillings is relatively high given that a large percentage of households subsist on less than one US dollar per day.[2] Transport costs to the market (*transpt*) are crucial as they influence cropping choices and the level of household integration to the market (Omamo 1998), as well as the demand for agricultural land. Increased demand for agricultural land could mean draining of wetlands to obtain more land for agricultural purposes.

Membership in groups (*group*) has a mean of 0.72 with a minimum of 0 and a maximum of 3. Groups are a form of institutions and may design rules of access to common property resources such as wetland products.

Perception of wetland degradation status

The decision on whether or not to commit resources to mitigate the effects of a given problem is founded on the acknowledgement and appreciation of the existence of the problem and the expected costs of the problem outcome vis-á-vis the expected benefits. Secondly, an individual will evaluate the severity of the problem relative to other problems that he/she faces and rank it accordingly. Thus, perception of wetland degradation problem by households will depend on the two aspects, which in turn will determine the level of engagement in the conservation of the wetland resources. The level of perception is likely to be influenced by the expected or realized loss in benefits by households over time.

The results (Table 3) show that more coefficients for the aggregated dataset are significant than the disaggregated ones. This could be explained by the number of observations and variables used in the

[2] The average transport costs are equivalent to one US dollar at the 2004 Kenyan shilling. For example, about 57% of the people in Kenya are considered to be poor and they live on less than one dollar a day.

Table 3 Multinomial logit regression results of factors influencing perception of wetland status

Variable/statistic	Tanzania		Kenya		Uganda		Pooled	
	Prob ($Y = 1$)	Prob ($Y = 2$)	Prob ($Y = 1$)	Prob ($Y = 2$)	Prob ($Y = 1$)	Prob ($Y = 2$)	Prob ($Y = 1$)	Prob ($Y = 2$)
Hhs	−0.07	−0.06	0.14	0.15	−0.17	0.02	0.05	0.07
Age	0.10	0.05	0.03	0.06	−0.01	0.21	0.0002	0.093*
Educ	−0.01	−0.01	0.00	0.002	0.001	0.001	0.0003	0.001**
Floodcr	0.14	−1.23	0.06	−0.66	−95.34	−94.31	−0.67**	−0.94**
drougcr	0.31	−0.75	0.42	0.26	−4.12	−0.60	−1.25***	0.35
Diseacr	0.26	0.76	1.10*	−0.66	2.18	2.14	0.25	−0.02
Hungcr	−0.89	−0.49	−2.85	−1.31	−1.46	−1.13	−0.52	−0.34
Distho	0.00	0.00	0.00*	0.00	0.01	0.01	0.00	0.000
Dummyke							0.33	−3.48**
Dummyug							2.75***	−1.58
Dummytz							1.13	−3.90**
Extvisit	−0.25	−0.45	−0.20	−0.54	−0.44	−0.45	−0.002	−0.08
Sex	−0.51	−1.19	0.69	−0.12	3.16	2.75	0.26	−0.02
Famca	1.02*	0.74	−0.001	−0.001	−0.01	1.10	0.00	0.001
Group	0.21	−0.31	−1.33*	−0.57	96.40	87.64	0.13	−0.52
Memdiv	0.01	0.03	0.16	0.02	−0.72	−1.18	−0.002	0.02
Particip	−0.01	−0.03	−0.16	−0.02	0.63	1.10	0.002	−0.02
Ageage	−0.001	0.00	0.00	0.00	0.001	−0.001	0.0002*	−0.001
Faror	0.00	0.00	−0.001	0.00	0.001	0.002	0.000	0.0002
Transpt	−0.001**	0.001	−0.01	−0.01	0.03	0.04	−0.001***	0.0002
Imputval	0.00	0.0001*	0.00	0.00	0.00	0.00	0.00	0.00
Wealth	−0.57	−0.95*	0.01	0.30	2.21	1.48	0.01	0.01
Hhinc	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crpeq	0.00	0.00	0.00	−0.001	0.001	0.001	0.00	0.00
Cognit	−0.04	0.11	0.01	0.004	0.15	0.37	0.003	0.05
Log-likelihood	−152.18		−159.30		−133.10		−498.20	
Chi^2	60.82**		71.06***		70.15***		214.28***	
df	42		42		42		48	
N	194		190		226		610	

df degrees of freedom, *N* number of observations

***,**, and * indicates 1, 5, and 10% significance levels, respectively

disaggregated models. A comparison of the status of the wetlands (*wetstatus*) between good and bad shows that age of household head (*age*) and education status (*educ*) are important determinants of poor rating of wetlands for pooled data. It is probable that with increased age, the more likely it is for a person to have experienced and observed changes of the wetlands over a longer period of time, thus leading to the appreciation of the temporal change of wetland status, unlike the youthful household heads.

The country dummy variables are negative, although those for Kenya (*dummyke*) and Tanzania (*dummytz*) are significant. This is a good indication that the level of wetlands degradation in Kenya and Tanzania is more advanced than in Uganda. This is possible given that it is only Uganda that has developed a wetland management strategy (i.e., Wetland Sector Strategic Plan, 2001–2010). Alternatively, it suggests that the respondents in Kenya and Tanzania are more sensitive to the status of the wetlands than those in

Uganda. It is likely that the land resource within the wetlands basin in Uganda can support the extant households without necessarily reverting to wetland reclamation. It may also be that shocks are more frequent and of a greater magnitude in Kenya and Tanzania. According to KIPPRA (2007), the average ratio of food aid to consumption in the 2001–2003 period was 2.6 for Kenya, 1.6 for Uganda and 1.4 for Tanzania. The ratio for Uganda is expected to be much lower than for Tanzania were it not for the conflicts in the northern part of Uganda. The same study also shows that the Daily Energy Supply (DES) in the 1990–2004 period was highly variable for Tanzania (coefficient of variation is 47.00) compared to Uganda (coefficient of variation is 33.72). Kenya was included among the top ten hungers' global hot spots on June 10, 2008.[3] The global hunger index was 19 for Uganda, 21 for Kenya and 26 for Tanzania while the percentage of the population malnourished was 44, 31, and 19%, respectively (IFPRI 2007). These statistics suggest that scarcity of food can easily aggravate the wetland degradation problem.

The flood crisis variable (*floodcr*) is a significant determinant of the perception of the wetland status for the aggregated data, but insignificant for disaggregated data, although it is negative. The occurrence of floods is likely to be due to increased incidences of upstream deforestation and reduced capacity of wetlands to slow down the flood flow. The inhabitants of the degraded wetlands are more likely to experience floods as a result. It thus suggests that the respondents are at least aware that floods arise from instability in the wetland ecosystem or its degradation. In most cases, floods are accompanied by diseases and general disasters.

Transport costs to the nearest major market (*transpt*) for households do matter with respect to the perception of wetlands. The variable is negative and significant with regard to the "bad state" perception of wetlands for aggregated data and the dataset from Tanzania. Considering that high transport costs deter households engaging in the market for goods and services, it follows that wetlands provide a rational alternative for acquiring the requisite goods and services. Excessive extraction of such goods and services will be reflected in degraded wetlands and, thus, the associated bad state perception. Furthermore, since the exit options from poverty are limited, households are likely to continue deriving livelihoods from wetlands products.

Disease crises (*diseacr*) are positively and significantly associated with the perception of a fair/moderate status of the wetlands in Kenya. This is surprising given that incidences of floods are frequent. However, it suggests that respondents are not aware of the ameliorating capacities of wetlands on disease occurrences and effects. Flood occurrences are associated with, among others, increased disease incidences, especially malaria and other water-borne diseases. In the 1997–1998 period, average temperatures in Kenya's highlands were as much as four degrees higher than usual, and incidence of malaria increased 300% over the baseline average for the 1995–2002 period. Meanwhile, malaria incidence in highland areas of Tanzania and Uganda increased by 146% and 256%, respectively, over the baseline.[4] Compared to the reference bad state perception, high levels of farm capital lead to a fair/moderate perception of the wetland status in Tanzania. Although it is location-specific, this result seems to suggest that farm capital reduces pressure on wetland resource extraction where high imputed values of wetland products are associated with the good perception variable. In contrast, though wealthier households perceive the state of wetlands as being bad. This may arise since wealthier households have high substitution possibilities and can easily out-migrate if conditions deteriorate.

In Kenya, the distance to farm fields from the homestead (*distho*) leads to fair/moderate perception of the wetlands status. This suggests that as more time is spent in the distant fields, respondents appear indifferent about the state of wetlands. The group (*group*) and group membership diversity (*memdiv*) variables influence the perception of wetland status by respondents as fair relative to bad and this effect is significant. The significance of the group variable may be due to information flow. Membership into self-help groups can offer an insurance mechanism against income shocks, provided that these shocks are not correlated among participants. Groups are part of social networks and are essential in risk pooling and

[3] http://www.wfp.org/english/?ModuleID=137&Key=2868, accessed on 20th August 2008.

[4] http://www.idrc.ca/en/ev-118958-201-1-DO_TOPIC.html, accessed on 20th August 2008.

risk sharing. If groups are already formed around a common purpose and share a common set of norms and values, this reduces the information and coordination costs of their organizing around another purpose, having already established a history of coordination and trust (Balland and Platteau 1996).

Willingness to pay for wetland conservation

The factors that influence the respondents' willingness to pay for wetland conservation are presented in Table 4. The results show that whereas location variables (*dummyke*, *dummytz*, and *dummyug*) have no impact on the willingness to pay for conservation measures, drought crises (*drougcr*) reduce the willingness to pay for wetland conservation in Uganda and Tanzania and for pooled data. This suggests that droughts increase the households' vulnerability and reduces their capacity to engage in wetland conservation.

Formal education variable of the household head (*educ*) matters in the willingness to pay for wetland conservation only in Uganda. The results show that the willingness to pay declines with increase in formal education. Whereas this might appear unexpected (Auci et al. 2006), it suggests indifference to conservation by the relatively educated since they are more likely to have alternative sources of income and, therefore, the conservation of the wetlands matters little to them as a source of livelihoods.

Hunger crisis (*hungcr*) negatively and significantly influences the willingness to pay for wetland conservation. Hunger is prevalent in Kenya. Households would thus be more concerned about surviving the hunger shock than paying for wetland conservation, which implies that wetland conservation through contributions from households is bound to fail during periods of prolonged drought unless the effects are ameliorated. Uganda does not experience consistent or widespread drought but rather periodic episodes of drought in its northern districts. In Kenya, drought patterns are serious and have become increasingly frequent.[5]

Extension services are important in mobilization and sensitization programmes. With regard to wetlands, this would take the form of informing the extant inhabitants of the value of the inherent wetland ecosystem. The study results show that the number of extension visits (*extvisit*) is a significant determinant of the willingness to pay for wetland conservation for pooled data. This is also apparent for the Ugandan and Tanzania datasets, whereas its effect in Kenya is insignificant. The insignificance of extension in Kenya has also been reported by Mwakubo et al. (2005), and this raises the question of the effectiveness of the extension service in raising awareness about the importance of wetlands in Kenya. As already indicated this may be due to predominant focus of formal extension systems on major food staples rather than conservation of wetlands.

The group membership variable (*group*) positively and significantly influences the likelihood of individual households' willingness to pay for wetland conservation in Kenya. This holds also for the aggregated data. Membership in self-help groups is a form of social capital and is quite instrumental in the reduction of transaction costs, especially with information acquisition (Mwakubo et al. 2005). Self-help groups are non-market institutions and are more appropriate if management of certain natural resources has certain fixed costs, which can be met through group labour inputs. The time cost of organizing and participating in collective action decreases if wages fall, which is likely in organized groups. On the other hand, membership diversity (*memdiv*) negatively and significantly influences the willingness to pay for wetland conservation in Kenya and the pooled dataset, whereas its effect is positive for Uganda. The effect of this variable on wetland conservation in Tanzania is insignificant. These results imply that organizations with diverse memberships, which would potentially provide increased opportunities for wetland conservation (e.g., through information sharing), have location-dependent effects. Higher membership variability is likely to create conflicts, or that such people cannot easily mesh up and form one group. This could explain the result for the Kenyan and pooled data sets. Collective action has been found to be successful with homogenous groups (Balland and Platteau 1996; Fehr and Fischbacher 2004; Carpenter et al. 2004). Yet, heterogeneity in group membership seems to provide an

[5] http://www.unisdr.org/africa/af-partners/docs/IGAD-vol4-disaster-risk-management-program.rtf, accessed on 20th August 2008.

Table 4 Tobit regression results of factors affecting willingness to pay for wetland conservation

Variable/statistic	Tanzania		Kenya		Uganda		Pooled	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Hhs	−58.75	42.41	35.05	72.44	17.48	24.52	−10.80	26.11
Age	67.76*	35.97	3.15	5.18	0.41	0.78	0.46	1.16
Educ	0.21	0.64	−0.35	0.51	−0.47**	0.24	−0.20	0.2592
Floodcr	110.87	373.63	−230.25	480.19	−157.07	113.33	−103.13	159.7290
Drougcr	−1,274.00**	399.72	−293.41	673.35	−232.25*	120.17	−698.68***	175.2890
Diseacr	205.11	211.03	702.60	431.04	−194.56	135.69	213.05	143.19
Hungcr	388.24	255.44	−2,931.58**	1,025.71	6.78	117.37	110.12	166.30
Distho	0.00	0.02	0.01	0.03	−0.001	0.01	−0.001	0.01
Dummyke							−585.64	419.52
Dummyug							−338.87	346.33
Dummytz							95.21	377.08
Extvisit	185.30*	96.70	−89.89	125.56	10.29***	3.64	12.16*	6.95
Sex	320.26	338.08	250.72	389.25	88.32	105.11	241.29	148.00
Famca	−7.03	6.78	1.12	0.96	0.05	0.19	0.06	0.31
Group	10.58	391.42	2,302.95***	597.27	−1,256.48	779.02	1,157.25***	254.78
Memdiv	−50.26	33.13	−194.80**	81.75	155.32*	88.69	−104.96***	26.30
Particip	50.58	33.01	193.90**	81.74	−155.13*	88.68	104.58***	26.27
Ageage	−0.67*	0.37	−0.14	0.12	−0.07	0.04	−0.06	0.05
Faror	−0.16	0.21	0.20	0.39	−0.02	0.11	−0.05	0.13
Transpt	−0.18	0.20	4.35	2.86	−0.26	0.70	−0.11	0.20
Imputval	−0.01	0.01	0.002	0.002	−0.01	0.03	0.002*	0.001
Wealth	−160.63	211.37	114.28	255.36	−43.42	135.84	4.59	26.12
Hhinc	0.00	0.00	−0.002	0.002	0.00	0.000	0.00	0.00
Crpeq	0.00	0.001	0.003	0.02	0.01*	0.01	0.00	0.001
Cognit	−3.80	38.39	−2.27	1.92	42.48**	20.51	−0.84	1.39
Wetstatus	237.31	162.96	577.46***	205.21	−146.08	117.57	234.05**	97.34
Sigma	1,314.73***	71.01	1,871.84***	121.96	717.61***	39.97	1,397.41***	46.43
Log-likelihood	−1,511.623		−1,109.055		−1,387.008		−4,099.896	
N	194		190		226		610	

N number of observations, *SE* standard error

***,**, and * indicates 1, 5, and 10% significance levels, respectively

impetus for active participation in wetland conservation efforts in Uganda.

The imputed value of extracted wetland resources (*imputval*) positively and significantly determines the willingness to pay for wetland conservation (for pooled data) but is insignificant for dis-aggregated data. Lagged crop output value (*crpeq*) and cognitive social capital (*cognit*) are significant determinants of willingness to pay in Uganda. This means that a better and improved integration of farmers into the output markets would stimulate wetland conservation, which is likely to occur through improved crop returns. This finding is consistent with the argument by Grepperud (1996) and Lele and Stone (1989) that, in areas that are poorly integrated into markets, small-holder farmers degrade their environment as population growth leads to land fragmentation.

The overall perception of wetland degradation (*wetstatus*) is a significant variable for willingness to pay for wetlands conservation in Kenya and also for the pooled data. This means that acknowledgement of a degraded wetland would motivate farmers to more willingly contribute to conservation efforts. As Mitsch and Gosselink (1993) argue, perceived values of wetlands are determined not only by functional ecological processes but also by human perceptions, human population pressure and the extent of the resource.

The imputed value of wetland products

The imputed values of wetland products (*imputval*) represent the market value of the products once they have been extracted from the wetlands. It is expected that the higher the imputed value, the higher the likelihood of increased access and active exploitation of the resources. The results of the Tobit model in Table 5 show that flood occurrence (*floodcr*) positively and significantly influences the imputed value of extracted wetland products in Kenya and Uganda, and regionally as well. Floods are a frequent occurrence especially in the Kenyan study sites. They are usually accompanied by displacement of households from their homesteads and one would have expected that during such times, access to wetlands is curtailed and subsequently resource extraction from the

Table 5 Tobit regression results of factors affecting the imputed value of wetland products

Variable/statistic	Tanzania		Kenya		Uganda		Pooled	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Hhs	−942.39	831.43	5,002.65	3,119.37	95.14	107.33	1,595.02	1,346.33
Age	−30.27	719.79	−7.60	93.31	7.82	31.78	32.31	58.72
Educ	−10.88	11.20	17.41	22.29	0.41	1.14	5.32	12.54
Floodcr	2,193.11	7314.81	39,231.98*	20,948.35	913.05*	550.97	28,050.71***	8,550.40
Drougcr	3,840.15	8,438.41	−2,002.05	29,268.05	2,192.12***	589.22	30,741.78***	9,991.36
Diseacr	−213.57	4,008.91	20,984.37	18,197.16	−268.72	561.74	5,205.49	7,269.57
Hungcr	3,662.50	5,125.07	−30,009.72	43,413.67	−624.03	497.62	4,379.45	9,246.84
Distho	0.81*	0.44	−3.40**	1.52	0.004	0.04	−0.54	0.62
Dummyke							−12,786.29	21,294.34
Dummyug							−107,777.64***	18,492.48
Dummytz							−88,699.21***	19,758.05
Extvisit	243.41	1,820.75	−353.58	3,563.49	−17.21	30.07	−610.37	1,461.24
Sex	9,249.59	6,855.06	4,420.78	16,561.90	308.85	479.18	9,409.89	7,716.35
Famca	58.50	84.65	−45.88	39.51	−0.23	0.86	−22.77	16.33
Group	86.70	7,417.79	38,858.20	27,136.57	−4,765.71	3,842.06	36,412.15***	12,361.01
Memdiv	−992.60	613.20	−3,034.39	3,704.91	−158.10	393.56	−3,738.40***	1,296.51
Particip	1,007.09*	610.71	3,013.07	3,705.26	164.06	393.82	3,731.74***	1,294.70
Ageage	−1.01	7.40	2.11	4.64	0.14	0.39	−2.36	2.36
Faror	4.58	4.10	10.52	17.42	0.53	0.50	14.21**	6.94
Transpt			−5.92	126.90	16.79	11.33	−11.45	10.44
Wealth	−3,770.26	4,134.53	23.65	67.74	517.68	615.97	37.49	49.02
Hhinc	0.00	0.00	0.18***	0.070	0.000	0.00	0.00	0.00
Crpeq	0.01	0.02	−0.03	0.77	−0.003	0.02	0.03	0.05
Cognit	−52.52	781.81	78.54	92.76	37.79	115.10	53.54	67.71
Wetstatus	5,811.86*	3,161.97	1,454.79	9,083.23	−44.03	408.65	6,475.94	4,626.72
Sigma	23,480.84***	1,603.36	91,522.40***	4,695.00	2,650.37***	203.02	68,205.44***	2,429.87
Log-likelihood	−1,341.96		−2,440.223		−897.651		−5,036.549	
N	194		190		226		610	

N number of observations, *SE* standard error

***,**, and * indicates 1, 5, and 10% significance levels, respectively wetlands would also be impossible. Nevertheless, a plausible explanation would be that once the floods have receded and access is possible, the households extract resources intensively to compensate for deficits that might have occurred during the displacement period. It is during floods that local communities harvest fish that come along with the floods. Regeneration of wetlands vegetation is also faster immediately after the floods. Alternatively, wetlands provide the only buffer against drought effects, in which case farm households are likely to access resources in the wetlands that would be lacking in the surrounding areas due to drought effects.[6]

Drought (*drougcr*) positively and significantly influences the imputed value of wetlands in Ugandan and pooled datasets. This suggests that during periods of drought, there is intensive harvesting of wetland products to sustain livelihoods by the local communities. It may be that prices of wetland products are fairly competitive during droughts, thereby serving as an incentive for increased extraction. Nevertheless, the effect is regionally not widespread and it is more location-specific.

Distance from homesteads to the farm fields (*distho*) positively and significantly determines the imputed value of wetland products in Tanzania, whereas in Kenya it is negative and significant. Apparently, large distances to farms from homesteads facilitate increased extraction in Tanzania. If the increased extraction can be linked to wetland degradation, then a possible intervention would be to reduce homestead to farm-field distance. This can be achieved through land consolidation. The country dummy variables for Uganda and Tanzania are negative and significant. The implication of this result is that one is likely to observe lower imputed values or possibly lower quantities of extracted products from the wetlands in the two countries.

For pooled data, household membership in groups (*group*) is a significant and positive determinant of the imputed value of the wetlands products. One possible reason is that the group attribute of social capital may facilitate reduction of transaction costs as witnessed in grain marketing in Ethiopia (Gabre-Madhin 2001). There could also be other benefits of being in a group, such as risk pooling. As Turner (1991) argues, the underlying causes of wetland loss are economic and institutional. Homogeneous groups are likely to extract products in a wider scale and, consequently, the value of these products would be reflected in the individual households that belong to the group. Membership diversity coefficients are negative across all the datasets.

The farm orientation variable (*faror*) is a significant determinant of the imputed value of the wetlands products for pooled data. The results show that the more off-farm income a household has, the higher the value of extracted products. This implies that off-farm orientation is driven largely by wetland resources. The household income variable positively and significantly determines the imputed value of wetland products in Kenya. More household income may be used to access variable inputs, e.g., labour, which may increase exploitation of the wetland resources. It seems that higher incomes increase an agent's demand for environmental goods and services (Balland and Platteau 2006) and is consistent with the Environmental Kuznetz curve. On the other hand, perception of the wetland status matters in the imputed value of the wetland products in Tanzania.

Conclusions and policy implications

The findings of the empirical study in the Kenyan, Ugandan, and Tanzanian Lake Victoria watershed lend support to important linkages between incidences of households' vulnerabilities, livelihoods, and institutions in the use and management of wetlands in the Lake Victoria watershed. The dynamism associated with these facets can be characterised as general, and location-specific, with respect to effects and outputs. Vulnerabilities, livelihoods and local institutions are linked; local institutions in the form of collective action—defined by groups and group characteristics—influence the rate of use of wetland products as indicated by the imputed value of the extracted products. The effect of collective action varies with social capital attributes and also with location. It is evident that local institutions have effects on the level and intensity of wetland utilization, and that intensity

[6] Flooding can be both a blessing and a curse at the same time; a blessing as individuals are able to access fish resources more easily and a curse because households are forced to migrate to high lying areas or grounds. It seems that the positive effects outweigh the negative effects of flooding.

of wetland use is affected by community inherent shock.

The empirical evidence from this study suggests that the dynamics of wetland management, when livelihood assets and local institutions are factored in, are complex. The influence of these factors on these dynamics is context- and location-specific, whereby their effects may change the direction of relationships. One important insight from the results of this study is that livelihood shocks in one form or another do matter in the management and use of wetland resources, just as does local institutions in the form of groups which embed in social capital in all its attributes. The results have shown that social capital is important in the sustainability of wetlands.

The policy implication, therefore, is to devise innovative and cost-effective measures to encourage household membership into wetland user groups that can undertake self-regulation. Improving land tenure and helping households build asset endowments are also crucial.

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