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Cost-Benefit Analysis of Green Space Investment in Residential Areas of Dar es Salaam City, Tanzania

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Abstract

Urban green spaces are increasingly recognized as alternative ameliorative methods to technical solutions abating cities' environmental problems like poor air quality, climate change impacts, and heat stress. However, the costs of development and maintenance of green spaces in terms of materials, labor, and time are not known. The main objective of the study was to assess the costs and benefits associated with green space investment in residential plots of Dar es Salaam City. The study employed in-depth interviews using structured questionnaires and document review. Results indicated that households incur an average cost of TZS 136,579 (USD 59) and a maximum of TZS 6,629,019 (USD 2,882) for establishing more than one home greenery type. The total net monetary benefit per household after all costs due to disservices have been accounted for was TZS 3,148,827 (USD 1,369) annually. Based on a cost-benefit analysis of home greenery, it was found that the benefit was 2.6 times as much as the investment cost thus suggesting that maintaining home greeneries is cost-effective and a worthwhile investment. The results may help in evaluating trades off between courses of action as well as a decision tool for the households when investing in green spaces. The study recommends that residents and City managers should invest in allotments, shade trees, and/or fruit trees, as they were found to have the highest benefits, monetary savings, and benefit-cost ratio. Moreover, to maximize monetary benefit from home greenery, residents should select the right type of green space followed by choosing the right plant species, identification of the right location within the residential plot for establishing green space, and adopting building designs that optimally support green space functioning.

Keywords: benefit, ecosystem disservices, greenspace, development cost, maintenance cost, monetary saving

1. Introduction

Urban green spaces include grasses, trees, shrubs, lawns/parks, community gardens, playgrounds, Public seating areas, public plazas, and Vacant lots (Saphores & Li, 2012). Green spaces in urban areas have been considered to be an essential component as they provide various ecosystem services (Sousa, 2003) including air filtration, biodiversity and helping cities to deal with climate change, rainwater drainage, sewage treatment, recreational and cultural values, improvement of air quality and noise reduction (Bolund & Hunhammar, 1999; Chaudhry, 2013; Costanza et al., 2017).

Apart from the fact that green spaces have a lot of benefits to the society and environment, people are not willing to pay for investment and the maintenance cost of watering, fertilizing and pruning the green spaces among other costs (Saphores & Li, 2012). Green policies have been advocating the increase of conservation efforts on green spaces (Cilliers, 2013). However, most green spaces in Cities are destroyed by the establishment of impervious surfaces on streets and driveways and the construction of buildings (Vaz et al., 2017 and Wegner, 2011).

Dar es Salaam City is one of the rapidly urbanizing cities in Africa where green spaces are converted into brown spaces like residential buildings, industries, roads, etc. However, understanding the cost benefits of green spaces investment may proactively help in changing brown spaces into green spaces (Georgi & Dimitriou, 2010). It can help cities to cope with the impacts of climate change (Roy *et al.*, 2018; Sousa, 2003) and play a central role in the design of sustainable communities. The study on cost-benefit analysis of green spaces investment helps residents to stretch their level of investment by type and quantity of green spaces. The study aimed at assessing the cost-benefit of green space investment in Dar es Salaam City, Tanzania for supporting decision-making on green space management at the city level and place of domicile.

2. Methodology

2.1 Selection of Study Area

Although there are other cities in Tanzania which, are Mwanza, Arusha, and Mbeya, Dar es Salaam was selected for the study because it has the highest urbanization rate exacerbated by the high population growth rate and density in Tanzania mainland leading to a higher conversion rate of green spaces to residential, commercial and industrial purposes than any other City in Tanzania. Conversion of green spaces is so rampant that public open spaces and wetlands are fast disappearing and consequently Dar es Salaam City is most likely experiencing more impacts caused by the absence of green spaces than any other city in Tanzania. Therefore, challenges related to green spaces disappearances such as floods (stormwater problem), heat stress, the disappearance of recreational services, and the demand-supply gap of ecosystem services from green spaces (GS), make Dar es Salaam City the best representative urban center to assess the cost-benefit of green space investment.

2.2 Selection of Wards for the Study

The current study was conducted in four wards which were carefully selected to represent the Dar es Salaam City situation. The wards which were found to be predominantly residential were chosen using remote sensing techniques and GIS, in which 82 wards out of 90 wards were found to meet the requirement. Conducting the study in 82 wards was found to be prohibitive in terms of cost, time, and logistical challenges and as such the selected eighty-two (82) wards were further screened using remote sensing techniques and GIS and wards with all GS types (vegetation, rivers and open spaces) were selected. This led to the selection of 60 out of 82 wards, however, the number of selected wards was found to be still high to be able to undertake the study considering time limitations and resource scarcity. The selected 60 wards were then assessed in terms of green space abundance using building counting and population density criteria implying that areas with high building density are assumed to have low green space coverage and vice versa. Population density has implications on the extent of exposure to impacts of green spaces' disappearance. The assessment in terms of population density resulted in four classes of wards and in each class, one ward was chosen. The four (4) classes are as follows; class one-very high population and housing density; class two-high population and housing density; class three-moderate population and housing density and class four-low population and housing density. Wards within the class that were found to have similar characteristics of the building and population density were differentiated by the green space index. The green space indices were obtained by dividing the total area (coverage) of green space by the total area of the ward. The total area of the ward was obtained from the National Bureau of Statistics (NBS) of Tanzania. Green spaces coverage was obtained through on-screen digitization using the same high-resolution Dar es Salaam City ortho-rectified aerial imagery of 2017. Each green space chosen was digitized to get polygons. The areas were automatically generated by ArcGIS 10.3.1 software (ESRI, Redlands, California). In this regard, four wards across Dar es Salaam City were chosen. In class one, Makumbusho was chosen as the case study area out of four wards, for class two, Mburahati was selected out of four wards, for class three, Yombo Vituka was picked out of 15 wards while for class four, Kawe was chosen out of 37 wards.

2.3 Sampling of Households/Unit of Analysis

The unit of analysis in the study was a household. Households were chosen by the technique of purposive sampling. Based on Digital Elevation Model (DEM) all wards were sub-divided into a zone of high land and low land. The rationale for zoning is that among other factors the distribution and abundance of green spaces depend on the topographical nature of the area. The low land zone which is sometimes wetland in nature might have a good distribution and high abundance of green spaces than the high land due to the differences in soil fertility and soil moisture if all other factors are kept constant. The division of settlements/wards into high and low land was achieved through the development of a digital elevation model (DEM) for each settlement/ward. To capture zoning and the whole concept of green spaces, the DEM was overlaid with a green spaces map. Thereafter, each zone (high land and low land) in the overlay map was further subdivided into blocks of $0.02km^2$ within which the most greenery house(s) were marked as the selected households/respondents. The choice of households in both high land and low land zones considered their proximity to open spaces and open water bodies for capturing the whole concept of green space which may be vegetated land, stream, or unsealed and permeable spaces (open space).

2.4 Data Collection Methods

A questionnaire survey was used to get a deeper understanding of the economic value of ecosystem services and disservices, costs of green spaces development, and management of green spaces in households. Thus, questions were focused on the variables which can be used in determining the cost-benefit analysis of green spaces (Table 1&2). Other information included demographic information, land tenure as well as its monetary effects on green spaces. Differences in socio-economic and environmental contexts of the City were captured by conducting the study in four selected wards as detailed above. Data were collected from a total of 511 households within the case study areas. The distribution of questionnaires/respondents in selected wards was based on the size of the ward and the availability of residential houses with home greenery, streams, and open spaces. The number of questionnaires administered in Makumbusho, Mbezi, Mburahati, and Yombo Vituka wards was 127, 150, 100, and 134, respectively. Desired information was captured by administering both closed and open-ended questions to households.

2.4.1 Cost-Benefit Analysis of Green Space Investment

The key variables for cost-benefit analysis include Capital Recovery Factor (CRF), Economic Value of Green Spaces (EVGS), Economic Value of Ecosystem Disservices (EVED), and Total Investment Cost (TIC) i.e. Capital. To get EVGS, EVED, and TIC, several existing methods/ approaches were used concurrently. The key variables were determined as follows;

Capital Recovery Factor (CRF)

A capital recovery factor (CRF) is the ratio of a constant annuity to the present value of receiving that annuity for a given length of time. Using an interest rate *i*, the capital recovery factor is calculated using Equation 1 as per Ayyub (2014) and Benford (1985):

$$\mathrm{CRF} = \frac{i(1+i)^n}{(1+i)^n-1} \tag{1}$$

Where; i is the interest rate and n for this particular case is the average lifetime of home greenery. The Yombo Vituka average lifetime of home greeneries was found to be 14 years and the interest rate of 17% as used by the local banks in 2019, the CRF was found to be 0.19. This implies that if the investment cost was a loan from the bank for 14 years, the rate of returning the loan will be 19% of the borrowed month per year.

Economic Value of Green Spaces (EVGS)

The economic value of green spaces was determined based on Monetary Benefits (MB) derived from green spaces and Total Investment Cost (TIC) put on green spaces. TIC is included because urban green spaces (artificial or natural) are associated with investment costs. Thus, the Monetary Benefits (MB) from green spaces can be expressed as a net value. MB is the difference between the summation of Economic Value of Ecosystem Services (EVES) and the summation of Economic Value of Ecosystem Disservices (EVED) that a household experiences. Thus, the Economic Value of Green Spaces (EVGS) was determined using the following equation:

$$\mathrm{EVGS} = \mathrm{MB} + \mathrm{TIC} \tag{2}$$

Whereby

$$\mathrm{MB} = \sum_{n=1}^{n} EVES - \sum_{n=1}^{n} EVED$$

$$\sum_{n=1}^{n} EVES = \text{Monetary benefit of green spaces due to Food service provision} + \text{Monetary benefit of green spaces due to Temperature regulation service} + \text{Monetary benefit of green spaces due to storm water regulation service} + \text{Monetary benefit of green spaces due to air quality (dust control service)} +$$

$$\text{Monetary benefit of green spaces due to air quality (wind control service)} + \text{Monetary benefit of green spaces due to disease control service} + \text{Monetary benefit of green spaces due to Biodiversity conservation service} + \text{Monetary benefit of green spaces due to Disaster control service} +$$

Monetary benefit of green spaces due to aesthetic service + Monetary benefit of green spaces due to recreation service (3)

$$\sum_{n=1}^{n} EVED$$ = Monetary loss due to aesthetics related disservices + Monetary loss due to health related disservices + Monetary loss due to physical damage related disservices + Monetary loss due to social, economic and security-related disservices (4)

$$TIC = \sum_{n=1}^{n} (\text{Development cost} + \text{Replacement cost} + \text{Maintenance cost}) \quad (5)$$

However, each variable was obtained by method(s) indicated in Table 1 while the approach (es) used are shown in Table 2. The monetary value of each ecosystem service presented in Equation 1 was obtained by establishing two values, one was based on the scenario of monetary gain (cost avoided) due to the presence of green space and the second value was obtained based on a scenario of monetary loss that could occur due to the absence of green space. The two values were used to judge the value of green space due to particular service(s) enjoyed by the resident(s) at the household level. Furthermore, to obtain the current aggregate value of green spaces, monetary values due to the development cost, replacement cost as well as recovery, prevention, and control costs of ecosystem disservices were adjusted using the following inflation equation:

$A_n = A_{n-1}(1+r)$

Where,

A_n=Equivalent monetary cost as of 2019

A_{n-1}=Estimated monetary cost in the previous year

r =Country data on inflation rate in the present year

Table 1. Variables and approaches adopted to determine the economic value

S/N	Variable	Adapted Valuation method
1	**Economic Valuation of Ecosystem Services (EVES)**	
1.1	Monetary benefit of green spaces due to food provisioning service	Market Price, Opportunity cost, Travel cost
1.2	Monetary benefit of green spaces due to temperature regulation services	Avoided cost, Averting behavior, Opportunity cost, Travel cost
1.3	Monetary benefit of green spaces due to Storm water regulation service	Avoided cost, Deferred cost Opportunity cost
1.4	Monetary benefit of green spaces due to air quality improvement (dust control service)	Deferred cost, Opportunity cost
1.5	Monetary benefit of green spaces due to wind control service	Deferred cost, Opportunity cost, Opportunity cost
1.6	Monetary benefit of green spaces due to disease control service	Averting behavior, Opportunity cost, Travel cost
1.7	Monetary benefit of green spaces due to Biodiversity protection service	Deferred cost, Avoided, Opportunity cost
1.8	Monetary benefit of green spaces due to disaster mitigation service	Deferred cost, Opportunity cost
1.9	Monetary benefit of green spaces due to aesthetics	Contingent valuation –Willingness to pay
1.10	Monetary benefit of green spaces due to Recreational service	Contingent valuation –Willingness to pay
2	**Economic Valuation of Ecosystem Disservices (EVED)**	
2.1	Aesthetics disservices	Averting behavior, Opportunity Cost
2.2	Health disservices	Medication cost, Opportunity cost, Travel cost method
2.3	Physical disservices	Averting behavior , Opportunity Cost
3	**Total Investment cost (TIC)**	
3.1	Total Development Cost (TDC)	Market based method, Travel cost, Opportunity cost
3.3	Total Replacement Cost (TRC)	Market based method, Travel cost, Opportunity cost
3.4	Total maintenance Cost (TMC) per month or year	Market based method, Travel cost, Opportunity cost

Assumptions

The aggregate economic value of green space was obtained based on the following assumptions:

i. Food stuff are free from pollution

ii. The opportunity cost of time for the respondent /household head represents the opportunity cost of time for the whole household

iii. For temperature regulation, the rate of energy use of the electrical appliance is based on its specifications and no electrical appliances is used when a family member is outdoor

iv. For the economic value of green spaces due to stormwater regulation, soil type of the home greenery is uniform

v. For the economic value of green spaces due to disease regulation, the most significant source of the particular disease is the absence of home greeneries

vi. For the economic value of green spaces due to recreation and aesthetic services, the amount that the household head is willing to accept as compensation is the minimum value of the service offered.

Table 2. Valuation methods and approaches

Method	**Operationalization/approach of the method**
Contingent valuation (CV)	It seeks to establish whether respondents are willing to pay or accept a sum of money to achieve the outcome of protecting the ecosystem
Market price (MP)	It estimates the economic value of goods that are bought and sold in commercial markets.
Travel cost	It captures the travel time and travel cost
Opportunity cost	It is the monetary sacrifice to gain the benefits from ecosystem services provision.
Averting behavior (Abatement cost)	It finds costs incurred to mitigate against impacts
Treatment cost	This involves costing all costs related to illness
Deferred cost method (Cost of alternatives)	Cost of anthropogenic solution as an alternative to the ecosystem service
Avoided cost of damage	It is a cost estimate of the reduction in expected damage or economic burden like poor cooling

3. Results and Discussion

3.1 Ecosystem Services from Residential Plots

Ecosystem services from home greeneries that were found to be enjoyed by Dar es Salaam City residents were temperature regulation, food products, recreation and aesthetics, dust control, and wind attenuation. Others included biodiversity protection, disaster prevention, disease prevention, and stormwater control. Households obtained single or more than one service (Combination) from green spaces. The cumulative percentage of respondents who reported getting a single service from their residential plots was 32.8% while 67.2% obtained more than one service. This implies that households get a wide range of services to sustain their living in different ways. The percentage distributions of respondents who get a single service include 18.2% for shade, 9.4% for food products, and 3.2% for recreation. The predominant services obtained in combination from residential plots were food and shade which accounted for 10.2% of the respondents followed by a combination of recreation, food, and shade (4.9%) and a combination of recreation, shade, and food and biodiversity protection (1.6%). The settlement which was found to lead in terms of availability of service combination was Kawe. In general, the ecosystem services which were identified in the current study were similar to those which have been reported by CLUVA (2013). The common urban green space services found in the current study were food, medicinal resources, temperature control (shade), temperature control (evaporative cooling), temperature control (cooling), flood control (urban surface water regulation), erosion control, recreation, livelihoods and habitat for species.

3.2 Net Monetary Value of Green Spaces

The average net economic value of home greenery in case study areas was TZS 3,148,827 (about USD 1,370) per household per year being the average of the individually calculated difference in the total economic value of ecosystem services and disservices in case study areas. This implies that one household can avoid an average of TZS 3,148,827 (about USD 1,370) per year knowingly or unknowingly by investing in more than one home greenery type. However, households with allotments as the single home greenery type were found to have the highest net economic value per household per year followed by those with shade and/ or fruits thus suggesting that investing in the allotment is more paying than any other type of home greenery. Wards whose households were observed to have the highest annual average net monetary benefits were Yombo Vituka (TZS 4,206,393 (USD

1,830)) followed by Kawe (TZS 3,365,032 (USD 1,370)), Makumbusho (TZS 2,804,388 (USD 1,220)) and Mburahati (TZS 1,855,392 (USD 807)). One-way Analysis of Variance (ANOVA) results indicated that the differences in net benefits (p>0.05) for the four wards ($F_{(3, 506)} = 2.467$, $p = 0.0614$) were statistically insignificant thus implying that the net benefits of green spaces within Dar es Salaam City are independent of the location.

3.3 Cost Attached to Green Spaces Development and Management

3.3.1 Home Greenery Establishment Costs

Costs for developing and /or replacement of green spaces include material, labor, and the opportunity cost of time. Households were reported to incur an average cost of TZS 136,579 (USD 59) and a maximum of TZS 6,629,019 (USD 2,882) for establishing more than one home greenery type. The ward whose households lead in average establishment cost for home greenery was Kawe (TZS 277,608 (USD 121) followed by Mburahati (TZS 120,400 (USD 52)), Yombo Vituka (TZS 80,053 (35USD)) and Makumbusho (TZS 42,391 (USD 18)). Results of one-way Analysis of Variance (ANOVA) indicated that differences in green space establishment cost in residential plots at p<.05 level for the four wards was statistically significant ($F_{(3, 507)}$ =6.712, p=.00019). According to Tukey's honestly significant difference (HSD) post hoc test, significant differences were observed between Kawe and Makumbusho and, Yombo Vituka and Kawe. The significant difference between Kawe and Makumbusho might be contributed by average home greenery coverage which demands more investment cost. Kawe has bigger average green space coverage per household (505 square meters) as compared to Makumbusho (34 square meters). The significant difference between Kawe and Yombo Vituka might be partly contributed by differences in green space coverage as previously reported. Another difference is the level of investment, which might reflect the differences in income levels. Kawe has a significantly higher average household income per month (TZS 658,000) than Yombo Vituka (TZS 213,000). Based on the households with one home greenery type in their residential plots, the average development cost for those owning house gardens was the highest followed by those with open agricultural fields (Figure 1). The observed differences (Figure 1) may be due to higher requirements for watering, fumigations, and fertilizer application for house gardens and open agricultural fields compared to the other types of home greenery.

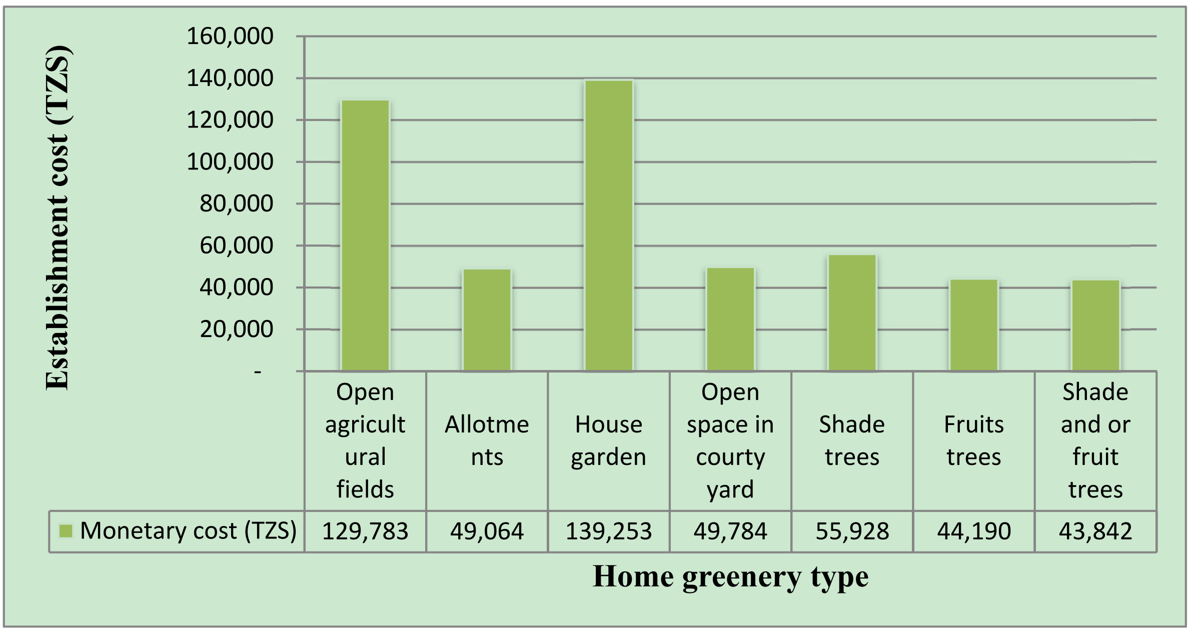

Figure 1. Greenspace establishment cost by type

3.3.2 Maintenance Costs of Green Spaces

In addition to the establishment costs that households are incurring, owners also have to bear maintenance costs related to the procurement of materials, labor force, and the opportunity cost of time if a household is directly engaged in daily green space maintenance activities. Results indicated that households in case study areas incur an average cost of TZS 99,283 (USD 43) per month for maintaining more than one home greenery type. The ward whose households were found to have the highest average maintenance cost for more than one home greenery type per month was Kawe (TZS 316,038 (USD 137)) followed by Yombo Vituka (TZS 166,569 (USD 72)), Makumbusho (TZS 69,657 (USD 30)) and Mburahati (TZS 65,390 (USD 28)). Moreover, the average maintenance cost that households incur since the establishment of home greenery was TZS 15,542,527 (USD 6758). The ward whose households lead in a total maintenance cost for more than one home greenery type since the establishment of green spaces was Kawe (TZS 27,107,223 (USD 11,786)) followed by Yombo Vituka (TZS 18,094,244 (USD 7,867)) Makumbusho (TZS 7,179,607 (USD 3,122)) and Mburahati (TZS 5,313,461 (USD 2,310)). One-way Analysis of Variance (ANOVA) indicated that differences in the total investment cost for the four wards are statistically significant ($F_{(3, 506)}$ =3.568, p=0.0141) at $p<0.05$. According to Tukey's honestly significant difference (HSD) post hoc test results, significant differences were observed between Kawe ward and Makumbusho and, Kawe and Mburahati. Households in Kawe were ready to commit maintenance costs (in terms of material, labor, and the opportunity cost of time) higher than in Makumbusho and Mburahati. For instance, households in Kawe were able to spend 48% of the average monthly income Mburahati 26% and Makumbusho 25% relative to their opportunity cost of time. These values seem to be high and as such, they may not represent reality. Unfortunately, there are no reported similar studies for comparison purposes that, have been done in urban areas in Tanzania. Recent studies have based on the role of urban green infrastructure in temperature regulation (Kibassa, 2014) and health risks due to urban agriculture (Leonard *et al.*, 2012). Notwithstanding that the findings of the current study could not be compared with results from previous studies, keeping other factors constant, households in Kawe may be regarded as the most committed to maintaining home greeneries by the proportion of their income they are committed to use for that purpose.

Based on the households with one home greenery type in their residential plots, the average maintenance cost for those owning open space in the courtyard was the highest followed by those with fruit trees (Figure 2). This might be because courtyards require a labor force and the opportunity cost of time for periodic cleaning and handling of wastes.

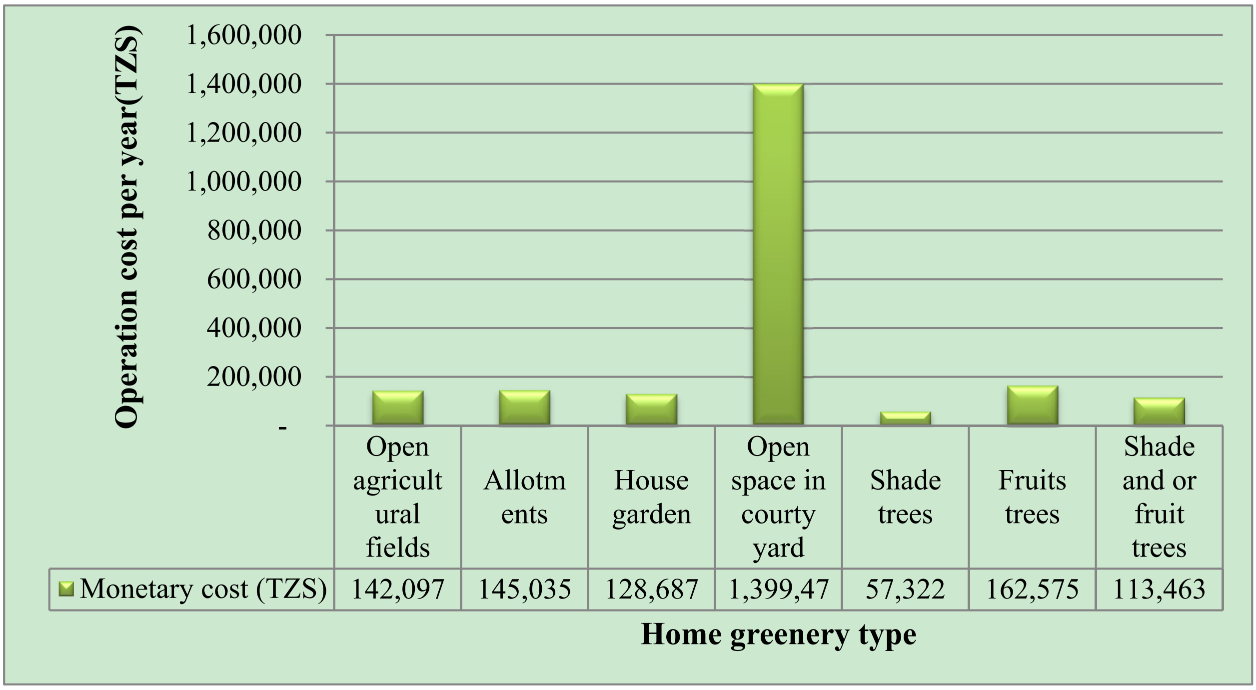

Figure 2. Greenspace maintenance cost by type

3.4 Capital Recovery Cost (CRC) and Total Annual Costs (TAC) of Green Space(s)

Capital Recovery Cost (CRC) is the annual equivalent of the capital cost. CRC is the product of capital cost and Capital Recovery Factor (CRF) (TZS 136,579×0.19). For home greenery investment, the CRC was computed and found to be TZS 25,950.0 (11USD). This implies that households need to earn back initial funds put into green space investment amounting to TZS 25,950.0 (11USD) per year. On the other hand, the total annual costs are the summation of the capital recovery cost (CRC) and all annual maintenance costs of home greenery. Upon summing up the CRC (TZS 25,950.0 (USD 11)) and annual maintenance costs (TZS 1,191,396 (USD 518)) the total annual cost is TZS 1,217,346.0 (USD 529).

3.5 Cost-Benefit Ratio (CBR)

Based on total annual net benefits (TZS 3,148,827 (USD 1,369)) and total annual cost (TZS 1,217,346.0 (USD 529)), the CBR for household home greenery is 2.6 meaning that investment in home greenery has more net benefits than costs implying that for each TZS spent in the management of more than one home greenery at the household level, the net benefit value of TZS 2.6 is realized by household in case study areas. Thus, maintaining green spaces is cost-effective and provides numerous monetary benefits.

For households that have invested in only one green space type, the monetary benefit was 35 times the total investment cost per year for households with shade trees (Table 3). On the other hand, the monetary benefit was about 34 times the total investment cost per year for households with green spaces used for shade and/or fruit trees. The green space type with the lowest cost-benefit ratio was open space inside the courtyard (Table 3). This is because the total investment and operational cost of open space inside the courtyard are greater than the benefits. From these observations, it can be implied that investing in shade trees, fruit trees and allotments is profitable. Comparison with results from previous studies could not be done due to the lack of published results on similar studies conducted elsewhere.

Table 3. Greenspace types and their Cost-Benefit Ratio (CBR)

Greenspace	Net benefit per year (TZS)	Investment cost (TZS)	maintenance cost per year (TZS)	Age	CRF	Capital Recovery Cost (CRC)(TZS)	Total Annual Cost (TAC) (TZS)	Benefit-Cost Ratio (CBR)
Open agricultural fields	2,646,732	129,783	142,097	9.5	0.21	28,422.48	170,519	15.52
Allotments	4,876,315	49,064	145,035	4.1	0.36	17,564.91	162,600	29.99
House garden	1,660,170	139,253	128,687	7.8	0.24	33,559.97	162,247	10.23
Open space in court yard	1,503,177	49,784	1,399,473	16.2	0.20	9,757.664	1,409,231	1.06
Shade trees	2,344,980	55,928	57,322	15	0.19	10,514.46	67,836	34.56
Fruits trees	1,985,077	44,190	162,575	8.2	0.24	10,384.65	172,960	11.47
Shade and or fruit trees	4,095,626	43,842	113,463	12.3	0.20	8,724.558	122,188	33.52

4. Conclusion

Cost-Benefit analysis of home greenery was found to be 2.6 times as much as investment cost implying that home greenery investment at the household level in the study area has a net benefit of at least two folds thus suggesting that maintaining home greeneries is cost-effective and a worthwhile investment. Investing more in green spaces will likely result in savings on avoided costs associated with the absence of green spaces at both the household level as well as at the City level. The avoided cost could be used for other developmental activities. Low-income residences, however, are likely to face challenges in the development and maintenance of green spaces due to the associated costs. It is recommended that residents and City managers should invest in allotments, shade trees, and/or fruit trees, as they were found to have the highest monetary benefits, monetary savings, and benefit-cost ratio. Moreover, to maximize monetary benefits from home greenery, residents should select the right type of green space followed by choosing the right species, selecting the right location within the residential plot for optimal benefits, and adopting building designs that support green space efficient functioning.

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