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What are we missing? Economic value of an urban forest in Ghana

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ABSTRACT

The ecosystem services of urban forests are under threat in Ghana due to continuous conversion of urban green spaces into other land uses. The loss of urban forests is contributing to decreases in resilience and increases in vulnerability of urban dwellings to flooding and windstorms. Investing in management of urban forests and including them in urban development planning is critical and can only be pursued if economic value of urban forest services are properly assessed and appreciated. In this paper the Contingent Valuation Method is used to estimate the economic value of non-market benefits of an urban forest in Ghana. Using Cost–Benefit Analysis, the monetary value of the urban forest in the course of time was estimated. The stated monetary value of the urban forest was found to be US$694,765.50. The Net Present Value of the urban green space was US$2,786,620.65. The estimated economic value covered nine times the 10-year maintenance cost of the urban green space. As a seminal work on economic valuation of a standing urban forest in Ghana, it is envisaged that the results will inspire further research in this field, and demonstrate the need for investment in creation and management of urban forests.

1. Introduction

Urban forests have several environmental, ecological, socio-economic as well as psychological benefits that contribute to the quality of urban life. The urban green spaces as broadly called provide services such as water purification, air pollution control, recreation and leisure, and maintenance of biodiversity (Cornelis and Hermy, 2004; Harris et al., 1999; McPherson and Simpson, 1999; Renema et al., 1999; Sherer, 2006). These services underscore the value of urban forests. However, due to rapid and unplanned urbanization, infrastructural development, and population pressures, huge areas of urban forests are rapidly being lost leaving cities and urban centers with less green areas but overly dominated with concrete. Gómez-Baggethun and Barton (2012) mentioned that, compared to other ecosystems like wetlands or forests, the attention given to urban ecosystems is relatively modest and that most studies on the topic have focused on single ecosystem services and/or value dimensions. One reason for the observed phenomenon particularly in developing countries is the inability of planners and researchers to articulate the value of urban forest in economic terms (More et al., 1988). Another reason is the excessive attention paid to commercial values of urban forest tree resources neglecting non-commercial use values. Chan et al. (2012) observed that monetary values of urban forests have been broadly examined in the literature while other non-market values remain largely unexplored.

Ghana continues to loose much of her urban green spaces to encroachment, infrastructural development and population growth (Quartey, 2013; Daily Guide Newspaper, 2012; Deikumah and Kudom, 2010). For instance, the Achimota forest, which is still the largest remaining urban forest in the country has shrank in size from the initial 500 ha to 360 ha due to encroachment. Kumasi, the second largest city has lost almost the entire cover of the Kumasi Forest Reserve with only fragments of it remaining (Quartey, 2013). Existing socio-economic conditions, lack of urban green space management policy (FAO, 1995) and future projections leave Ghana's urban forests with less hope for survival and urban dwellers deprived of the services they provide. For instance, it is estimated that about 51.5% of Ghanaians live in urban areas and that by the year 2025, this figure will increase to 65% (World Statistics Pocketbook, 2010). This means more destruction and conversion of urban forests for development, reduced nature areas for recreation and leisure, increased cost of water treatment and prevalence of air pollutants. The loss of urban green space may lead to decreases in resilience and increases in vulnerability of cities to flooding and windstorms. The economic cost of cleaning after these disasters may dwarf the cost of maintaining pockets of urban forests in the urban areas. Gómez-Baggethun and Barton (2012) state that the loss of ecosystems in cities may involve high long-term economic costs and severe impacts on social, and cultural values associated to ecosystem services. This makes management and conservation of urban forests increasingly important in Ghana particularly considering their social and environmental functions. Nowak and Walton (2005) note that, 'expanding urbanization increases the importance of urban forests in terms of their extent and the critical ecosystem services they provide to sustain human health and

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environmental quality in and around urban areas'. Investing in management of the country's urban green areas and including them in development planning activities is critical and can only be pursued if ecosystem services of urban forests are properly assessed. The estimation and appreciation of the economic values of the services of urban forests and tree resources are essential for policy makers and urban planners who are confronted with decision on whether to preserve urban green areas or convert them to other development projects such as shopping malls, market stalls, housing-flats and other land uses.

In spite of these, no study has attempted to estimate the economic value of urban forests in Ghana. In this paper, the Contingent Valuation Method (CVM) is used to estimate the economic value of non-market benefits of an urban forest. Using Cost–Benefit Analysis, the monetary value of the urban green space in the course of time was estimated. The paper further assessed people's awareness and perception of urban forest benefits. It is envisaged that results from this seminal work on economic valuation of urban forest in Ghana will demonstrate to urban city planners and policy makers how much space should be allowed for inclusion of urban green areas in urban development policies and planning.

2. Materials and methods

2.1. Study area

The study was carried out at the campus of Kwame Nkrumah University of Science and Technology (KNUST), Kumasi. The main university campus, about 18 km^2, is located some 13 km to the east of Kumasi, the Ashanti regional capital. It is known to have lots of urban greenery, characterized by urban forestry resources such as (i) public green parks and a botanical garden, (ii) street or avenue trees and (iii) trees in residential areas. KNUST has a student population of 27,810 with a workforce of about 3000 working in and around the educational institution. The Kumasi metropolitan area where the education complex is located covers an area of 238 km^2 with a population density of 2,035,064 (Ghana Statistical Services, 2010). It is estimated that 48% and 46% of the metropolis are urban and peri-urban respectively (Kumasi Metropolitan Assembly (KMA), 2013). The metropolis has two intact urban forests (Owabi Wildlife Sanctuary (13 km^2) and KNUST Botanical Garden, parks and street trees (3.3 km^2); and fragments or patches of remnant forests.

2.2. Data collection and analysis

The study uses Contingent Valuation Method (CVM), an approach useful in determining the non-market value of forest and environmental resources (Mitchell and Carso, 1989). This technique uses a hypothetical market situation to obtain bids from individuals indicating their willingness to pay (WTP) for a commodity, in this case an urban forest. The method has been widely applied in valuing non-market resources (Carson et al., 1995). Stratified random sampling was employed in the selection of respondents from the total population. The whole population was stratified into four namely, senior members, senior staff, junior staff and students. The staff categorization is based on educational qualifications. The senior members constitute staff with master's degree and above. The senior staff comprises those with bachelor's degree and high national diploma. Junior staff members are persons in the technical and vocational grade, and below. A total of 200 respondents (50 from each stratum) took part in the survey.

The contingent valuation survey (CVS) was conducted with the aid of a pretested structured questionnaire. Respondents' willingness-to-pay values were obtained using open-ended questions. The open-ended format has been shown to be a conservative choice and does not generate overbidding (Kriström, 1993; Kealy and Turner, 1993). The payment vehicle used was annual donation. Information on management and maintenance of the urban green areas on KNUST campus was collected from key staff of the Grounds and Gardens department using both structured and unstructured interview. To ensure that respondents understood and perceived correctly what constitutes an urban green forest, a description was provided right at the outset. Illustrations of the various urban green spaces (public green parks and botanical garden; street or avenue trees; and trees in residential areas) located and accessible in the university environs was shown to each respondent. Subsequently respondents' perception of the benefits of urban forest was obtained. The questionnaire also explored information on respondents' education, age and income level. The WTP question began by introducing a hypothetical scenario of conversion of the urban forest into land uses such as shopping mall, residential flats, cafeteria and additional sports complex. Respondents were asked to state the maximum amount they would be willing to pay annually for preservation and maintenance of the urban green space if the conversion is to be averted. To ensure realistic pronouncements of WTPs, respondents were reminded to consider their annual income and expenditure. As a subsequent check of unrealistic WTPs in the analysis, the questionnaires were checked to determine if respondents' stated WTPs was too high in relation to their stated income.

During data analysis, a threshold of 5% was set so that respondents whose stated WTP exceeded 5% of their income were discarded. Regression analysis was performed to explore the relationship between socio-demographic variables (age, income, education) and WTP. Pearson and Spearman's Correlation were used to determine the degree of correlation between socio-demographic factors and WTP.

2.3. Estimating economic value of urban forest

The monetary value of the forest was estimated as a product of the average WTP of respondents and the total number of consumers or users. The total number of users in this case is the population of people that use and access the urban forest resources. This includes the communities fringing the university, and the students and staff of the university. However, a conservative population comprising the university staff and students was used for the estimation of the economic value. The valuation restricted itself to the student and workers population on the assumption that these have direct and frequent access to the urban green areas that is in their immediate vicinity. The total working and student population is 30,810. The study tested how economic value of urban forest is affected by population size. This was done by holding mean WTP constant against four different population sizes varied at 25% interval (100%, 75%, 50%, 25%).

2.4. Cost–benefit analysis of urban forest services

The Net Present Value (NPV) of the urban forest using a simple cost–benefit analysis was estimated. This was done in order to compare the non-market value of the urban forest with the costs of conservation and maintenance of the forest. A period of 10 years was chosen taking into consideration the 10-year development plan that makes room for management cost of the urban green space. The estimated cost of conservation of the ecological heritage of the university (i.e., the urban green areas) as stated in the 2005–2014 Corporate Strategic Plan (KNUST, 2005) was US$80,000.00. The Declining Discount Rate (DDR) of 3.5% was chosen to compare the costs and benefits of the resources. Although the debate about the