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Ecosystem Functioning, Goods, Services and Economic Benefits in Buffalo City Metropolitan Municipality (BCMM) Eastern Cape, South Africa

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ABSTRACT This paper focused on the ecosystem functioning, goods, services and economic benefits in Buffalo City Metropolitan Municipality (BCMM) Eastern Cape, South Africa. Approval for this study was given by both the BCMM and the University of Fort Hare (with ethical clearance certificate number given as KUL011SOLA01). The analysis of results begin with the demographic characteristics of the study population (such as age, educational attainment and race), as well as other issues including the following: knowledge and benefits derived from CVEs, changes in features of coastal vegetation resources management and conservation, as well as the analysis of derivable services (such as provisioning, cultural and regulation services) in the study area. It presents the analysis of questionnaire results, which indicated that more males (122/48.2%) participated in the field exercise, while respondents that had the highest frequency in terms of age (that is, 36-40 years old respondents) were 97 (38.3%). As regards educational attainment, majority of the respondents, (that is, 117/46.1%) were university degree holders, and blacks were 172 (68.0%). This research also sought to know the respondents' knowledge of coastal vegetation resources, as well as the benefits derivable from the study area, and these were categorized into three areas namely, raw materials (154/56.9%), medicinal purposes (159/62.8%) and economic benefits (161/63.4%). The results were further elucidated with bar graphs, pie charts, scatter diagrams, plates and tables.

INTRODUCTION

This study focused on the functioning, goods and services as well as the economic benefits from Buffalo City Metropolitan Municipality. In general ecosystems offer several environmental functions and services, such as biodiversity conservation (Mace et al. 2012; Bommarco et al. 2013; Breuste et al. 2013), carbon sequestration (Egoh et al. 2012; Reyers et al. 2012), defense against soil erosion (Mendoza-González et al. 2012; Ninan 2012) and also, vegetation beautifies the environment (Reyers et al. 2012; Rao et al. 2015; FAO 2016), flood control (Sitas et al. 2014), desertification and water supply (Wangai et al. 2016; Turpie et al. 2017). This calls for continued research to be undertaken, monitoring, and protection to ensure ecosystem functioning and services which is fundamental in coastal green sustainability (Willemen et al. 2013; Cortinovis and Geneletti 2018). According to Bastian et al. (2012), there are two basic areas of ecosystem functioning, firstly are the functions which offer direct advantage to man and secondly the environment. These are those which uphold natural systems integrity in general and ecosystems in specificity (Cabello et al. 2012). Also, the classifications of functions (namely, information, habitat, production and regulation functions, (Egoh et al. 2012) was elucidated in this chapter. Also, the analysis of results were further illustrated with tables, plates, bar charts and scatter diagrams accordingly.

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The Conceptualization of Ecosystem Service (ES)

The concept of ecosystem services (ESs) was initially articulated as a tool for enlightening and communicating support efforts geared towards the conservation of biodiversity (De Groot et al. 2010; Gómez-Baggethun and Barton 2010). As the beamlight on environmental con-

servation and management is focused on securing the livelihood of species and ecosystems, wider societal attention on biodiversity concerns, as well as the numerous human and environmental merits holds much promise, and this concomitantly anticipates increased disposition to safeguard biodiversity, especially where severe ecosystem disturbances have been stated (Mononen et al. 2015). In the course of studying ecosystem services in the early years, the concept was marked with wide multiplicity as regards the use of concepts and terminologies (Haines-Young et al. 2012). However, latter developments such as the invention of the cascade model as well as the execution of the Common International Classification of Ecosystem Services (CICES) have endeavored to unite the terminologies and brought some levels of accord amongst different scientific fields of science (Haines-Young et al. 2010; Monomen et al. 2015; La Notte et al. 2017). The European Commission underscores the significance of precise information on ecosystem service as a platform for the operationalization of the 2020 EU Biodiversity Strategy (Cortinovis and Geneletti 2018). It is on this premise therefore that it is imperative to assess ecosystem goods and service delivery in our communities (Jorda-Capdevila et al. 2016). Instances of operationalizing the CICES categorization include the Green Frame strategy of mapping green infrastructure (Kopperoinen 2014) as well as the national ES classification of Belgium, (Turkelboom 2013). Notwithstanding the numerous progress in the developmental stages of ecosystem service, associated conceptions and operationalization, a lot is still required to done regarding the incorporation of ecosystem services in practical terms regarding the enactment of policies on national or regional scales. This is premised upon the all-encompassing characteristic of the concept, inadequate instances of ES applications, as well as typologies of the ES.

In the urban scene, for example, the significance of ES cannot be over-emphasized. For example, Elmqvist et al. (2015), posited that financing, restoring, conserving, and improving ecosystem services and green infrastructure in urban climes goes beyond its social or ecological values. It is also economically sustainable, even in the face of prevailing economic situations. Further, the applications of ES is vital in decision-making procedures associated with urban land use and management practices and to guide restoration practitioners, landscape planners, urban managers architects, and other stakeholders as well as private and institutional stakeholders in the course of environmental service delivery (Jorda-Capdevila et al. 2016). Despite the fact that economic considerations provide worthwhile arguments for environmental developments, they are inadequate to fully measure or capture or monitor the wide array of merits associated with urban ecosystem services restoration. Indeed, many significant ecosystem services were not acknowledged in some published works on economic valuations of urban green infrastructure, other merits considered in this chapter incorporates other benefits such as promoting well-being, provisioning services, and social comfort, as further research efforts is required to satisfactorily capture these values. Urban ES are produced in diversities of habitats, green spaces, urban forests parks, vacant lots, landfills; cemeteries, gardens and yards, blue spaces, campus areas, and including streams, lakes, ponds, artificial swales, and storm water retention ponds, etc. (Chen et al. 2014; Elmqvist et al. 2015), and are generally typified by high demand on account of very large number of immediate local beneficiaries.

Aim of Study

The aim of this study is to determine the ecosystem functioning, goods, services and economic benefits in Buffalo City Metropolitan Municipality (BCMM) Eastern Cape, South Africa.

MATERIAL AND METHODS

This study involved the distribution of 300 copies of the questionnaire to different categories of individuals in the study area of Buffalo City Metropolitan Municipality (BCMM) Eastern Cape, South Africa (Fig. 1) and these include government officials (provincial and municipality officials) related to vegetation conservation, headsmen, local leaders (area and ward councilors), Community-Based Organizations (CBOs), Non-Governmental Organizations (NGOs), traditional healers, grassroot dwellers, students,

community members and the general public residing in the study area. The analysis of the field results begin with the demographic characteristics of the surveyed respondents. Out of the 300 copies of the questionnaire distributed, a total of 254 copies were returned. The results were analyzed in the Statistical Package of the Social Sciences (SPSS version 32). The analysis of results include the demographic characteristics of the study population (such as age, educational attainment and race), as well as other issues including the following: knowledge and benefits derived from CVEs, changes in features of coastal vegetation resources management and conservation, as well as the analysis of derivable services (such as provisioning, cultural and regulation services) in the study area. Also, the analysis of results were further illustrated with tables, plates, bar charts and scatter diagrams accordingly, ecosystem services in the context of coastal environmental protection was stated and finally, the findings from the field survey, which were derived from the collected data pertaining to the ecosystem functions, goods, services and economic benefits derivable from the study area were also discussed.

RESULTS AND DISCUSSION

Demographic Characteristics of Respondents

This section contains data presentation and discourse on the research findings based on the broad and specific objectives of this thesis. The core argument of this chapter is that demographic factors. The types of demographic factors that exist in literature are age, gender (or sex), educational attainment level (for example, matric, MSc),

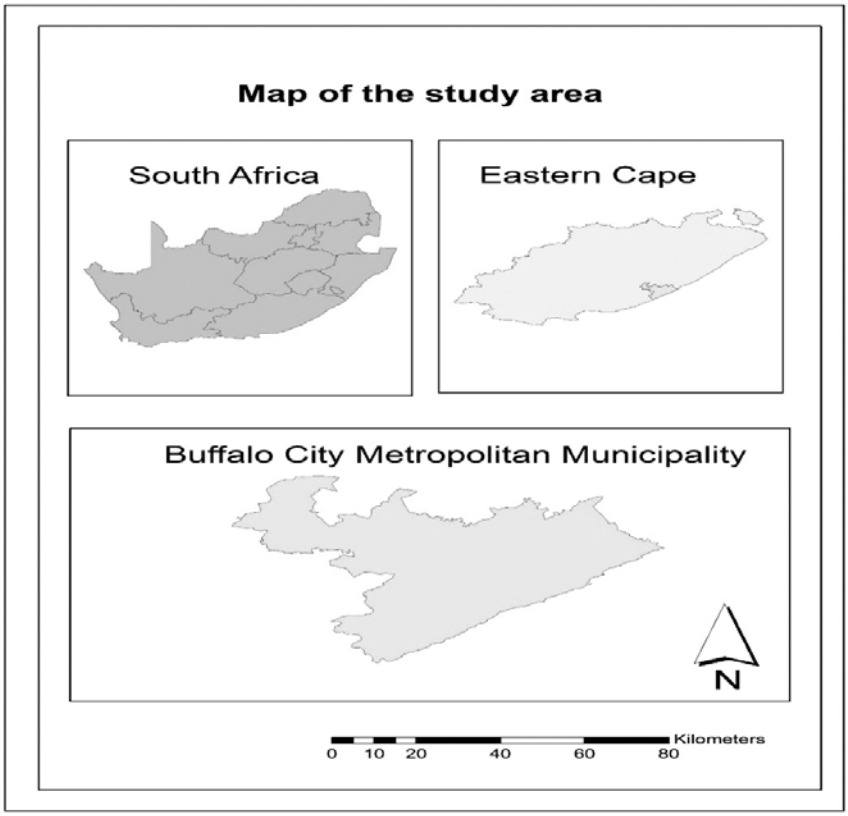

Fig. 1. Map of study area

religion (for example, Christianity, Islam, etc.), some of the relevant demographic factors to this study are hereby defined below.

Gender of Respondents

Gender denotes the socially- fashioned comportments, actions, roles, and special features that a society comprehends as suitable for men and women. Table 1 depicts the gender of the surveyed respondents.

Table 1: Gender distribution of the respondents

Gender	*Frequency*	*Percentage (%)*
Male	122	48.2
Female	131	51.8
Total	253	100.0

Source: Author 2019

Table 1 reviewed that 122 (48.2% of the respondents) were males, while the residual number, that is, 131 (51.8%) were females. Other empirical studies conducted that supports the findings of this research include Keane (2016), who opined that women placed greater significance on conservation practices, and attributed preservation values to non-human ecological components than their male counterparts.

Age of Respondents

Age is conceptualized as the longevity of a person or phenomenon that ever lived or existed. WHO (2011) states that age is the longevity or amount of protracted time of one's existence and life duration. From the foregoing, the respondents that were between 36- 40 years old were in the majority (that is, 97/ 38.3%), who were essentially working class respondents, followed in sequence by respondents of between 26-30 years of age (34/13.4%), who were mostly postgraduates and working class respondents. Further, respondents that were above 45 years of age totaled 22 (8.6%).

Educational Attainment

Educational qualifications refer to diplomas, certificates, degree, professional titles etc. that an individual has accomplished through private, part-time or full-time study, whether conferred locally or internationally by educational authorities, as well as special professional or examining bodies. Table 2 depicts the level of educational attainment of the respondents.

Table 2: Educational attainment of the respondents

Level of educational attainment	*Frequency*	*Percentage (%)*
Middle school	9	3.5
Matric	104	41.3
Undergraduate students	17	6.7
National diploma	6	2.4
University degree	117	46.1
Total	253	100

Source: Author 2019

Table 2 displays the results from the third question in the survey form, which refers to the level of educational attainment of the respondents, and reveals that majority of the respondents (that is, 117/46.1%) possessed university degrees (such as honors, masters and Doctor of Philosophy degrees from various higher education institutions), while 104 (41.3) respondents were matriculated. Also, undergraduates and middle school respondents numbered 17/6.7 percent and 9/3.5 percent correspondingly.

Racial Distribution of Respondents

Information regarding the racial distribution of the respondents was also garnered in the course of the field survey. The results are hereby presented in tabular format in Table 3.

Table 3: Racial distribution of respondents

Race	*Frequency*	*Percentage (%)*
Black	172	68.0
White	16	6.3
Colored	33	13.04
Indian	24	9.5
Asian	7	2.8
Total	253	100

Source: Author 2019

Table 3 reveals the fourth question in the questionnaire, which refers to the racial sensibilities of the surveyed respondents, with majority of them (that is, 172/68.0%) were predom-

inantly blacks (who were either Xhosas, Zulus or other foreign nationals), while colored respondents (predominantly Afrikaans) were 33 (13.04%). Also, the white population of surveyed respondents were 16/6.3 percent, were mostly East London dwellers, a, while 7 (2.8%) respondents were Asian.

Level of Knowledge and Care for Coastal Vegetation Resources and the Environment

The researchers sought to know the respondents' level of knowledge for coastal vegetation resources as well as their level of care. This is because these two aforementioned underpinnings will form the foundation for the interview. Hence, the research findings from this exercise as depicted in Table 4.

Table 4 depicted reveals the level of knowledge and care of the respondents towards coastal vegetation resources and the environment. The table reveals that while 144 (56.9 %) respondents have knowledge of coastal resources and the environment, a high number (that is, 77/ 30.4%) of respondents still claim ignorance of the significance of ecological resources, and 32 (12.6%) respondents maintained neutrality in this regard, hence, this thesis is long overdue, as urgent strategies towards orientation of the populace on the germaness of conserving our CVEs and environmental resources should be expedited. Furthermore, it's one thing to have knowledge, and another to care for CVEs. As revealed from the Table 4, 24 (9.5%), as well as 50 (19.8%) respondents neither had knowledge nor cared for CVEs, while 178 (70.6%) responded in the affirmative.

Benefits Derived from Coastal Vegetation Environments (CVEs) by Respondents

The researchers sought to know the benefits which the BCMM dwellers derive from their CVEs. The results are tabulated in Table 5.

Table 5: Benefits derived from coastal vegetation environments (CVEs) by respondents

Benefits	*Frequency*	*Percentage (%)*
Raw materials	154	60.9
Medical purposes	159	62.8
Economic	161	63.4
Total	253	100

Source: Author 2019

Table 5 reveals the benefits that the surveyed respondents derive from CVEs. It depicts that 159 (62.8%) of the respondents derive medicinal benefits from the CVEs. This is buttressed by Wintola and Afolayan (2015), who stressed that *Hypoxis hererocallidea*, *Strychonos henningsii*, *Rumex lanceolatus*, *Ozoroa mucronata Acacia karoo, Cotyledon orbiculata*, etc. are available in the study area for medicinal purposes. Also, 154 (60.9%) and 161 (63.4%) respondents were of the opinion that the raw material and economic benefits of the CVEs respectively. Also, 154 (60.9%) respondents indicated raw material benefits from BCMM's ecosystem. From the foregoing, the researchers observed during field interactions with locales that the significance of the study area is further acknowledged as a source of diverse raw materials which are utilized in clothing-making and fashion-based factories (such as animal feathers and skin), timber (for furniture and carving). The next subsection analyzes the changed regarding the coastal vegetation resources in the study area.

Changes Regarding the Coastal Vegetation Resources in the Study Area

On account of natural and anthropogenic factors, there have been alterations in the quality and quantity of resources in the CVEs of the study area. From the foregoing, the responses of the respondents are analyzed in Table 6.

Table 4: Level of knowledge and care for coastal vegetation resources and the environment

Question	*Yes*	*No*	*Neutral*	*Total*
Knowledge of coastal resources and the environment	144 (56.9%)	77 (30.4%)	32 (12.6%)	253 (100%)
Care for coastal resources and the environment	178 (70.6%)	24 (9.5%)	50 (19.8%)	253 (99.7%)

Source: Author 2019

Table 6: Features of coastal vegetation changes in study area

CVE changes that have occurred	*Frequency*	*Percentage (%)*
Overall quality	119	48.0
Species abundance	41	16.5
Ecosystem diversity	53	21.4
Total	253	100

Source: Author 2019

Due to the developmental activities taken place in the study area since the post- 1994 apartheid period, the study area has witnessed the removal of coastal vegetal cover as well as environmental degradation (Hagen 2010). It is on this premise that research was carried out in order to ascertain the features of coastal vegetation in the study area. Table 6 reports that a total of 119 (48.0%) respondents stated that the overall quality had changed, 41 (16.5%) stated that the species abundance had been altered, while 53 (21.4%) believed that there were changes in the diversity of the ecological system in the study area.

Nature of Coastal Vegetation Changes in the Study Area

In a bid to ascertain the nature of change, (whether positive or negative), and the result is tabulated in Table 7.

Table 7 depicts the nature of coastal vegetation changes in the study area, and it was revealed that majority of respondents (that is, 179/ 72.5%) were of the opinion that CVEs have witnessed a decline in resource base, and this assertion is in conformity with existing literature, such as Dearborn, and Kark (2010), Syphard et al. (2011), Egoh et al. (2012), Fu et al. (2013) and Ferreira and Lacerda (2016). The reasons deduced in order of importance include urbanization and natural factors (such as climate change). Also, 12 (4.9%), respondents asserted that there were no changes, while and 29 (11.7%) reported increased change.

Table 7: Nature of coastal vegetation changes in the study area

Nature of coastal vegetation change	*Frequency*	*Percentage (%)*
Increased change	29	11.7
Decreased change	179	72.5
No change	12	4.9
Don't know	27	10.9
Total responses	247	100

Source: Author 2019

Goods and Services Obtainable in the Study Area

This section deals with the goods and services that are available in BCMM, and have been grouped into provisioning, cultural and regulating functions correspondingly, and are hereby presented below in the tables below respectively.

Table 8 refers to the provisioning services provided in the study area, which is in response to question 17(a) of the questionnaire. Out of a total of 254 respondents, those who confirmed the availability of timber and pines were 130 (51.2%) and 83 (32.8%) correspondingly, and this was confirmed by the researchers in the process of field observation, for example some species of *Tectona grandis* were seen in parts of Schornville, Gonubie and Zwelitsha, while *Pinus caribaea* was available in areas such as King Williams Town, East London and Mdantsane. Further, 146 (57.5%) respondents asserted to the prescence of

Table 8: Provisioning services available in study area

Timber 130 (51.2%)	*Fuelwood 122 (48.2%)*	*Pines 83 (32.8)*	*Genetic resources 104 (40.9%)*
Medicinal and cosmetic plants 146 (57.5%)	Livestock134 (52.8%)	Fiber crops 81 (31.9%)	Tree plantations 135 (53.1%)
Food 176 (69.3%)			
	Total	254 (100%)	

Source: Author 2019

medicinal plants, and these species were confirmed by Petrovska (2012), and Wintola and Afolayan (2015), to be found in the study area, namely, *Hypoxis hererocallidea*, *Strychonos henningsii*, *Rumex lanceolatus*, *Ozoroa mucronata*, *Acacia karoo*, *Cotyledon orbiculata*. These medicinal plants provide chemicals that can be used as drugs and pharmaceuticals (Choudary and Sekhon 2011), or which may be used as models to synthesize these drugs (Lahlou 2013). In addition, the study area is known to be a haven for genetic resources, as 104 (40.9%) respondents laid credence to this. A major advantage of genetic research is that many biotic components which were formerly obtained in the wild are now acquired from cultivated flora and domesticated fauna species in the study area (Larson et al. 2014). However, many significant plant species could not sustain their commercial status without the genetic support of their wild relatives. In order to maintain the output of these cultivars, the genes of the species are modified to harness certain qualities such as taste, improved resistance to pathogenic disturbances, as well as the ability to adapt to certain environmental conditions (De Wit 2016), regular inputs of genetic material from their primitive ancestors and wild relatives remains sacrosanct (Plucknett and Smith 2014; Tadele 2017), and the inputs may differ from simple cross-breeding between wild and cultivated diversities of major flora species to complex outputs of hybrid species/genetic resources which are discovered through biotechnological experiments and genetic research (Mannion and Morse 2012; Shanks 2015; Rizvi 2016; Yohannes 2017).

Also, 176 (69.3%) respondents depended on the BCMM ecosystem to feed. This is due to the facts received during the researchers' field observation, that the BCMM ecosystems (around the fertile soils of KWT, East London, Mdantsane, Zwelitsha and parts of Dimbaza) are an abundant source of edible plants/vegetables such as *Spinacia oleracea* (spinach) and domesticated animals such as poultry processing factories, such as Gallus domesticus (chicken), *Meleagris gallapavo* (turkey). Others include beef, mutton, pork, dairy products, as well as fruit processing such as *Mangifera indica* (mango), *Pyrus malus* (apples), *Musa paradisicum* (banana), *Citrus limon* (lemon), *Citrus hystrix* (lime), etc.), as well as cereal grains such as *Zea mays* (maize), and East London factories for the processing of *Tristicum aestivum* (wheat), and animal-feed (for example, grass, leaves, krill etc.) Also, there is a preponderance of subsistence farming practices in several residential areas and private residences around King Williams Town, Zwelitsha, Dimbaza, Gonubie, Vincent, Quigney, etc. The following sub-section discusses the cultural services available in the study area.

Table 9 presents the cultural services provided by the BCMM ecosystem as depicted by the respondents, with a total number of 156 (61.4%) accounting for the highest frequency as regards educational services, and good include the University of Fort Hare and Buffalo City Graduate School, which are both situated in East London. Also, tourism accounts for 145 (57.3%) counts from the respondents. This is due to the presence of tourist attraction sites such as the Lion park (is located at about 5 and half kilometers along the East London – Stutterheim highway), the Amathole (King Williams Town) and East London museums, Mpongo private game reserve, East London Aquarium, Queens park zoo and gardens, as well as the Hemmingways casino resort in East London. Furthermore, Hagen (2010) and Daniel (2012) opined that the natural BCMM ecosystem provides many tourist prospects for entertainment and recreation, such as hiking, walking, swimming, fishing, camping, and nature study. With

Table 9: Cultural services available in study area

Recreational 141 (56.0%)	Tourism/Ecotourism 145 (57.3%)	Landscape beauty 120 (47.2%)	Education 156 (61.4%)
Scientific research 124 (48.8%)	Traditional knowledge 120 (47.4%)	Cultural heritage 126 (49.6%)	Religious 120 (47.2%)
	Total	254 (100%)	

Source: Author 2019

increasing populations, material comfort and leisure-time, the demand for recreation in eco-tourism in the study area faces imminent increase in future. It is on this premise, that Acheampong et al. (2014) asserted that the tourism businesses in BCMM increased from 123 to 952 from year 1994 to 2009 respectively, thereby contributing to the overall South African GDP of R66 billion, and providing over 500,000 jobs (Acheampong et al. 2015). Other cultural underpinnings of the study area as indicated by the respondents include traditional knowledge and religious services, 120 (47.4%), on account of its spiritual significance (through the use of ecosystem goods for religious and cultural formalities), while 124 (48.8%) respondents affirmed scientific research services (this is also affirmed by Daniel, 2012). Further, 156 (61.4%) respondents indicated that the BCMM ecosystem serves education functions. This is due to the fact that the BCMM natural ecosystems provide unlimited opportunities for nature study and environmental education (for example, through excursions) and function as 'field laboratories' for scientific research (as 124/48.8% respondents opined), leading to thousands of research publications each year. Natural areas also serve as important reference areas for monitoring environmental change.

Regulation Services Provided by BCMM

According to Craik (2012) and Bommarco et al. (2013), the BCMM Coastal ecosystems play germane roles as managers and regulators of life support systems, as well as ecological developments and processes. Some of the such as the transfer and storage of energy and minerals in food chains, the conversion of solar energy into biomass, bio-geochemical cycles, decomposition of carbon-based matter in sediments and soils, and stabilization of the climatic conditions (Vo et al. 2012). All these processes, are controlled by the interaction of abiotic factors (that is, climate) with fauna components through mechanisms of control and evolution. Hence, the sustenance of mankind is hinged on the sustained integrity of these natural coastal ecosystems and processes (Riggio 2015; Scott et al. 2016). Despite the fact that the regulation services of coastal ecosystems are seldom documented (Fabricius and Pereira 2015), until they are degraded or destroyed, however, they are essential for man's earthly survival (Breuste et al. 2013). The following sub-section elucidates the regulating services provided by the study area.

Table 10 illustrates the responses of the study population as regards the regulating services provided by the study area, and 129 (50.8%) responses affirmed air quality regulation function of the study area. According to Bommarco et al. (2013), life on earth exists on account of the balancing of air quality in the atmosphere and vegetation, and any alterations in that balance can either positively or negatively affect natural as well as economic and social processes. It is also important to note that biogeochemical procedures regulate the chemical configuration of oceans and the atmosphere, and these are concomitantly influenced by many biotic and abiotic components of natural ecosystems (Burkhard et al. 2012), and vital examples are the influence of natural biota on processes that regulate the CO^2 /O^2 balance, and the maintenance of the ozone-layer (O^3). The main services provided

Table 10: Regulation services available in study area

Erosion control 132 (52.0%)	Hydrological regulation 84 (32.9%)	Climate regulation 129 (50.8%)	Soil purification 110 (43.3%)
Water purification 136 (53.5%)	Waste treatment 130 (51.2%)	Flood buffering 84 (33.1%)	Pest prevention 87 (34.3%)
Air Quality 129 (50.8%)	Habitat maintenance 117 (46.1%)	Carbon sequestration 88 (34.6%)	Coast stabilization 94 (37.0%)
Nursery 126 (49.6%)			
	Total	254 (100%)	

Source: Author 2019

by the air regulation function of the study area are the maintenance of clean, breathable air, and the prevention of diseases (for example, skin cancer), that is, the general maintenance of a habitable planet. An important issue when trying to determine the service value from this ecosystem function is the scale at which the analysis is carried out. For example, the influence of 1 hectare of ocean, or forest, as a carbon-sink is difficult to measure (Fabricius and Pereira 2015). However, the cumulative effect of losing 50 percent of the earth forest-cover, or 60 percent of the coastal wetlands, and the reduction of algae-productivity in large parts of the oceans due to pollution, on the gas regulation function is considerable.

Further, the respondents that indicated in favor of climate regulation functions were 129 (50.8%). According to National Research Council (2010) and Chapi et al. (2011), the regulation of climate and local weather are determined by the complex interaction of regional and global circulation patterns with local topography, vegetation, albedo, as well as the configuration of, for example, lakes, rivers and oceans (which are all evident in the study area). Due to the greenhouse-properties of some atmospheric gases, gas regulation (see above) also plays an important role in this function, but reflectance properties of ecosystems are also important in determining weather conditions and climate at various scales (Willemen et al. 2013). The services provided by this function relate to the maintenance of a favorable climate, both at local and global scales, which in turn are important for, among others, human health, crop productivity, recreation and even cultural activities and identity (Redmond and Abatzoglou 2014).

Furthermore, 132 (52.0%) respondents signified the importance of erosion control as a significant ecosystem service provided by the study area, and in conformity to this postulation, Hagen (2011) indicated that coastal ecosystems prevents ecosystem disturbance. This function relates to the ability of ecosystems to ameliorate natural hazards and disruptive natural events such as catastrophic effects of soil erosion, storms, floods and droughts through its storage capacity and surface resistance; coral reefs buffer waves and protect adjacent coastlines from storm damage. The services provided by this function relate to providing safety of human life and human constructions. As regards hydrological regulation functions, 84 (32.9%) responded in the affirmative. According to Reyers et al. (2012), water regulation deals with the influence of natural systems on the regulation of hydrological flows at the earth surface. This ecosystem function is distinct from disturbance regulation in so far as it refers to the maintenance of 'normal' conditions in a watershed and not the prevention of extreme hazardous events. Ecosystem services derived from the water regulation function are, for example, maintenance of natural irrigation and drainage, buffering of extremes in discharge of rivers, regulation of channel flow of a medium for transportation. A regular distribution of water along the surface is, therefore, quite essential, since too little as well as too much runoff can present serious problems. In addition, Dominati et al. (2010), posited that erosion control helps in the maintenance of crop productivity on cultivated lands and the integrity and functioning of natural ecosystems in the study area.

The significance of water purification as a regulation service performed by ecosystems cannot be under-rated (Percival et al. 2017), no wonder why 136 (53.5%) respondents indicated in favor of this regulation function. This ecosystem function refers to the filtering, retention and storage of water in, mainly, streams, lakes and aquifers. The filtering-function is mainly performed by the vegetation cover and (soil) biota. The retention and storage capacity depends on topography and sub-surface characteristics of the involved ecosystem. The water supply function also depends on the role of ecosystems in hydrologic cycles, but focuses primarily on the storage capacity rather than the flow of water through the system. Ecosystem services associated with water supply relate to the consumptive use of water (by households, agriculture, industry, etc.) in the study area. Furthermore, 126 (49.6%) respondents mentioned the importance of the study area in serving nursery functions. This is due to the fact that many ecosystems, especially coastal wetlands, provide breeding and nursery areas to species which, as adults, are harvested elsewhere for either subsistence or commercial purposes. Unfortunately, the nursery services of many eco-

systems are often unknown or ignored and in many instances nursery areas are, and have been, transformed to other more direct 'economic' uses with disastrous ecological and socio-economic consequences (Hagen 2010). Also, 130 (51.2%) respondents registered the importance of waste treatment functions which the BCMM ecosystem serves. This is due to the fact that natural ecosystems are able to store and recycle certain amounts of organic and inorganic human waste through dilution, assimilation and chemical recomposition. Forests, for example, filter dust particles from the air, and wetlands and other aquatic ecosystems can treat relatively large amounts of organic wastes from human activities acting as 'free' water purification plants. It is also germane to state that 117 (46.1%) mentioned the importance of the BCMM ecosystem as regards providing a safe haven for endangered flora and fauna species, (that is, habitat functions and interrelated services in the ecosystem). According to Cardinale et al. (2012) and Briggs (2016), coastal ecosystems provide a safe haven for flora and fauna species on the planet.

CONCLUSION

Engaging in ecosystem functioning discourse in academic climes remains sacrosanct towards ensuring a decent, conducive, livable, efficient and highly productive environment. It is on this premise that this chapter conceptualized ecosystem functioning, goods, services and economic benefits derivable from Buffalo City Metropolitan Municipality (BCMM). A synopsis of the entire study reveals the types and importance of the ecological systems in the study area. It is expedient to state that life on earth depends on the continuous (re)cycling of more than 30 of the 90 chemical components occurring in coastal ecosystems. Also, several operational and functional characteristics of coastal ecosystems facilitate nutrient cycling at both local and wider scales. For instance, organic matter are mineralized or decomposed by soil organisms, and this concomitantly results in the release of nutrients required for local plant growth, as well as the atmosphere, ditto for algae in coastal waters which operationalizes this same ecological service. Also, movement of fauna on land and sea plays an important role in the distribution of nutrients between coastal ecosystems. In addition, coastal ecosystems prevent in excess of 90 percent of all prospective incidences of diseases from human and crop pathogens. Furthermore, coastal ecosystems provide many resources ranging from food, oxygen, genetic resources water, medicinal resources, clothing and construction materials as well as energy sources. One significant dissimilarity between biotic and abiotic resources is their renewable ability. By and large, biotic resources are renewable, while most abiotic resources could be recycled. Furthermore, coastal ecosystems provide strong fibers and timber (for construction purposes), biodynamic/ bio-chemical compounds (such as oils, tannins, gums, latex, hormones, waxes, dyes, etc.) for all kinds of engineering and manufacturing endeavors. In addition, coastal environments also provide many energy resources including fuelwood, bio-chemicals (ethanol, hydrocarbons, etc.), to power animals as well as organic matter. Further, coastal ecosystems are prospective environments for spiritual enhancement, mental development and relaxation. Also, wild fauna and flora species are also collected and commercialized as pets, or to complement botanical/zoological collections. Further, wild flora and fauna species, as well as abiotic resources such as precious stones and minerals are widely utilized for ornamental purposes. Similarly, the aesthetic beauty, landscape and beach resort advantages provided by the metro municipality has culminated in population increases and economic benefits especially around these areas, for instance, accommodation around the East London ocean view or near parks are usually more expensive than similar facilities in less preferred areas. In addition, coastal ecosystems has played vital developmental roles in different spheres of human endeavor, such as cinematography, fashion, film making, national symbols, book-writing, artwork, advertising, magazines, sculptures, music industry, architecture, folklore, etc. Fascinatingly, despite the fact that coastal ecosystems are used for all the aforementioned purposes, we do not seem to acknowledge these services and the economic benefits accruing from them are rarely quantified in literature.

RECOMMENDATIONS

In order to ensure optimum functioning of the ecosystem services in the study area, the following suggestions are recommended:

There should be holistic management of all coastal biodiversity components, and social management should be in the lead concerning the qualitative execution of guidelines in the Integrated Coastal Management (ICM) Act, hence, it is needful for policy makers and other stakeholders to ensure strict commitment and compliance for the Act to be effective. The Act also ensures that more powers are vested on provincial and local authorities. Local authorities should therefore take up the challenge of executing the new Act and ensure better management of the South African coast and policy-makers need to be furnished with the required knowledge on coastal resources conservation and management which are imperative for informed decision making. Furthermore, it was observed that there is the need to build capacity of stakeholders of the study area regarding sound integrated coastal zone planning and management so as to ensure that the study area optimally enjoys the dividends of good governance pertaining to coastal resources conservation and management.

REFERENCES

Acheampong KO 2015. Tourism policies and the space economy of the Eastern Cape Province of South Africa: A critical realist perspective. *African Journal for Physical Health Education, Recreation and Dance*, 21(3.1): 744-754.

Acheampong KO, Campus BC, London E 2015. South Africa's Eastern Cape Province Tourism Space Economy: A System of Palimpsest. African Journal of Hospitality, Tourism and Leisure, 4, (Special Edition). www.ajhtl.com.

Bastian O, Haase D, Grunewald K 2012. Ecosystem properties, potentials and services-The EPPS conceptual framework and an urban application example. *Ecological Indicators*, 21: 7-16.

Bommarco R, Kleijn D, Potts SG 2013. Ecological intensification: Harnessing ecosystem services for food security. *Trends in Ecology and Evolution*, 28(4): 230-238.

Briggs D, Walters SM 2016. *Plant Variation and Evolution*. UK: Cambridge University Press.

Breuste J, Haase D, Elmqvist T 2013. Urban landscapes and ecosystem services. *Ecosystem Services in Agricultural and Urban Landscapes*, 83-104.

Burkhard B, Kroll F, Nedkov S, Müller F 2012. Mapping ecosystem service supply, demand and budgets. *Ecological Indicators*, 21: 17-29.

Cabello J, Fernández N, Alcaraz-Segura D, Oyonarte C, Pineiro G, Altesor A, Paruelo JM 2012. The ecosystem functioning dimension in conservation: Insights from remote sensing. *Biodiversity and Conservation*, 21(13): 3287-3305.

Cardinale BJ, Emmett D, Gonzalez A, Hooper DU, Perrings C, Venail P, Narwani A 2012. Biodiversity loss and its impact on humanity. *Nature*, 486(7401): 59.

Chapin FS, Matson PA, Vitousek PM 2011. Landscape heterogeneity and ecosystem dynamics. *Principles of Ecosystems Ecology Journal*, 369-397.

Chen M, Liu W, Lu D, Chen H, Ye C 2018. Progress of China's new-type urbanization construction since 2014: A preliminary assessment. *Cities*, 78: 180-193.

Choudhary N, Sekhon BS 2011. An overview of advances in the standardization of herbal drugs. *Journal of Pharmaceutical Education and Research*, 2(2): 55.

Cortinovis C, Geneletti D 2018. Ecosystem services in urban plans: What is there, and what is still needed for better decisions. *Land Use Policy*, 70: 298-312.

Daniel TC, Muhar A, Arnberger A, Aznar O, Boyd JW, Chan KM, Grêt-Regamey A 2012. Contributions of cultural services to the ecosystem services agenda. *Proceedings of the National Academy of Sciences*, 109(23): 8812-8819.

De Groot RS, Alkemade R, Braat L, Hein L, Willemen L 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecological Complexity*, 7(3): 260-272.

De Groot R, Brander L, Van Der Ploeg S, Costanza R, Bernard F, Braat L, Hussain S 2012. Global estimates of the value of ecosystems and their services in monetary units. *Ecosystem Services*, 1(1): 50-61.

De Wit MM 2016. Are we losing diversity? Navigating ecological, political, and epistemic dimensions of agrobiodiversity conservation. *Agriculture and Human Values*, 33(3): 625-640.

Dearborn DC, Kark S 2010. Motivations for conserving urban biodiversity. *Conservation Biology*, 24(2): 432-440.

Dominati E, Patterson M, Mackay A 2010. A framework for classifying and quantifying the natural capital and ecosystem services of soils. *Ecological Economics*, 69(9): 1858-1868.

Egoh BN, O'Farrell PJ, Charef A, Gurney LJ, Koellner T, Abi HN, Willemen L 2012. An African account of ecosystem service provision: Use, threats and policy options for sustainable livelihoods. *Ecosystem Services*, 2: 71-81.

Elmqvist T, Setälä H, Handel SN, Van Der Ploeg S, Aronson J, Blignaut JN, De Groot R 2015. Benefits of restoring ecosystem services in urban areas. *Current Opinion in Environmental Sustainability*, 14: 101-108.

Fabricius C, Pereira T 2015. Community biodiversity inventories as entry points for local ecosystem

stewardship in a South African communal area. *Society and Natural Resources*, 28(9): 1030-1042.
Ferreira AC, Lacerda LD 2016. Degradation and conservation of Brazilian mangroves, status and perspectives. *Ocean and Coastal Management*, 125: 38-46.
Food and Agriculture Organization of the United Nations 2016. Food and Agriculture Organization of the United Nations, Roma, Italy.
Fu Y, Lu X, Zhao Y, Zeng X, Xia L 2013. Assessment impacts of weather and land use/land cover (LULC) change on urban vegetation net primary productivity (NPP): A case study in Guangzhou, China. *Remote Sensing*, 5(8): 4125-4144.
Gómez-Baggethun E, Barton DN 2013. Classifying and valuing ecosystem services for urban planning. *Ecological Economics*, 86: 235-245.
Hagen B 2010. *The Critical Natural Capital of the Buffalo City Municipality, South Africa: Harnessing Local Action for Biodiversity Conservation. Hagen, Brett. "The Critical Natural Capital of the Buffalo City Municipality, South Africa: Harnessing Local Action for Biodiversity Conservation."* PhD Dissertation. South Africa: Rhodes University.
Haines-Young R, Potschin M, Kienast F 2012. Indicators of ecosystem service potential at European scales: Mapping marginal changes and trade-offs. *Ecological Indicators*, 21: 39-53.
Jorda-Capdevila D, Rodríguez-Labajos B, Bardina M 2016. An integrative modelling approach for linking environmental flow management, ecosystem service provision and inter-stakeholder conflict. *Environmental Modelling and Software*, 79: 22-34.
Keane A, Gurd H, Kaelo D, Said MY, de Leeuw J, Rowcliffe JM, Homewood K 2016. Gender differentiated preferences for a community-based conservation initiative. *PloS One*, 11(3): e0152432.
Kopperoinen L, Itkonen P, Niemelä J 2014. Using expert knowledge in combining green infrastructure and ecosystem services in land use planning: An insight into a new place-based methodology. *Landscape Ecology*, 29(8): 1361-1375.
La Notte A, D'Amato D, Mäkinen H, Paracchini ML, Liquete C, Egoh B, Crossman ND 2017. Ecosystem services classification: A systems ecology perspective of the cascade framework. *Ecological Indicators*, 74: 392-402.
Lahlou M 2013. The success of natural products in drug discovery. *Pharmacol Pharm*, 4(3A): 17-31.
Larson G, Piperno DR, Allaby RG, Purugganan MD, Andersson L, Arroyo-Kalin M, Doust AN 2014. Current perspectives and the future of domestication studies. *Proceedings of the National Academy of Sciences*, 111(17): 6139-6146.
Mace GM, Norris K, Fitter AH 2012. Biodiversity and ecosystem services: A multilayered relationship. *Trends in Ecology and Evolution*, 27(1): 19-26.
Mannion AM, Morse S 2012. Biotechnology in agriculture: Agronomic and environmental considerations and reflections based on 15 years of GM crops. *Progress in Physical Geography*, 36(6): 747-763.
Mendoza-González G, Martínez ML, Lithgow D, Pérez-Maqueo O, Simonin P 2012. Land use change and its effects on the value of ecosystem services along the coast of the Gulf of Mexico. *Ecological Economics*, 82: 23-32.
Mononen L, Auvinenc A, Ahokumpud A, Rönkäe M, Aarrasf N, Tolvaneng H, Kamppinenh M, Viirretd E, Kumpulab T, Vihervaarada N 2015. National ecosystem service indicators: Measures of social–ecological sustainability. *Elsevier-Journal of Ecological Indicators: Ecological Indicators*, 61(2016): 27–37.
National Research Council 2010. *Monitoring Climate Change Impacts: Metrics at the Intersection of the Human and Earth Systems*. South Africa: National Academies Press.
Ninan KN 2012. *Conserving and Valuing Ecosystem Services and Biodiversity: Economic, Institutional and Social Challenges*. UK: Routledge.
Petrovska BB 2012. Historical review of medicinal plants' usage. *Pharmacognosy Reviews*, 6(11): 1.
Plucknett DL, Smith NJ 2014. *Gene Banks and The World's Food*. Volume 457. New Era Estate, Oldlands, West Sussex, UK: Princeton University Press.

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