Environment for Development

Discussion Paper Series May 2023 ■ EfD DP 23-07

Willingness to pay for Nature Restoration and Conservation in Sub-Saharan African Cities:

The Case of Forests, Rivers and Coasts in Dar es Salaam, Tanzania

Byela Tibesigwa, Herbert Ntuli and Telvin Muta

Discussion papers are research materials circulated by their authors for purposes of information and discussion. They have not necessarily undergone formal peer review.

Central America
Research Program in Economics and Environment for Development in Central America Tropical Agricultural Research and Higher Education Center (CATIE)

Chile
Research Nucleus on Environmental and Natural Resource Economics (NENRE)
Universidad de Concepción

China
Environmental Economics Program in China (EEPC)
Peking University

Colombia
The Research Group on Environmental, Natural Resource and Applied Economics Studies (REES-CEDE), Universidad de los Andes, Colombia

Ethiopia
Environment and Climate Research Center (ECRC), Policy Studies Institute, Addis Ababa, Ethiopia

Ghana
The Environment and Natural Resource Research Unit, Institute of Statistical, Social and Economic Research, University of Ghana, Accra

India
Centre for Research on the Economics of Climate, Food, Energy, and Environment, (CECFEE), at Indian Statistical Institute, New Delhi, India

Kenya
School of Economics
University of Nairobi

Nigeria
Resource and Environmental Policy Research Centre, University of Nigeria, Nsukka

South Africa
Environmental Economics Policy Research Unit (EPRU)
University of Cape Town

Sweden
Environmental Economics Unit
University of Gothenburg

Tanzania
Environment for Development Tanzania
University of Dar es Salaam

Uganda
EfD-Mak, School of Economics and Department of Agribusiness and Natural Resource Economics, Makerere University, Kampala

USA (Washington, DC)
Resources for the Future (RFF)

Vietnam
University of Economics
Ho Chi Minh City, Vietnam

Willingness to pay for Nature Restoration and Conservation in Sub-Saharan African Cities: The Case of Forests, Rivers and Coasts in Dar es Salaam, Tanzania

Byela Tibesigwa[1] Herbert Ntuli[2] and Telvin Muta[3]

Abstract

Sub-Saharan Africa's urban ecosystem is under considerable pressure due to rapid urban sprawl and high direct dependency on the natural ecosystem. But the value of nature conservation or restoration is poorly understood. The current paper reports the results of an investigation of willingness to pay for nature restoration and conservation in Dar es Salaam, Tanzania. To account for preference and scale heterogeneity a menu of models - random parameter logit, generalised multinomial and latent class model - with varying assumptions are employed. Findings are that the marginal WTP is highest in relation to forests, where WTP is between TSH88- and TSH331, (US$0.04 – US$0.17) depending on the estimation model. This is followed by WTP for restoration and conservation of rivers, the value of which is TSH5-TSH53 (US$0 – US$0.03). The value placed on conservation of coasts is TSH2-TSH23 (US$0 – US$0.01). The low value placed on nature restoration and conservation by residents in the city of Dar es Salaam open up policy dialogue on the importance of nature in cities amidst rapid urbanization in the region. The figures also cast doubt on the potential for generating revenue to finance green infrastructure from the residents of cities in developing countries. The maximum revenue that can be collected ranges from US$43650 for coasts and US$743050 for forests. Lack of environmental awareness and concern translates into environmentally unsustainable behaviour in cities such as starting of veldt fires, deforestation, wetland conversion, stream bank cultivation and littering of beaches. Our results suggest the need for massive awareness campaigns to sensitize the city's residents about different attributes of nature and their value in provision of ecosystems goods and services to charge their perceptions and attitudes.

Keywords: choice modelling, WTP, conservation, restoration, forests, rivers, coasts, heterogeneity, Tanzania

JEL Codes: Q25, Q5, Q53, Q57

---

1 Byela Tibesigwa is a Director at Mellben Research; a Senior Research Fellow at Environment for Development (EfD) in Tanzania, University of Dar Es Salaam; and a Research Associate at the Environmental Policy Research Unit (EPRU), University of Cape Town. byela@mellbenresearch.com

[2] Herbert Ntuli is a Senior Research Fellow, EfD - Environmental Policy Research Unit (EPRU) in the School of Economics at the University of Cape Town. ntuliherb@yahoo.com

[3] Telvin Muta is at the Jomo Kenyatta University of Agriculture and Technology (JKUAT) in Nairobi, Kenya. ddtelvin.td@gmail.com

This paper is an output of the Ecosystem Services Accounting for Development (ESAfD) project, conducted by the Environment for Development (EfD) initiative and the Swedish EPA, and funded by the Swedish International Development Cooperation Agency (Sida). See EfD Natural Capital Collaborative (NatCap): https://www.efdinitiative.org/natural-capital-collaborative-natcap

Willingness to pay for Nature Restoration and Conservation in Sub-Saharan African Cities: The Case of Forests, Rivers and Coasts in Dar es Salaam, Tanzania

Abstract

Sub-Saharan Africa's urban ecosystem is under considerable pressure due to rapid urban sprawl and high direct dependency on the natural ecosystem. But the value of nature conservation or restoration is poorly understood. The current paper reports the results of an investigation of willingness to pay for nature restoration and conservation in Dar es Salaam, Tanzania. To account for preference and scale heterogeneity a menu of models - random parameter logit, generalised multinomial and latent class model - with varying assumptions are employed. Findings are that the marginal WTP is highest in relation to forests, where WTP is between TSH88- and TSH331, (US$0.04 – US$0.17) depending on the estimation model. This is followed by WTP for restoration and conservation of rivers, the value of which is TSH5-TSH53 (US$0 – US$0.03). The value placed on conservation of coasts is TSH2-TSH23 (US$0 – US$0.01). The low value placed on nature restoration and conservation by residents in the city of Dar es Salaam open up policy dialogue on the importance of nature in cities amidst rapid urbanization in the region. The figures also cast doubt on the potential for generating revenue to finance green infrastructure from the residents of cities in developing countries. The maximum revenue that can be collected ranges from US$43650 for coasts and US$743050 for forests. Lack of environmental awareness and concern translates into environmentally unsustainable behaviour in cities such as starting of veldt fires, deforestation, wetland conversion, stream bank cultivation and littering of beaches. Our results suggest the need for massive awareness campaigns to sensitize the city's residents about different attributes of nature and their value in provision of ecosystems goods and services to charge their perceptions and attitudes.

Key words: choice modelling, WTP, conservation, restoration, forests, rivers, coasts, heterogeneity, Tanzania

JEL Classifications: Q25, Q5, Q53, Q57

1. Introduction

Dar es Salaam is a coastal city in Tanzania with both planned and largely unplanned areas (Halloran and Magid 2013). Lack of proper planning is a characteristic of many African cities which gives rise to informal settlements (Smit et al., 2017). Cilliers et al. (2013) observes that unplanned land use emerges because of population pressure on housing and land for subsistence farming, which triggers shortages and forces people to encroach on urban green open spaces, forests, wetlands and unused municipal land. Evidence shows that demand for housing in the formal market is elastic since the population is increasing (Monkkonen 2013), while its supply could be inelastic in the short-run because of stringent housing regulations which force poor people to illegally acquire land for housing in the informal sector (Monkkonen 2013; Gyourko and Molloy 2015). The combination of the formal and informal housing brings together households with diverging preferences for environmental attributes (Lategan and Cilliers 2014).

Most cities in sub-Saharan African are overwhelmed by rapid urbanisation due to a combination of a very high population growth rate and rural-urban migration (Jedwab and Vollrath 2019). It is estimated that the population in sub-Saharan Africa could double in size by 2050 (Bongaarts and Casterline 2013) and close to 70% of this population will be located in urban areas (Henderson 2002; Duranton 2014; Jedwab and Vollrath 2019). Rapid urbanization in Africa is also responsible for the increasing share of informal settlements, referred to as urban slams in the literature on urbanization and growth (Lategan and Cilliers 2014; Cilliers and Cilliers 2015). Because this rapid urbanisation is unlikely to be planned, it will increase urban challenges such as degradation of the natural environment. Some scholars attribute environmental degradation to urbanization without growth (Henderson 2002). Dar es Salaam is not an exception to these occurrences, and like many other cities in the region, it is likely to follow a similar trajectory with tragic results.

In Tanzania households have a high and direct dependence on natural ecosystems, e.g., coastal fisheries and forests for fuel. Thus, urban restoration and conservation programmes become important for sustainable development (Constant and Taylor 2020). Theoretically, the benefits that households derive from a natural resource directly translate into the use value that these households attach to the resource (Nielsen et al. 2007). However, households report low values because they fail to incorporate non-use values associated with ecosystem goods and services (Shackleton et al. 2015). This value is also distorted in the presence of competing land uses (Bullock 2008). For example, a community might decide to use land that is currently demarcated as a wetland for agricultural purposes which means that their valuation of that resource is also influenced by an alternative land-use option. Cilliers (2013) argue that communities do not usually take into consideration the value of ecosystem goods and services when deciding among alternative land use options. It becomes imperative from a policy point of view to demonstrate the value of natural resources in the context of competing land uses so that city authorities are able to design appropriate policy interventions to reduce environmental degradation.

In the context of cities in developing nations like Dar es Salaam, the values that poor urban resource users ascribe to urban amenities like forests, rivers, and coastal areas are unknown, yet this knowledge is thought to contain significant clues to the issue of environmental degradation in Africa. Typically, it becomes imperative from a policy perspective to ascertain how users value the natural resources they depend on in order to develop effective policy interventions that are specifically customized to suit local problems. What need to be estimated in this study is the worth of ecosystems services and the value of restoration and conservation efforts such as soil erosion control, air and water filtration, and water reticulation, retention, If the value of these is made available to policymakers, this knowledge might be used to inform policy processes such as the creation of sustainable long-term financing mechanisms for restoration and conservation programmes. To the best of our knowledge, few studies have been conducted in Africa in this field (Constant and Taylor, 2020), with the bulk of this literature concentrating on either developed nations or other developing regions such as Asia and South America (e.g., Chen and Jim, 2010; Zander et al. 2010). As a result, environmental policy interventions addressing restoration and conservation issues on the African continent have only had modest success, either because they were ardently backed based on weak empirical evidence or adopted from other regions in their current form without being modified to suit local conditions (Ashagre et al. 2018; Constant and Taylor, 2020).

Given the challenges faced by policymakers and conservationists in coming up with practical solutions to combat environmental degradation, the six issues highlighted earlier, i.e., urban planning, demand for housing, housing demand elasticities, urban growth, dependence on and value of natural ecosystems, should not be viewed as interconnected. Our study will contribute to the global picture by assessing the value that urban-based resource users place on nature, which complements other studies. The contribution of this study is twofold. First, our paper contributes to the growing literature on WTP for urban nature-based infrastructure in the context of a typical African city. On a methodological front, we contribute to the body of knowledge by designing and applying a choice experiment to elicit preference for attributes of an environmental programme such as nature restoration and conservation. By so doing, our study adds to studies that have previously estimated the value of restoring ecosystems by providing evidence from sub-Saharan Africa on how poor urban dwellers value nature. The information from this study can be used to inform policies in the region on land use and urban planning.

Based on the preceding discussion of the problem, the contribution of this study, and research gaps identified in the literature, three important policy questions arise. i) Are Dar es Salaam residents willing to pay for nature restoration and conservation and how much? ii) Does their willingness to pay differ across districts and wealth categories? iii) What are the factors driving willingness to pay? To this end, a choice experiment is used to tease out household preferences for different restoration and conservation programmes. Unlike the contingent valuation technique (CVM) which only conveys WTP values, this method is chosen because it does not only tell us about the WTP values that households place on nature, but also the attributes that matter the most. Based on this method, it is assumed that resource users have the ability to disaggregate a public good into important attributes, place a value on each attribute, and aggregate these values for a total value. This value may be different to the value derived using the CVM approach. Either way, we argue that the choice experiment approach yields better results by giving a more realistic value since it allows the respondent to think of a public good in terms of it's functionality or attributes.

Using the choice experiment and data from 705 households randomly selected from all districts in Dar es Salaam, this study estimates the willingness to pay (WTP) for forest, river and coastal restoration and conservation. To account for preference and scale heterogeneity a menu of models with varying assumptions are employed, including random parameter logit, generalised multinomial and latent class models - Our results show that the marginal WTP is highest for forests, and this ranges from TSH88 to TSH331 (US$0.04 - US$0.17), depending on the estimation model. This is followed by rivers, which produced a value of TSH5-TSH53 (US$0 - US$0.03). The value placed on coasts is TSH2-TSH23 (US$0 - US$0.01). At the district level, WTP for forests is given the highest value in Ilala (TSH323-TSH688), followed by Temeke and lastly Kinondoni. River restoration and conservation is most highly valued by the residents of Temeke (TSH48-TSH352) and valued the least by Kinondoni residents. The marginal value of WTP for coastal conservation is rated highest in Temeke (TSH56-TSH294).

The rest of the paper is organised as follows: Nature conservation in Dar es Salaam is explained in the subsequent section. This is followed by a discussion of valuations in past studies in section 3. The choice experiment, data collection and analytical methods are presented in section 4. Section 5 provides the results, and concluding remarks are offered in section 6.

2. Nature restoration and conservation in Dar es Salaam

Several forests, rivers and coastal areas are located either within the confines of or near the city of Dar es Salaam. These natural resources differ in characteristics such as level of degradation, causes of environmental degradation, location, size, uses or resources harvested, users, management and their importance to the city's inhabitants, authorities, and visitors. Section 2.1 provides a description of forest resources in Tanzania and their level and causes of environmental degradation. Table A.1 in Appendix A shows the location of the forests discussed.

2.1 Forests in Dar es Salaam

Kazimzumbwi Forest Reserve is located in the Pugu Hills area about 23.5 Kilometers from Dar es Salaam and was established in 1936. It covers an area of 4,887 hectares of which only 900 ha can be considered forest. The protective forest reserve is managed by Kisarawe District. Kazimzumbwi is among the most famous coastal forests in Tanzania, along with Pugu and two other forest reserves which lie outside Dar es Salaam. These forests represent the main water catchments for the Msimbazi, Kimani, Nzasa, and Nyeburu rivers. They offer enormous potential for education and recreation for the citizens of Dar es Salaam. A botanical survey conducted in 2011 and 2012, revealed 343 plant species in 234 genres and 70 families in four sites of the reserve. These are Buyuni, a recently cleared site in the forest, and sites in Pugu; Mambisi, and Pugu Relini (recently deforested), Pugu Dunda, Kimani (recently degraded and being cleared) and Pugu Mpakani and Minaki Bwawami (less disturbed forests) (Gwegime et al. 2013). According to Gwegime, et al., Kazimzumbwi forest has experienced forest disturbance including pole and timber extraction, and charcoal production and cultivation activities continue to be major threats to the forest. Charcoal kilns are widespread across the forest reserve with 114 and 48 charcoal kilns found in 9 transects in Kazimzumbwi in 2011 and 2012 respectively. Fire is also a widespread problem in Kazimzumbwi with 169 events of fire recorded in 2011-2012. At the current rate of deforestation, assessed on the basis of a survey spanning the period 2011 to 2012 and satellite image analysis carried out by the Tanzania Forestry Conservation Group (TFCG), the forest of Kazimzumbwi was predicted to disappear by 2014, but this didn't happen originally predicted, due to increased enforcement of the rule of law by the forest agency which came at a huge cost to the government and this is not sustainable. Coordinated conservation efforts are urgently needed to save these important and unique forests. This requires different approaches such as co-management or full devolution models with a high level of political support and commitment to enforcing the Forest Act, 2002[1].

[1] Forest Act, 2002. Gazette of the United Republic of Tanzania No. 23. Vol. 83, 7 June, 2002

Pugu Hills Forest Reserve is located in the Pugu hills near Dar es Salaam adjacent to Kazimzumbwi forest. Together with Kazimzumbwi, the Pugu forest (previous known as Mogo Forest) is one of the oldest forests in the world (Boussougou et al., 2018). The area is characterized by large numbers of endemic animal and plant species. Pugu Hills Forest Reserve is 2,180 ha of which less than 400 ha remains in reasonable condition and is one of the last remaining vestiges of lowland coastal forest in Tanzania (Gwegime et al. 2013). It is suggested that the small amount of natural vegetations remaining in the reserve should be given full protection with Nature Reserve Conservation status (Burgess et al. 2013).

The 2012 TFCG survey found that, as in Kazimzumbwi, pole and timber extraction, charcoal production and cultivation activities are major threats to the Pugu forest. Charcoal kilns are widespread across the reserve. In total 107 and 72 charcoal kilns were counted along 9 transects in Pugu in 2011 and 2012 respectively. Fire is also a widespread problem in Pugu, with 115 fire events recorded in 2011-2012. According to Burgess et al. (2013), the TFCG survey and analysis of satellite image data, the Pugu forest will completely disappear by 2017 if deforestation continues at its current rate. The current status of the Pugu Reserve still makes the forest vulnerable to bushfiresalthough it is not suitable for charcoal production. Forest degradation has led to the loss of endemic plant species at Pugu (Boussougou et al. 2018). Proposals for a Kisarawe Railroad Hub threaten hopes that Pugu Hills Forest Reserve could become an urban nature park by the transformation of Pugu Kajiungeni into a middle-class suburb of Dar es Salaam (Boussougou et al., 2018).

Pande Forest Reserve is located approximately 25 km Northeast of Dar es Salaam and 16 km inland from the city. It covers area of 1226 hectares and has a boundary length of 15 km. The area was declared a forest reserve in 1952 and in 1990 it became a Game Reserve currently managed by the Wildlife Division of the Ministry of Natural Resources and the Kinondoni Municipality. The reserve can be accessed from Bagamoyo Road via Bunju B or Morogoro Road via Mbezi. The Wildlife Division is responsible for managing Pande Forest Reserve according to standard practice for game reserves with a focus on law enforcement. However, between 1989 and 2001 much of the centre of Pande Forest Reserve was completely cleared of forest. In 2001 TFCG began to work with communities around the forest to promote greater community support for the sustainable management of the forest reserves. This has led to an improvement in the cooperation between local communities and the Wildlife Division. Vikindu Forest Reserve is located south of Dar es Salaam near Pwani region, covering an area of 1,599 ha, much of which is under plantation. The forest is completely degraded and attempts to rescue it were abandoned because of the extent of the damage caused (Sunseri 2005). It was home to the Sokoke pipit (*Anthus Sokokensis*), a bird species in the Motacillidae family found in Kenya and Tanzania and threatened by habitat loss. The pipit's natural habitat is subtropical or tropical moist lowland forests.

2.2 Rivers in Dar es Salaam

The Msimbazi River has a total length of about 35 km with a catchment area of about 289 square km and a mean runoff of about 71mm per year. The river flows from Pugu Forest Reserve towards the Indian Ocean and it has three major tributaries and sub tributaries, namely lLuhanga, Ubungo (a tributary of the Luhanga River) and Sinza, which lies mainly in the city. It is an important source of drinking water and water for other household uses for the residents of Dar es Salaam, such as irrigation of vegetable gardens. It supports agriculture and industry while at the same time acting as an environmental buffer. At the same time, it is one of the most polluted urban rivers in Tanzania (Chen et al., 2022). The river's catchment area includes sources of pollution such as on-site sanitation systems, industries that release effluent, sewers, and a major crude solid waste disposal site. It is evident that being flanked by human settlements and industrial establishments contributes to the river's vulnerability to pollution. Industrial effluents, including heavy metal pollution and illegal sewage systems are threatening the potential of Msimbazi to provide ecosystem goods and services (Mwegoha and Kihampa 2010).

Mzinga river is one of four major urban rivers located in the watershed of the region and in the city of Dar es Salaam, the others being the Mpiji, Kizinga and Msimbazi Rivers. Mpiji River forms the northern boundary of Dar es Salaam. Together with Kizinga River, Msimbazi River originates from the Pugu Kisarawe hills, flowing to the north of the city centre. from It consists of sandy sediments favouring filtration which recharges the ground water, sustaining the river flow during the dry season. Water from Kizinga River and Msimbazi River flows into the harbour area of the city. The Mzinga River has a total length of 10 km and catchment of 41 km^2. The water in Mzinga river originates from springs in the highland of Msongola where the river has its main tributaries, including the Bunguni, Mianzini and Toangoma tributaries. The deterioration in water quality of Mzinga river is due to improper waste disposal from agro-industrial plants and environmental degradation from deforestation of river catchments (Saria 2015). It also suffers as a result of an increase in domestic agricultural The Mzinga river is located in the south of Dar es Salaam crossing Charambe ward and Mbagala Rangi Tatu, Mbagala Kuu, and Tandika. Mzinga River flows from west to east in the centre of the city and serves as a source of water for agriculture and domestic activities.

Almost all the freshwater bodies discussed are being polluted by expanding human population, industrialization, intensive agriculture practices and discharge of massive amount of wastewater which result in deterioration of water quality (Mwegoha and Kihampa 2010).

Dar es Salaam city receives its water supply from the Ruvu and Kizinga rivers with three water treatment plants, namely upper Ruvu, lower Ruvu and Mtoni. The river flows in a North-easterly direction to the Indian Ocean. Kizinga has a total length of 17.5 km and a catchment area of 432 squares km. The water in the Kizinga River meets domestic standards for drinking water. Kizinga flows throughout the year and supports domestic water supply in the Mbagala area. Mpiji River forms the northern border between Dar es Salaam and the Coastal Regions. It is a seasonal river stretching to about 12.7 km with a catchment of 52 square km. Despite the city expanding towards Bagamoyo, the river is still less polluted than other rivers draining the city centre. There are also other small and seasonal rivers and streams in Dar es Salaam, including the Tegeta, Mbezi, Mlalakuwa, Kimani, Uvumba, Kimanga, Makulimula, Mkusa Kijitonyama, Sinza and Tabata. These are essentially temporary rivers largely serving as a drainage network for Dar es Salaam city. Table A.2 shows the locations of the rivers.

2.3 Coasts in Dar es Salaam

Dar es Salaam is Tanzania's largest coastal city.It is home to Tanzania's main harbour and functions as the country's economic hub. Apart from being an attractive site for tourism, the Tanzanian coast has a wide range of ecosystems. The coastal region contributes one third of the national gross domestic product. These natural resources are extremely sensitive to overexploitation and increased utilisation may lead to unrecoverable damage of coastal areas. The coastal area of Dar es Salaam region north of Dar es Salaam which spans the 23 km shoreline of Msasani Peninsula. The Peninsula is divided into six sections namely the shoreline on the island of Mbudya, Pangavuni and Bongoyo, Msasani Bay, Kunduchi Coastline and

Kawe. of the coastal areas south of Dar es Salaam extends from Kivukoni to Kigamboni and covers over 30 kms of beaches. Based on ownership status, the coastal areas can be categorised into private coastal areas, semi-private coastal areas, semi-public coastal areas, and public coastal areas.

Private coastal areas are not accessible to the public since they are developed all the way to the shore or cliff edge and surrounded by walls or fences. Semi-private coastal areas include any kind of coastal development targeted at customers of a higher socioeconomic status than the general population of Dar es SalaamI. Semi-public coastal areas include coastal developments that do not fence off the beach These developments follow the 60-meter regulation which allows public access to the development's beaches[2]. Public coastal areas are those that have been demarcated by the government as public. They also include unallocated coastal stretches between private and semi-private establishments that are easily accessible and open to the public.

Most public beaches are affected by solid waste flow from the city primarily from waste illegally dumped into rivers which washes up on the shore. At the same time there is poor waste management on the beaches with no waste bins. Erosion is also a problem, especially in Kunduchi, which is the result of natural forces human activity. Other challenges include population growth, excessive exploitation and uncontrollable use of coastal and marine resources, such as mangrove cutting, increased pressure from tourism and the growth of industry. Table A.3 in the Appendix A shows the location of these coastal areas.

3. Valuation of Environmental restoration and conservation

Studies in the literature have discussed the value of different aspects of nature conservation worldwide (e.g., Kramer and Mercer 1997; Tyrväinen and Miettinen 2000; Coles and Bussey 2000; Turpie 2003; Martín-López et al. 2007 Chen and Jim 2010; Brander and Koetse 2011; Shackleton and Blair 2013; Lee et al. 2016). or. We classify this literature according to the level of economic development of the study country (first world, economies in transition, and developing countries) and note that the WTP declines as we move from first world country studies to research on developing countries. Not only did the methods and theoretical frameworks used in these studies vary but also the WTP values differ substantially both within and across regions.

Kramer and Mercer (1997) measure the value that United States residents place on tropical rainforest protection and find a one-time value of US$21-31 per household. Tyrväinen and Miettinen (2000) value urban forest in Salo, Finland using the hedonic approach and find that houses in close proximity to forests were more expensive. Coles and Bussey (2000) estimate the value of urban woodland in UK. In Western Australia, Pepper et al. (2005) use a contingent valuation method to determine the economic value of urban bushland. They find that the value placed on urban bushland by the community exceeds the cost of establishing alternative facilities. Hougner et al. (2006) estimate the value of ecosystems support in Stockholm, Sweden using a production function and replacement cost methods. Martín-López et al. (2007) find a WTP of €23 for biodiversity conservation in Spain. Spash (2006) reports on WTP for environmental improvements in the United Kingdom and finds that environmental attitudes are important in explaining the values. Nielsen et al. (2007) use choice experiments to estimate WTP for urban forest protection.

[2] This regulation states that private developments should start at least 60 meters from public beaches to allow access to everyone.

Bernath and Roschewitz (2008) analyse WTP for urban forest areas in Zurich based on the theory of planned behaviour.

In Seoul, Korea, Kwak et al. (2003) applies the contingent valuation method to estimate the value of mountain landscapes and finds a total value of US$ 2.9 million per year. Lo and Jim (2010) investigate WTP for conserving urban green spaces in Hong Kong. The investigation finds a WTP value of US$9.90 per household per month for a period of five years. In their willingness to pay study of urban biodiversity conservation in Guangzhou, China, Chen and Jim (2010) show a median value of RMB 149 per household per year. In a meta-analysis, Brander and Koetse (2011) report a positive and significant relationship between population density and WTP for open spaces. A study by Birdir et al. (2013) assesses the WTP for beach improvements in the Kizkalesi, Yemiskumu and Susanoglu coastal areas of Turkey and discovers values of €2.33, €2.22 and €1.77 respectively. Horton et al. (2003) use contingent valuation to elicit non-users' WTP for implementation of a programme to protect the Brazillian Amazon. The study produces a value of US$45.60 per household per year for protecting 5% of the Amazon, and US$59.28 for 20%.

In sub-Saharan Africa we find fewer studies on urban ecosystem services (see Cilliers et al., 2013). In South Africa Shackleton and Blair (2013) estimate perceptions of and WTP for green spaces in two towns and find higher levels of WTP from more affluent communities. Lee et al. (2016) estimate the value of nature trails in the Eastern Cape, South Africa, using choice experiments. Their results show the WTP for establishing a nature trail along the Sundays River estuary to be R34 per year for every user. Bayrau and Bekele (2007) analyse the determinants of investor WTP for land in Addis Ababa, Ethiopia. They find urban land to be highly correlated with accessibility to basic services, plot grade, and investors' capital.

Dumenu (2013), evaluates urban forests in Ghana using contingent valuation methods, and finds the value of these forests to be US$694,765.50. Turpie (2003) estimates WTP for biodiversity conservation in the Western Cape and finds a value of $3.3 million per year for fynbos and $58 million for national biodiversity. Cilliers and Cilliers (2015) use a hedonic price method to estimate the value of green spaces in Potchefstroom, South Africa. They observe a positive relationship between green spaces and neighbourhood-scale, but a negative relationship with site-scale. In another study in South Africa, in Bridgeton, Lategan and Cilliers (2014) analyse the effects of backyard dwellings and encroachment on the quality of green spaces. In a study involving low-income neighbourhoods in South Africa, Shackleton et al. (2015) find residents of informal settlements value the trees in the urban periphery, more specifically the firewood that can be obtained from the trees and the regulating services that trees provide such as fresh water supply and temperature regulation.

Although the literature is still growing, there are very few specific case studies demonstrating WTP for conservation initiatives in sub-Saharan Africa in general. Obviously, this knowledge gap also translates into a policy gap since policymakers will not be able to design sound policies in the absence of good information or information that is not context specific. Our study contributes to the literature on the valuation of nature conservation programmes by eliciting information about WTP for the attributes of restoration and conservation initiatives in Dar es Salaam. It is currently unclear whether city dwellers in developing nations place a positive WTP value on nature restoration and conservation, and if so, how much. Additionally, it is unclear what the WTP drivers are or how they vary across location and levels of wealth. This information is useful for policy design.

4. Empirical Strategy

4.1 Theoretical Framework

In this study a survey-based choice experiment was used to elicit preferences of residents of Dar es Salaam for restoration and conservation attributes. To design this choice experiment we followed best practices and guidance by Johnston et al. (2017). The primary goal of experimental design in CEs is to develop designs that yield efficient and unbiased estimates of preference parameters and value estimates (Moro et al. 2013; Johnston et al. 2017; Ntuli et al. 2020).

The theoretical basis of choice experiments hinges on the characteristic of goods theory (Lancaster, 1966) and random utility theory (McFadden 1973; Mansky 1977) as its building blocks. While goods theory posits that people derive utility from the attributes of a commodity in addition to mere consumption of the physical units of a good, the latter suggests that by observing a consumer's choice we cannot tell all the predictors of their utility. Louviere et al. (2000) provides a detailed discussion of the conceptual framework and underpinnings of the choice experiment approach in terms of an individual's decision making and choice processes. In principle, in this approach respondents are asked to choose the alternative they would prefer. The utility derived by individual *i* can be expressed as an additive function of a deterministic and unobservable component (Train1998; Greene and Hensher 2003; Mansky 1977), as portrayed in equation (1):

$$\mathrm{U_{ij}} = \mathrm{V_{ij}}(X_{\mathrm{ik}}, \mathrm{Z_{ij}}) + \varepsilon_{\mathrm{ij}} \qquad (1)$$

where V_{ij} is the deterministic component, X_{ik} represents the socioeconomic characteristics of the individual $\mathrm{Z_{ij}}$ captures the choice experiment attributes, and ε_{ij} is the unobservable component. The consumer will only choose alternative *k* over *j* from a set *S* if they derive a higher utility from *k* than *j*. Alternative *k* is chosen over alternative *j*, if $\mathrm{U_{ik}} > \mathrm{U_{ij}}$. The probability of a consumer choosing e *k* over *j* from a set *S* can be expressed as:

$$\begin{aligned} \mathrm{P}(k|S) &= \mathrm{P}\big(u_{\mathrm{ik}} > \mathrm{u_{ij}}\big)\forall k \neq j \\ &= \mathrm{P}\big[\big(v_{\mathrm{ik}} - \mathrm{v_{ij}}\big) > (\varepsilon_{\mathrm{ik}} - \varepsilon_{\mathrm{ij}})\big]\forall k \neq j \end{aligned}$$

In other words, the difference in the systematic utility of alternatives *k* and *j* exceeds the difference in the random utility of alternatives *k* and *j*. The difference in the observed utility is attributed to the difference in the attributes of *k* and *j*. The observable part is defined as a function of the attributes of the alternative options and those of the respondent,

$$v_{\mathrm{ik}} = X_{\mathrm{ik}}\gamma + Z_{\mathrm{i}}\delta$$

Analysis of stated preference data should allow for both observed and unobserved preference heterogeneity and should consider the relevance of this heterogeneity for the use of study results to support decision making (Johnston et al. 2017). Following the literature, we use different models to estimate the utility function and choose the best model that fits our data (see Ntuli et al. 2020, Tibesigwa et al. 2020; Thiam et al. 2021). First, we run the conditional logit model, followed by a mixed logit model or random parameter logit model (RPL), latent class analysis (LCA) and finally, we estimate the generalised multinomial model (GMNL). McFadden (1973) demonstrate that a CLM can be used to analyse the consumer choice, with the attributes of the good or service acting as the predictors, and a ratio of the coefficients of attributes and prices used to recover the marginal willingness to pay for an attribute. In the CLM the probability of individual i choosing alternative *j* is:

$$P_{ij} = \exp\big(V_{ij}(Z_{ij})\big) \,/\, \sum_{k=1}^{C} \exp(V_{ik}(Z_{ik})) \qquad (2)$$

From equation (2) we estimate the following conditional indirect utility function outlined in equation (4), which assumes a linear specification, and where μ_{ij} is the associated cost.

$$U_{ij} = \mathbf{Z}_{ij}\beta + \lambda\mu_{ij} + \varepsilon_{ij} \qquad (3)$$

However, the CLM faces some shortfall and as a result we apply alternative models such as the RPL model. The advantage of the RPL model is that it relaxes the assumptions of independence of irrelevant alternatives (IIA) in the CLM by allowing heterogeneity in preferences (Train 1998). Under this model, the utility derived by individual *i* from choosing alternative *j* is presented in equation (4), where β is preference heterogeneity which varies across individuals by a random term τ_i

$$U_{ij} = V(Z_j(\beta + \tau_i) + \varepsilon_j \qquad (4)$$

The RPL to be estimated for the probability of an individual *i* for choosing option *j* which accounts for heterogeneity takes the following form:

$$P_{ij} = \exp\big(V(Z_j(\beta + \tau_i)\big) \,/\, \sum_{k=1}^{C} \exp(V(Z_k(\beta + \tau_i)) \qquad (5)$$

We also use the generalized multinomial model (GMNL). The advantage of this model is that it accounts for scale and preference heterogeneity. The individual specific parameter is defined as follows (Gu et al. 2013):

$$\beta_i = \sigma_i\beta + (\gamma + \sigma_i(1-\gamma))\,\theta_i \qquad (6)$$

Lastly, we use the Latent class model. The welfare measure is estimated as shown in equation (7), where CV is the welfare measure, and λ is the marginal utility of income. V_i^1 and V_i^0 are the values calculated from the utility function before and after the change respectively.

$$CV = \lambda^{-}\ln\left(\sum_{i\epsilon C}\exp(V_i^1) - \sum_{i\epsilon C}\exp(V_i^0)\right) \qquad (7)$$

$$MWTP = -1(\lambda_{ca}/\lambda) \qquad (8)$$

To compare attribute estimates, the marginal willingness to pay (MWTP) measure is calculated as a ratio of the marginal rate of substitution between an attribute and the cost as depicted by equation (8), where λ_{ca} is the choice attribute.

4.2 Experimental Design4.2.1 Defining Attributes of Restoration and conservation Schemes

restoration and conservationTo define policy relevant attributes of restoration and conservation schemes, we conducted a qualitative review of existing literature and sought expert opinion. Table 1 defines the attributes and levels that we identified as important for the nature restoration and conservation programmes.

Table 1: Nature Crestoration and conservation Attributes and Levels

Attributes	Descriptions	Levels
Forest restoration and conservation	o Restoration of forests within Dar es Salaam, i.e., reforestration o Conservation of forests within Dar es Salaam, i.e., prevent tree cutting for charcoal burning or agriculture encroachment	10% (753 ha)/25% (1880 ha) /50% (3760 ha)
River restoration and conservation	o Restoration of rivers within Dar es Salaam, i.e., removing litter and other toxics o Conservation of rivers within Dar es Salaam, i.e., prevent the accumulation of litter, toxins and heavy metals in rivers	10% (4 km)/25% (11 km) /50% (21 km)
Coastal Area restoration and conservation	o Restoration of rivers within Dar es Salaam, i.e., removing litter and other toxics o Conservation of rivers within Dar es Salaam, i.e., prevent the accumulation of litter, toxins and heavy metals in rivers	10% (0.25 km)/25% (0.60 km) /50% (1.2 km)
Cost	Monthly cellphone deductions	TSH500, TSH1000,TSH2000, TSH3000, TSH4500, TSH6000

The components of the selected attributes were then refined from the additional information obtained from focus group discussions (FGDs) and previous experience in management of forests, rivers and coastal areas in Dar es Salaam (Johnston et al., 2017). In total, four FGDs were held with the general public and government employees who are in charge of green spaces in Dar es Salaam. Participants of the focus groups were recruited with help from the local leadership including government officials and chairpersons of various committees in the study area. FGDs were conducted in different locations making sure that participants came from different segments of the society. The nature restoration and conservation programme consisted of three attributes: forest, river and coastal area restoration and conservation, with the fourth attribute consisting of the payment attribute. Through FGDs, we were able to develop a localised understanding of important concepts associated with restoration and conservation of forests, rivers and coastal areas restoration and conservationas well as a way to convey these to respondents.

4.2.2 Data Collection

Respondents were informed of a proposed programme to improve the environment in Dar es Salaam by increasing green areas and parks available to its residents. Respondents were asked to consider three alternatives of the programme. In each choice question, the respondent was given the task of choosing programme 1, programme 2 or no programme (status quo). Table 00 provides detail about the programme choices.

To assess their WTP for these environmental programmes, respondents were told that each programme involves a cost to the household. If respondents did not like any of the options presented, they were given an option to support none of them. Respondents were informed that there is no right response to the question. restoration and conservation. Table 2 presents additional information about the different nature restoration and conservation programmes.

4.2.2.1 Questionnaire

A survey was conducted to collect primary data for this study. The survey instrument collected individual-, household- and neighbourhood-level data. The questionnaire was divided into 6 sections. Section one introduced the topic by collecting background information on the respondent's views of parks and other green areas and their use of these amenities. This was followed by a section two that described the choice tasks. The choice tasks presented three alternative programmes and respondents were asked to choose among the three options which included the status quo. The choice tasks collected responses related to nature restoration and conservation programme in Dar es Salaam. The next section consisted of debriefing questions to obtain the reasons for respondent's responses relating to the programme. The final sections captured data on household and neighbourhood socio-economic characteristics. In each section visual aids were used to increase the respondent's understanding of the survey. On average the survey took about 50 minutes to administer.

4.2.2.2 Choice Cards

The choice experiment data collection instrument included choice questions selected on the basis of D-efficiency, using a Bayesian design. The choice sets were randomly allocated to 30 blocks of 4 choice sets. Given our sample size of 660, this implies that each block is assigned to approximately 22 households. The assignment of blocks to household, was random using random numbers, but this was done proportionately at district level. Each survey instrument and respondent were randomly assigned 1 block of the choice experimental design. Table 3 shows an example of a choice card presented to respondents.

Please Vote/choose:

	Program 1	**Program 2**	**No Program**
Forest restoration and conservation	10% (753 ha)	50% (3760 ha)	No restoration
River restoration and conservation	10% (4 km)	10% (4 km)	
Coastal restoration and conservation	50% (1.2 km)	0.25% (10 km)	
Your additional monthly fee	TSH1000	TSH2000	No additional costs
I would vote for this option	❒	❒	❒

Note: US$1 = TSH2000

Table 2: Nature conservation choice set example

4.2.3 Payment Vehicle

Respondents were informed that funding for the programme is separate from the rest of the city budget. As its payment vehicle, a monthly fee will be collected from a mobile phone of each household over five years and deposited into a fund managed by a community board to be selected by the beneficiaries themselves. The board would include representatives from citizen associations, environmental organisations, and local government and fund would undergo annual audits. Information on cell phone ownership of households was therefore collected at the beginning of each interview. If no one in the household had a mobile phone, the survey continued on the assumption that in the near future the household would have a phone

<table>
<tr><th>River Restoration and Conservation</th><th>Coastal Restoration and Conservation</th><th></th></tr>
<tr>
<td>
o Kazimzumbwi, Pungu and Vikindu Forests, located in Dar es Salaam, are targeted for restoration and conservation
o Restoration and conservation is to prevent tree cutting for charcoal burning or agriculture encroachment or any other reason that may promote tree cutting
o The advantage of restoration and conservation is it allows forests to provide important ecosystem services
o The Kazimzumbwi forest reserve is 3,550 ha located in Pungu hills
o Pungu forest is 2,179 ha and is adjacent to Kazimzumbwi Forest. Both forests are believed to be among the oldest forests in the world
o Vikindu forest is 1,796 ha
o This is an example of what a forest looks like if it is degraded and has not undergone any restoration or conservation (SHOW PICTURE of an un-conserved forest). This is what a conserved forest looks like (SHOW PICTURE of conserved forest) under restoration and conservation
</td>
<td>
o A potential target for river restoration and conservation is the Msimbazi River
o The Msimbazi River runs across Dar es Salaam from Kisarawe and discharges into the Indian Ocean covering a distance of 45,25km. It receives water from the Luhanga, Mambizi, and Ubungo sub tributaries, and the Sinza and Zimbire, and Kimanga tributaries (12.15, 6.5, 20, 19.25, 4.35 and 2.25 km respectively)
o Restoration and conservation is to prevent the accumulation of toxins and heavy metals from industry waste, and waste from slaughterhouses, household sanitation systems, and agricultural activities that use manure and fertilizers along the river basin.
o This is important because the current pollution is preventing the river from providing clean water to households and limits its environmental functions.
o Mzimbazi River is an example of an area that needs restoration. (SHOW PICTURE of an un-conserved river). After restoration, this river will look like (SHOW PICTURE of potential state, a river that is in good condition).
</td>
<td>
o A potential target for coastal restoration is the Msasani Bay
o Msasani Beach is 2.37 km
o Msasani Bay is polluted by toxins and heavy metals from domestic and industrial waste
o Msasani Beach is an example of an area that needs restoration. This (SHOW PICTURE of an un-conserved coast). After restoration, this coast will look like a healthy coast (SHOW PICTURE of potential state). The picture shows a coast that is in good condition.
</td>
</tr>
<tr><td colspan="3">
In the following questions, I ask you to select your favorite option. Each option is described using the following attributes:
• Forest restoration and conservation: 10%, 25% or 50% of the total ha of forest
• River restoration and conservation: 10%, 25% or 50% of the total ha of river
• Coastal restoration and conservation: 10%, 25% or 50% of the total ha of coast
• Your additional monthly fee: Your household’s required payment is a fixed payment per month for the next five years.
• Note that there would be no entrance fees to access the restored forest, river, and coastal areas
• Please Vote/choose:
</td></tr>
</table>

Table 3: Restoration and conservation Programmes

4.2.4 Sampling

The sample consists of 705 households in the city. Sampling was based on three stage stratified probability sampling which allows each household to have an equal chance of being included in the sample. The first stage uses three districts (Ilala, Temeke and Kinondoni) as the strata, where sample size selection is proportionate to the population of each district. In the second stage, the strata are based on 10 divisions, while the last stage is based on wards. This approach is used to accommodate differences in the distribution of households in Dar es Salaam at district, division, and ward level. Stratification produces homogeneity in each stage, while proportionate, instead of disproportionate or optimal allocation, allows the sample to be representative of the population of Dar es Salaam.

Using stratified probability sampling also has the advantage of producing self-weighted means and reducing variance. At the ward level, we used street jumps and random numbers to identify the households to be interviewed. The advantage of this approach is that Dar es Salaam is a young city with a mixture of informal and rural settings and detailed maps or information on street addresses are unlikely to be available for the informal and rural sections of the city. Using this approach, the field team were given the street names and the households to be interviewed. Streets and households were selected using random numbers.

5. Results

5.1 Respondent Characteristics and Attitudes to Environmental Restoration and Conservation in Dar es Salaam

The descriptive statistics, in Table 4 show that 45% of respondents are men, and the average age is 41 years. The table further shows that 70% of respondents are married. The average number of years of education is 9 years, with about 75% being employed. The average monthly household income is TSH847,708. Additionally, the average household size is 5 members with about half being children below 18 years. These household characteristics vary across districts.

5.2 Estimation results

The conditional logit results are shown in Panel A of Table 5, while the test of the Independence of Irrelevant Alternative (IIA) assumptions is shown in Table 6. Panel A Column 1 reports the attributes only, while Column 2 adds ASC interactions, and Column 3 includes interactions with socio-economic characteristics. While the interaction with household characteristics captures preference heterogeneity, the interaction with the ASC, captures the preferences for alternatives. As expected, the cost coefficient is negative and significant indicating that utility decreases with an increase in the cost. With regard to the attributes, the forest coefficient bears the expected sign and is statistically significant, while the river and coastal coefficients are not significant. Panel B and C show the results from using the mixed logit and generalised multinomial logit models. Here, the forest coefficients are consistent across models in relation to the sign and level of significance.

Additionally, the coast coefficient becomes significant in the generalised multinomial logit model. The standard deviation coefficients remain significant even after controlling for preference heterogeneity by introducing interactions and scale heterogeneity (in Panel C). To determine the model that is more appropriate, we use the likelihood ratio (LR) test, this is applicable here because the mixed logit is nested within the generalised multinomial logit model. The test provides a statistic of 414.84 (Prob > chi2 = 0.0000), suggesting that the generalised multinomial logit model improves model fit. The full models are reported in Appendix B. Table 7 shows the results when we run the same models disaggregated by district. Column 1 shows that in the Kinondoni district all three attributes are positive and significant. In Ilala only the forest coefficient is significant, as shown in Column 2, while in the Temeke district the forest and coast coefficient are significant.

To further unveil heterogeneity, we use the latent class model to identify the number and type of respondents with similar preferences. To determine the optimal number of classes, we run a sequence of 9 models with 2-10 classes, and thereafter we use the AIC, CAIC and BIC information criteria to select the optimal model (Train 2008). Besides relying on statistics and information criteria, we also use our own judgement, following Swait (1994). Table 9 shows the information criteria values of each of the classes in the models. We select the model with two classes as optimal. The average class share is 24% for Class 1 and 76% Class 2, which we will refer to as poor and non-poor households respectively. There is no general agreement on the classification of a poor households. For example, the Word Bank classified 40% of poor households in sub-Saharan Africa as living below $1.90 (Schoch and Lakner 2020). Our definition of a poor household is relative as the concept of poverty is also a relative term. We then test the model's performance with regard to its ability to identify the different preferences for each class by computing the mean highest posterior probability of class membership. Our calculation produces a value of 0.96 which indicates that the model performs well in identifying preference patterns. The significance in the coefficients in the two classes indicates unequal gains from environmental restoration and conservation. While the attributes in Class 1 are insignificant, in Class 2 forest, river, and coast attributes are positive and significant as shown in Table 8.

In order to determine the source of heterogeneity, we determine the characteristics of the respondents in each of the classes, as shown in Table 10. We find that the respondents in Class 2, where the attributes are positive and significant, are mainly from Ilala district (44%), while those from Kinondoni and Temeke district are 28% and 27% respectively. The respondents in this class are more educated with about 10 years of education, are employed, and the size of their households is smaller. Their average household income is close to twice that of respondents in Class 1. More importantly, perceive forest, river and coastal environments to be more important than respondents in Class 1. Further, the respondents in Class 1, where the attributes are insignificant, are mainly from Temeke district (46%), while 34% are from Ilala and 20% from Kinondoni. The test of mean difference shows that the difference between Class 1 and Class 2 in Ilala and Kinondoni is statistically significant for district, age, education, employment, income, and household size, as well as attitudes regarding the importance of nature conservation. This finding on district differences is somewhat similar to that depicted in Table 9 when we disaggregated the models by district – most attributes were found to be significant in Kinondoni and Ilala, with only forests being weakly significant in Temeke district.

5.3 Willingness to pay estimates

In this sub-section, we present the results of the monthly instalments that will be paid by the households towards the restoration and conservation programme for five years. The marginal willingness to pay (WTP) estimates are reported in Tables 11 and Table 12. The marginal WTP is highest for forest programmes, and this ranges from TSH88 to TSH331 (US$0.04 – US$0.17) per month, depending on the estimation model. This is followed by river programmes, which produced a value of TSH5-TSH53 (US$0 – US$0.03) per month. The value placed on coastal conservation is TSH2 - TSH23 (US$0 – US$0.01) per month. At the district level, forest programmes were given the highest value by residents of Ilala ranging from TSH323 to TSH688 (US$0.16 – US$0.34) per month, followed by Temeke residents and lastly those living in Kinondoni. River programmes are given a high value by residents of Temeke, at TSH48 - TSH352 (US$0.02 – US$0.18) per month, and a low value by Kinondoni residents.

The marginal WTP for coastal conservation is highest in Temeke, at TSH56-TSH294 (US$0.03 – US$0.15) per month. The latent class model identifies two main groups of households, those that perceive environmental conservation to be important have higher socio-economic status, while those that perceive environmental conservation to be less important have lower socio-economic status. Class 2 places the highest value on forests, of TSH1681.46 (US$0.84) per month, and this group consist mainly of residents from Kinondoni (43%), this is followed by their WTP for conservation of rivers, with a value of TSH1231.78 (US$0.62) per month, and finally coasts with a WTP value of TSH1087.71 (US$0.54) per month. The results from the latent models are somewhat similar to those found in the district analysis. Besides district, the other characteristics that are found to be significant include education, employment, and income.

5. Discussion

Our results show great variability in the sampled households and respondents. Theoretically, this is what we would expect in a context where resource users are many with diverse interests (Johnston et al., 2017). The descriptive statistics are consistent with previous urban studies done in Tanzania (e.g., Tibesigwa et al. 2020) and in sub-Saharan Africa (Shackleton et al. 2015; Thiam et al. 2021).

The CLM, RPL and GML models show that the coefficient for forest programmes is positive and statistically significant most of the time while those for river and coastal programmes are insignificant. Our results suggest that a healthy forest has utility residents of Dar es Salaam. These results seem to indicate these residents of the value forests for the benefits derived from forest products such as firewood, charcoal, bushmeat, insects, fruits and wild vegetables, rather than their aesthetic value Shackleton confirms that for households in Africa, use value is the biggest driver of resource value. If households depend on a natural resource for survival, they are likely to place a high value on the resource (Shackleton et al. 2015).

When we consider the disaggregated results at district level, it might not be surprising that residents in Kinondoni care about forests, rivers, and coastlines since it is a relatively wealthy suburb. The literature shows that people care more about the environment as their level of income increases (Brander and Koetse 2011). Although the theory suggests a u-shaped relationship between income and environmental concerns, the exact level of income at which people start to think about the environment is not yet known (Apergis and Ozturk 2015). Households in most African countries could be far away from this turning point. Measures are therefore required to preserve the environment other than waiting for household incomes to rise (Lin et al. 2016). The turning points could be different in different countries. High dependence on forests in Temeke and Ilala could translate into increased WTP or use value since there is a fair share of poor households in both suburbs (Tibesigwa et al. 2020).

There is a higher proportion of non-poor households in class 2 which is not surprising if we separate households by education and employment in an urban context. The literature reveals that the majority of urban dwellers in Africa have secondary education and are employed, either formally or informally (Bryceson 2002). The analysis of the disaggregated models according to class show that Class 2 has positive and significant attributes. This also confirms the Kuznets theory that wealthier, more educated households with employment and smaller families care more about the environment. However, the low value placed on resources by poor communities could be because the resources are so degraded that they have low use value. According to the literature, poor households and communities suffer the most when a resource they depend on collapses due to mismanagement (Ntuli et al. 2019).

In general, the WTP value placed on forests, rivers and coastal areas by residence in the city of Dar es Salaam are arguably on the lower end of the spectrum. They do however communicate a strong message to policymakers about the needs of urban communities. These findings are consistent with most studies done across Africa and in other developing regions (e.g., Bayrau and Bekele 2007; Dumenu 2013; Cilliers and Cilliers 2015; Tibesigwa et al. 2020). WTP values decrease as we move from forests to coastal areas. The valuation criteria could thus be linked to the use value of these natural resources. Or the findings could reflect the state of degradation of natural resources in urban areas (Cilliers and Cilliers 2015). While studies suggest that people tend to place a higher value on a resource as it becomes scarcer, i.e., the shadow value of that resource increases (Cilliers et al. 2013), some natural amenities in urban areas are degraded to the extent that people do not see them as valuable city assets.

Interestingly, the WTP for forest resources is much higher in poorer districts such as Ilala and Temeke compared to wealthier districts such as Kinondoni. The majority of poor urban households depend on firewood and charcoal to meet their daily fuel needs in the face of increasing electricity costs (Burgess et al. 2013). The high WTP values for forests could therefore be associated with the cost of electricity which might be expensive for most households in these areas (Boussougou et al. 2018). Poor urban households also harvest non-timber forest products which contribute significantly to their welfare in terms of income, food security, and nutrition (Shackleton et al. 2015; Ntuli et al. 2017). Dependence on these resources could explain why these residents place a high value on urban forests.

River conservation is also given a much higher value in a poor district such as Temeke since rivers provide fish, fresh water for drinking, water to irrigate crops and most poor households depend heavily on urban agriculture for survival (Mwegoha and Kihampa 2010). Contrary to previous theoretical and empirical accounts, poor residents from Temeke also place a high value on coastal conservation. This is because most coastal areas in developing countries are used by poor households as fishing grounds (Chande and Mgaya 2003). The order of importance for the natural resources also matters from a policy perspective as it may reflect the extent of resource degradation in a community. Furthermore, forests are likely to experience more pressure from natural resource users since they are more valuable than rivers and coastal areas from an exploitation point of view. Another possible reason is that rivers and costal fisheries are already degraded and resource users have possibly diverted their attention to forest resources (Ashagre et al. 2018) which may be more resilient to exploitation (Ntuli et al. 2019). River and coastal resources are subject to regime shifts such that their regeneration rate is drastically reduced (Ntuli et al. 2019). These results possibly confirm our initial speculation that the significance of a natural resource for poor households in developing countries depends on the value derived from its use rather than its intrinsic (aesthetic) value.

The LCA model, however, tells a different story from the results of the other three models. The model suggests that wealthier residence from Kinondoni placed a high WTP value on forests, rivers and coasts in that order. As already alluded to, this behaviour could be driven by a pure conservation motive and appreciation of the aesthetic value of nature. This outcome could however be linked to the use value of these resources. If so, a problem is that users could destroy the resource being driven by market forces. The tragedy of the commons occurs when resource users are many and in the absence of robust and efficient common pool resource oversight institutions (Ostrom 2007; Ntuli et al. 2019). This is the case with most African forest, river and coastal fishery resources (Constant and Taylor 2020). Although they harvest less, wealthier households consume more environmental resources in total which could be disastrous for natural resource management as they drive market demand for environmental resources (Ntuli and Muchapondwa 2017).

6. Conclusion

This study measured the willingness to pay for environmental restoration and conservation of households in Dar es Salaam, Tanzania using a choice experiment to determine WTP preferences of respondents from 705 randomly selected households from different districts in Dar es Salaam. To account for preference and scale heterogeneity a menu of models - random parameter logit, generalised multinomial and latent class model - with varying assumptions were employed. Our results show that the marginal WTP is highest for forest restoration and conservation programmes, followed by programmes targeting rivers. At the district level, forest programmes were valued the most by residents of Ilala followed by Temeke, and lastly Kinondoni. River conservation and restoration programmes were given a high value by residents of Temeke and valued the least Kinondoni residents. Programmes targeting coastal areas were given the highest value in Temeke.

Several policy implications emerge from the results. First, the fact that the highest marginal WTP is reported for forest programmes in low-income location such as Ilala implies that households place a high value on forest resources because of their use value, to poor urban households. There is need for policy interventions that aim to reduce dependence on forest resources for energy by urban and peri-urban households though encouraging efficient alternative energy Alternative policy interventions include afforestation and reforestation programmes in urban areas.

The second highest marginal WTP is reported for rivers in Dar es Salaam which also play a vital role in terms of supplying freshwater and food. The value placed on rivers will continue to increase in most African cities through increased demand for water and river-based resources as the population. Watershed and wetland destruction is responsible for reduction in the supply of freshwater. Policy intervention should aim at protecting watersheds and river ecosystems so that the resource will be able to meet the demand of increasing populations in the future.

The low marginal WTP for programmes targeting coastal area could reflect, first, the depletion or destruction of fisheries which reduces the value of the coastal areas (Cesar and Chong, 2004). Policy interventions must aim to revive coastal fisheries through the establishment of marine protected areas so that the fish population can be rejuvenated. Second, the low WTP may reflect the low demand for recreational sites such as beaches in most African communities where residents have very little time for leisure (Tibesigwa et al., 2020). Further, most beaches in Tanzania are heavily polluted. Policy interventions should aim to clean up the country's coastal areas.

6. References

Cesar, H., & Chong, C. K. (2004). Economic valuation and socioeconomics of coral reefs: Methodological issues and three case studies. *Economic valuation and policy priorities for sustainable management of coral reefs*, 14-40.

Chen, S. S., Kimirei, I. A., Yu, C., Shen, Q., & Gao, Q. (2022). Assessment of urban river water pollution with urbanization in East Africa. *Environmental Science and Pollution Research*, *29*(27), 40812-40825.

Chande A.I., and Mgaya Y.D. 2003. The fishery of Portunus Pelagicus and species diversity of portunid crabs along the Coast of Dar es Salaam, Tanzania. *Western Indian Ocean Journal of Marine Science*, 2(1):75-84.

Apergis N. and Ozturk I. 2015. Testing environmental Kuznets curve hypothesis in Asian countries. *Ecological Indicators*, 52:16-22.

Ashagre B.B., Platts P.J., Njana M., Burgess N.D., Balmford A., Turner R.K., Schaafsma M. 2018. Integrated modelling for economic valuation of the role of forests and woodlands in drinking water provision to two African cities. *Ecosystem Services*, 32:50-61.

Bayrau, A., & Bekele, G. (2007). Investors' willingness to pay for urban land: The Case of Addis Ababa City.

Bertram, C. and Rehdanz, K. (2014). The Role of Urban Green Space for Human Well-Being. *IfW Working Paper* 1911.

Bernath, K., & Roschewitz, A. (2008). Recreational benefits of urban forests: Explaining visitors' willingness to pay in the context of the theory of planned behavior. *Journal of Environmental Management*, *89*(3), 155-166.

Bongaarts J., and Casterline J. (2013). Fertility transition: is sub-Saharan Africa different? *Population and Development Review*, 38: Suppl 1:153.

Boussougou G, Brou YT, Valimba P. 2018. Vulnerability of Pugu and Kazimzumbwi Forest Reserves under anthropogenic pressure in Southeast Tanzania. In: International Conference on Computational Science and Its Applications, pp. 231-240. Springer, Cham.

Birdir, S., Ünal, Ö., Birdir, K., & Williams, A.T. (2013). Willingness to pay as an economic instrument for coastal tourism management: cases from Mersin, Turkey. *Tourism Management*, 36, 279-283.

Birol, E., Karousakis, K., & Koundouri, P. (2006). Using a choice experiment to account for preference heterogeneity in wetland attributes: the case of Cheimaditida wetland in Greece. *Ecological Economics*, *60*(1), 145-156.

Brander, L.M., & Koetse, M. J. (2011). The value of urban open space: meta-analyses of contingent valuation and hedonic pricing results. *Journal of Environmental Management*, *92*(10), 2763-2773.

Bryceson D.F. 2002. Multiplex livelihoods in rural Africa: recasting the terms and conditions of gainful employment. *The Journal of Modern African Studies*, 40(1):1-28.

Budziński, W., Campbell, D., Czajkowski, M., Demšar, U., & Hanley, N. (2016). *Using geographically weighted choice models to account for spatial heterogeneity of preferences* (No. 2016-17).

Burda, M., Harding, M., & Hausman, J. (2008). A Bayesian mixed logit–probit model for multinomial choice. *Journal of Econometrics*, *147*(2), 232-246.

Bullock, C.H. (2008). Valuing urban green space: hypothetical alternatives and the status quo. *Journal of Environmental Planning and Management*, *51*(1), 15-35.
Burgess N.D., Abdallah J., Lukumbuzya K., Urock J., Malugu I., Sumbi P., Kijazi A., Milledge S., Schaafsma M., Makala J. 2013. Trends in the production of charcoal and timber from Tanzania's Coastal Forests. *The Arc Journal* (28):25-30. Dar es Salaam: Tanzania Forest Conservation Group..
Cavan, G., Lindley, S., Jalayer, F., Yeshitela, K., Pauleit, S., Renner, F., and Shemdoe, R. (2014). Urban morphological determinants of temperature regulating ecosystem services in two African cities. *Ecological Indicators*, *42*, 43-57.
Chen, W.Y., & Jim, C. Y. (2010). Resident motivations and willingness-to-pay for urban biodiversity conservation in Guangzhou (China). *Environmental Management*, 45(5), 1052-1064.
Cilliers, S., Cilliers, J., Lubbe, R., & Siebert, S. (2013). Ecosystem services of urban green spaces in African countries—perspectives and challenges. *Urban Ecosystems*, *16*(4), 681-702.
Cilliers, J., & Cilliers, S. (2015). From green to gold: A South African example of valuing urban green spaces in some residential areas in Potchefstroom. *Stads en Streeksbeplanning= Town and Regional Planning*, *2015* (67), 1-12.
Coles, R. W., & Bussey, S.C. (2000). Urban forest landscapes in the UK—progressing the social agenda. *Landscape and Urban Planning*, *52*(2), 181-188.
Colombo, S., & Hanley, N. (2011). Econometric analysis of individuals' preference heterogeneity: an application to the economic evaluation of uphill landscape. *Economía Agraria y Recursos Naturales (Agricultural and Resource Economics)*, *8*(15), 103-124.
Constant N.L., & Taylor P.J. (2020). Restoring the forest revives our culture: Ecosystem services and values for ecological restoration across the rural-urban nexus in South Africa. *Forest Policy and Economics* 118:102222.
Dumenu, W. K. (2013). What are we missing? Economic value of an urban forest in Ghana. *Ecosystem Services*, *5*, 137-142.
Duranton, G. (2014). Growing through cities in developing countries. *The World Bank Research Observer*, *6*, 6-15.
Germann-Chiari, C., & Seeland, K. (2004). Are urban green spaces optimally distributed to act as places for social integration? Results of a geographical information system (GIS) approach for urban forestry research. *Forest Policy and Economics*, *6*(1), 3-13.
Greene, W.H., and Hensher, D.A. (2003). A latent class model for discrete choice analysis: contrasts with mixed logit. *Transportation Research Part B* 37: 681-698.
Gu, Y., Hole, A. R., & Knox, S. (2013). Fitting the generalized multinomial logit model in Stata. *Stata Journal*, *13*(2), 382-97.
Gyourko, J., and Molloy R. (2015). Regulation and housing supply. In: Handbook of regional and urban economics, Vol. 5, pp. 1289-1337.
Gwegime, J.Y., Mwangoka, M., Said, H., Mulungu, E., Nowak, K., & Doggart, N. 2013. Two surveys of the plants, birds and forest condition of Pugu and Kazimzumbwi Forest Reserves in 2011 and 2012. TFCG Technical Paper. 2011;36.
Hanley N., Wright R. & Adamowicz, V. (1998). Using choice experiments to value the environment. *Environmental and Resource Economics*, 11, 413-428.
Henderson, V. (2002). Urbanization in developing countries. *The World Bank Research Observer*, *17*(1), 89-112.
Hess, S., Hensher, D.A., Daly, A. (2012). Not bored yet – Revisiting respondent fatigue in stated choice experiments. Transportation Research Part A: Policy and Practice 46, 626–644.
Horton, B., Colarullo, G., Bateman, I. J., & Peres, C.A. (2003). Evaluating non-user willingness to pay for a large-scale conservation programme in Amazonia: a UK/Italian contingent valuation study. *Environmental Conservation*, 30(2), 139-146.
Hu, H., Geertman, S., & Hooimeijer, P. (2014). The willingness to pay for green apartments: the case of Nanjing, China. *Urban Studies*, 0042098013516686.

Huang, J., & Poor, P. J. (2004). Welfare measurement with individual heterogeneity: economic valuation of beach erosion control programs. *Department of Economics, University of New Hampshire*.
Johnston, R.J., Boyle, K.J., Adamowicz, W.V., Bennett, J., Brouwer, R., Cameron, T.A., Hanemann, W.M., Hanley, N., Ryan, M., Scarpa, R., Tourangeau, R., Vossler, C. A., (2017). Contemporary guidance for stated preference studies. *Journal of the Association of Environmental and Resource Economists* 4 number 2.
Kramer, R. A., & Mercer, D. E. (1997). Valuing a global environmental good: US residents' willingness to pay to protect tropical rain forests. *Land Economics*, 196-210.
Kuhn, I., Brandl, R. and Klotz, S. (2004). The flora of German cities is naturally species rich. *Evolutionary Ecology Research* 6 (5), 749-764.
Lancsar, E., Fiebig, D.G., & Hole, A.R. (2017). Discrete choice experiments: a guide to model specification, estimation and software. *PharmacoEconomics*, 1-20.
Lancaster, J.K., (1966). A new approach to consumer theory. *Journal of Political Economy*. 74 (2), 132–157.
Lategan, L.G., & Cilliers, E.J. (2014). The value of public green spaces and the effects of South Africa's informal backyard rental sector. *WIT Transactions on Ecology and the Environment*, *191*, 427-438.
Lee, D., Du Preez, M., & Hosking, S. G. (2016). Valuing user preferences for improvements in public nature trails around the Sundays River Estuary, Eastern Cape, South Africa. *Journal of Economic and Financial Sciences*, *9*(1), 43-59.
Lo, A.Y., & Jim, C.Y. (2010). Willingness of residents to pay and motives for conservation of urban green spaces in the compact city of Hong Kong. *Urban Forestry & Urban Greening*, *9*(2), 113-120.
Lo, A.Y., & Jim, C.Y. (2015). Protest response and willingness to pay for culturally significant urban trees: implications for Contingent Valuation Method. *Ecological Economics*, *114*, 58-66.
López-Mosquera, N., & Sánchez, M. (2012). Theory of Planned Behavior and the Value-Belief-Norm Theory explaining willingness to pay for a suburban park. *Journal of Environmental Management*, *113*, 251-262.
López-Mosquera, N., García, T., & Barrena, R. (2014). An extension of the Theory of Planned Behavior to predict willingness to pay for the conservation of an urban park. *Journal of Environmental Management*, *135*, 91-99.
Lin B, Omoju, O.E., Nwakeze, N.M., Okonkwo, J.U., Megbowon, E.T. (2016). Is the environmental Kuznets curve hypothesis a sound basis for environmental policy in Africa? *Journal of Cleaner Production*, 133:712-24.
Louviere, J.J., Hensher, D.A., & Swait, J., 2000. Stated Choice Methods: Analysis and Application. Cambridge University Press, Cambridge.
Luttik, J. (2000). The value of trees, water and open space as reflected by house prices in the Netherlands. *Landscape and Urban Planning*, *48*(3), 161-167.
Kwak, S.J., Yoo, S.H., & Han, S.Y. (2003). Estimating the public's value for urban forest in the Seoul Metropolitan Area of Korea: a contingent valuation study. *Urban Studies*, *40*(11), 2207-2221.
Martín-López, B., Montes, C., & Benayas, J. (2007). The non-economic motives behind the willingness to pay for biodiversity conservation. *Biological Conservation*, 139(1), 67-82.
Mansky, C., (1977). The structure of random utility models. *Theory and Decision* 8 (3), 229–254.
McFadden, D., (1973). Conditional logit analysis of qualitative choice behavior. In: Zarembka, P. (Ed.), Frontiers in Econometrics. Academic Press, New York.
Mensah, C.A. (2014). Urban green spaces in Africa: nature and challenges. *International Journal of Ecosystem*, *4*(1), 1-11.
Monkkonen P. (2013). Urban land-use regulations and housing markets in developing countries: Evidence from Indonesia on the importance of enforcement. *Land Use Policy*, 34:255-64.
Mosha, A. C. (2014). The use and misuse of urban public open spaces in Botswana: case study, Gaborone, Botswana.
Moss, D., Happold Group, Afriarch, and QConsult (2013). Dar es Salaam master plan (2012-2032), Main Report.

Mwegoha, W.J., and Kihampa, C. (2010). Heavy metal contamination in agricultural soils and water in Dar es Salaam city, Tanzania. *African Journal of Environmental Science and Technology*, 4(11):763-9.

Myeong, S., Nowak, D. J. and Duggin, M.J. (2006). A temporal analysis of urban forest carbon storage using remote sensing. *Remote Sensing of Environment* 101 (2), 277-282.

Nielsen, A.B., Olsen, S.B., & Lundhede, T. (2007). An economic valuation of the recreational benefits associated with nature-based forest management practices. *Landscape and Urban Planning, 80*(1), 63-71.

Niemelä, J., Saarela, S.R., Söderman, T., Kopperoinen, L., Yli-Pelkonen, V., Väre, S., & Kotze, D.J. (2010). Using the ecosystem services approach for better planning and conservation of urban green spaces: a Finland case study. *Biodiversity and Conservation*, *19*(11), 3225-3243.

Ntuli, H., Crépin, A.S., Muchapondwa, E., Schill, C. (2019). Sanctioned quotas vs information provisioning for community wildlife conservation in Zimbabwe: a framed field experiment approach. *Environment for Development Initiative Discussion Paper*, MS.724:19-5.

Ntuli, H. & Muchapondwa, E. (2017) Effects of wildlife resources on community welfare – income, poverty and inequality. *Ecological Economics* (131) 572 – 583.

Pepper, C., McCann, L., & Burton, M. (2005). Valuation study of urban bushland at Hartfield Park, Forrestfield, Western Australia. *Ecological Management & Restoration*, *6*(3), 190-196.

Provencher, B., & Bishop, R.C. (2004). Does accounting for preference heterogeneity improve the forecasting of a random utility model? A case study. *Journal of Environmental Economics and Management, 48*(1), 793-810.

Saria, J.A. (2015). Physical-chemical and bacterial contamination levels in Mzinga River catchments of the Southern Dar es Salaam City, Tanzania: public health implications. *Science Research*, 3(6):283-8.

Schoch, M. and C. Lakner, 2020. The number of poor people continues to rise in Sub-Saharan Africa, despite a slow decline in the poverty rate, World Bank

Shackleton, C.M., & Blair, A. (2013). Perceptions and use of public green space is influenced by its relative abundance in two small towns in South Africa. *Landscape and Urban Planning*, *113*, 104-112.

Shackleton, S., Chinyimba, A., Hebinck, P., Shackleton, C., & Kaoma, H. (2015). Multiple benefits and values of trees in urban landscapes in two towns in northern South Africa. *Landscape and Urban Planning*, *136*, 76-86.

Smit S, Musango, J.K., Kovacic, Z., Brent, A.C. (2017). Conceptualising slum in an urban African context. *Cities*, 62:107-19.

Spash, C.L. (2006). Non-economic motivation for contingent values: Rights and attitudinal beliefs in the willingness to pay for environmental improvements. *Land Economics*, 82(4), 602-622.

Sunseri, T. (2005). 'Something else to burn': forest squatters, conservationists, and the state in modern Tanzania. *The Journal of Modern African Studies*, 43(4):609-40.

Termansen, M., McClean, C.J., & Jensen, F.S. (2013). Modelling and mapping spatial heterogeneity in forest recreation services. *Ecological Economics*, *92*, 48-57.

Thiam D.R., Dinar, A., Ntuli, H. (2021). Promotion of residential water conservation measures in South Africa: the role of water-saving equipment. *Environmental Economics and Policy Studies*, 23(1):173-210.

Tibesigwa, B., Ntuli, H., Lokina, R. (2020). Valuing recreational ecosystem services in developing cities: The case of urban parks in Dar es Salaam, Tanzania. *Cities*. 106:102853.

Torres, C.M., Colombo, S., & Hanley, N. (2014). Incorrectly accounting for preference heterogeneity in choice experiments: implications for welfare measurement. *Economía Agraria y Recursos Naturales-Agricultural and Resource Economics*, *14*(2), 97-121.

Turner, R.K., Paavola, J., Cooper, P., Farber, S., Jessamy, V., & Georgiou, S. (2003). Valuing nature: lessons learned and future research directions. *Ecological Economics*, 46(3), 493-510.

Turpie, J.K. (2003). The existence value of biodiversity in South Africa: how interest, experience, knowledge, income and perceived level of threat influence local willingness to pay. *Ecological Economics*, 46(2), 199-216.
Train, K. (1998). Recreation Demand Models with taste differences over people. *Land Economics* 74(2), pp. 230-239.
Train, K.E. (2009). *Discrete choice methods with simulation*. Cambridge University Press.
Tyrväinen, L., & Miettinen, A. (2000). Property prices and urban forest amenities. *Journal of Environmental Economics and Management*, *39*(2), 205-223.
Wang, P.W., Ya, J., Zhong, L.S., & Mei, R. (2016). Respondent uncertainty and reliability in contingent valuation—a case of the Dalai Lake protected area. *Limnologica-Ecology and Management of Inland Waters*, *58*, 59-68.
White, M.P., Alcock, I., Wheeler, B.W. and M.H. Depledge (2013). Would you be happier living in a greener urban area? A fixed-effects analysis of panel data. *Psychological Science* 20 (10), 1-9.
Whitehead, J.C. (2006). A practitioner's primer on contingent valuation. *Handbook on Contingent Valuation.* Cheltenham, *UK: Edward Elgar*, 92-115.
Zander, K.K., & Straton, A. (2010). An economic assessment of the value of tropical river ecosystem services: heterogeneous preferences among Aboriginal and non-Aboriginal Australians. *Ecological Economics*, *69*(12), 2417-2426
Zander, K.K., Garnett, S.T. & Straton, A. (2010). Trade-offs between development, culture and conservation–willingness to pay for tropical river management among urban Australians. *Journal of Environmental Management*, 91(12), 2519-2528.

Appendix A. Additional Tables and Figures

Table 4: Descriptive Statistics

	Overall		Ilala		Kinondoni		Temeke	
Variable	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Age	41.16	12.80	40.13	12.53	40.45	12.57	43.05	13.15
Male	0.448	0.497	0.483	0.500	0.414	0.493	0.459	0.498
Education years	9.719	4.323	9.126	3.468	11.457	4.764	8.050	3.587
Married	0.705	0.456	0.700	0.458	0.679	0.467	0.743	0.437
Employed	0.757	0.429	0.754	0.431	0.757	0.429	0.761	0.426
Employed full-time	0.184	0.388	0.150	0.357	0.279	0.448	0.096	0.295
Employed part-time	0.006	0.075	0.000	0.000	0.007	0.084	0.009	0.095
Full time student	0.009	0.092	0.010	0.098	0.014	0.119	0.000	0.000
Part-time student	0.189	0.391	0.188	0.391	0.200	0.400	0.174	0.379
Staying at home	0.040	0.195	0.048	0.214	0.021	0.145	0.055	0.228
Retired	0.013	0.112	0.005	0.069	0.011	0.103	0.023	0.150
Self employed	0.560	0.496	0.599	0.490	0.468	0.499	0.642	0.479
No. of household members	4.702	2.817	4.546	2.617	4.836	3.231	4.679	2.391
No. of children in the household	1.930	1.723	1.792	1.507	1.936	1.827	2.055	1.766
No. of members with an income	1.684	1.187	1.604	0.884	1.736	1.543	1.693	0.863
Household income (TSH)	847708	1568096	759300	1356899	1160837	1998581	529473	916742
Forests important	0.926	0.261	0.913	0.282	0.911	0.285	0.959	0.199
Rivers important	0.906	0.291	0.860	0.347	0.889	0.314	0.972	0.164
Coasts important	0.855	0.352	0.725	0.447	0.879	0.327	0.950	0.219

Table 5: Estimates from different models

	Panel A: Conditional Logit Base model			Panel B: Mixed Logit Controlling for preference heterogeneity			Panel C: Gen Controlling H
	(1) attributes only	(2) with asc	(4) with characteristics	(1) Attributes only	(2) with asc	(4) with characteristics	(1) attributes only
cost	**-0.000280*** **	**-0.000285*** **	**-0.000284*** **	**-0.000349*** **	**-0.000346*** **	**-0.000347*** **	**-0.0102*** **
	(2.45e-05)	(2.54e-05)	(2.48e-05)	(3.12e-05)	(3.00e-05)	(3.29e-05)	(0.00166)
asc	**-1.215*** **	**-1.444*** **	**-1.261*** **	**-7.488*** **	**-8.165*** **	**-6.654*** **	**-28.09*** **
	(0.203)	(0.464)	(0.199)	(1.109)	(1.661)	(1.272)	(4.831)
fore	**0.0930*** **	**0.0937*** **	**0.217***	**0.112*** **	**0.113*** **	**0.172**	**0.898*** **
	(0.0330)	(0.0328)	(0.120)	(0.0416)	(0.0424)	(0.174)	(0.213)
rive	**0.0149**	**0.0146**	**-0.0613**	**0.0181**	**0.0167**	**-0.120**	**-0.0573**
	(0.0264)	(0.0267)	(0.102)	(0.0339)	(0.0338)	(0.115)	(0.0465)
coas	**0.000633**	**0.00128**	**0.122**	**0.00578**	**0.0126**	**0.191**	**0.241*** **
	(0.0300)	(0.0308)	(0.102)	(0.0361)	(0.0366)	(0.148)	(0.0674)
τ							1.518***
							(0.245)
Obs	8,460	8,460	8,460	8,460	8,460	8,460	8,460
LL	-2754.073	-2645.506	-2719.427	-2062.419	-2029.534	-2058.006	-1855.001
AIC	5518.145	5315.013	5472.854	4142.839	4093.068	4158.011	3730.001
BIC	5553.361	5399.53	5592.587	4206.227	4212.8	4305.916	3800.432
LR test		217.13	69.29		65.77	8.83	
Prob> chi2		0.000	0.000		0.000	0.7176	

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
The full models are in Appendix C

Table 6: Independence of Irrelevant Alternative (IIA) assumption test

Alternative dropped	Chi.Sq (5) (χ^2)	Probability
Choice 1	84.12	0.00
Choice 2	5.17	0.27
Status-quo	75.85	0.00

Table 7: Estimates by District

	Panel A: Conditional Logit			Panel B: Mixed Logit			Panel C: Generalised Multinomial Logit		
	Base model			Controlling for preference heterogeneity			Controlling for preference and scale heterogeneity		
VARIABLES	Ilala	Kinondoni	Temeke	Ilala	Kinondoni	Temeke	Ilala	Kinondoni	Temeke
cost	**-0.000253*****	**-0.000309*****	**-0.000277*****	**-0.000329*****	**-0.000387*****	**-0.000365*****	**-0.00664*****	**-0.00312*****	**-0.00935*****
	(3.81e-05)	(4.75e-05)	(3.86e-05)	(5.14e-05)	(5.76e-05)	(5.83e-05)	(0.00189)	(0.000784)	(0.00177)
sasc	**-0.901*****	**-2.388*****	**-0.303**	**-7.578*****	**-10.72*****	**-2.631*****	**-26.17*****	**-39.01*****	**-14.48*****
	(0.282)	(0.339)	(0.326)	(1.693)	(2.243)	(0.854)	(5.498)	(10.22)	(2.251)
fore	**0.174*****	**0.0469**	**0.0762**	**0.216*****	**0.0600**	**0.117**	**3.764*****	**0.444****	**0.359*****
	(0.0646)	(0.0462)	(0.0633)	(0.0808)	(0.0626)	(0.0777)	(1.194)	(0.198)	(0.0719)
rive	**0.0323**	**-0.0511**	**0.0977***	**0.0491**	**-0.0750**	**0.128**	**0.982*****	**-0.110**	**0.227**
	(0.0450)	(0.0356)	(0.0566)	(0.0578)	(0.0460)	(0.0793)	(0.304)	(0.128)	(0.180)
coas	**-0.0280**	**-0.0328**	**0.0816**	**0.00716**	**-0.0503**	**0.0994**	**1.456****	**0.0651**	**0.760*****
	(0.0430)	(0.0497)	(0.0611)	(0.0545)	(0.0604)	(0.0762)	(0.654)	(0.0935)	(0.206)
τ							2.672***	2.316***	-2.995***
							(0.165)	(0.156)	(0.213)
SD									
sasc				-11.73***	7.578***	6.080***	-27.21***	-25.87***	-24.44***
				(2.134)	(1.541)	(1.416)	(5.556)	(6.581)	(3.962)
fore				0.640***	0.552***	0.520***	9.599***	-0.489***	0.681***
				(0.116)	(0.108)	(0.102)	(2.761)	(0.159)	(0.148)
rive				-0.0256	0.00459	0.336**	3.748***	0.0723	0.910***
				(0.0941)	(0.0267)	(0.148)	(1.133)	(0.0546)	(0.143)
coas				-0.0125	0.436***	-0.242	0.578***	0.602***	-0.469***
				(0.116)	(0.130)	(0.173)	(0.160)	(0.176)	(0.0675)
				-11.73***	7.578***	6.080***	-27.21***	-25.87***	-24.44***
				(2.134)	(1.541)	(1.416)	(5.556)	(6.581)	(3.962)
LL	-826.9001	-951.2807	-895.8387	-589.6079	-760.5031	-674.2738	-557.2828	-676.2433	-575.7916
AIC	1663.8	1912.561	1801.677	1197.216	1539.006	1366.548	1134.566	1372.487	1171.583
BIC	1692.888	1943.16	1831.024	1249.574	1534.084	1419.372	1192.742	1433.684	1230.277
Observations	2,484	3,360	2,616	2,484	3,360	2,616	2,484	3,360	2,616

Robust clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 8: Estimates from Latent Class model

VARIABLES	(1) Latent class 1	(2) Latent class 2
Cost	**-0.00201*****	**-0.000283*****
	(0.000677)	(1.59e-05)
Fore	**-0.277**	**0.476*****
	(0.270)	(0.0273)
Rive	**-0.125**	**0.349*****
	(1.133)	(0.0262)
Coas	**-0.296**	**0.308*****
	(1.197)	(0.0265)
Constant	-1.525***	
	(0.102)	
Average class share	0.791	0.209
Log likelihood	-2279.5	
AIC	4577.0	
CAIC	4627.0	
BIC	4618.0	
Observations	8,460	8,460
Number of groups	2,820	2,820

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 9: Latent Class number test

Classes	LLF	AIC	CAIC	BIC
2	-2279.52	4577.0	4627.1	4618.1
3	-2082.08	4192.2	4270.0	4256.0
4	-2071.51	4181.0	4286.6	4267.6
5	-2061.19	4170.4	4303.8	4279.8
6	-2045.28	4148.6	4309.7	4280.7
7	-2035.01	4138.0	4327.0	4293.0
8	-2034.78	4147.6	4364.3	4325.3
9	-2039.25	4166.5	4411.1	4367.1
10	-2048.61	4195.2	4467.6	4418.6

LLF = log likelihood; AIC = Akaike information criterion; BIC = Bayesian information criterion.

Table 10: Characteristics of the two Latent classes

Variable	Class 1	Class 2	Test of mean difference
Ilala	.33858268***	.28373702***	-0.0548
Kinondoni	.20472441***	.43944637***	0.235***
Temeke	.45669291***	.27681661***	-0.180***
Age	43.464567***	40.653979***	-2.811**
Male	.46456693***	.44463668***	-0.0199
Education years	8.4094488***	10.058824***	1.649***
Married	.73228346***	.69896194***	-0.0333
Employed	.7007874***	.76989619***	0.0691
Employed full-time	.1023622***	.20242215***	0.100***
Employed part-time	0.0000000	.00692042**	0.00692
Full time student	0.0000000	.01038062**	0.0104
Part-time student	.24409449***	.17647059***	-0.0676*
Staying at home	.05511811***	.03633218***	-0.0188
Retired	0.00787402	.01384083***	0.00597
Self-employed	.59055118***	.55363322***	-0.0369
No. of household members	5.1496063***	4.6038062***	-0.546**
No. of children in the household	2.1338583***	1.8858131***	-0.248
No. of members with an income	1.503937***	1.7231834***	0.219*
Household income (TSH)	486377.95***	927100.96***	440,723***
Forests important	.81102362***	.95155709***	0.141***
Rivers important	.82677165***	.92387543***	0.0971***
Coasts important	.7480315***	.87889273***	0.131***

Table 11: Marginal willingness to pay (TSH/Month)

	Conditional logit	Mixed logit	Generalized multinomial logit	Latent class Average	Class 1	Class 2
Forests	331.71 [87.3, 576.0]	321.52 [81.2, 561.8]	88.45 [66.4, 110.4]	1355.83	-137.72 [-241.5, 366.2]	1681.46 [1344.1, 2101.6]
Rivers	53.24 [-131.8, 238.3]	51.74 [-138.9, 242.4]	-5.64 [-14.4, 3.1]	1000.14	-62.28 [-702.3, 3045.6]	1231.78 [945.7, 1588.2]
Coasts	2.25 [-207.3, 211.8]	16.54 [-186.5, 219.6]	23.78 [9.7, 37.7]	866.67	-147.17 [-790.8, 2978.5]	1087.71 [814.6, 1427.9]

Note: US$1 ≈ TSH2000 Average= weighted average of classes

Table 12: Marginal willingness to pay (TSH/Month) by District

	Conditional logit			Mixed logit			Generalized multinomial logit		
	Ilala	Kinondoni	Temeke	Ilala	Kinondoni	Temeke	Ilala	Kinondoni	Temeke
Forests	688.82 [90.3, 1287.2]	152.02 [-141.7, 445.7]	274.76 [-195.4,744.9]	655.47 [105.2, 1205.7]	155.15 [-158.0, 468.2]	321.43 [-125.6, 768.5]	323.76 [277.5, 370.0]	62.68 [-34.7, 160.1]	62.81 [53.9, 71.7]
Rivers	127.76 [-220.5, 476.0]	-165.33 [-394.2, 63.5]	352.29 [-70.8, 775.4]	149.19 [-195.6, 494.0]	-193.93 [-427.8,40.0]	352.11 [-94.6, 798.8]	236.04 [173.2, 298.7]	-78.24 [-167.4,10.9]	48.97 [31.3, 66.5]
Coasts	-110.78 [-448.6, 227.0]	-106.21 [441.0,205.3]	294.23 [-161.3,749.8]	21.76 [-301.6, 345.1]	-130.15 [-429.0,168.7]	272.33 [-174.7,719.4]	-84.55 [-139.6, -29.4]	-8.47 [-55.2,38.2]	56.39 [45.9,66.8]

Note: US$1 ≈ TSH2000

Figure 1: Importance of nature conservation (%)

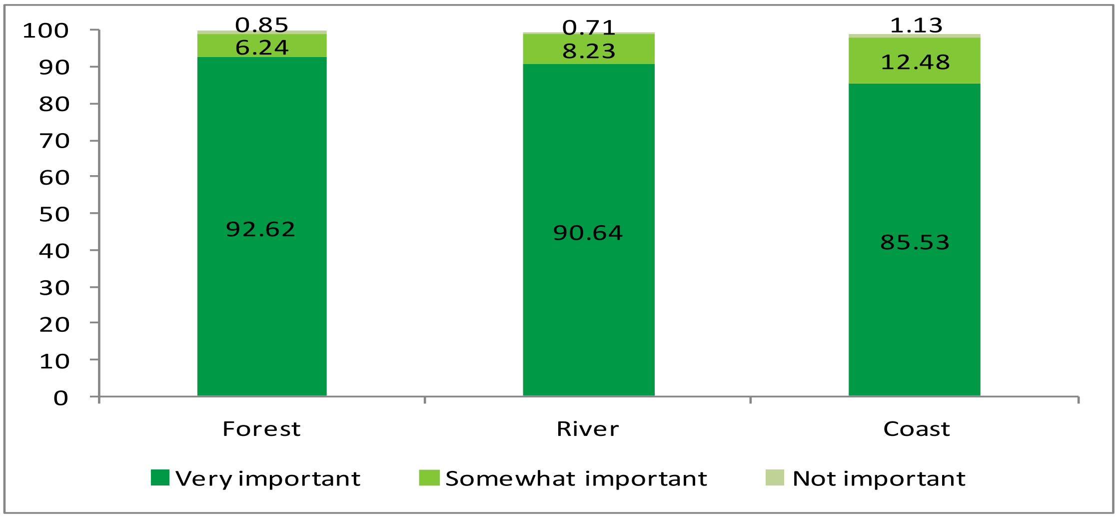


Figure 2: Importance of nature conservation (%) by District

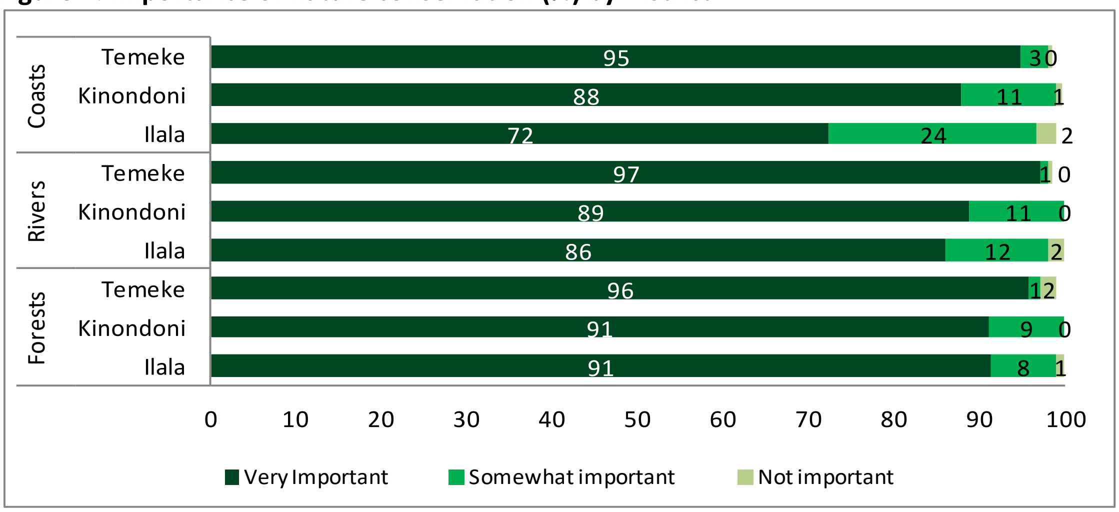


Figure 3: Maintenance of nature areas (%)

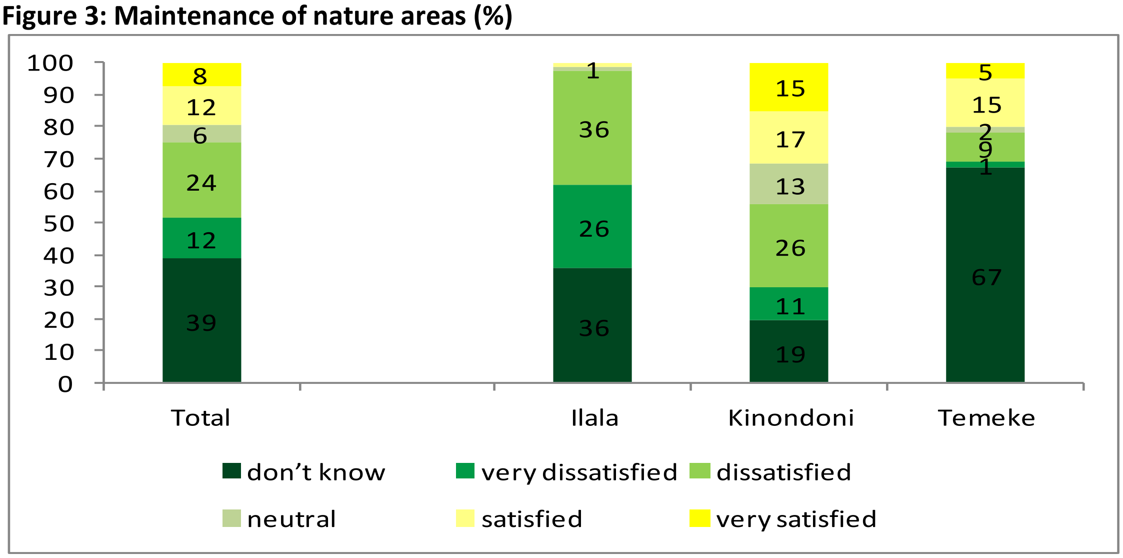


Figure 4: Comparing marginal WTP from each model

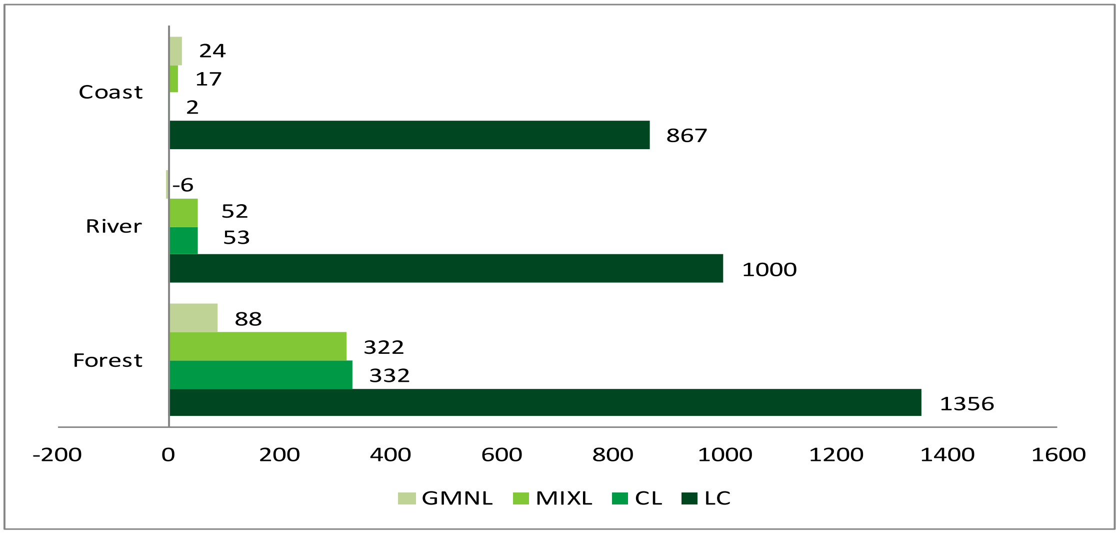


Figure 5: Marginal WTP from latent class models

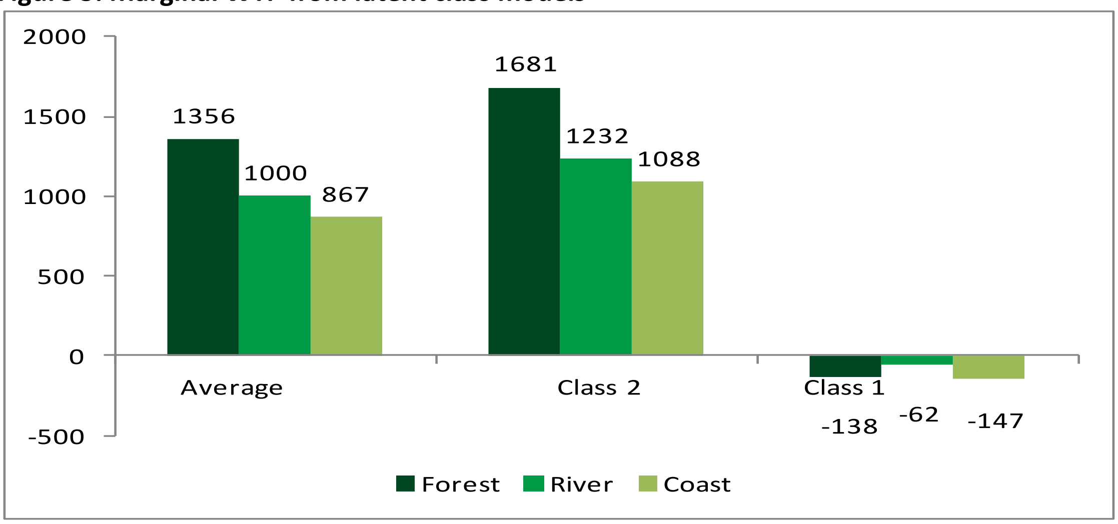
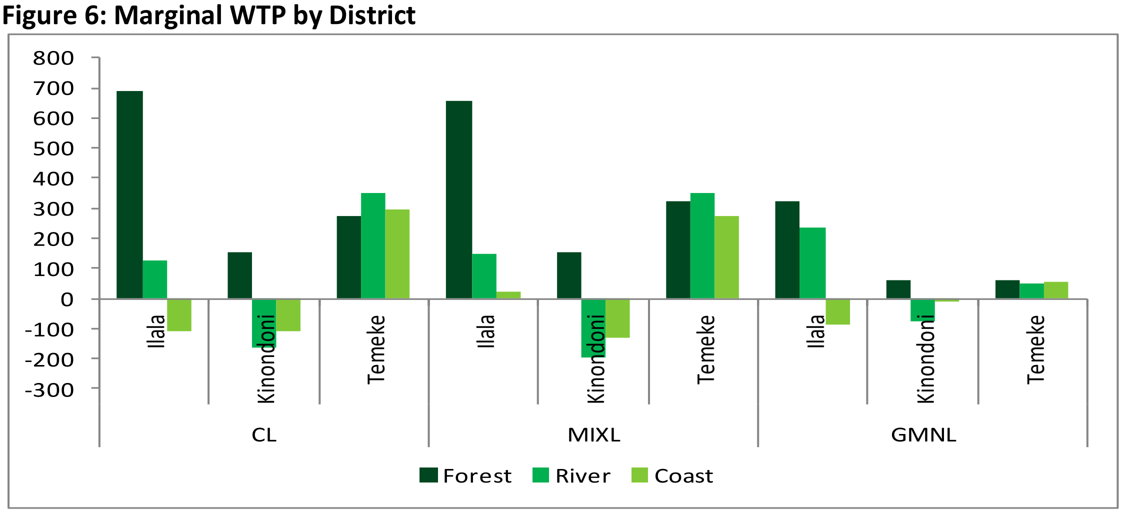


Figure 6: Marginal WTP by District



Appendix B: Distribution of Forests, Rivers and Coastal Areas in Dar es Salaam

Table B.1: Distribution of Forests in the District

Forest	District Location
Pugu Hills Forest	ILALA
Kazimzumbwi Forest	ILALA
Pande Forest Reserve	KINONDONI
Reserve Forest Mangrove	KINONDONI
Vikindu Forest	TEMEKE

Table B.2: Distribution of Rivers in the District

Rivers	Location	Tributaries	Location
Msimbazi	ILALA	Ubungo	KINONDONI
Mzinga	TEMEKE	Sinza	KINONDONI
Kizinga	TEMEKE	Luhanga	KINONDONI
Mpiji	KINONDONII	Bungoni	TEMEKE
		Mianzini	TEMEKE
		Toangoma	TEMEKE
		Tegeta	KINONDONI
		Mbezi	KINONDONI
		Kijitonyama	KINONDONI
		Kimani	ILALA
		Tabata	ILALA
		Mlalakuwa	KINONDONI
		Kimanga	ILALA
		Uvumba	KINONDONI
		Mkusa	KINONDONI

Table B.3: Distribution of Coastal Amenities in the District

Coastal Areas	Ownership Category	District Location
White Sands Hotel and Resort	Private	KINONDONI
Giraffe Ocean View Hotel	Private	KINONDONI
Slipway Shopping Centre	Private	KINONDONI
Sea Cliff Hotel	Private	KINONDONI
Dar es Salaam Yacht Club	Private	KINONDONI
The Golden Tulip	Private	KINONDONI
Coco Beach	Public	KINONDONI
Palm Beach	Semi-Private	KINONDONI
Ocean Road	Public	ILALA
Kawe Beach	Public	KINONDONI
Kunduchi Beach	Semi-Public	KINONDONI
Kivukoni Waterfront	Public	ILALA
Mbudya	Semi-Public	KINONDONI
Bongoyo	Semi-Public	KINONDONI
Mikadi	Semi-Private	TEMEKE
South Beach Resort	Semi-Private	TEMEKE
Kijiji Beach Resort	Semi-Private	TEMEKE
Bamba Beach	Semi-Private	TEMEKE
Mbalamwezi Beach	Semi-Public	KINONDONI

Appendix C: Estimation Results

Table C.1: Estimates from Conditional Logit model

VARIABLES	(1) attributes only	(2) asc interaction	(3) Socio-eco interaction
Cost	-0.000280***	-0.000285***	-0.000284***
	(2.45e-05)	(2.54e-05)	(2.48e-05)
Sasc	-1.215***	-1.444***	-1.261***
	(0.203)	(0.464)	(0.199)
Fore	0.0930***	0.0937***	0.217*
	(0.0330)	(0.0328)	(0.120)
Rive	0.0149	0.0146	-0.0613
	(0.0264)	(0.0267)	(0.102)
Coas	0.000633	0.00128	0.122
	(0.0300)	(0.0308)	(0.102)
Agefo			-0.00234
			(0.00231)
Ageri			-0.000293
			(0.00225)
Ageco			-0.00306
			(0.00224)
Sexri			0.0446
			(0.0463)
Sexco			-0.0143
			(0.0477)
Sexfo			-0.0998
			(0.0625)
Incfo			0.0814*
			(0.0421)
Incri			0.0705***
			(0.0230)
Incco			0.0132
			(0.0231)
Hhmfo			-0.0235
			(0.0156)
Hhmri			-0.0114
			(0.00919)
Hhmco			-0.00189
			(0.0118)
Agesc		0.0112	
		(0.00689)	
Incsc		-0.405**	
		(0.166)	
Hhmsc		0.111***	
		(0.0348)	
Sexsc		0.129	
		(0.177)	
Marsc		-0.127	
		(0.186)	
distr2sc		-0.957***	
		(0.355)	

distr3sc		0.504	
		(0.333)	
Observations	8,460	8,460	8,460

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table C.2: Estimates from Mixed Logit model

VARIABLES	(1) attributes only	(2) asc interaction	(3) Socio-eco interaction
Cost	-0.000349***	-0.000346***	-0.000347***
	(3.12e-05)	(3.00e-05)	(3.29e-05)
Sasc	-7.488***	-8.165***	-6.654***
	(1.109)	(1.661)	(1.272)
Fore	0.112***	0.113***	0.172
	(0.0416)	(0.0424)	(0.174)
Rive	0.0181	0.0167	-0.120
	(0.0339)	(0.0338)	(0.115)
Coas	0.00578	0.0126	0.191
	(0.0361)	(0.0366)	(0.148)
Agefo			-0.000867
			(0.00365)
Ageri			0.000473
			(0.00285)
Ageco			-0.00366
			(0.00326)
Sexri			-0.00673
			(0.0624)
Sexco			-0.106*
			(0.0622)
Sexfo			-0.177*
			(0.0955)
Incfo			0.0909*
			(0.0496)
Incri			0.0741**
			(0.0312)
Incco			0.00607
			(0.0261)
Hhmfo			-0.0188
			(0.0193)
Hhmri			-0.000459
			(0.0124)
Hhmco			0.00463
			(0.0169)
Agesc		0.0225	
		(0.0325)	
Incsc		-1.353***	
		(0.265)	
Hhmsc		0.792***	
		(0.202)	
Hhcsc		-0.691**	
		(0.285)	
Sexsc		1.031*	
		(0.546)	
Marsc		-0.612	
		(0.540)	
distr2sc		-4.881***	
		(1.480)	
distr3sc		2.789**	

		(1.382)	
SD			
Sasc	8.889***	8.870***	8.262***
	(1.214)	(1.296)	(1.331)
Fore	0.511***	0.508***	0.526***
	(0.0633)	(0.0671)	(0.0737)
Rive	0.00963	0.00778	-0.00881
	(0.0325)	(0.0539)	(0.0467)
Coas	-0.292***	0.279***	0.209
	(0.0695)	(0.0860)	(0.152)
Observations	8,460	8,460	8,460

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table C.3: Estimates from Generalised Mixed Logit model

VARIABLES	(1) attributes only	(2) asc interaction	(3) Socio-eco interaction
Cost	-0.0102***	-0.00406***	-0.00248***
	(0.00166)	(0.000511)	(0.000356)
Sasc	-28.09***	-13.07***	-18.60***
	(4.831)	(1.862)	(3.033)
Fore	0.898***	0.529***	0.181
	(0.213)	(0.100)	(0.427)
Rive	-0.0573	0.178*	-0.325
	(0.0465)	(0.102)	(0.566)
Coas	0.241***	0.0417	-0.289
	(0.0674)	(0.104)	(1.016)
Agefo			-0.00237
			(0.00361)
Ageri			-0.00272
			(0.00375)
Ageco			-0.00541
			(0.0188)
Sexri			0.278
			(0.317)
Sexco			-0.0145
			(0.127)
Sexfo			-0.186*
			(0.113)
Incfo			0.338**
			(0.134)
Incri			0.283
			(0.334)
Incco			0.211**
			(0.0835)
Hhmfo			-0.0353
			(0.0816)
Hhmri			-0.0252
			(0.0899)
Hhmco			0.0605
			(0.0393)
Agesc		0.0314***	
		(0.00967)	
Incsc		-4.613***	
		(0.533)	
Hhmsc		0.567***	
		(0.0897)	
Hhcsc		0.0154	
		(0.0959)	
Sexsc		2.047***	
		(0.352)	
Marsc		-1.456***	
		(0.270)	
distr2sc		-15.10***	
		(1.888)	
distr3sc		0.567***	

		(0.216)	
Constant	3.026***	2.667***	2.270***
	(0.0978)	(0.104)	(0.113)
SD			
Sasc	23.61***	16.33***	-20.69***
	(3.858)	(2.018)	(5.486)
Fore	1.560***	0.00710	0.432
	(0.259)	(0.0463)	(0.323)
Rive	1.024***	0.0228	-0.295***
	(0.168)	(0.0286)	(0.0419)
Coas	1.518***	0.0200	0.0554
	(0.245)	(0.0801)	(0.403)
Observations	8,460	8,460	8,460

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix D: Conservation efforts in Dar es Salaam

This is a notice to the public indicating that entry to the forest in order to cut down trees for firewood or charcoal or for building or for any other purpose is prohibited