Community Attitudes and Perceptions Towards Urban Ecological Issues in Maun and Gaborone, Botswana

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Abstract

This paper is derived from a broader study that examined community attitudes and perceptions towards ecological issues in Maun and Gaborone to determine how these could be harnessed towards ecologically sustainable urban development. The major problem in the two study sites is that there has been rapid urban growth since the 1970s, but very little attention has been devoted to the environmental implications of that growth. The environmental issues on which community attitudes and perceptions were sought included the following: urban water and waste water; urban solid waste management; urban impacts on wildlife; and urban energy conservation and management. These issues were selected on the basis of what the authors were able to obtain socio-ecological data on, given the time and financial constraints of the study. The urban ecosystems management model is used as an analytical framework that could be further harnessed by policy and decision-makers to mobilize stakekeholders towards sustainable urban development. A social survey method was used to generate data among heads of households in Maun and Gaborone. It was found that most ordinary members of the community were not involved by government authorities in decision-making affecting natural resource use and environmental issues. However and in general, the communities had positive attitudes and perceptions towards environmental issues. The major draw-back is that these communities are generally not consulted by state agencies in decision-making processes affecting their environment. It is concluded that this is inimical to ecological urban development.

Introduction

This paper is based on the social survey component of a broad and multiple method study that was carried out by the authors in Gaborone and Maun between April 2003 and February 2005. The actual survey was undertaken between June 2003 and April 2004. The aim of the social survey was to examine local communities' attitudes and perceptions on various issues affecting the relationship between urban growth and the environment in general, and the use of certain natural resources in particular. The study also sought to assess how community attitudes and perceptions to urban growth could be harnessed for environmental management, and how in turn urbanization and ecological balance could be attained for sustainable urban development. Data on other aspects of the study, which was generated via other methods such as key informant interviews, focus groups, and documentary analysis is reported elsewhere (e.g Mbaiwa *et al,* n.d.).

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The Research Issue

Botswana has experienced phenomenal urban growth since the 1970s. In 1971, for example, the country had a population of 596,944, of which only 9% was urban. By 1991 and 2001, however, urban growth had intensified to 45% and 54% of the population respectively. Against this background Gaborone and Maun have been among the fastest growing settlements in Botswana. For instance, in 1971 and 1981 Maun had populations of 13,637 and 14,925 respectively - a growth rate of a mere 0.9% per annum. Between 1991 and 2001, however, the Maun growth rate had risen sharply to 5.1%, the settlement having 43,776 inhabitants in 2001. Similarly, the population of Gaborone was 18,799 in 1971, but this tripled to 59,657 in 1981, an annual rate of growth of 12.2% in the 1971-1981 period. In 1991 and 2001 the population of Gaborone was 133,468 and 185,891 respectively. Although the Gaborone annual growth rate had dropped significantly from 8.4% in 1981-1991 to 3.4% in 1991-2001, the growth of the greater Gaborone area was still phenomenal as population was absorbed in the peri-urban villages rather than in the city proper, mainly because of shortage of land and housing to accommodate rural to urban migrants. The population of Mogoditshane, for instance, a peri-urban village to the west of Gaborone, tripled between 1991 and 2001 from 14,246 to 38,816 respectively (Toteng, 2004). Similarly, the population of the peri-urban village of Tlokweng to the east of Gaborone nearly doubled from 12,501 in 1991 to 22,394 in 2001 (Toteng, 2004). Despite the urban growth patterns and trends shown above, there has been little investigation into how fast urban growth and development impacts on the environment in Botswana in general (e.g. Molebatsi, 1998; Toteng, 2001; Toteng, 2002; Toteng, 2004), and in the two settlements in particular.

Background: Urbanisation in Maun and Gaborone

Urban growth in Botswana, similar to trends and patterns in most urban areas of sub-Saharan Africa, has been increasing rapidly over the last three decades. This growth is apparent from rising successive census figures. For instance, as a proportion of the national population, urban population in Botswana stood at approximately 9% in 1971, rose to 18% in 1981, to 45% in 1991, and to 54% in 2001. The growth of urban settlements in Botswana has therefore invariably contributed to the increased use and depletion of various types of natural resources such as water and fuel wood (source problems), and has also contributed to the intensification of sink problems such as urban solid waste generation. These challenges put into question the sustainability of urban centres, and justify the need to promote ecologically sound urban development. Understanding and applying the urban ecosystem management framework could contribute to the attainment of sound development.

Maun and Gaborone are both designated and assigned equivalent status as *primary centres* in the Botswana National Settlement Policy (NSP) hierarchy. Reminiscent of the central theory propositions, these are settlements described as having 'a high development potential', 'diversified and sophisticated economies', 'host high order infrastructure and services', and have a population of at least 20,000 people (Republic of Botswana, 1998:17-18).

Apart from their common NSP designations, Maun and Gaborone are geographically far removed from one another. They lie in different ecological zones. They also have slightly different major functions. On the one hand, Gaborone is the capital city of Botswana. It has most of the amenities and conveniences found in similar capital cities. Maun, on the other hand, is a tourist capital, hub, and a gateway to Botswana's prime tourism attractions. Maun lies at the foot of the ecologically sensitive and fragile Okavango Delta wetland system. Tourist attraction to Maun and the Delta revolves around natural pristine wilderness assets, mostly predicated on

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the viewing of a rich diversity of wildlife species. Gaborone does not command the same tourist gateway status and ecological fragility as the Maun area. These differences notwithstanding, both settlements continue to grow and impose their ecological footprints on their hinterlands and beyond in terms of abstraction and the use of natural resources such as fuel wood, water, and wildlife (fauna). Further, the imposition of urban ecological footprints by the two settlements is apparent from the general problem of waste disposal in Botswana within the urban fringe. Often this disposal is without adequate measures to ensure that the waste causes minimal harm to both biophysical and human environments. In the study from which this paper is derived, the theme of ecological urban development was explored to determine the extent to which it could be used in practice to attain sustainable urban development.

Theoretical Framework: the Urban Ecosystem Management Model

The urban ecosystem management model highlights the intrinsic nature of human-environment interdependence. Although the biophysical aspects of ecosystems received more attention in the past, the political and institutional dimensions and implications of the approach have been neglected in the management of natural resources such as water (Mackenzie, 1997:173). The urban ecosystem management model is part of human ecology. This has been defined as 'the study of human social systems in relation to their total environment' (Hengeveld and de Vocht, 1982:8). Human ecology therefore seeks to illuminate how human society responds and adapts to changing and restricting biophysical environmental conditions (Hengeveld and de Vocht, 1982:7). Human ecology examines how human society's own organisation and structure affect both natural systems and the quality of human life. One of the dimensions of human ecology is urban ecological planning or ecopolis (Tjalingii, 1995). Ecopolis focuses attention on the relationship between urbanization and the natural environment. In ecological planning, human society occupies a key position in its relationship with the natural environment (Hengeveld and de Vocht, 1982:13). The urban ecosystem management model draws our attention to human system impacts on aspects of the natural system (Hengeveld and de Vocht, 1982:17). The urban human ecosystem model is predicated on certain principles, most of which are originally derived from how natural ecosystems function. Some of the key principles of the ecosystem model are highlighted below.

The first principle is *carrying capacity*. Carrying capacity in natural ecosystems refers to the threshold beyond which the environment will be unable to support additional users of environmental resources without degrading the biophysical environment itself. The concept originates in biophysical ecological studies that determine, for example, how many livestock can be supported by a certain vegetation cover. Thus in ecological terms carrying capacity is defined as '... the population of a given species that can be supported indefinitely in a given habitat without permanently damaging the ecosystem upon which it depends' (Rees, 1992:125). In the human settlement context, although the idea remains the same the definition is slightly different: carrying capacity is the maximum rate of resource consumption and waste discharge that can be sustained indefinitely in a given region without progressively impairing the functional integrity of relevant ecosystems (Rees, 1992:125).

The urban ecosystem model propounds that human settlements and communities resident therein embed and superimpose most of their activities on pre-existing natural or biophysical ecosystems initially at local, then at the regional, and ultimately at the global level. Often cities are founded in particular locations because of considerations of environmental amenities and major resource bases in their areas. However, the development of modern trans-

port systems and carriers has revolutionized city locations despite the fact that some biophysical environmental factors impose locational influence. Concerns over cities' carrying capacity are encapsulated in Rees' (1992) concept of 'cities ecological footprints'. This draws attention to the fact of the inability of cities to support themselves solely from within their own hinterlands, both in terms of resource consumption and disposal of waste. Cities occupy 2% of the earth's surface but account for 60% of human water use (Worldwatch Institute cited in *The Voice*, July 1999, Vol. 136). Further, it has been noted that London, for example, requires additional land comparable to about 58% of its total area just to supply its residents with timber. *Meeting the needs of everyone in the world the same way the needs of Londoners are met would require at least three more Earths* (Worldwatch Institute cited in *The Voice*, p. 2, July 1999, Vol. 136) (emphasis added). It is therefore apparent that cities have tended to extend their ecological footprints to distant places.

Yet the carrying capacity in highly agglomerated human settlements such as cities cannot entirely be defined in biophysical terms (Brugman, 1992). There is a need to reflect on the degree of environmental damage that human communities are prepared to accept. Through the urban ecosystem management model and process, it may well be possible for the local municipality to '...begin to respect the principle of carrying capacity by defining carrying capacity itself' (Brugman, 1992:15). The definition of carrying capacity will most likely vary and be determined by specific natural resources endowment in the local or regional context. Once carrying capacity has been locally defined, for example through a stakeholder management process, indicators and standards of resource consumption and the disposal of waste may then be developed as a way of monitoring and improving the prevailing urban environmental planning and management system. Carrying capacities may also be improved by understanding people's perceptions and other factors that might contribute to behavioural changes towards their use of resources (Hengeveld and de Vocht, 1982; Brugman, 1992; Tjalingii, 1995).

The second principle is *feedback*. Using cybernetics as an analogy often elucidates this principle. Cybernetics is a branch of science in which electronic and mechanical systems are studied and compared to biological systems. The feedback principle is therefore a derivative of the cybernetic nature of ecosystems, and it is directly linked to the principle of carrying capacity. In order to maintain equilibrium, sub-ecosystems both in nature and in cities need to have feedback mechanisms for monitoring developments in the entire ecosystem. There are both negative and positive feedbacks. Positive feedbacks act as incentives to activities that enhance ecosystem performance. Negative feedbacks act as penalties for activities that contribute to ecosystem dysfunction. Positive feedback mechanisms are mostly prevalent in young ecosystems, and they stimulate further growth. Negative feedback becomes important when ecosystems mature and their carrying capacity is almost exceeded. In the context of urban growth it is argued that while municipal managers implement the feedback principle in by-law enforcement such as in building development control, financial management, and other sub-systems, few municipalities have established feedback systems to direct and regulate urban growth, pollution, habitat destruction, and other impacts on an ecosystem's carrying capacity (Brugman, 1992:15).

In the face of increases in resource use intensity and consumption by growing cities, urban environmental management systems with good feedback systems may reduce excessive resource consumption as well as increases in pollution and other forms of environmental hazards, initially at the local and regional levels and ultimately at the global level (Brugman, 1992, Rees, 1992, Tjalingii, 1995).

The third principle is *integration*. Natural ecosystem components are understood to be

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connected, linked and interdependent. These components include climates, soils, vegetation and biochemical processes. The essence of the concept of integration is that destabilizing one aspect of an ecosystem can result in knock-on effects within the entire ecosystem. Through the maintenance of integration, ecosystem components continue over time to mutually benefit from each other, thereby increasing the efficiency and vitality of the system as a whole.

In human settlement systems by their very abiotic nature, however, integration of human activities is not automatic. Deliberate action has to be undertaken by stakeholders in such a system for their own benefit as well as that of the ecosystem. These stakeholders seldom play their roles effectively due to disintegration of management efforts within the human ecosystems in the first instance (Hengeveld and de Vocht, 1982; Brugman, 1992). In the second instance, this disintegration affects the relationship between the human settlements and their natural ecosystems. This raises questions about the effectiveness of the nature and scope of mechanisms at the disposal of urban human communities to co-exist harmoniously with natural systems.

Methodology

A social survey based on a sample of 1,000 households (500 in each of the two project sites - Maun and Gaborone) was conducted. The respondents were heads of households. The survey was based on the use of a standardized questionnaire. The majority of the questions were close-ended and pre-coded. The aim of the survey was to assess attitudes and perceptions of the members of the local communities in the study sites to some key issues in the study. Two research assistants with a first university degree and research project experience were engaged in the survey to conduct the face-to-face interviews. Face-to-face interviews considerably improved the response rate, although replacements were still required for non-response households selected initially in the sample.

In terms of sampling procedure, an electronic list in Microsoft Excel from the Central Statistics Office (CSO) of the Republic of Botswana was used as a sampling frame. The list was originally designed for the 2001 national population and housing census, but was found convenient to use because it was readily available, contained all major settlements in Botswana, and samples could be proportionately selected from it. The associated enumeration area maps prepared by the Department of Surveys and Mapping (DSM) for the 2001 population census were used in conjunction with the CSO list to identify and sample areas based on enumeration areas.

Sample sites were purposefully and methodically selected from the DSM and CSO enumeration area maps such that all areas in the two settlements were spatially represented in the sample. The other stage of the sample was to select every third house or plot along transects such as paths and roads. There were some problems with this approach, although these were not insurmountable. The first problem, which was manifest in the case of Maun, was that in most parts of the village, most plots were not laid out in a grid pattern. This complicated the procedure somewhat. The second challenge applicable to both project sites was the need to make replacements in non-response houses that had been sampled. The third problem, also manifest in Maun, was the non-availability of street maps with plot numbers. The two problems of lack of maps and non-linear structure of plot layouts are typical of most settlements in Botswana that have historically been considered to be 'rural' despite the fact that many of them have increasingly assumed many urban physical, social-economic and environmental characteristics.

The sampling problems explained above were overcome as follows: The boundaries of plots not laid out in a grid pattern were physically identified in an enumeration area, for instance by using roads, footpaths etc., and every other plot within the area was selected; Non-response house-holds were replaced on the second visit on a different day. And the lack street maps was resolved by identifying plot boundaries as described above.

The survey data was analyzed using the Statistical Package for Social Sciences (SPSS) software. It should be noted, however, that this paper is based on data analyzed up to the level of descriptive statistics, particularly measures of the central tendency such as the mean or average. The justification for this is that the analysis is on-going, and esoteric inferential statistical reporting will be considered for a separate medium of information dissemination with a technical emphasis.

Assessment of Community Attitudes and Perceptions on Ecological Issues

This section focuses attention on an assessment of environmental or ecology-related issues from the perspective of the communities that were studied. The issues and the approach that was adopted were not of a biophysical nature whilst the ecological issues explored such as water, sources of household energy, waste management, and public involvement in decision-making processes have biophysical environmental ramifications. Because the research team did not have a physical geographer or biophysical environmental scientist it was not possible for the study to undertake such an assessment. This is an aspect that can be incorporated and explored in future studies, to both expand and replicate the scope of the present study in other settlements in Botswana. This limitation notwithstanding, a human or environmental social science assess-ment was systematically undertaken.

Water

The first question sought to establish how the respondents obtained their water. The main options of water supply in Botswana are either piped water connections or non-piped water connections such as wells, boreholes, and direct access to dams. In the questionnaire the options were broadened to include various types of piped water supply and acquisition systems. The responses are summarized in Table 1.

Table 1. Source of household water.

Source	Gaborone		Maun	
	Frequency	Per cent	Frequency	Per cent
Piped water connection	500	100	268	52.4
Other sources	0	0.0	232	47.6
Total	500	100	500	100

Source: Authors' Field Survey, 2003-2004).

In the case of Gaborone all respondents (100%, n=500) obtained water from a piped water delivery system. In contrast, in the case of Maun 52.4% (n=500) obtained water from a piped water delivery system, while the remaining 47.6% obtained their water from others sources, including wells on the riverbed, open wells not on river beds, and mechanized boreholes. These differences in water acquisition are important ecologically in the sense that there is a likelihood

of people far removed from direct contact with the biophysical environment by virtue of their use of a piped water delivery system to have a lesser sense of duty of care for the environment from which the water is obtained.

Water Pricing

Water charges or tariffs is by far the most widely used water conservation and demand instrument by state agencies in Botswana (Toteng, 2000). The instrument is generally applied by the Water Utilities Corporation (WUC), a public enterprise, in the urban centres in Botswana (Toteng, 2000). In rural areas the instrument is used to a limited extent by both local authorities (District Councils) and the Department of Water Affairs. However, it should be noted that the use of water tariffs is not the only water conservation option that could be used to contribute to ecological urban development. Other alternatives that could be used include the use of rainwater harvesting through roof top collections, water use regulations to control demand, the use of water saving technological devices in industry and houses, and the promotion of public awareness and education on water conservation programmes (Arntzen *et al*, 1999; Toteng, 2000). In Botswana the alternatives to water tariffs have not been fully explored in urban areas (Toteng, 2000).

Respondents were asked whether or not they were actually paying for the water they use to determine the extent to which the water pricing instrument was being applied. The majority of respondents (72.4%, n=1000) in the whole study area indicated that they paid for water. This shows the wide use of the water pricing instrument. In Gaborone 70% (n=500) of the respondents reported that they paid for water against 30% who said that they did not do so. The 30% probably relied on communal water standpipes before these were discontinued in most urban centres during the last few years. In Maun about 75% (74.8%, n=500) reported that they were subject to the water tariff system.

People were asked to state whether they thought it was a good idea to pay for the water that they use. A higher rate of willingness among urban residents to pay for water would be an ecological benign opportunity for consolidating urban water conservation. A large majority of respondents (78.3%) across the study area were of the view that it is a good idea to pay for the water they use. The residents of Maun were more willing to pay for the water, as an over-whelming majority (86.6%, n=500) stated that it was a good idea to pay for water compared to a reduced majority (70%, n=500) in the case of Gaborone. Normally, one would expect a higher willingness to pay in the capital city where residents are usually assumed to have more access to information and therefore expected to be more enlightened.

Water Availability in Botswana

Community perceptions on water availability in Botswana are an indicator of the extent to which water scarcity in the country is recognized. As more people recognize that Botswana has scarce water resources the environmental limitations to the provision of water to burgeoning urban populations will be taken more seriously.

With respect to water availability in Botswana, most respondents (64.2%) in the whole study area (n=1000) described the resource as scarce. More respondents in Maun (72.4%, n=500) recognized that Botswana is a water scarce country compared to Gaborone 54.2% (n=500). The availability of reliable and efficient piped water delivery systems in most urban centres in Botswana may create a certain degree of complacency towards water conservation measures. Although no direct causality between the reliability of the water delivery system in Gaborone and the lower recognition of water scarcity in the country at the time of the study has

been proved, it is possible that the reliability of the water delivery system resulted in communities in the area forgetting that Botswana is a water scarce country. This is an ecologically incompatible perspective to the urbanization of cities in semi-arid environments such as Botswana. Table 2 summarizes how respondents felt about responsibility apportionment for water management.

Table 2. Responsibility for proper water management.

Whose responsibility?	Gaborone		Maun	
	Frequency	Per cent	Frequency	Per cent
Individual persons	212	42.4	196	39.2
Government/councils	190	38.0	146	29.2
Government & individual persons	89	17.8	117	23.4
Don't know	9	1.8	41	8.2
Total	500	100	500	100.0

Source: Authors' Field Survey, 2003-2004.

About 41% (n=1000) of all respondents in the two study sites were of the view that individuals ought to take responsibility for proper water management in view of water scarcity in the country. More respondents in Maun (42%, n=500) compared to Gaborone (39%, n=500) felt that it is up to the individual person to take responsibility for managing water resources properly rather than abdicating this responsibility to the government. This points to a positive opportunity for ecological urban development planning as communities recognize their role in managing water resources.

Waste Water Re-Use and Recycling

The next assessment on the water variable sought to determine whether or not households re-used water. The majority of respondents in Gaborone (63.2%, n=500) did not re-use water in their homes, quite in contrast to an overwhelming majority in Maun (83.6%, n=500) that reported re-using waste water in their homes. The differences in the household waste water re-use rates between Gaborone and Maun could be the basis for a hypothesis that an over-dependence on a piped water system associated with higher levels of urbanization could contribute adverse impacts on limited water resource bases in semi-arid environments such as Botswana, particularly where communities are not constantly educated on the value of water conservation. At the time of writing this paper in 2005, Gaborone is undergoing a major water crises due to a severe drought cycle. This has seen the Gaborone Dam empty by more than 75% several months before the start of the rain season. As a result, water has to be expensively transferred from distant Letsibogo Dam via the 350 kilometre-long North-South Water Carrier pipeline. Such transfers impose adverse ecological foot-prints on areas which are far removed from the user and benefit little from the urban centres themselves.

Respondents that were re-using wastewater were asked to indicate what they were re-using it for. All respondents in Gaborone (100%, n=184) who reported re-using wastewater said that they used it for purposes other than cooking and drinking, for instance cleaning and watering non-vegetable plants. In the case of Maun, of the 49.4% (n=500) who re-used water (n=247), 92% reported that they re-used wastewater for non-cooking and non-drinking purposes. There is therefore much scope for re-using more wastewater in both urban settlements

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for purposes other than cooking and drinking. Water conservation policy could promote this potential and reduce the ecological impacts of urban centres associated with increasing water demand.

Further to the water re-use inquiry, respondents were asked to state whether they thought wastewater recycling should be explored as a water conservation alternative. Most respondents in the whole study area (82.8%, n=1000) agreed strongly that water should be recycled. The respondents were appraised of the difference between water re-use and recycling, and there was more confidence in the need to use recycled water compared to merely re-using gray water. In Maun more respondents (87.2%, n=500, compared to 78.4% in Gaborone, n=500) expressed support for water recycling.

Despite the fact that there was strong support for water recycling there was still much reluctance that this water be used for cooking and drinking. There was a higher preference that recycled water should be used for cleaning and other purposes. For instance, in the case of Maun, 42.9% (n=436) of those who were receptive to water recycling accepted that this type of water should be used for cooking and drinking against a no vote of 57.1% (n=436). This reluctant audience could be assured about the quality of recycled water by public authorities through public awareness programmes. In the case of Gaborone 51.5% (n=392) positively viewed the need to use recycled water for cooking and drinking against a minority of 48.5% (n=392) who did not accept this. The overall proportion of people in the study area (47.2%, n=428) who were willing to accept using recycled water for cooking and drinking is an opportunity for ecological urban development that could be enhanced through public education programmes.

Sanitation and Wastewater Disposal

Different sanitation systems affect the environment differently. Respondents were asked to state whether they had access to a water-borne sewage disposal system. The majority of respondents (56.3%, n=1000) in both Gaborone and Maun had access to water-borne sanitation systems, while the remaining 43.7% (n=1000) did not have access to such systems. In Gaborone more people (62.0%, n=500) had such access compared to about 51% (50.6%, n=1000) in Maun.

There are different methods in which wastewater is disposed of at the household level in Botswana, but there are two major categories. Either the houses are connected to a water-borne piped central sewage disposal system or an on-site septic tank system that is periodically emptied through a pumping system or there is no water-borne disposal system. In cases where there is no water-borne system, human waste is normally disposed of in pit latrines, with wastewater disposed of by open discharge on-site or in the vicinity of the site.

Respondents were asked whether they had access to a water-borne sanitation system. The majority of respondents (56.3%, n=1000) in the entire study area answered in the affirmative. In the case of Gaborone a large majority of 62% (n=500) answered in the affirmative, compared to 50.6% (n=500) in Maun.

For those respondents who did not have access to water-borne sanitation systems, they were asked through a follow-up question to specify how they disposed of wastewater; the results are summarized in Table 3.

Most households in Maun (37.8%, n=500) used random spilling to dispose of wastewater compared to those in Gaborone (27.2%, n=500). Random water spillage is not ecologically compatible with environmental conservation as some of the water may contain chemicals that are detrimental to the natural environment.

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Table 3. Methods of wastewater disposal.

Method	Gaborone		Maun	
	Frequency	Per cent	Frequency	Per cent
Random spilling on-site	189	37.8	136	27.2
Systematic spilling on-site	18	3.6	50	10.0
Other methods	51	10.2	11	2.2
Not applicable	242	48.4	303	60.6
Total	500	100.0	500	100.0

Source: Authors' Field Survey, 2003-2004.

Respondents who had no access to a water-borne sanitation system were further asked if they would prefer to have access to one. Many of them (45.2%, n=1000) agreed that they would prefer such a facility, although there were some differences in the two study sites. In Gaborone, 97.0 % (n=310) said that they would prefer a waterborne sanitation system against 3.0% who did not want to change the status quo. Equivalent responses for Maun were 97.2% (n=247) for a waterborne sanitation system against 2.8% who did not mind the status quo.

In general, therefore, most people in the study area - even those that did not have access to a water-borne sanitation system - preferred this option. Although the widespread use of water-borne sanitation systems may mean an increase in water demand if portable water is used, for instance for flushing toilets, lack of use of such systems may be ecologically destructive in situations where groundwater resources in the vicinity of large urban settlements are contaminated by nitrates being leached from pit latrines. A case in point elsewhere in Botswana is the Ramotswa groundwater resource or well-field that used to augment the Gaborone water supply system but was subsequently discontinued due to groundwater pollution from pit latrines. The contaminated water can still be used but its processing to portable status will be more costly. This is an option that some private companies, recognizing the profits they could make from the Gaborone water crisis in 2005, are urging government to use. Prevention of the contamination of the Ramotswa well-field would have been ecologically benign and prudent compared to fixing the damage after it had occurred. The point therefore is that there is a need to strike a delicate ecological balance between the demands of urban growth and environmental considerations since the two are interdependent. This point is at the centre of the urban ecosystem management conceptual framework.

Community Participation in Strategic Water Management Decision-making
For communities to feel a sense of ownership in decision-making processes that could contribute to ecological urban development, such as in the area of water conservation and management, they need to have opportunities to participate, be consulted, and contribute to decision-making processes affecting their welfare. It was based on this assumption that respondents were asked to indicate their perceived level of consultation by water authorities, and their communities' involvement in decision-making processes affecting water management in their area. A large majority of respondents in the entire study area (81.2%, n=1000) indicated that they were neither consulted nor did they participate in water management decision-making processes in their area. The corresponding figures for Gaborone and Maun were 88.0% (n=500) and 74.4% (n=500) respectively. This scenario is inimical to ecological urban development, and the urban planning process should be used as a means to rectify this anomaly if environmental

considerations are taken seriously. This is particularly important since it was found that most people interviewed in the whole study area (83.2%, n=1000) indicated their willingness to be consulted and participate in water management decision-making processes affecting their area.

Household Level Water Conservation Practices

Respondents were asked whether they did practice water conservation in the home. Most respondents in the two study sites answered in the affirmative: 52.6% in Gaborone (n=500) and 54.4% (n=500) in Maun. This variable could be correlated with those related to water re-use and recycling.

The people interviewed were also asked to state whether they had any knowledge of rainwater harvesting through roof run-off collection. Most respondents in the study area (88.9%, n=1000) said that they were knowledgeable about rainwater harvesting, 82.6% in Gaborone (n=500) and 92.5% in Maun (n=500). The overall high proportion (88.9%, n=1000) in the study area who knew about rainwater harvesting as one water conservation strategy is an opportunity for the enhancement of ecological urban development and urban planning through the involvement of local communities in decision-making processes.

The above scenario notwithstanding, there were very few households who actually practiced rainwater harvesting in their own dwellings, although there was no inquiry as to why this was the case. In the whole study area (n=1000), only 35% harvested rain through roof run-off collection. There were, however, major differences in that more people in Maun (48.0%, n=500) harvested rainwater from roof top run-off compared to a dismal 19% (n=500) in the case of Gaborone. This scenario buttresses the hypothesis posed earlier that in urban situations where a reliable water supply and distribution system is in place, as has been the case in Gaborone, there is a tendency for communities to forget about the need to use various complimentary strategies to conserve water, and in the process ecologically balanced urban development is undermined.

Water and the Environment

Respondents were asked to state whether they thought that the abstraction of fresh water from the biophysical environment linked to increased urban growth in their areas had any impact of the environment. Most of them thought that there was no link between the two. In Gaborone (n=500), for instance, only 10.4% agreed that water abstraction was detrimental to the bio-physical environment; 53.2% were emphatic that there was no effect or link; and 36.4% said that they did not know of any link. The corresponding figures for Maun (n=500) were 35.25% (there is a link); 29.8% (no link), and 35.05% (didn't know).

Solid Waste Disposal and Management

Solid waste disposal and management is a growing problem in tandem with increasing urbanization in Botswana. Improper solid waste disposal, particularly littering, is by far the most common environmental problem associated with an increase in population in large or urbanising settlements in Botswana (Esselfie, 1997; Maphorisa, 2000; Babugura, 2001; Madzathunya, 2004). Respondents were asked to state how they disposed of solid waste. The results of this inquiry are summarized in Table 4.

Table 4. Methods of solid waste disposal.

Disposal options	Gaborone		Maun	
	Frequency	Per cent	Frequency	Per cent
Burnt inside yard	151	30.2	209	41.8
Tipping and burning at un-designated dumping site	207	41.4	249	49.8
Tipping and burning at designated dumping site	30	6.0	39	7.8
Other methods	112	22.4	3	0.6
Total	500	100	500	100

Source: Authors' Field Survey, 2003-2004.

From Table 4 the most common methods of household solid waste disposal in the study area were on-site burning and tipping and burning at off-site designated dumping sites. Although no questions were asked on the performance or effectiveness of the public solid waste collection and management system, recent studies elsewhere in the country, for instance Toteng *et al* (2005) in a study on peri-urban access to services and infrastructure in Mogoditshane and Tlokweng, found that the public waste collection systems were considered by the communities to be so highly erratic and unreliable that residents resorted to dumping and burning of solid waste. Dumping and burning may not be sustainable and environmentally friendly in the long term in cases where volumes of waste generated increase. Burning may also in the long term contribute to ozone depletion, particularly in urban areas where solid waste also includes a significant portion of plastics and other synthetic materials that may release harmful airborne substances. Improper solid waste disposal and management systems are therefore not in line with ecologically balanced urban development. They should be discouraged through the use of alternatives delivered via a participatory urban planning system that is cognizant of the environmental implications of urban development.

Urban Impact on Wildlife Conservation

The spatial expansion of urbanization into the countryside in most countries adversely affects wildlife conservation and biodiversity unless deliberate steps are taken to create greenbelts and urban parks to form safe havens for wildlife. In the case of Gaborone, the creation of peri-urban wildlife parks such as the privately owned Mokolodi Nature Reserve to the southwest and the government-owned Gaborone Game Reserve to the northeast of the city have contributed to environmental education and tourism. The Mokolodi Nature Reserve in particular has been host to two United States of America Presidents recently, namely George W. Bush and Bill Clinton. These visits by high profile world leaders confirmed the peri-urban tourist significance of the reserve. It is in the above context that communities were asked to state whether they thought urban growth had any impact on wildlife. The responses are summarized in Table 5.

The majority of respondents in Gaborone 43.2% (n=500) stated that they did not know whether urbanization has any impact on wildlife whilst 54.8% in Maun stated that urbanization definitely has an adverse impact on wildlife. The Maun response could perhaps be attributed to the fact that the Ngamiland area is home to most wildlife species, and residents would have seen the populations decline in the face of urban growth in the last three decades.

Table 5. The impact of urban growth on wildlife.

Does urban growth impact on wildlife?	Gaborone		Maun	
	Frequency	Per cent	Frequency	Per cent
Yes, has impact	158	31.6	274	54.8
No, there is no impact	126	25.2	89	17.8
Don't know	216	43.2	137	27.4
Total	500	100	500	100

Source: Authors' Field Survey, 2003-2004.

Energy Conservation and Management

Energy is required in most aspects of urban living to drive various processes ranging from industrial and commercial to domestic uses. Most energy sources are obtained from the physical environment. Urbanization invariably results in increases in energy demand across sub-sectors of the urban economy. Household or domestic energy use is one such sector. The use of energy has two main impacts on the environment. On the one hand the acquisition of energy from the environment can result in depletion of the resources if they are non-renewable. Fossil fuels are an example of non-renewable sources. On the other hand the burning or combustion of materials to release heat and light energy results in emissions of gaseous materials that could pollute the atmosphere. In the urban ecosystem management context the use of energy should therefore to be ecologically balanced.

The focus in this study was on an assessment of energy issues at the domestic or household level to determine the ecological implications of urban growth in the two study sites.

The initial question sought to determine the sources of household energy and what these were used for. The responses are summarized in Table 6.

Table 6. Household energy sources and their uses.

Source	Gaborone						Maun					
	Cooking		Lighting		Cook & light		Cooking		Lighting		Cook & light	
	N	%	N	%	N	%	N	%	N	%	N	%
Fuelwood	40	8.0	11	2.2	11	2.2	148	29.6	4	0.8	9	1.8
Paraffin	4	0.8	57	11.4	105	21.0	112	22.4	15	0.3	15	0.3
Electricity	1	0.2	4	0.8	326	65.2	6	1.2	4	0.8	366	73.8

Source: Authors' Field Survey, 2003-2004.

Electricity was the dominant source of energy used for the combined tasks of cooking and lighting, followed by the use of paraffin, in both Gaborone and Maun. For cooking only, fuelwood was the dominant source in both settlements.

Another line of inquiry sought to determine whether respondents paid for the energy that they used. In Gaborone about 98% (97.6%, n=500) responded that they did so compared to 95% in Maun (n=500). The majority of people in the whole study area (96.3%, n=1000) paid for the energy they used. Compared with the use of water, there were far more people paying for the energy they used. Residents were further asked whether they thought it is a good idea to pay for

the energy they used. Most respondents agreed that it is a good idea to do so: 78% (n=1000) in the entire study area, 69.4% (n=500) in Gaborone and an even higher proportion of 83.4% (n=500) in Maun.

Communities were then asked to state what they thought about energy resource availability in terms scarcity or abundance. In Gaborone 54% (n=500) stated that energy sources were scarce, and in Maun 34.0% (n=500) gave the same answer. Overall, in the whole study area, most people (44.1%, n=1000) were of the view that energy resources are scarce. These perceptions are compatible with ecological urban development and urban plan-ning in the sense that because of that recognition, communities are more likely to be receptive to urban energy conservation initiatives. Table 7 summarizes the responses to the energy availability question.

Table 7. Perceptions on energy resource availability in Botswana.

Perceptions	Gaborone		Maun	
	Frequency	Per cent	Frequency	Per cent
Scarce	271	54.2	170	34.0
Abundant	81	16.2	60	12.0
Sufficient	124	24.8	226	45.2
Don't know	24	4.8	44	8.8
Total	500	100.0	500	100.0

Source: Authors' Field Survey, 2003-2004.

Respondents were asked to state who they thought should ensure that energy resources are properly managed. The major divisions of responsibility were between the individual and the government. Most respondents were of the view that individuals ought to take more respons-ibility for proper energy management. Table 8 summarizes the responses.

Table 8. Responsibility for energy conservation.

Category	Gaborone		Maun	
	Frequency	Per cent	Frequency	Per cent
Individuals	196	42.8	243	48.6
Government/Council	130	26.0	200	40.0
Government & individuals	115	23.0	54	10.8
Don't know/other	41	8.2	3	0.6
Total	500	100.0	500	100.0

(Source: Authors' Field Survey, 2003-2004).

Communities were further asked to state their level of involvement or participation in decision-making processes affecting energy planning and management in their area. As in the case of water, the majority of people in the whole study area (82.8%, n=1000) reported that they were not consulted and therefore did not participate in decision-making processes affecting energy issues. The non-participation rates were 89.0% (n=500) in the case of Gaborone and 76.6% (n=500) in Maun. The high non-participation rate was despite the fact that the majority of the

respondents in the whole study area (84.4%, n=1000) stated that they would like to be involved in decision-making processes. In Gaborone 75% (n=500) wished that they could participate compared to 93.8% (n=500) in Maun. The high proportion of residents who wished to participate in energy decision-making processes is positive for ecological urban development, planning and management. Table 9 provides a summary of community perceptions on their participation in energy management.

Table 9. Local participation in energy management issues.

Variable	Gaborone		Maun	
	Frequency	Per cent	Frequency	Per cent
Participate	117	23.4	55	11.0
Do not participate	383	74.6	445	89.0
Total	500	100.0	500	100.0

Source: Authors' Field Survey, 2003-2004.

In both Maun and Gaborone there was little participation by households in strategic decision-making affecting access to and use of household energy. Yet this is a basic component of urban livelihoods, which also determines their resilience to poverty. At the time of the study there was no government policy known to and recognized by communities that was geared towards mitigating the negative impacts of a lack of access to affordable and dependable household energy.

Conclusion

The survey set out to assess attitudes and perceptions of communities in Gaborone and Maun to determine their compatibility with ecological urban development. Although the list of issues assessed is not exhaustive with respect to all the pertinent urban issues that need to be addressed, the following were selected for assessment: urban water and waste water; urban solid waste management; urban impacts on wildlife; and urban energy conservation and management. The issues were chosen based on what the authors thought were feasible variables which could be used to obtain socio-ecological data, given the limited duration and funds available to the study.

It was found that with respect to most natural resource management issues examined, for instance energy and water availability, communities recognized their scarcity and were willing to participate more in resource conservation, should state authorities and other agencies give them adequate opportunity to do so. However, it was also found that community participation was hampered by their lack of involvement by state agencies, in particular in decision-making processes affecting environmental issues. This approach by state agencies is inimical to ecological urban development. The urban development planning systems in the two areas need to be explored further to determine how they can be harnessed and be proactively used as a participatory tool to involve local communities in order to ensure that ecological urban planning and urban development and management are achieved. The urban ecosystem management framework is a useful tool that could be used in urban development, not only by drawing analysts' attention to ecological issues but also to focus attention on the need to involve stakeholders such

as communities in decision-making processes that are environmentally beneficial to the communities themselves.

References
Arntzen, J., Chigodora, K., Kgathi, D.L., and Segosebe, E.M. (1999) *Water Demand Management: Botswana Country Study*. Gaborone: Department of Environmental Science, University of Botswana.

Babugura, A.A. (2001) *An Investigation of Solid Waste Disposal in Kweneng District, Botswana: A case study of Gabane*. Unpublished MSc (Environmental Science) Thesis, University of Botswana.

Brugman, J. (1992) *Managing Human Ecosystems: Principles for Ecological Municipal Management*. Toronto: International Council for Local Environmental Initiatives (ICLEI).

Essilfie, V.N. (1997) *Solid waste management in Gaborone : The role of government, NGOs and the Public*. Unpublished MSc (Environmental Science) Thesis, University of Botswana.

Hengeveld, H. & de Vocht, C. (1982) *Role of Water in Urban Ecology*. Amsterdam & Oxford: Elservier Scientific Publishing Company

Mackenzie, S.H. (1997) Toward integrated resource management: lessons about the ecosystem approach from the Laurentian Great Lakes, *Environmental Management*. 21 (2) 173-183.

Madzathunya, G. (2004) *An Assessment of Environmental Awareness and on Waste Management Strategies: Case Study of Letlhakane Village*. Unpublished BA (Environmental Science) research project report, Department of Environmental Science, University of Botswana.

Maphorisa, K. (2000) *An Assessment of the Solid Waste Management Systems in Gaborone City*. Unpublished MSc (Environmental Science) Thesis, University of Botswana.

Mbaiwa, J.E., Toteng, E.N., and Moswete, N.N. (n.d). The development of urban tourism in Botswana: the case of Maun and Gaborone. Paper submitted to *Development Southern Africa*.

Molebatsi, C.O. (1998) Urban environmental problems in Botswana. In: Atlhopheng, J.R., Molebatsi, C.O., Toteng, E.N., and Totolo, O. *Environmental Issues in Botswana*. Gaborone: Light Books Publishers.

Rees, W.E. (1992) Ecological footprints and appropriated carrying capacity: what urban economics leaves out. *Environment and Urbanization* 4 (2) 121-130.

Republic of Botswana. (1998) *Botswana National Settlement Policy*. Government Paper No. 2 of 1998. Gaborone: Government Printer.

Tjallingii, S. (1995) *Ecopolis: Strategies for Ecologically Sound Urban Development*. Leiden: Backhuys Publishers.

Toteng, E.N., Mathope, G., and Simela, S. (2005) *Peri-Urban Access to Services and Infrastructure in the Gaborone Urban Fringe: Study on Mogoditshane and Tlokweng* (Research Report). Gaborone: Department of Environmental Science, University of Botswana.

Toteng, E.N. (2004) The private sector, urban water conservation and developing countries: a stakeholder theory-driven perspective from Botswana. *South African Geographical Journal*. 86(2). 113-121.

Toteng, E.N. (2002) Understanding the disjunction between urban planning and water planning and management in Botswana: a challenge for urban planners. *International Development Planning Review*, 24 (3), 271-298.

Toteng, E.N. (2001) Urban environmental management in Botswana: towards and theoretical explanation of public policy failure. *Environmental Management* 28, 19-30.

Toteng, E.N. (2000) *A Stakeholder Approach to Understanding the Political Ecology of Urban Water Resource Management in Gaborone*, Botswana. Unpublished PhD Thesis, Cardiff University, Wales, U.K.