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Modeling the Economic Value of Green Spaces in Residential Areas of Dar Es Salaam City, Tanzania

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Abstract

The economic value of green spaces in residential areas has been advocated to raise the land and property values. However, the establishment of the economic value of green spaces need many data such that it is costly and needs expertise. The objective of this study was to develop a user-friendly mathematical model that employ few data to determine the economic value of green spaces in residential areas in Dar es Salaam City. The study was cross sectional and employed structured questionnaires as a data collection method. Linear regression model was developed by relating economic values of green spaces to various environmental and socio-economic conditions of households. The study revealed that the net economic value of home greenery was significantly influenced by income of the households, area covered, age of the respondents and green space type. The average net benefit calculated from the model (1,317USD per household per year) was not far from the normal arithmetic mean calculated through traditional methods (1,369USD per household per year). This implies that the model can best predict the overall mean of the net benefit by 96.2%. It is therefore, recommended that the model can be used to estimate the economic value of ecosystem services from home greenery, property value and can guide the establishment of compensation for households due to green space availability.

Keywords: ecosystem services, ecosystem disservices, compensation, residential area, home greenery

1. Introduction

Urban green spaces provide many ecosystem services to urban dwellers. Positive association with urban green spaces in terms of increasing level of coverage, setting budget for management as well as proper use can result into various ecosystem services beneficial to household members. The benefits can be categorized as provisioning services (food), regulation services (temperature/cooling service, climate regulation, storm water management, air quality and climate regulation), cultural services (recreation, education, aesthetics) and habitat service (nurseries services) (Costanza, d'Arge, de Groot, Farber, Grasso, Hannon, Limburg, Naeem, O'Neill, Paruelo, et al., 1997; Daily, 1997; Fisher et al., 2008; Higgins et al., 1997; Kibassa & Shemdoe, 2016; Kosenius et al., 2014). These enhance human welfare in different ways (safety, health, raw materials and social relation) whose impact can be at household level and beyond (Kopecká *et al.*, 2017). Negative association in terms of mis-use, mis-handling and poor choice of Green Space result into ecosystem disservices like mosquito sites breeding as well as safety and security problems associated with a lack of visibility. These affect the human welfare not only at household level but also beyond (Ernstson & Sörlin, 2013).

There are various global efforts to increase, restore and manage cities green spaces to increase supply of their services. Among the efforts include planning codes (e.g percentage of green space in master plan) (Elmqvist *et al.*, 2015). Most of the efforts in place are not successful due to the fact that, human beings do not give due weight to their services and their values are poorly understood. Consequently, the trade-offs on green spaces that are being made are not properly evaluated or understood (Union & Conservancy, 2005). The lack of understanding is rooted from poor ecological knowledge of ecosystem services (Kremen, 2005), and flawed decision support systems and policy responses (Fisher *et al.*, 2008) and lack of understanding of value of ecosystem services.

There are various methods which have been used in ecosystem services and disservices valuation- the way of comparing monetary benefits and costs associated with green spaces (Seidl & Moraes, 2000; Wilson & Carpenter, 1999). The common economic approaches/methods are contingent valuation, choice modelling, market-based and market-cost based approaches (Defra, 2007). The methods are service specific. There is no single method that can be used to value the economic value of green space. The value of urban green space is the function of multiple services ranging from provisioning, regulation services, cultural and habitat services, and ecosystem disservices. Most of the methods are applicable to particular service(s) and if it happens to value more than one service, the method tends to be more effective to one service than the other. Thus hybrid methods have been used for valuation of green space having more than one ecosystem services and disservices (Mwageni and O'Farrell, 2022). However, the hybrid methods have been complex and require more resources and expertise for data acquisition and analysis. Mathematical models have been advocated to easily solve such complexities. Unlike the hybrid approach, the model use limited data to get similar results on green space value. In turn, they are user-friendly due to their simplicity. They help in avoiding cost and resources, and observing the sensitivity of variables to the model outputs.

This study developed a mathematical model for the determination of the economic value of green spaces in residential areas in Dar es Salaam City. The current modelling methods used have been establishing values at regional level that cannot be used at local level. The developed model in this study establishes the values of ecosystem service or disservices in data scarce situation and at spatial scale of residential area. The mathematical model can explicitly help to evaluate and understand trade-offs that are made among households on developing green spaces. This will help to increase the spirit of conservation and management of ecosystems in Dar es Salaam City and other Cities in Tanzania. This addresses sustainable development goals (SDG) 13 which focuses on taking urgent action to combat climate change and its impacts and 15 which anchored on protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

2. Methodology

2.1 Selection of Case Study Area

This study was done in Dar es Salaam City which is a business capital and located in eastern part of Tanzania. It is the City having the highest urbanisation rate exacerbated by high population growth rate and density in Tanzania mainland. This has been leading to high conversion of Green Spaces to residential, commercial and Industrial purposes than any other Cities in Tanzania. Thus, the high demand-supply gap of ecosystem services from green spaces make Dar es Salaam the best City to determine and model the economic value of ecosystem services.

2.2 Selection of Case Study Wards

Dar es Salaam City has 90 wards. The selection of settlements for the study started by identifying all residential settlements (wards) within Dar es Salaam City which have green spaces types. The obtained settlements were further analyzed and compared in terms of population density and building density. To capture population density and building density at the same time, settlements identified to have all green space types were further categorized into four classes based on population density and building density (very high, high, moderate and low). Hence, two separate maps of population and building density for the settlements were made. The maps were then overlaid to get four classes (very high population and housing density (class one), high population and housing density (class two), moderate population and housing density (class three) and low population and housing density (class four).

In order to get the representative residential ward in each class, the ward which was found to lead in building and population densities was chosen to represent the respective class. In case two wards/settlements within a class were equally found to have the highest building and population densities, the wards were re-examined based on Green Space index in terms of vegetated land, streams/rivers and open spaces. The Green Space indices were obtained by dividing the total area of green space by total area of the ward. The total areas of the green spaces were obtained through on screen digitization using the same high resolution Dar es Salaam City ortho-rectified aerial imagery of 2017. The areas were automatically generated by ArcGIS 10.3.1 software.

The competing wards which had the highest green space index for home greenery, streams and open space coverage was chosen as a case settlement in the respective class. In this regard, four settlements across Dar es Salaam City were chosen (Table 1).

Table 1. Sample wards

Category	Sample ward	Other wards within the category
1	Makumbusho	Makurumla, Tandale and Manzese
2	Mburahati	Ndugumbi, Kigogo and Azimio
3	Yombo Vituka	Vingunguti, Mwananyamala, Magomeni, Mzimuni,Charambe, Mchikichini, Tabata,Sandali,Kiwalani, Sinza, Kijitonyama,Mbagala,Mtoni, Ilala
4	Kawe	Kinondoni, Ukonga, Kimanga,Miburani, Temeke,Makubuli, Gongo la mboto, Ubungo,Kigamboni, Kipawa, Mbezi juu,Chang'ombe, Kimara, Kivule,Kitunda,Chamazi,Vijibweni,Upanga Magharibi,Saranga, Mikocheni, Majohe, Pugu,Kinyerezi, Makongo, Kibamaba, Chanika, Kunduchi, Goba,Mbezi,Bunju,Msongola,Kwembe,Somangila,Kimbiji, Kisarawe II,Pemba mnazi.

2.3 Selection of Households

The units of analysis in the study were households 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. In order to capture zoning and the whole concept of Green Spaces, the DEM was overlaid with green spaces map. Thereafter each zone (high land and low land) in the ward overlay map was further subdivided into blocks of 0.02km^2 and within which the most greenery house(s) were marked as the proposed households/respondents. The choice of households in both high land and low land zones considered their proximity to open spaces and streams. This is to capture the whole concept of green space in which it may be vegetated land, stream or unsealed and permeable spaces (open space). In general, a total of 511 households were selected. The distribution were 127 for Makumbusho, 100 for Mburahati, 134 for Yombo Vituka and 150 for Kawe wards.

2.4 Data Collection Methods

Structured questionnaire was the main data collection method. The method intended to capture the demographic information, land tenure, green space coverage as well as its monetary benefits accrued from ecosystem services and effects (disservices) of green spaces. Differences of socio-economic and environmental contexts of the City were captured by conducting the study in four different case studies. Concerning the type of value, this study based on relational value of ecosystem services. Thus, the value was determined depending on tangible materials and non-material things from green spaces which were being realised by household members in residential areas. The questionnaire was administered in four different settlements which had different planning status, tenure information, socio-economic and environmental context (Table 2). In total, data were collected from 511 households within case study areas. The distribution of questionnaires/respondents in selected wards was based on the size of the ward/*mtaa* and availability of residential houses with home greenery, streams and open spaces.

Table 2. Respondents characteristics in sample households

Key characteristic		**Sample Settlement**			
		Kawe	**Makumbusho**	**Mburahati**	**Yombo Vituka**
Sex distribution	Male	69	55	47	42
(%)	Female	80	71	53	92
Income per	Minimum	10,000	10,000	50,000	10,000
month (TZS)	Median	657,533.3	270,000	248,800	213,806
	Maximum	10,000,000	1,500,000	1,500,000	1,000,000
Age (%)	Youth (18-35)	49	32	14	33
	Middle aged (35-45)	26	27	26	30
	Old age (above 45	74	68	60	71
Education level	No school	6	4	1	11
(%)	Religious education	0	0	1	1
	Primary	53	69	64	73
	Secondary	41	43	22	37
	College/university	48	11	12	12
Religion (%)	Buddhist	0	1	0	1
	Christian	101	41	58	56
	Muslim	47	85	40	76
Tenure	Home owner	48	52	36	58
information (%)	Legal owner	58	39	39	43
	Owned by relatives	14	5	10	6
	Renting	0	1	0	0
	Residence care taker	10	4	3	2
	Tenants	20	26	12	25

2.5 Data Analysis

The basic attributes of quantitative data were analyzed by descriptive statistics and then followed by linear regression modelling. R Studio software version 3.5.2 was used for data analysis. To check the statistical significance of the relationship among variables, each inferential statistical test used was attached with either p – value at 95% confidence level with threshold being 0.05 of which when is equal or below the relationship was considered statistically significant.

2.6 Determination of the Economic Value of Green Spaces

Monetary Benefits (MB) from Green Spaces was expressed as a net value. The MB is the difference between the summation of Economic Value of Ecosystem Services (EVES) and summation of Economic Value of Ecosystem Disservices (EVED) that households experience from Green Spaces.

The two values were used to establish the value, 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 (Mwageni and Kassenga, 2022). Thus, using the two information, the hidden value of green spaces was revealed and hence providing a realistic monetary value of green space which can either be as the range or average of the two. Monetary value of ecosystem services due to presence of green spaces may be less than or equal to monetary loss due to effects of the absence of Green Spaces.

2.7 Model Development for Determining Economic Value of Green Spaces

This was done by exploring the relationship between dependent variable (the economic value of ecosystem services and disservices) and independent variables (environmental, social and economic factors of the households). This was done by establishing multiple regression model. Prior to model interpretation and prediction, a model underwent diagnosis, variable selection and validation. Diagnosis was done by checking linearity of residuals, normality assumptions, constant variance assumptions and presence of influential observations. The method of minimum least square called best linear unbiased estimator was used to estimate the coefficient of the model. Where the response (dependent) variable was not normally distributed, the data were the transformed. To ensure data transformation, the natural log was applied to the response variable (net economic values).

2.7.1 Variable Selection

In order to investigate the exclusion or inclusion of model variables in the general model, the Aikaike information criterion (AIC) was used.

$$AIC = -2 * \max \log L + 2p$$

Where; *p is the number of parameters in the model*

max log L is the maximum log likelihood of the function that produces estimates for the population parameters that maximize the probability of observing data (Hox et al., 2017).

The variables that cause the model to have the lowest AIC value were used to establish the model. Thus, stepwise regression method was used that combine both forward and backward selection procedure of model variables. At each stage, an investigation was done to see on whether the variable was supposed to be added or removed to the model. This was determined by looking at the model with the lowest AIC. So, starting with model with only intercept; and by consecutive adding and removing model variables while comparing the AIC at each step, the predictor variables to be retained in the model were selected.

2.7.2 Model Validation

The model validation was done through a10 fold cross validation process. This involved dividing dataset into training and test sets. The first set which was about 80% of the whole data set of which was used for model building and the remaining 20% was used for prediction. The method involved randomly splitting the prediction set of data into k subsets. In this process 100 rows were divided into 5 datasets each with 20 items. One subset of 20 rows was reserved and 80 rows data subsets were used to build the model. The model was thereafter tested using the reserved subset and the prediction error was recorded. The process was repeated until each of all the 5 subsets served as a test set. Finally, the averages of the 5 prediction errors from 5 subset data were computed. This average of prediction error from the selected 20% data set was compared with that of 80% data set that formed a training set.

2.7.3 Model Interpretation

Since the response (dependent variable), was log transformed then the interpretation of relative percentage difference in average net benefit of the categorical predicator variable to reference predictor variable was calculated through the formula adapted from Ford, (2018),

$(exp(\beta_i) - 1) * 100\%$.Where (β_i) is the model estimate.

3. Results and Discussion

3.1 Reference Predicator for the Net Economic Value of Green Spaces

The study revealed that the net economic value of Green Spaces among households depend on settlement where the respondent resides, income, area of home greenery, religious affiliation, education status of the person, the tenure information, location within the settlement, age of respondents, age of green space, green space type and sex of the respondent. However, some variables were found to have strong correlation with the economic value of Green Spaces as compared to other variables (p-value<0.05). For categorical variables predictors, it was worth mentioning the reference variables for the regression model interpretation (Table 3).

Table 3. Model estimates

Reference predicator of categorical variable	Coefficient	Estimates (β_i)	Std Error	t-value	p-value
	Intercept (General intercept or intercept of reference predictor categorical variable) (β_o)	14.924	1.265	11.797	0.000
	Income/10,000	0.003	0.001	3.439	0.000
Education: Graduate	Education: No schooling	-0.283	0.396	-0.715	0.475
	Education: Others	0.023	0.333	0.070	0.944
	Education: Primary education	-0.090	0.264	-0.342	0.733
	Education: Secondary	-0.099	0.270	-0.367	0.714
	Area covered	0.001	0.0003	1.855	0.006
Tenure: Homeowner	Tenure: Legal owner	-0.369	0.139	-2.652	0.008
	Tenure: Owned by relatives	-0.243	0.288	-0.843	0.400
	Tenure: Residents take care	-0.451	0.316	-1.426	0.155
	Tenure: Tenant	-0.154	0.188	-0.820	0.413
Settlement: Kawe	Settlement: Makumbusho ward	-0.203	0.184	-1.107	0.269
	Settlement: Mburahati ward	-0.401	0.188	-2.133	0.0336
	Settlement: Yombo vituka ward	-0.107	0.176	-0.611	0.5415
Religion: Buddha	Religion: Christian	-0.167	1.212	-0.139	0.889
	Religion: Muslim	-0.290	1.213	-0.239	0.811
Location: Highland	Location: Low land	-0.130	0.167	-0.779	0.436
	Location: Stream	0.263	0.146	1.800	0.073
Age of respondent		-0.007	0.004	-1.580	0.015
Age of green space		0.009	0.007	1.237	0.217
Sex	Male	0.039	0.124	0.314	0.754
Green space type: Multiple green spaces	Green space type: Allotments	-0.171	0.253	-0.674	0.501
	Green space type: Shade trees	-0.509	0.178	-2.862	0.004
	Green space type: Fruit trees	-0.088	0.301	-0.293	0.770
	Green space type: House garden	-0.350	0.269	-1.301	0.194
	Green space type: Open agricultural field	-0.151	0.324	-0.464	0.643
	Green space type: Open Space inside courtyard	-0.960	0.549	-1.749	0.081

The multiple regression model equation based on above variable estimates was as follows.

$$\begin{aligned}
&\mathbf{ln[Net\ \ benefit|x_i]} \\
&= 14.924 + 0.003 * \frac{\text{Income}}{10{,}000} - 0.283 * \text{No school}_{\text{EDU}} + 0023 * \text{Others}_{\text{EDU}} - 0.09 \\
&* \text{Primary}_{\text{EDU}} - 0.099 * \text{Secondary}_{\text{EDU}} + 0.001 * \text{Area covered} - 0.369 \\
&* \text{Legal owner}_{\text{TENURE}} - 0.243 * \text{Relatives}_{\text{TENURE}} - 0.451 * \text{Residents take care} \\
&- 0.154 * \text{Tenant}_{\text{TENURE}} - 0.203 * \text{Makumbusho}_{\text{WARD}} - 0.401 * \text{Mburahati}_{\text{WARD}} - 0.107 \\
&* \text{Yombo vituka}_{\text{WARD}} - 0.167 * \text{Christian}_{\text{RELIGION}} - 0.290 * \text{Muslim}_{\text{RELIGION}} - 0130 \\
&* \text{Lowland}_{\text{LOCATION}} + 0.263 * \text{Stream}_{\text{LOCATION}} - 0.007 * \text{Age of respondent} + 0.009 \\
&* \text{Age of green spaces} - 0.039 * \text{Sex}_{\text{MALE}} - 0.171 * \text{Green space type}_{\text{ALLOTMENTS}} \\
&- 0.509 * \text{Green space type}_{\text{SHADE TREES}} - 0.088 * \text{Green space type}_{\text{FRUIT TREES}} - 0.350 \\
&* \text{Green space type}_{\text{HOUSE GARDEN}} - 0.151 * \text{Green space type}_{\text{OPEN AGRICULTURAL FIELD}} \\
&- 0.960 * \text{Green space type}_{\text{OPEN SPACE INSIDE COURTYARD}} + \varepsilon_i
\end{aligned}$$

The model has R square of 0.1562 which suggest that about 16% of variability in the response (dependent variable) can be explained by the predictor variables (independent variable). Having a low R square in regression model depends on the usefulness of the model such that if the model is to be used for prediction then R square is essential as it indicates on how much variability in the response can be predicted by the independent or predictor variables; for models geared for explanatory purposes R square is typically essential but of less concerns with overall model usability (Neter *et al.*, 1996).

3.1.1 Model Interpretation

The intercept of the model was 14.924 (the value of ln (net benefit) when other factors are kept zero) and when transformed the net benefit of home greenery became TZS 3,029,778 (1,317USD) per household per year. This has two interpretations. Firstly, this represents the average net benefit of the home greenery per household in case study areas regardless of other factors. This estimate was statistically significant. Secondly, it represents the economic value of home greenery regarding their reference predictor categorical variables (Education (Graduate), tenure (Homeowner), settlement (Kawe), religion (Buddha), location (highland) and Green Space type (Multiple green spaces)).

The average net benefit calculated from the model (TZS 3,029,778 (1,317USD) per household per year) was not far from the normal arithmetic mean calculated (TZS 3,148,827 (1,369USD) per household per year). The mean calculated from the model looks lower by TZS 119,049 (52USD) per household per year, meaning that there is an error of 3.8%. This means that the model can best predict the overall mean of net benefit (net economic value of home greenery) by 96.2%. Moreover, the model estimates for specific categorical variables were as shown in Table 4. It can be noticed that each specific variable has average net benefit (TZS) that deviates positively or negatively from the overall mean calculated from the general model (TZS 3,029,778 (1,317USD) per household per year). The difference between calculated mean from the model and the normal arithmetic mean might be because model takes into account data variability by finding the best fit line averaging data points and hence exclusion of outliers. In normal arithmetic mean, outliers were included in mean calculations. This has increased mean due to presence of outliers of very high net benefit. Thus, calculated mean from the model corrects for other variables included in the model while the normal mean arithmetic does not. That is to say, the calculated mean from the model can best express the net monetary benefit of home greenery.

Table 4. Estimates of net benefit per category

Categories/variable	Estimate	Estimate of mean net benefit from model (TZS)	Normal arithmetic mean (TZS)
No schooling	$\exp(\beta_0 + \beta_{No\_schooling})$	2,282,998	2,908,006
Others	$\exp(\beta_0 + \beta_{Others})$	3,100,271	314,103.25
Primary	$\exp(\beta_0 + \beta_{Primary})$	2,769,009	795,572.36
Secondary	$\exp(\beta_0 + \beta_{Secondary})$	2,744,200	236,148.67
Legal owner	$\exp(\beta_0 + \beta_{Legal\ owner})$	2,094,866	2,718,997
Owned by relatives	$\exp(\beta_0 + \beta_{Owned\ by\ relatives})$	2,376,169	2,361,877
Residents take care of the land	$\exp(\beta_0 + \beta_{Residents\ take\ care}\ )$	1,929,941	2,332,394
Tenant	$\exp(\beta_0 + \beta_{Tenant})$	2,597,344	3,464,714
Makumbusho	$\exp(\beta_0 + \beta_{Makumbusho})$	2,473,142	2,804,388
Mburahati	$\exp(\beta_0 + \beta_{Mburahati})$	2,028,891	1,855,392
Yombo Vituka	$\exp(\beta_0 + \beta_{Yombo\ vituka})$	2,722,334	4,206,393
Christian	$\exp(\beta_0 + \beta_{Christian})$	2,563,797	3,429,621
Muslim	$\exp(\beta_0 + \beta_{Muslim})$	2,267,073	2,891,642
Lowland	$\exp(\beta_0 + \beta_{Lowland})$	2,660,434	2,291,170
Stream	$\exp(\beta_0 + \beta_{Stream})$	3,941,217	4,084,884
Male	$\exp(\beta_0 + \beta_{Male})$	3,150,274	428,909
Allotments	$\exp(\beta_0 + \beta_{Allotment}$	2,553,562	4,876,315
Shade trees	$\exp(\beta_0 + \beta_{Shade\ trees}$	1,821,189	2,344,979
Fruit trees	$\exp(\beta_0 + \beta_{Fruit\ trees}$	2,774,552	1,985,076
House garden	$\exp(\beta_0 + \beta_{House\ garden}$	2,135,049	1,660,170
Open agricultural field	$\exp(\beta_0 + \beta_{Open\ agricultural\ field}$	2,605,148	2,646,732
Open Space inside courtyard	$\exp(\beta_0 + \beta_{Open\ space\ inside\ courtyard}$	1,160,080	1,503,177

3.2 The Mathematical Model for Determining the Economic Value of Green Spaces

The study revealed that the predictor variables that caused the model to have the lowest AIC Aikaike information criterion (AIC) of 140.64 were income of the households, area covered, age of respondents and Green Space type. Factors like education level, religious affiliation, location and the settlement type had no profound influence on the net economic value of home greenery. Thus, the final model with predictor variables that were worth to be kept is.

$$\mathbf{ln}[\mathbf{Net\ \ benefit}|\mathbf{x_i}] = \beta_o + \beta_1 \mathrm{Income} + \beta_2 \mathrm{Area\ \ covered} + \beta_3 \mathrm{Age\ \ of\ \ respondent} + \beta_4 \mathrm{Green\ \ space\ \ types} + \varepsilon_i$$

This suggested that the model could be used to predict the net benefit of Green Spaces in the new dataset using income of the households, area covered, age of respondents and Green Space type. This simply means that if one collects new data, the model can predict the value of net benefit of such individual. Thus, a final developed regression model was.

$$\mathbf{ln[Net\ benefit|x_i]} = 14.445 + 0.004 * \frac{\text{Income}}{10{,}000} + 0.0004 * \text{Area coverage of green space} - 0.007 * \text{Age of repondent} - 0.226 * \text{Green space type}_{\text{ALLOTMENTS}} - 0.440 * \text{Green space type}_{\text{SHADE TREES}} - 0.105 * \text{Green space type}_{\text{FRUIT TREES}} - 0.325 * \text{Green space type}_{\text{HOUSE GARDEN}} - 0.233 * \text{Green space type}_{\text{OPEN AGRICULTURAL FIELD}} - 0.957 * \text{Green space type}_{\text{OPEN SPACE INSIDE COURTYARD}} + \varepsilon_i$$

The model can predict the average economic value of semi-natural Green Spaces for households with similar attributes. The prediction interval of the model is between TZS 142,920.80 and 14,370,065. The model can be applied anywhere within Dar es Salaam City for household(s) with income level between TZS 10,000 to TZS 10,000,000 per month and Green Space coverage of 1SQM to 1,400SQM.

This model can be used to decide the compensation to be given to households based on the economic value of green spaces. The current compensation does not consider other benefits apart from provisioning services. This underestimates the compensation. Also, it can be used as additional factor to be considered in valuation of houses for sale. The current property valuation does not consider the associated benefits related to green spaces and hence under estimation of property value for sale. Due to lack of methodology for valuation, the value of Green Spaces is excluded in property valuation.

Houses with different green spaces coverage have different property value. For instance, based on households' information of income level of TZS 100,000, area coverage of green space of 24SQM, age of green space of 40 years and green space type allotments, the net benefit of green space will be equal to TZS 1,188,972 (517USD). This implies that if these households are to be compensated under the current compensation practices, TZS 1,188,972 (517USD) per year is disregarded in compensation issues. This is the benefit that the household can lose if green space is not considered during compensation.

3.3 Limitation of the Model

The model can be used in Dar es Salaam City, Tanzania with the following limitations;

i) The model can be used for determining economic value of green spaces at geographical spatial scale of residential plot and spatial social scale of household level

ii) The model can be applied to any other cities found in Tanzania but social demographic data need to be collected to update the model.

4. Conclusion and Recommendations

The developed multiple linear regression models have statistically shown that income, green space type and coverage have influence to average net economic value of residential green space. The model can best predict the overall mean of net benefit (net economic value of home greenery) by 96.2%. The model has shown that for every addition of TZS 10,000 of income invested in green space the households in the study wards, the net benefit of green space increases by 0.36% provided that other factors remain constant. For every addition of 1 square meter of the area covered by residential home greenery the net benefit increases by 0.762% provided that other factors remain constant. Individuals having a combination of green space types were found to have more benefits compared to individual who had single green space type. However, individuals who owned fruit trees only had more net benefit compared to other green space types because its value was found to be 8.4% compared to the individuals who had multiple green spaces provided that other factors were constant. Other green space types like allotments, shade trees, house garden, agricultural field and open space inside courtyard had less net benefits by 15.7%, 39.9%, 29.5%, 14%, and 61.7% compared to the individuals who had multiple green spaces respectively. In addition, it has been observed statistically that other predictor variables including education status, residential settlement location, location within a settlement and religious affiliation have no influence on net benefit. The model developed along with the emergent results should be adopted and used by disaster risk managers, environmentalists, town planners, evaluators, architects, policy makers, NGOs as well as real estate investors. This could be extended to include issues of compensation and sales of properties.

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