

Cultural and Demographic Factors Contributing to Environmental Degradation along the Metsimotlhabe River near Gaborone, Botswana

Lebogang P. Makaba

*Department of Geography and Environmental Science, North West University,
Private Bag X2046, Mmabatho, 2735, South Africa
E-mail: lebomakaba@gmail.com*

KEYWORDS Hydrology. Sand Extraction. Migration. Unemployment. Urbanisation

ABSTRACT Environmental degradation in developing countries is caused by several factors including demographic, economic, political and social factors. Poverty alleviation and the pursuit of economic development are often prioritised in many developing countries at the expense of environmental wellbeing. This scenario has resulted in environmental degradation. This paper highlights the role of cultural and demographic factors in environmental degradation along Metsimotlhabe River on the northern outskirts of Gaborone city, Botswana. The river is under intense human use as source of construction sand. Field observation, focus group discussions and questionnaires were used in determining the cultural and demographic factors that are contributing to environmental degradation in the area. Rapid rise in the human population, unemployment, rural to urban and cross border migration and the cultural norm of livestock keeping have contributed to degradation along the Metsimotlhabe River. The traditional communal system of keeping large livestock herds has also been a contributory factor.

INTRODUCTION

Environmental awareness has increased globally in the decades since the 1980s. However, environmental degradation due to the pressure exerted on the natural resources by human use is still viewed as a problem of the rich nations and side effect of industrialisation. In developing countries there is a more direct dependence on extracting natural resources for livelihoods, and concerns about environmental degradation are seen as somewhat limiting economic development (Azam 2016). Indeed what is seen as environmental degradation in a developed country may be seen as 'development' in the developing world. For example, Delfanti et al. (2016) reported the aesthetic erosion of the country side by solar panels in a developed country as environmental degradation, but it would perhaps not be regarded as such in an underdeveloped country.

In general, the causes of environmental degradation globally are varied and they include cultural, political, demographic, and economic factors (Donohoe 2003). Therefore, culture contributes to environmental change (Proctor 1998).

Institutional factors have also contributed to environmental degradation (Amechi 2009). Urbanisation and its associated problems of poverty are at the core of environmental degradation in developing countries (Swingdon 2003; Kavzoglo 2008; Azam and Khan 2016; Capps et al. 2016; Pribadi and Pauleit 2016).

Environmental problems become particularly serious where there is rapid expansion in urban population, and in most developing countries not much regard has been given to the environmental implications of such rapid urban expansion (Hardoy et al. 1997; Panayatou 2000). Urban growth threatens basic ecosystems and global biodiversity as human beings depend on the resources of their environment for sustenance (Devi and Agarwal 2011). Rising poverty and unemployment in the urban areas have increased pressure on natural resources as more people are forced to rely directly on them. There is, therefore, a vicious cycle relationship between poverty and environmental degradation (Ravnborg 2005).

There is a need for location context-specific analyses of causes and manifestation of environmental degradation in the developing world context. Such analyses are a very important contributor towards the attainment of environmental sustainability. For developing nations the degradation that results from the conflict be-

Address for correspondence:
Lobatse Secondary School,
Private Bag 13, Lobatse, Botswana

tween economic development and the environment is a survival issue (Retief et al. 2008; Fentiman and Zabbey 2015). This paper provides insights into this scenario, using the environmental degradation scenario along Metsimotlhabe River near Gaborone city, Botswana. Botswana in general has seen an increase in human and livestock populations, which have contributed to land degradation and desertification (Darkoh 1999).

METHODOLOGY

Study Area

The study area is Metsimotlhabe River, which is located in the northern fringes of the city of Gaborone, Botswana (Fig. 1). The river flows north-eastwards through Metsimotlhabe Village (Fig. 1), and has permanent and semi-permanent wetlands along its course. It is ephemeral and flows only during the period when the area receives very heavy rains (Masundire et al. 1998).

The sand deposits on the channel bed of Metsimotlhabe River have for a long time been extracted for use in the construction industry of Gaborone City and surrounding villages like Metsimotlhabe. Gaborone is the capital city of Botswana, and has the largest and fastest growing population in the country (Central Statistics Office 2012). The growing population fuelled demand for building sand to meet the accommodation needs of the city. The nearby Metsimotlhabe River has, therefore, served as source of the sand for the city. The rapid infrastructural development of Gaborone city eventually degraded Metsimotlhabe River as an environmental resource.

In June 2010 sand mining at Metsimotlhabe River was halted, due to concerns about the deterioration in the environmental quality of the river. The Department of Mines, which is responsible for issuing all mining permits (including sand mining permits), stopped issuing permits for extracting sand from the Metsimotlhabe River. However, illegal sand mining has continued on Metsimotlhabe River, particularly in the section of the river which is nearest to Gaborone such as that at Metsimotlhabe village.

Data and Analysis

The study utilised field observation, questionnaires, and focused group discussions, as

well as demographic data of Gaborone and Metsimotlhabe. Census reports obtained from the Central Statistics Office of the Government of Botswana were used in obtaining long-term population data.

For field observations the local community leaders led the researcher to the sections of Metsimotlhabe River where the sand mining problems was most acute. The coordinates of the sites were recorded using a Global Positioning System (GPS) handset. The field observations gave first-hand information on the nature of the degradation that the sand mining was causing on the river.

A focus group discussion with the community was held at Metsimotlhabe Village. The group was composed of the river side community leaders, and included: (1) a village chief/headman (*'kgosi'*), (2) an assistant headman, (3) members of the Village Development Committee, and (4) two local police officers. A pre-constructed list of issues to be discussed guided the discussion. The issues included the community's perceptions of the causes and effects of environmental degradation, the alleged perpetrators of illegal sand mining, as well as enforcement of the ban on sand extraction.

The ordinary members of the community were interviewed using a questionnaire. The homesteads closest to the river were judged to be appropriate for the questionnaire interviews as they belonged to the oldest (long-term) inhabitants of the area. The long-term inhabitants saw the Metsimotlhabe River almost on a daily basis and were aware of the human activities along it, and the changes the activities caused. Most of the residents of the village who lived in locations away from the vicinity of the river were tenants who commuted to Gaborone city. They were in Metsimotlhabe Village because high costs and shortages of accommodation had made the villages in the vicinity of Gaborone city, such as Metsimotlhabe, to be preferred for accommodation. Being new, these residents were less ideal for the questionnaire interviews. Using these selection criteria a total of 94 households was, therefore, utilised in the sample.

The questionnaire had questions that sought demographic information such as age, employment and education status. As with the focus group discussion the questionnaire also sought responses on the community's perceptions of the causes and effects of environmental degrada-

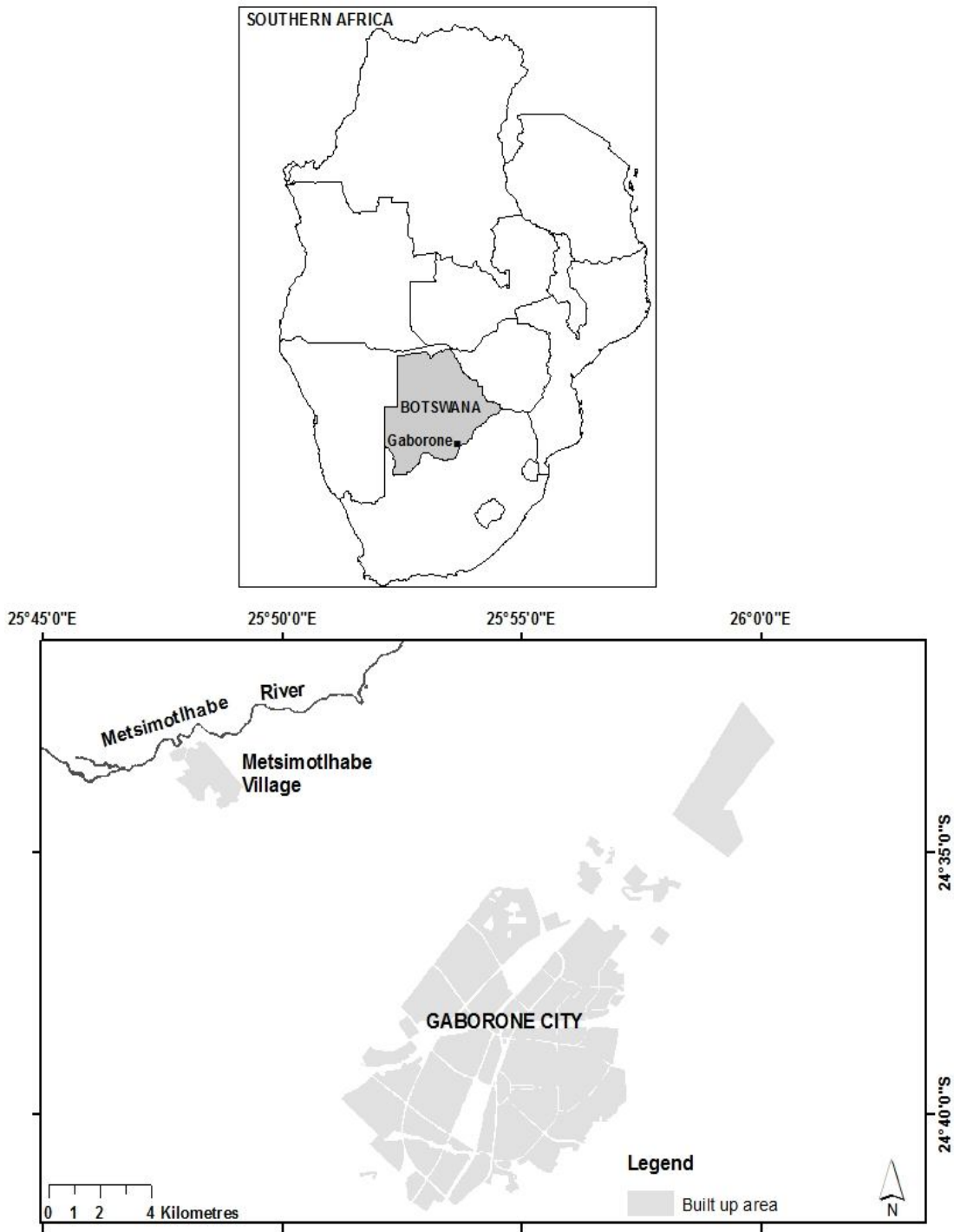


Fig. 1. Location of the study area

dation, the alleged perpetrators of illegal sand mining, as well as enforcement of the ban on sand extraction. The respondents were asked to select the indicators of environmental degradation that they had noticed, from a list that included reduced birdlife in the river, reduced vegetation cover, reduced water flow in the river, and reduced recreation use of the river. The interviewer-assisted method of administering the questionnaire was employed. The questionnaires were administered to all households bordering Metsimotlhabe River. The questionnaires were pretested to determine the clarity of the questions. Judgemental sampling was used to select the households.

Summary statistics were generated from the results of the interviews, in a spreadsheet. From the population census data summary statistics were generated in a spreadsheet, and then long-term trends were established.

RESULTS

Environmental Degradation

A number of indicators of degradation along the Metsimotlhabe River were observed during the field visits. These indicators were quite noticeable from an environmentalist point of view. At the time of the visit in the month of March the river was dry, when it should have been at rain season-dictated river peak flow. The riverine environment was aesthetically degraded. In several places concave excavations into the river bank had caused the bank walls to collapse. As a result of this degradation the recreation use of the river was eroded. The collapsed river banks were visibly a disturbance to birdlife since birds nested in the trees and reeds on the river bank.

On the river bed the sand excavation pits made the river bed uneven. In general, scouring

a river bed is recognised as a threat to fish spawning sites (Kondolf 1994; Boudaghpour and Monfared 2009; Howson et al. 2010). Some of these burrow pits were being used as livestock watering holes, and herds of the livestock (cattle, goats, sheep) were frequenting the riverbed. The livestock owners actively dug pits in the river bed until they reached the water table, to serve as water holes for the livestock. In places rubble and other waste was found to have been dumped on the river bed.

Demographic and Cultural Factors Causing Environmental Degradation

Table 1 shows the population values for the city of Gaborone and Metsimotlhabe Village, for the census years 1991, 2001 and 2011. Population censuses are conducted only every 10 years in Botswana, so these were the only years with population data. The population of both the city of Gaborone and Metsimotlhabe village increased between 1991 and 2011. At a change of nearly 75 percent between 1991 and 2011 the population of the city of Gaborone nearly doubled in twenty years. There was an even more acute population growth for Metsimotlhabe Village, with an increase of over 400 percent in the twenty years 1991-2011, and more than 100 percent in just 10 years between 2001 and 2011 (Table 1). This rapid growth in the urban and peri-urban population poses a threat on the Metsimotlhabe River since the river is used as source of construction sand. The increased population requires housing accommodation, which meant that new housing units needed to be constructed to cater for it.

With the increased population is the likelihood of unemployment, especially among the youth. The illegal sand mining industry is one of the sources of income, both for the sand miners and for the youth who are employed as la-

Table 1: Population trends in the study area

Census year	Actual population		Population change	
	Gaborone City	Metsimotlhabe Village	Gaborone City	Metsimotlhabe Village
1991	133 468	1 586	1991 to 2001: 39.4%	1991 to 2001: 155.7%
2001	186 007	4 056	2001 to 2011: 25.3%	2001 to 2011: 119.0%
2011	233 135	8 884	1991 to 2011: 74.7%	1991 to 2011: 460.2%

Population data: Central Statistics Office, Gaborone, Botswana.

bourers to load and offload sand trucks. The focus group discussion revealed that the labourers were usually the youth who were aware of the location of 'ideal' sand deposits in the river course. Added to the youth demographics was the aspect of immigrants from other countries in Southern Africa, who had been driven out of their countries by political strife. The focus group discussion indicated that some of the sand mine industry employees (truck drivers, sand loaders) were immigrants.

Of the questionnaire respondents, the majority (51.1%) were within the age range of 41-60 and 66 percent were unemployed. There were also low levels of education among the respondents: 35 percent had only attained primary school level education, while 23.5 percent had never received education in formal schools. Only about 41 percent of the respondents had formal education beyond primary school: 29.8 percent with secondary and 11.7 percent with tertiary education.

Despite the urban sprawl from the city of Gaborone towards the surrounding villages like Metsimotlhabe, the villagers had maintained the cultural norm of keeping large herds of cattle and other livestock. The livestock are both a source of meat and income. Therefore, culturally owning a large herd of cattle was a status symbol. Livestock keeping is the mainstay of Botswana's rural economy (Makepe 2006) and relevant legislation has enhanced it both as an economic sector and as a cultural norm. However, the large herds have become a source of environmental degradation on Metsimotlhabe River. Botswana being semi-arid country and, therefore, surface water being scarce, the Metsimotlhabe River has become an important source of water for the livestock. When the river is dry, livestock owners excavate pits on the river bed until they reach the water table. These pits then become waterholes for the livestock. However, river bed pits constitute environmental degradation since they destroy fish spawning areas and can alter the river's longitudinal profile (Kondolf 1994; Baiju et al. 2009; Jiang et al. 2013).

Community Awareness and Punitive Measures for the Environmental Degradation

Some of the respondents appeared to be well aware of the negative effects of sand mining on the river, with 58.5 percent indicating that the

river had dried up, and 21.3 percent indicating a combination of negative impacts (decreased water quality, burrow pits in the river bottom, less sand in the river). However, these effects can be termed as "economic use value" environmental effects since they relate to actual economic uses of the river that the respondents obtained. Some of the respondents indicated specific "non-economic use" environmental effects of river sand mining that they had noticed. They were: reduced bird life (3.2% of the respondents), reduced vegetation (21.3%), and reduced recreational use (8.5%).

The community was also aware of the punitive measures against illegal sand mining, with 56.4 percent of the respondents indicating awareness. The respondents who had not seen illegal sand miners being arrested indicated that they did not know why the culprits did not get arrested, while 36.2 percent indicated that illegal sand miners escaped before capture, 4.3 percent thought the legislation was inadequate, and 3.2 percent thought there were inadequate law enforcement officers. During the focus group discussion the police officers stated that part of the reason for the low arrest rates with regard to the illegal sand miners was that the law enforcement personnel were overstretched in terms of resources.

DISCUSSION

Rapid rise in the human population, unemployment, rural to urban and cross border migration, and the cultural norm of livestock keeping emerged from this study as the demographic and cultural factors that contributed to degradation along the Metsimotlhabe River.

The acute rise in the population of Metsimotlhabe Village between 1991 and 2011 (Table 1) is because of the high cost of accommodation in the city of Gaborone, as well as limits in the available residential accommodation in the city. As a consequence, the villages surrounding Gaborone city, including Metsimotlhabe Village, became alternatives both to native inhabitants and migrants. The demand for accommodation in such villages resulted in the building of new residential units there, and consequently environmental degradation since the construction sand was sourced from Metsimotlhabe River. During the field visit, new housing units under construction were evident, nearly all of which had piles of fresh sand beside them.

In order to meet the accommodation demands of the growing population in the city of Gaborone and surrounding peri-urban villages, Metsimotlhabe River has been overexploited as a source of sand. The lack of alternatives in the vicinity of the city is forcing the sand miners to continue to illegally mine sand at Metsimotlhabe. The penalties for illegal sand mining that existed at the time of this study were somewhat affordable and too low to deter illegal sand mining. According to the Department of Mines of the Government of Botswana, the penalty was P200 (24 US dollars) while for a 10m³ truck load of sand the penalty ranged from P800 to P1200 (96 – 144 US dollars). The monetary returns from the sand business were high, but got reduced if sand miners had to travel a long way to find the sand. Faced with an affordable fine as an alternative it is, therefore, understandable why the sand miners continued the illegal mining.

The questionnaires revealed that most (51.1%) of the unemployed respondents were able bodied, in the 41-60 years age group. This could be one of the factors that contributed to the illegal sand mining since, to escape poverty, these able bodied people sought sources of income such as sand mining as a business. The low levels of education were also a contributing factor, as 58.5 percent of the respondents had either no formal school education or only attained primary school education. In Botswana there are limited employment opportunities when people are less educated.

The river bed water wells and burrow pits that were used as livestock watering points indicated the intensity of livestock keeping in the area. Many cattle, sheep and goats were noticed in the vicinity of Metsimotlhabe River during the field visit. The excessive grazing and concentrated trampling by cattle outward from the watering points had led to deterioration of land and reduction in grass cover and herbaceous biomass. Nationally the Government of Botswana has, through policy, strongly supported livestock production both in the form of high prices for beef and livestock input subsidies. This support for the cultural norm is an added incentive that has indirectly contributed to environmental degradation on the Metsimotlhabe River.

In addition to changing the river channel geometry, river sand extraction can result in changes in the abundance and distribution of

fish, riparian plants and birds (Tamang and Kumar 2015; Sitzia et al. 2016). Fish, for example, are negatively affected as the steep river bed slopes and turbulent waters resulting from sand extraction prevent them from spawning on the river bed (Kumar 2015; Teshome et al. 2015).

The community's low levels of awareness of such "non-economic use" environmental effects of river sand mining illustrate the way environmental degradation is perceived in a developing country. Effects on the intrinsic environmental value of the environment, such as reductions in birdlife and fish spawning, are somewhat of less importance in a developing country context than benefits from the environment that constitute "development". Examples of such "development" are increased accommodation facilities for residents of Metsimotlhabe Village and Gaborone in this study. These developing country perceptions of environmental degradation are in stark contrast from the environmental values in developed countries; for example solar panels in the country side in Italy were perceived as degrading the landscape, as reported by Delfanti et al. (2016). In order to achieve sustainability, environmental education would help improve the perceptions of environmental degradation in developing country contexts such as the one in this study.

CONCLUSION

This study provides location context-specific insights into the causes and manifestations of the conflict between development and the environment, in a developing country context. It uses the sand mining problem near Botswana's capital city, Gaborone. Sand is extracted from the Metsimotlhabe River which flows through the area. Despite legislation banning the activity, the legislation has only slowed down but not stopped or deterred it. The result has been degradation of the riverine environment, which has manifested through reduced aesthetic quality, hydrologic impacts that threaten birdlife and fish, as well as negative effects on the riparian vegetation. Although some members of the community were aware of the environmental degradation at the time of the study, the majority only perceived reductions in the services that they obtained from the riverine environment as environmental degradation. Environmental degradation in the form of disturbances to the intrinsic

value of the environment, such as reductions in birdlife, was not regarded as degradation by the majority of the community.

A number of demographic and cultural factors are responsible for the environmental degradation in the study area. Rapid rise in the human population, unemployment, rural to urban and cross border migration, and the cultural norm of livestock keeping emerged from this study as the demographic and cultural factors that contributed to degradation along the Metsimotlhabe River.

RECOMMENDATIONS

Future research can incorporate sampling from other villages in the vicinity of Gaborone, such as Bokaa and Thamaga. Extensive environmental education of the public is essential to deter the Metsimotlhabe local community from participating in activities that degrade their environment, as well as to enable them to perceive degradation in intrinsic (non-economic value) aspects of the environment as constituting environmental degradation as well. This will contribute to the quest for attaining sustainable development. Sand, as a natural resource, should be taken care of by the local community through Community Based Natural Resource Management (CBNRM). With community participation illegal sand miners can be apprehended, thereby being an aid to the overstretched police force. The setting up of a dedicated police service to deal with the enforcement of environmental law would help. Additionally, penalties for illegal sand mining need to be increased. The affordable fines for illegal sand mining at the time of this study did not deter illegal sand miners from continuing the activity.

ACKNOWLEDGMENTS

The author extends gratitude to the North-West University (Mafikeng Campus) for the postgraduate bursary that made this study possible. The Botswana Central Statistics Office is thanked for providing demographic data.

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Paper received for publication on August 2014
Paper accepted for publication on December 2016