A Study of the Contribution of Sustainable Natural Resource Management to Economic Growth, Poverty Eradication and Achievement of NDP 10 Goals

A Discussion Paper

By

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<table>
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<th>Description</th>
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<tbody>
<tr>
<td>ALDEP</td>
<td>Arable Lands Development Programme</td>
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<td>ARAP</td>
<td>Accelerated Rainfed Arable Programme</td>
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<tr>
<td>BCA</td>
<td>Botswana College of Agriculture</td>
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<tr>
<td>BIDPA</td>
<td>Botswana Institute for Development Policy Analysis</td>
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<tr>
<td>BoB</td>
<td>Bank of Botswana</td>
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<td>BOBS</td>
<td>Botswana Bureau of Standards</td>
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<tr>
<td>CBNRM</td>
<td>Community Based Natural Resource Management</td>
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<tr>
<td>CEDA</td>
<td>Citizen Entrepreneurial Development Agency</td>
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<td>CH1</td>
<td>Community Hunting 1</td>
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<td>CH2</td>
<td>Community Hunting 2</td>
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<tr>
<td>CSO</td>
<td>Central Statistics Office</td>
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<td>DCs</td>
<td>District Councils</td>
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<td>DEA</td>
<td>Department of Environmental Affairs</td>
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<td>DWA</td>
<td>Department of Water Affairs</td>
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<td>DWNP</td>
<td>Department of Wildlife and National Parks</td>
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<td>FAO</td>
<td>Food and Agriculture Organization</td>
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<tr>
<td>FAP</td>
<td>Financial Assistance Policy</td>
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<td>FMD</td>
<td>Foot and Mouth Disease</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GoB</td>
<td>Government of Botswana</td>
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<td>HIES</td>
<td>Household Income and Expenditure Survey</td>
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<tr>
<td>ISPAAD</td>
<td>Integrated Support Programme for Arable Agriculture Development</td>
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<tr>
<td>LIMID</td>
<td>Livestock Management and Infrastructure Development</td>
</tr>
<tr>
<td>LPG</td>
<td>Liquefied Petroleum Gas</td>
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<tr>
<td>LWDP</td>
<td>Livestock Water Development Programme</td>
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<tr>
<td>MDG</td>
<td>Millennium Development Goals</td>
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<tr>
<td>MEWT</td>
<td>Ministry of Environment Wildlife and Tourism</td>
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<td>MFDP</td>
<td>Ministry of Finance and Development Planning</td>
</tr>
<tr>
<td>MOA</td>
<td>Ministry of Agriculture</td>
</tr>
<tr>
<td>NAMPAADD</td>
<td>National Master Plan for Arable Agriculture and Dairy Development</td>
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<tr>
<td>NDMO</td>
<td>National Disaster Management Office</td>
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<td>NDP</td>
<td>National Development Plan</td>
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<td>NGO</td>
<td>Non Governmental Organization</td>
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<td>NWNP</td>
<td>National Water Master Plan</td>
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<td>RWH</td>
<td>Rain Water Harvesting</td>
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<td>SLOCA</td>
<td>Services for Livestock Owners in Communal Areas</td>
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<td>SOER</td>
<td>State of the Environment Report</td>
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<tr>
<td>TGLP</td>
<td>Tribal Grazing Land Policy</td>
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<tr>
<td>UNEP</td>
<td>United Nations Environmental Programme</td>
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<tr>
<td>UNFCC</td>
<td>United Nations Framework on Climate Change</td>
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<td>WUC</td>
<td>Water Utilities Corporation</td>
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Executive Summary

This discussion paper aims to provide an understanding of how natural resources contribute to employment and economic growth in Botswana and the ways in which improved natural resource use can contribute to poverty eradication. Botswana is critically dependent on her natural resources. Approximately 75% of paid employment can be linked to natural resources in agriculture, mining, tourism (hotels & restaurants) and water. In addition, virtually all subsistence employment in agriculture, fishing and veld food collection (which is unrecorded in official employment statistics) depends on natural resources.

Although a great deal of the discussion of economic growth and poverty eradication is framed in terms of GDP, the critical importance of NR use is not adequately captured by GDP for two reasons. Firstly, most of the ecosystem services from land, water and air are simply not captured in monetary terms by GDP – no value is given to the regulating services provided by carbon storage for example. Hence, GDP measures understate the contribution of ecosystems to Botswana. Evidence from total economic valuation of the Okavango Delta is that regulating services have an economic value of at least half the annual GDP contribution of tourism, agriculture and natural resource harvesting in this area. Secondly, environmental externalities (e.g. damage from mining) are not subtracted from GDP.

Section 2 of this discussion paper sets out a conceptual framework to capture the links between natural resource use, ecosystem services, the policy and regulatory environment and human development. This suggests that certain questions are likely to determine how effective natural resource use will be in poverty eradication. These include:

1. Whether the poor can effectively access ecosystem services e.g. water.
2. Whether measures to strengthen local governance would enable poor local communities to get a better return from tourism e.g. from more effective community-based natural resource management (CBNRM).
3. Whether government revenue derived from NR is well targeted towards the poor. This is particularly relevant as declining mineral income requires Government to target its support for poverty eradication projects more effectively.

Key findings from each section of the report are as follows:

Climate change

- The Intergovernmental Panel on Climate Change (IPCC) indicates that over the longer term Botswana will be affected significantly by climate change. This is likely to result in increased frequency and intensity of severe weather events including droughts and floods.
Botswana may, on average, experience up to 20% less rainfall each year and that average temperatures may rise by 1-2 degree(s) Celsius.

- Botswana’s rural poor are particularly vulnerable to climate change because they depend most heavily on rain-fed agriculture, wild foods and harvesting local natural resources. The urban poor are also likely to be affected by water scarcity and rising food prices.
- Challenges facing the country include increased threats to human and animal health, reduced food production and some loss of wildlife tourism.
- Coordination and harmonization across Government is required to develop preparedness to tackle climate change through adaptation measures, thereby increasing resilience. These could include use of drought resistant varieties in agriculture, disease risk reduction strategies and developing cultural tourism in addition to wildlife tourism.

Non-Renewable Natural Resources

- Revenue from mining (principally diamond mining) has been the main driver of development in Botswana over the past 25 years. In 2005, mining accounted for about 38% of Botswana’s real gross domestic product (GDP) and provided more than 50% of Government revenues. Despite employing relatively few people, mining supports remittances from employed relatives and government transfers that are major sources of income for poor households.
- Diamonds are, however, an exhaustible resource and this source of Government revenue is expected to fall sharply from 2021 onwards.
- Economic diversification is a high priority for Government but diversification of exports has largely occurred within the mineral sector itself (to minerals other than diamonds).
- Copper and nickel mining, in particular, has a significant environmental impact.
- Coal has the potential to be a major new export for Botswana (contingent on the international coal price remaining high). This will require very large investments in rail infrastructure and large coal exports are likely to present serious environmental risks (including risks to tourism) that have to be carefully managed.

Agriculture & Veld Products

- Arable land accounts for only 0.7% of Botswana’s land and 85% of this area is used for traditional agriculture with yields of some 400kg/ha.
• In 2004 121,000 households practiced traditional agriculture, primarily for own food production. This is a vital component in the livelihood strategy of the poor. Lack of water and labour are the main constraints faced.

• Subsidies from the ARAP and ALDEP programmes and good rains doubled yields between 1983 and 1990 but this was not sustainable and most benefits went to non-poor households. By 2004, yields had fallen back to below the 1983 level.

• ISPAAD was introduced in 2008 as it was recognized that previous interventions had not significantly improved the food security situation in the country. Subsidized ploughing and seeds have proved popular although there has been very limited uptake of fertilizer. The impact of ISPAAD on the poor is yet to be evaluated.

• Increasing the productivity of small-scale arable agriculture does offer the potential for pro-poor growth. Poverty levels in this sector are significantly higher than the average and so increased yields are expected to reduce poverty if these are obtained by poor farmers. It is important to consider whether investments in soil and vegetation conservation, land rehabilitation, water conservation and rainwater harvesting and use of drought resistant crop varieties offer an advantage in terms of poverty eradication over traditional support to agriculture.

• It is possible to draw on some evidence from around the region to begin to address this question. In Tanzania, rainwater harvesting (RWH) in semi-arid areas with high levels of evapotranspiration and irregular rainfall has been demonstrated to significantly increase maize, maize/lablab and sorghum yields and to reduce poverty. This RWH does involve additional labour, both to create structures to capture the rain and to undertake additional weeding. In Botswana, unlike Tanzania, on-farm labour for this kind of work is in very short supply and is relatively expensive. Hence in Botswana, new approaches are likely to be needed to tackle the twin limiting factors of water and labour availability. One option the Government might consider piloting is to allow work permits for foreign farm labourers where farmers commit to introducing RWH. However, the urban rather than rural poor may be more likely to gain as a result (from decreased food prices as supply increases) given that the poorest farmers are unlikely to take the risk of contracting labour.

• Horticultural production and yields in Botswana have risen by more than 500% since 1998, in part, as more literate farmers have moved into this sector. Yet, imports have risen even faster in response to rising urban incomes.

• Vegetable selling is dominated by women and there is significant potential for poor women to gain from horticultural production as well. However, experience from Malawi suggests that this was only realized following NGO support over a number of years to build the capacity of low-income female producer groups.
Up to 3000 veld products are used across Botswana and play an important role in reducing vulnerability and, in some areas, are a source of cash income. For example, in the Makgadikgadi, veld products generate far more income for livelihoods than does arable or livestock agriculture. The value of this production is not recorded in national accounts. There is potential for further commercialization of veld products to benefit low income rural producers but effective governance arrangements need to be place beforehand to avoid over-exploiting and degrading the natural resource.

Total cattle numbers in Botswana have fluctuated from 2-3 million over the past two decades depending mainly on rainfall. On average 62% of households do not own cattle (an increase from 50% in 1986). Approximately 80% of cattle are held on open-access communal land and 20% on commercial farms. Small stock numbers peaked at 3 million in 1997 but fell back to 2 million in 2004.

Overall, the contribution of livestock to the national economy declined by some 20% in real terms between 1994 and 2004. Despite very large subsidies, livestock has contributed a declining share of agricultural GDP over time: falling from about 74% in 1994 to 48% in 2009.

DEA/CAR (2007) compare regional herd sizes against potential carrying capacity across village grazing (VGA) and cattle post areas (CPA) and conclude that overgrazing and degradation are mostly local and sometimes regional problems. “Local problems are found in the village grazing areas (VGA) and around boreholes. Regional problems are found in small districts such as North-East and South-East, which do not have space for CPA and where VGA are small and overcrowded” (pp. 9). Moreover, they find that the VGA are most important for small herd owners (some 60 000 with an estimated 1 million LSU), but they suffer from the highest grazing pressure (9 ha/ LSU in 2001).

Although policy interventions such as LWDP give lower rates of subsidy to large herds we have not been able to find specific evidence on the impact this has had on poverty. We do know that cattle ownership rises with income across most of the income range and so policies that subsidise up to half of the private production cost will favour the non-poor.

Most (58%) of the poorest 17% of households do not own any cattle, but those that do are highly dependent on them for their livelihoods. For poor households that do rely on livestock in areas where overgrazing is a problem, low levels of productivity make it very difficult to use livestock production as a strategy for moving out of poverty. More research is needed if policy makers are to better target this group. However, we do know that livestock livelihoods of the poor are likely to be particularly vulnerable to climate change: tackling over-grazing will help to improve resilience.
Tourism & Fisheries

- Tourism in Botswana is overwhelmingly wildlife-based with Chobe and Moremi wildlife parks accounting for 90% of visits.

- The tourism sector has grown strongly in recent years: visitor numbers rose from 1 million in 2000 to 2 million in 2010 and the NDP target is for tourism to increase its current share of GDP from approximately 6% to 9% by 2016. While this is feasible, Botswana needs an effective strategy to win some share in the competitive international market.

- Most (54%) of employees in this sector are local women and, as formal qualifications are generally not required, this has provided one route out of poverty for rural households.

- Community-based natural resource management (CBNRM) offers the potential to incentivize good local NR management (as local people profit), ensure a higher proportion of tourism spend goes to the local community and develop local businesses. Where poor members of the community share in this, CBNRM is an effective means of poverty reduction.

- CBNRM has produced some notable success stories generating 8000 jobs and 52.5 million Pula from 2006 to 2009. The case study of Sankuyo illustrates what CBNRM can achieve. However, nationally, the potential of CBNRM for poverty reduction has not been realized. Some 88% of CBNRM revenues have been concentrated in 8 CBOs and nearly 2/3 of revenues have come from trophy hunting which will be lost with the move to photographic tourism. The failure of CBO governance has meant that a small number of Board members rather than poor communities have gained most from CBNRM. This failure results, as research from the Makgadikgadi shows, in local people feeling they have no stake in tourism.

- The evidence from Namibia suggests that there are three categories of CBNRM communities: those that are resource rich (relative to the number of inhabitants), a medium resource/beneficiary and a low resource/beneficiary category. For resource-rich communities CBNRM can provide a route out of poverty but only if there is sustained and significant NGO and Government support over a number of years to build local capacity and if the appropriate legal framework is in place.

- Fisheries has been a somewhat neglected sector: there is no national fisheries policy and it is not included in NDP10. Approximately 19 million Pula/year is spent on imported fish yet only a small fraction Botswana’s fish production is realized. There is potential to increase sustainable commercial and sport fishing in natural waters as well as increasing the sustainable catch from dams (which can all contribute to poverty eradication).

- One of the constraints to developing this sector is the weak regulatory framework. Currently, some 80% of fish output is from the Okavango aquatic system where there has
been a long-running conflict between commercial fishers and recreational fishing promoters. Failure to join up fishing policy across borders allows fishing on the Namibian side of the Chobe river but bans it in Botswana (within the National Park).

- Survey evidence confirms that subsistence fishing provides an important social safety net for many households in the Okavango Delta and that the majority of subsistence fishers are single women heading households. Sustainable development of the fisheries resource will need to take the interests of this stakeholder group into account.

Water, Energy & Waste Management

- Groundwater supplies two-thirds and surface water one-third of national water consumption.

- Supply has struggled to keep pace with rapidly increasing demand for water (reflecting urbanization, rising real incomes and growing industrial use). Serious water supply shortage problems have emerged in districts and sub-districts such as Goodhope, Kweneng East, Kgalagadi, North West and Okavango. In addition, water quality (salinity) is a problem in the western district of Kgalagadi.

- Tackling excess demand for water is very costly. SIDA (2008) estimates that inter-basin water transfers and water purchase from neighbouring countries as well as internal recycling of water, and water conservation will add an estimated 300 million Pula to annual water supply costs in Botswana.

- Declining water use in agriculture has been outweighed by increasing use by households (88% of whom now have piped water) and the tourism and mining sectors. A number of conflicts over limited supplies have been documented. For example, groundwater use by the Orapa mine is likely to restrict the groundwater available for local households and livestock in the Makgadikgadi. As water from privately-owned boreholes has no price per unit consumed, users have no incentive to conserve water if they believe there is sufficient supply to meet their needs. This use can impose a cost on society more generally (an “externality”) and government intervention is likely to be required to solve this problem (through market-based instruments or regulation).

- GOB has undertaken to promote re-use of wastewater for agriculture. The approach is to put the available land within close proximity of wastewater generation under irrigation. Crop production using irrigation is also being expanded using fresh water extracted from sand rivers where practicable.

- According to (Ketlogetswe et al., 2006), 23% of the urban population and 77% of the rural population rely on fuel wood for cooking; the highest proportion of fuel-wood users being the poorest 20% of households. The average distance for fuel wood collection is 6
km, and the time for collection is about 3.5 hours, constraining particularly women from participating in other activities (SIDA, 2008).

- Waste management will require very significant investment in the coming years. Requirements include trade effluent standards and agreements, licensing water of sewer networks and treatment facilities, proper legislation and monitoring protocols.

- The current waste management experience demonstrates that formal organizations alone cannot deal adequately with the increasing volumes, complexity and diversity of urban wastes. The waste management challenge in Botswana requires sustained waste recycling, re-use and composting programs via a partnership approach with a framework that will clearly outline the responsibilities of all parties involved. This calls for the development of Integrated Waste Management Systems in urban centres of Botswana.

The Makgadikgadi Pan

- The Makgadikgadi Pan is a unique saline wetland ecosystem. Arntzen et al. (2010) estimate direct and indirect use values to Botswana from the Makgadikgadi management area (MFMP) of more than a thousand million Pula a year in 2010 prices. Putting these into the TEEB ecosystem service framework tell us that the annual value of provisioning ecosystem services account for nearly 2/3 of the total estimated value (with soda ash and salt being the most important component). Although regulating services only account for 14% of total economic value, their ecological value in terms of ensuring the MFMP is sustainable will be much higher.

- Although there is little evidence on how these economic values relate to poverty in this area we do know that local livelihoods derived directly from the natural resources of the MFMP are small in comparison to the economic benefits gained by the country as a whole (22% of the total).

- The share of total tourism income that goes directly to support local livelihoods is particularly low (6%). Consequently, local people prioritize livestock use on marginal land that is far better suited to wildlife-based tourism (McCulloch, 2010). Unless CBNRM is developed to benefit the community as a whole, local people will continue to feel they lack a stake in developing tourism.

- Veld products generate far more income for livelihoods than does arable or livestock agriculture. This is true at a local level and even more evident at a national level once the cost of subsidies are taken into account: every Pula of household income from agriculture costs the Government money but this is not the case with wild foods or grasses. Despite
this, there is little in the way of policy to secure sustainable use of these natural resources and realise their potential for income generation.

- The carbon sequestration value of the Makgadikgadi is very high – 136 million Pula/annum – but this is currently a notional value. It makes sense to consider the scope for local communities to benefit from payment for environmental services as there is a significant potential return per household which has a good chance of influencing local behaviour.

The Okavango Delta

- The Okavango Delta, is the largest inland wetland in the world. Economic values were estimated by Turpie et al (2006) for the ODMP area covering the 55,374 km$^2$ Okavango Delta Ramsar Site (ODRS). Within the Ramsar site, wildlife populations are concentrated primarily in Moremi Game Reserve, which is managed by the Department of Wildlife and National Parks (DWNP).

- In order to minimize risk, most people in this area rely on a mix of livelihood activities but virtually all livelihoods in the ODRS depend directly on natural resource use. Approximately a quarter to a third of adults are in formal employment (in wildlife-based tourism or for the DWNP). Three-quarters of households in the study area are crop farmers although livestock farming (mainly cattle) produces the largest amount of income from local resource use. Fishing is undertaken by up to a third of households in some areas and many households rely on pensions and other government transfers.

- The annual contribution of the Delta tourism industry to the national economy is estimated to be 401 million Pula per year in 2005 prices (622 million in 2010 prices) which accounts for 85% of all annual direct use values (733 million in 2010 prices). Estimates by Turpie et al. suggest that tourism also accounts for 120 thousand Pula/year or 53% of local income from natural resource use by the community themselves and this is less than 0.5% of the total economic value of tourism in the area. Clearly there is very considerable scope for the community to gain more from tourism.

- Turpie et al (2006) conservatively estimate indirect use values of 277 million Pula/year (430 million in 2010 prices) to Botswana of which 58% are attributable to carbon storage and 28% to wildlife refuge services. These are currently notional values. It makes sense to consider the scope for local communities to benefit from payment for environmental services as there is a significant potential return per household which has a good chance of influencing local behaviour.
• As with the economic analysis for the Makgadikgadi Pan, there is no evidence on how financial returns (or access to NR) are distributed within the community and how this impacts on poverty. Again, this is an area where further research is needed.

• Our conclusions relating to the Okavango Delta are also similar to those reached for the Makgadikgadi Pan. In both cases, livelihoods are critically dependent on natural resources and, in order to provide sustainable benefits for the country as a whole, local natural resource users need better incentives for natural resource management. Indeed, in both cases, the data presented understates the importance of natural resources for local livelihoods as pensions and other forms of direct government support (income transfers) are largely funded by mining and tourism. At the moment the returns to poor households from wildlife are far too low to encourage the use of land that is in the national interest. Wildlife-based tourism is an important source of national income but could also generate more income for the poor if CBRNM was more effective.

• Local people are well aware of the importance of resilience and reduced vulnerability and they rely on a diverse range of income sources. However, as these are all based on NR use, increased climatic variation as a result of climate change poses a significant threat.
1. Introduction

For more than a decade, Botswana’s economic policy has been to diversify the economy, and reduce dependence on the mining sector in general, and on diamonds in particular (MFDP, 2010). Since mining in Botswana is capital intensive and employs relatively few people, Botswana’s economic diversification objectives are to create poverty-reducing employment and self-employment opportunities. Wildlife-based tourism, which is far more labour intensive than mining is seen as an ideal way of achieving this.

Statistics Botswana (2011) has shown that the country has made impressive reductions of the incidence of income poverty, from 30 per cent in 2003 to 20 per cent in 2010. However, long-term growth projections by the Ministry of Finance and Development Planning (2010) suggest that further growth and declines in poverty rates will be a function of continued high rates of growth of the non-diamond private sector. Hence, there is a need to understand and facilitate the contribution of sustainable natural resource management to attract private sector investment, growth and competitiveness in order to influence economic growth and poverty eradication.

The heavy reliance of Botswana on her natural resource base means that achieving the NDP10 goals is particularly sensitive to climate change, pollution and degradation of natural resources. MFDP (2010) revealed that during NDP 9, the natural resource base was observed to be declining due to inadequate coordination, enforcement, and management of natural resources. During the same period, improper management of natural resources and waste disposal led to increased pollution of the environment, increasing desertification, and habitat loss. Thus there are frequent reports of increased human/wildlife conflicts and declines of some wildlife species, loss of forests due to excessive and indiscriminate harvesting for firewood, fencing poles and veld products (MFDP, 2010).
This discussion paper aims to provide an understanding of how natural resources contribute to employment and GDP in Botswana and the ways in which improved natural resource use can contribute to poverty eradication. In order to achieve these objectives, the discussion paper is guided by the NDP 10 goals that include the implementation of various strategies that involve promoting non-consumptive use of wildlife resources (e.g. photographic activities) and provision of water within protected areas, and promotion of the growth of wildlife populations and fish populations as a bedrock for tourism.

Section 2 of this discussion paper sets out a conceptual framework to capture the links between natural resource use, ecosystem services, the policy and regulatory environment and human development. Issues of climate change (that cut across all natural resource sectors) are summarized in Section 3. The subsequent sections consider the major natural resource (NR) sectors: the main minerals; agriculture, livestock, veld products, tourism, fisheries, forestry, water, energy and waste. Sections 6 and 7 review the substantial economic valuation studies and management plans for the Makgadikgadi Pan and Okavango Delta with the aim of drawing out lessons for sustainable economic growth and poverty eradication. In section 8 we set out our conclusions of this report and highlight areas that require further research.
2. A Conceptual framework for analysing the links between natural resource use and human development

The conceptual framework outlined in Figure 1 below inevitably presents a simplified version of the real world. Nonetheless it can help us analyse linkages between natural resources and human development.

Figure 1: A conceptual framework for natural resource use & human development in Botswana

Blue arrows trace the paths through which natural resource use contributes to human development. Brown arrows illustrate how human use of natural resources can produce environmental damage.
The 2005 UN Millennium Ecosystem Assessment\(^1\) drew on a body of ecological and ecological economics literature to set out a linkage from ecosystems and biodiversity within nature to ecosystems services that generate human well-being. This has been expressed in a slightly modified form by TEEB (2010)\(^2\) and serves as the inspiration for the left-hand side of Figure 1. Ecosystem services provide food (agriculture and wild food), raw materials from local NR use, regulation of the natural environment (e.g. preventing erosion) and amenity (e.g. tourism) or culture as well as maintaining natural habitats. The TEEB (2010) typology of ecosystem services is shown in Table 1 below.

### Table 1: Typology of ecosystem services in TEEB

<table>
<thead>
<tr>
<th><strong>PROVISIONING SERVICES</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Food (e.g. fish, game, fruit)</td>
</tr>
<tr>
<td>2 Water (e.g. for drinking, irrigation, cooling)</td>
</tr>
<tr>
<td>3 Raw Materials (e.g. fibre, timber, fuel wood, fodder, fertilizer)</td>
</tr>
<tr>
<td>4 Genetic resources (e.g. for crop-improvement and medicinal purposes)</td>
</tr>
<tr>
<td>5 Medicinal resources (e.g. biochemical products, models &amp; test-organisms)</td>
</tr>
<tr>
<td>6 Ornamental resources (e.g. artisan work, decorative plants, pet animals, fashion)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>REGULATING SERVICES</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>7 Air quality regulation (e.g. capturing (fine) dust, chemicals, etc)</td>
</tr>
<tr>
<td>8 Climate regulation (incl. C-sequestration, influence of vegetation on rainfall, etc.)</td>
</tr>
<tr>
<td>9 Moderation of extreme events (e.g. storm protection and flood prevention)</td>
</tr>
<tr>
<td>10 Regulation of water flows (e.g. natural drainage, irrigation and drought prevention)</td>
</tr>
<tr>
<td>11 Waste treatment (especially water purification)</td>
</tr>
<tr>
<td>12 Erosion prevention</td>
</tr>
<tr>
<td>13 Maintenance of soil fertility (incl. soil formation)</td>
</tr>
<tr>
<td>14 Pollination</td>
</tr>
<tr>
<td>15 Biological control (e.g. seed dispersal, pest and disease control)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>HABITAT SERVICES</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Maintenance of life cycles of migratory species (incl. nursery service)</td>
</tr>
</tbody>
</table>

---

\(^1\) MA (Millennium Ecosystem Assessment), 2005b. Ecosystems and Human Well-being: Current State and Trends, Volume 1, Island Press, Washington D.C.

17 Maintenance of genetic diversity (especially in gene pool protection)

CULTURAL & AMENITY SERVICES

18 Aesthetic information

19 Opportunities for recreation & tourism

20 Inspiration for culture, art and design

21 Spiritual experience

22 Information for cognitive development

Source: TEEB (2010), Chapter 1 Table 3

Economic values from human use of renewable natural resources can, in theory, be linked to the ecosystem services provided. The governance and policy environment will influence the access people have to these services and whether particular services are taxed or subsidised and how tax revenue is spent. This will affect human development across economic, social and ecological dimensions.

Extractive resources are also derived from natural capital or natural resources. However, unlike renewable natural resources they cannot be used sustainably: for people to benefit from them natural capital has to be used up. The right-hand side of Figure 1 illustrates the linkage from the extraction of resources through to human development. Mining produces direct gains for those involved (employment or health care, for example) and government revenue (from taxation or royalty payments) that finances government expenditure. Both these benefits from mining can contribute to human development, with the governance and policy environment determining who gets to benefit.

Extracting mineral resources has a negative impact on the environment which will, in turn, affect ecosystem services available to citizens. Human development itself is also likely to affect ecosystem services (e.g. from expanding towns and air pollution).

Government policy, local governance and poverty eradication

Government policy and local governance play a vital role in determining how much or how little the poor gain from natural resource (NR) use. For the purposes of this report we are not interested in competing theories of political ecology that explain why this occurs but it is
important to note where NR governance and policy could have a more pronounced impact on poverty outcomes.

In the context of Figure 1 we need to consider:

1. Whether the poor can effectively access ecosystem services e.g. water.
2. Whether measures to strengthen local governance would enable poor local communities to get a better return from tourism e.g. from more effective community-based natural resource management (CBNRM).
3. Whether government revenue derived from NR is well targeted towards the poor. This is particularly relevant as declining mineral income requires Government to target more effectively\(^3\).

**Links between natural resources and human development in Botswana**

Botswana is critically dependent on her natural resources. Approximately 75% of paid employment can be linked to natural resources in agriculture, mining, tourism (hotels & restaurants) and water as shown below.

<table>
<thead>
<tr>
<th>Economic Activity</th>
<th>Share of employment in 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>12%</td>
</tr>
<tr>
<td>Mining</td>
<td>25%</td>
</tr>
<tr>
<td>Water and electricity</td>
<td>6%</td>
</tr>
<tr>
<td>Hotel and Restaurants</td>
<td>32%</td>
</tr>
<tr>
<td>Transport</td>
<td>26%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>


In addition, virtually all subsistence employment in agriculture, fishing and veld food collection (which is unrecorded in official employment statistics) depends on natural resources. However, this critical dependence is not captured in GDP for two reasons that Figure 1 helps to illustrate.

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Firstly, most of the ecosystem services\textsuperscript{4} from land, water and air are simply not captured in monetary terms by GDP – no value is given to the regulating services in Table 1 for example. Hence, GDP measures vastly understate the contribution of ecosystems to Botswana. Evidence from total economic valuation of the Okavango Delta discussed later in this report is that regulating services have an economic value of at least half the annual GDP contribution of tourism, agriculture and natural resource harvesting. Secondly, environmental externalities (e.g. damage from mining) are not subtracted from GDP.

\textsuperscript{4} In this study we use the TEEB (2010) categorization of four ecosystem services rather than that proposed by the 2005 UN Millennium Ecosystem Assessment
3. Climate Change

Key findings

- The Intergovernmental Panel on Climate Change (IPCC) indicates that over the longer term Botswana will be affected significantly by climate change. This is likely to result in increased frequency and intensity of severe weather events including droughts and floods. Botswana may, on average, experience up to 20% less rainfall each year and that average temperatures may rise by 1-2 degree(s) Celsius.

- Botswana’s rural poor are particularly vulnerable to climate change because they depend most heavily on rain-fed agriculture, wild foods and harvesting local natural resources. The urban poor are also likely to be affected by water scarcity and rising food prices.

- Challenges facing the country include increased threats to human and animal health, reduced food production and some loss of wildlife tourism.

- Coordination and harmonization across Government is required to develop preparedness to tackle climate change through adaptation measures, thereby increasing resilience. These could include use of drought resistant varieties in agriculture, disease risk reduction strategies and developing cultural tourism in addition to wildlife tourism.

Climate Change

Over the next century climate change “will alter the structure, reduce biodiversity and perturb functioning of most ecosystems, and compromise the services they currently provide” (IPCC, 2007). The consequences of climate change are most likely to be felt by rural dwellers who earn a living from “climate sensitive” sources like agriculture (Omari, 2010). Botswana’s climate is arid and semi-arid, with low rainfall and high rates of evapotranspiration. Mean annual rainfall is 450 mm, ranging from 650 mm in the North East to 250 mm in the extreme South West (Parida and Moalafhi, 2008). Rainfall pattern has large temporal and spatial variations. Rain generally falls between October and March, but the pattern is highly irregular. Frequent droughts are characterized by conditions of low rainfall, high temperatures and elevated soil moisture stress (Ministry of Environment Wildlife and Tourism, 2006). These conditions greatly diminish the ability of the agricultural sector to produce enough to meet the country’s food needs. Only about 5% of the country is suitable for agricultural crop production and less than 1% is cultivated (Central Statistics Office Botswana, 2002). Most arable production takes place in the eastern region where rainfall and soil conditions are most favourable. The western region with the poorest soil and climatic conditions has the lowest level of production for all crops. In the
following, we present a discussion of the potential effects that climate change is likely to have in Botswana.

**Agriculture:** Drought affects the livelihoods of the majority of the population, who are dependent on agriculture and the rural communities that depend on individual water sources that cannot withstand prolonged drought. Droughts have occurred in 2001-03, 2005-06 and 2007 (Ministry of Finance and Development Planning, 2008). The consequences of drought induced water stress adversely affects crop and livestock productivity as well as the condition of wildlife. Botswana is vulnerable to climate variability and experiences some drought and flooding. The Intergovernmental Panel on Climate Change (IPCC) indicates that over the longer term Botswana will be affected significantly by climate change. This is likely to result in increased frequency and intensity of severe weather events including droughts and floods. Whilst climatic change modelling is subject to uncertainty a general synopsis for Southern Africa suggests that Botswana may, on average, experience up to 20% less rainfall each year and that average temperatures may rise by 1-2 degrees(s) Celsius (Ministry of Environment Wildlife and Tourism, 2006). This as a result may affect food security both at household and national levels. According to Skoufias et al. (2011) some are concerned that climate change is likely to reverse the declining poverty trends, which have been observed at an international level.

**Biodiversity:** According to Desanker (2010) “biodiversity is an important resource for African people”, with both consumptive (food, shelter, fuel) and non consumptive uses (ecosystem services) (pp. 4). From the observation that majority of people in Africa rely on natural resources, it follows therefore that they are vulnerable to the effects of climate change. The Botswana Biodiversity Strategy and Action Plan indicates that “Botswana is considered a dryland country, therefore the predictions that countries will get drier and hotter has serious implications for the country’s biodiversity” (pp. 9). According to Omari (2010), climate change is expected to negatively affect Okavango Delta through reduced rainfall by up to 68 percent and increasing temperatures and evapo-transpiration rates. Omari (2010) further reports that climate change will negatively affect the “migratory” species, which forms an important part of tourism.

Already there is evidence that climate change is affecting Botswana; malaria is now appearing in new areas including Ghantsi and Kgalagadi, and anthrax which poses a threat to the livestock
industry is being found further south than ever before. In 2008 heavy rainfall led to 532 reported infant deaths from diarrhoea due to poor sanitation (National Disaster Management Office 2009). The threat posed by climate change means that stresses caused by water scarcity and land degradation will worsen. Without doubt the poor and most vulnerable will be most severely affected by climate change in Botswana. The challenge is therefore to ensure appropriate coordination and harmonization across Government to develop preparedness to tackle climate change through adaptation measures. Such measures could include use of drought resistant varieties in agriculture and risk reduction strategies to tackle diseases like malaria in the health sector.
4. **Non-renewable Natural Resources**

**Key findings**

- Revenue from mining (principally diamond mining) has been the main driver of development in Botswana over the past 25 years. In 2005, mining accounted for about 38% of Botswana’s real gross domestic product (GDP) and provided more than 50% of Government revenues. Despite employing relatively few people, mining supports remittances from employed relatives and government transfers that are major sources of income for poor households.

- Diamonds are, however, an exhaustible resource and this source of Government revenue is expected to fall sharply from 2021 onwards.

- Economic diversification is a high priority for Government but diversification of exports has largely occurred within the mineral sector itself (to minerals other than diamonds).

- Copper and nickel mining, in particular, has a significant environmental impact.

- Coal has the potential to be a major new export for Botswana (contingent on the international coal price remaining high). This will require very large investments in rail infrastructure and large coal exports are likely to present serious environmental risks (including risks to tourism) that have to be carefully managed.

**The Minerals Sub-sector**

The mineral industry of Botswana has dominated the national economy since the early 1990s (Ministry of Finance and Development Planning 2003; Ministry of Finance and Development Planning, 2009; Newman, 2010). Diamond mining, in particular, has been the leading component of the mineral sector since large-scale diamond production began 25 years ago. Copper, gold, nickel, and soda ash production has also contributed significant, though smaller, roles to economic growth. For instance, in 2005, mining accounted for about 38% of Botswana’s real gross domestic product (GDP), and more than 50% of Government revenues were derived from mining and mineral-processing activity. In the same year of 2005, the nominal value of minerals produced in Botswana exceeded that of 2004 by about 20% in terms of the United States (U.S.) dollar. Much of the increase was attributed to higher international mineral prices. Diamond, copper-nickel matte, and gold, in order of value, accounted for most of the increase (U.S. Department of Energy, 2006).
**Diamonds**

**Production Trends and Production Volumes by Mines in Botswana**

Botswana has since independence been able to establish mines at Orapa (1971), Letlhakane (1977), Jwaneng (1982), Damtshaa (2002) and Lerala (2008) (Republic of Botswana, und.) Jwaneng mine, which is a joint venture between De Beers and the Government of Botswana, is the richest (by value) in the world and Botswana on average produces 30 million carats per year (Matsheka and Tombale, 2009). Figures 2 and 3 show diamonds opening stocks and production respectively. Total stock declined from 1053 in 1980 to 627 million carats in 2005, representing a decrease of about 40 percent. On the other hand total diamond production increased over time. Figure 3 shows that diamond production increased from about 5 million carats in 1980-1981 to about 33 million carats in 2008. Such increase has been attributed to plant production efficiencies. Evidence has demonstrated that Orapa mine accounts for a larger share of total diamond production in Botswana. For instance in 2002, of the 28.4 million carats, 14.33 million carats were from Orapa, 13.03 million carats from Jwaneng 1.03 million carats from Letlhakane, and 0.01 million carats from Damtshaa (Table 2).

**Figure 2: Diamond Opening Stock; 1980-2005**

Source: Adopted from Department of Environmental Affairs and Centre for Applied Research (2007)
Figure 3: Diamond Production; 1980-2008 (Million Carats)

![Diamond Production Chart]

Source: Republic of Botswana (various)

Table 2: Diamond Production by Location

<table>
<thead>
<tr>
<th>Year</th>
<th>Orapa</th>
<th>Letlhakane</th>
<th>Jwaneng</th>
<th>Damtshaa</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>14.33</td>
<td>1.03</td>
<td>13.03</td>
<td>0.01</td>
<td>28.397</td>
</tr>
<tr>
<td>2003</td>
<td>16.294</td>
<td>1.061</td>
<td>12.765</td>
<td>0.292</td>
<td>30.412</td>
</tr>
<tr>
<td>2004</td>
<td>16.07</td>
<td>1.03</td>
<td>13.68</td>
<td>0.34</td>
<td>31.125</td>
</tr>
</tbody>
</table>

Source: Republic of Botswana (various)

Despite an observed increasing trend in production depicted in Figure 3, mining of current diamond deposits in Botswana is projected to increase up to 2017 and begin to diminish to near unsustainable levels by 2029 (Basdevant 2008). According to Figure 4 the period from 2017 to 2021 is expected to be characterized by declining diamond production as more of the reserves would be drawn down. Furthermore, during the period 2021 to 2029, as this natural resource continues to be drawn down, Debswana will have to shift to underground mining. This method of mining is characterized by very high costs of extraction and is likely to bring problems of lack of profitability and sustainability of mining this natural resource.
Basdevant (2008) predicted that the reduction in diamond production is expected to reduce the fiscal revenue by about two thirds during the period from 2021 to 2029. The possible consequences of such depletion include reduced economic growth, and government revenue. During that period, Botswana will face widening problems including the costs of maintenance of infrastructure, higher education that will limit the country’s ability to eradicate poverty. The country would also be facing serious environmental problems associated with managing and rehabilitating the land that has experienced physical destruction during the mining period. Hence, Botswana should invest in sustainable economic diversification process using the current advantage of being a major diamond producer. Benefits from being a large diamond producer could include using the diamond revenue to create comparative advantage in skills development that would be in very high demand in the future. These could include increased human resource in critical sectors like of health. Developing a strong health sector can be a major source of jobs for the poor in the related services such as care givers or hospitality industry.
Diamond and Economic Growth and Development

Several indicators can be used to assess the performance of diamonds in Botswana’s economic growth and development. They include contribution to Gross Domestic Product (GDP), mineral revenue, exports and employment levels. For instance value added for mining sector grew by 9 percent per annum during the period from 1974 to 2010 and was among the highest growing sectors in the country (TRANSTEC and BIDPA, 2010). While there is no disaggregated data to show the contribution of diamonds to GDP, it is acknowledged that “the production and export of diamonds has driven high rates of economic growth and increase in per capita income, as well as government fiscal position and balance of payments” (United Nations, 2007: 2). Notwithstanding the above, the government initiative of Economic Diversification Drive (Republic of Botswana, 2008) is expected to result in outcomes that would provide the country with alternative sources of economic growth to provide a coping strategy that would provide sustainable sources of growth, once the diamonds have reached unsustainable levels of exploitation.

Mineral Revenue: Table 3 presents disaggregated information indicating the share of sources of total mineral revenue to Botswana government. The Table shows that diamond dividends and royalties were the main sources of total mineral revenue in Botswana, constituting about 99 per cent for the period 2002 to 2005. It should be noted that unlike most other minerals mined in Botswana, Botswana Government owns the diamond mining company, Debswana, on a 50 per cent share basis with the De Beers Mining Company. Other minerals increased their share of total mineral revenue accrued to the Botswana Government from 2007/08 (Table 3). This trend suggests that although the mining sector in Botswana is highly concentrated on diamonds as a source of government revenue, in recent years there has been some marginal diversification within the sector towards other minerals. However, continued dominance of the mining sector by diamonds poses a high risk to sustainable economic growth of the Botswana economy. As diamonds are a non-renewable natural resource, current predictions show that diamonds would be depleted in less than 20 years. Therefore there is an urgent need to diversify the economy away from diamonds to more sustainable sources of revenue and ensure that current efforts of

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5 For the years 2002 to 2005 it is not clear what ‘other” meant, but for the last two years we aggregated shares for copper/nickel, Soda Ash, Gold and others.
eradicating poverty are sustained. There is also a need to carefully consider urgent steps to ensure that the natural resources are sustainably utilized to cater for the needs of future generations. Hence, investing in agriculture using modern technology and tourism should be considered as priorities that can ensure future sustainable development of the country.

Table 3: Sources of Mineral Revenue (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Diamond Dividends</th>
<th>Diamond Royalties</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>77.43</td>
<td>21.62</td>
<td>0.95</td>
</tr>
<tr>
<td>2003</td>
<td>76.50</td>
<td>22.69</td>
<td>0.81</td>
</tr>
<tr>
<td>2004</td>
<td>76.83</td>
<td>22.52</td>
<td>0.65</td>
</tr>
<tr>
<td>2005</td>
<td>80.00</td>
<td>19.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2007/08</td>
<td>77.25</td>
<td>21.18</td>
<td>1.57</td>
</tr>
<tr>
<td>2008/09</td>
<td>78.27</td>
<td>19.54</td>
<td>2.20</td>
</tr>
</tbody>
</table>

Source: Republic of Botswana (various)

**Exports:** With regard to exports of principal commodities produced in Botswana, Figure 5 also reveals that diamonds have dominated the share of the total value of exports since 1980. Diamonds consistently outperformed other sectors, increasing from about 41 percent 1974 to 64 percent in 2008. Government, through the National Development Plans has since emphasized the need for economic diversification. The results have been a marginal decline pattern in the share of diamonds among the principal export commodities for the period 2000-2008, but the diversification was mainly occurring within the mineral sector (Figure 4). Thus, the share of other minerals, including copper/nickel, gold and others, to total exports has been rising. Although mining is an important source of revenue to the Botswana economy, it has very limited trickledown effect as most activities in this sector are capital intensive and mines are not linked to the rest of the economy to generate more indirect employment required to address high unemployment and poverty problems. Thus, despite such observation in marginal declines of the importance of the diamond mining, unemployment remains constant at 17 per cent since the year 2005 (Statistics Botswana, 2011).
Figure 5: Share of Exports of Principal Commodities; 1974-2008

Source: CSO (Atlapedia Online)

**Employment:** The role of the mineral sector in employment creation compared with other economic sectors declined over time at the national level. For instance, in 1980 the mineral sector’s share in total formal employment was about 9 percent in 2007; its share had declined to 4 percent of the total formal employment (CSO, variousb). According to UN (2002) the mineral sector has not been able to “create significant spinoffs in other areas of the economy apart from the public sector” (pp. 5). Table 4 shows employment levels for diamond mines. Employment in the Orapa, Lethakane and Damtshaa mines declined by about 30 percent from 5,232 people in 1998 to 3,647 people in 2004. However, during the same period, employment at Jwaneng mine increased from 2,654 to 3,042 people. Most beneficiaries to new employment opportunities in Jwaneng were locals and this could significantly contribute to eradication of poverty rates in the country.

**Table 4: Diamond Mining Employment Levels; 1998-2004**

<table>
<thead>
<tr>
<th>Year</th>
<th>Orapa, Lethakane &amp; Damtshaa</th>
<th>Jwaneng</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Batswana</td>
<td>Foreigners</td>
</tr>
<tr>
<td>1998</td>
<td>4,412</td>
<td>820</td>
</tr>
<tr>
<td>1999</td>
<td>3,654</td>
<td>575</td>
</tr>
<tr>
<td>2000</td>
<td>2,554</td>
<td>182</td>
</tr>
<tr>
<td>2001</td>
<td>2,694</td>
<td>238</td>
</tr>
<tr>
<td>2002</td>
<td>2,838</td>
<td>246</td>
</tr>
<tr>
<td>2003</td>
<td>2,853</td>
<td>248</td>
</tr>
<tr>
<td>2004</td>
<td>3,441</td>
<td>206</td>
</tr>
</tbody>
</table>

Source: Republic of Botswana (various)
Diamond mining in particular, is highly linked to economic growth and poverty eradication in Botswana. This is because the government uses its dividends and royalties to invest in infrastructure, human capital development and maintenance of social safety nets. It is also a major source of revenue used to maintain public sector jobs. Most poor people in Botswana have indicated that transfers from employed relatives and government remittances are their major sources of income (Moepeng, 2010). Thus, the mineral sector, especially diamonds mining, contributed to the declining malnutrition rates, increasing school enrollments and sustained declining poverty incidence in the country.

Debswana Diamond Company has also made some important contributions towards national development. For instance, in 2001 through its Donations Fund an amount of P2,521,711.78 million was distributed to different sectors, with preference given to the disabled and disadvantaged (Debswana, 2001). Another way was through Peo (Pty) LTD, which was established in 2008 to facilitate the establishment and development of commercially viable enterprises in Botswana. As at 2003 a total of P6.8 million was given to businesses, which generated jobs for over 450 people (Debswana, 2003). Another initiative was through the Masedi Farms established in 1998 to promote a viable agro-industry and small scale farming in Pandamatenga, implying that the company has contributed towards food security. In recent years, Debswana was also involved in sponsoring agricultural shows to promote agricultural extension and education to farmers.

**Copper and Nickel**

Copper-Nickel is the second most important mineral product after diamonds. Most of the production of Copper (Cu) and Nickel (Ni) are from ore bodies that contain other metals such as gold (Au), cobalt (Co), lead (Campbell) and zinc (Zn). Cu-Ni matte is produced at the long established BCL Mine and smelter in Selibe Phikwe. The minerals constituting the Selibe Phikwe Cu-Ni orebodies include chalcopyrite (CuFeS$_2$), bunsenite (NiO), chacocite (CuS), penroseite ((Ni,Cu)Se$_2$) and magnetite (Fe$_3$O$_4$). Cobalt also occurs in most of the minerals (Ekose, 2008). Tati Nickel Mining Company (TNMC) owned by Norilsk Nickel (85%) and Government of Botswana (15%) also exploits Cu-Ni deposits and sends its concentrate for toll-smelting at Selibe Phikwe. Matte produced by the BCL smelter is refined in Norway. Mowana
Copper mine, owned 100 percent by African Copper, mines pure copper. According to BIDPA (2011), NDP estimates indicated that the combined production of copper and nickel from TNMC and BCL ranged between 51,000 tonnes in 2003 and 69,000 tonnes in 2005. Mowana mine restarted shipment of copper concentrates in 2009. The company has also opened a mine at Matsitama (Thakadu mine). Both Mowana and Thakadu mines have a capacity of 1.2 million tonnes of ore per annum.

Figure 6 depicts the trends in total matte production by both BCL Limited and TNMC and trends in production of Cu and Ni for the period 1990 to 2008. Overall, the production of total matte has been steadily increasing over time from 48,000 in 1990 to 62,000 tonnes in 2008 (Department of Mines, 2008). In 2008 the total matte production contained 28,940 tonnes Ni and 23146 tonnes Cu compared to 1990 when total matte production contained 19,022 tonnes Ni and 22,000 tonnes of Cu. The increase in production of Cu and Ni has been due to the increase in global demand for these metals and this is a positive sign for economic growth in Botswana but has serious implications to increasing depletion of the natural resources being mined and increased environmental pollution occurring during the value addition processes at the Selibe Phikwe smelter.

**Figure 6: Trends in total matte production and production of Cu and Ni (tons)**

![Figure 6: Trends in total matte production and production of Cu and Ni (tons)](image)

**Source:** Department of Mines, 2008

**Employment in the Copper-Nickel mines**

Figure 7 depicts trends in total employment by the three Cu and Ni mines of BCL in Selibe Phikwe, TNMC in Francistown and African Copper in Mowana. Overall, employment increased from a total of 5,457 in 1998 to 9,015 in 2008, representing a 65 percent increase in direct
employment created by the expansion of mining copper and nickel mines in Mowana and Thakadu. Of the total number of people directly employed in Cu and Ni mines, Batswana accounted for about 90 percent of total employment in 2008 (Department of Mines, 2008). BCL Limited is the biggest employer followed by TNMC. Mowana started operations in 2007.

**Figure 7: Trends in employment by different mining companies**

![Graph showing employment trends by different mining companies](image)

Source: Department of Mines, 2008

**Corporate Social Responsibility (CSR)**

TNMC has a corporate social responsibility policy programme (CSRP). The corporate social responsibility is relevant for this study as it demonstrate how TNMC is promoting sustainable projects in the communities impacted upon by the mining activities. The primary objective of CSRP is to promote a healthy, well educated and skilled community with enhanced employment and business opportunities. This programme has two main areas of focus, these being the social investment (focusing on provision of education and health services as well as on community development initiatives) and business development (focusing on supporting manufacturing and production related enterprises in order to achieve visible strides towards employment creation). TNMC also aims at assisting mini factories, vegetable production, poultry farming and other agricultural based initiatives in the fifty kilometer radius (Megwe, 2010).

**Number of Students sponsored**

Figure 8 depicts the number of students sponsored by BCL. By sponsoring students, BCL was fulfilling their mandate on CSR to promote a well educated and skilled community. Even though
the numbers of students sponsored have drastically declined over years, BCL has sponsored about 1000 students for degree programme since 2000 to 2008. In addition, BCL started sponsoring students for post graduate degrees (Masters) from 2005. The sponsored students not only acquired skills and higher education, they became competitive in the job market and earn better salaries to enable them to escape poverty and even provide for their family members through remittances.

**Figure 8: BCL Sponsored students**

Source: Megwe (2010)

**Impact on the Environment**

The BCL’s mining section mines the highly sulphide ores. During mining, a vast amount of dust and waste rock are generated, requiring a vast amount of water to be used to suppress the dust and wash the ore. The major waste products produced during the mining of copper and nickel are the unwanted rock or waste rock and waste water produced during the washing of the ore rocks and during suppression of dust (Nelson Mandela Metropolitan University 2010). The waste rocks are then disposed off as waste heaps. After cooling, lime is added to the waste water to raise its low PH and then disposed off into the environment. The waste water is discharged into the Lion’s V-Notch Club along the highly seasonal Mathathane River which is a tributary to Letlhakane River (Nelson Mandela Metropolitan University 2010). This waste water has made the Mathathane, Letlhakane and Motloutse Rivers more susceptible to pollution which has affected agricultural production downstream negatively.

In addition to slag and waste water, dust and smelter smoke are produced during smelting which are released into the atmosphere environment through two stacks and pollutes the air quality. The
dust is produced during the drying of the concentrate before it is charged into the furnace. On the other hand, the smelter smoke which is a waste product from the furnace consists of various gases such as carbon dioxide, carbon monoxide (CO), nitrogen (N), sulphur trioxide (SO₃) and sulphur dioxide (SO₂). The gases are sent to the flash furnace for processing before they are discharged into the atmosphere. The pollution is particularly severe around the mine and smelter, in the village of Mmadinare in the area to the south west of Selibe Phikwe. Of particular concern is the labour force, which experiences a higher level of exposure to environmental hazards due to mining compared to residents within the town. Frequent chest pains, repeated coughing, constant influenza/common cold and persistent headaches were very significantly higher amongst workers (Ekose, 2008). Chest pains have been related to breathing of gaseous fumes and the particulate air matter (PAM) (rich in sulphur and heavy metals) included gases such as SO₂ and to a lesser extent hydrogen sulphide (H₂S) have a choking effect on human beings, affecting their respiratory system (Nelson Mandela Metropolitan University 2010). Table 5 shows the types of stacks that emit gases into the atmosphere.

<table>
<thead>
<tr>
<th>Stack</th>
<th>Height</th>
<th>Emission Rate</th>
<th>SO₂ Concentration</th>
<th>Emission Concentrate SO₂ allowed</th>
<th>Amount of Smoke Dust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Stake</td>
<td>153m</td>
<td>40 normal cubic metres per second</td>
<td>7.7 percent</td>
<td>11 percent</td>
<td>150 milligrams cubic metres</td>
</tr>
<tr>
<td>Electric Arc Furnace</td>
<td>50m</td>
<td>9 normal cubic metres per second</td>
<td>2.3 percent</td>
<td>4 percent</td>
<td>750 milligrams cubic metres</td>
</tr>
<tr>
<td>Spray Drying</td>
<td>72m</td>
<td>46 normal cubic metres per second</td>
<td>0.02 percent</td>
<td>0.03 percent</td>
<td>250 milligrams cubic metres</td>
</tr>
<tr>
<td>Tati Drier</td>
<td>50m</td>
<td>5.8 normal cubic metres per second</td>
<td>0 percent</td>
<td>0 percent</td>
<td>2.5 milligrams cubic metres</td>
</tr>
</tbody>
</table>

Source: Nelson Mandela Metropolitan University (2010)

**Coal**

**Core elements of this natural resource**

Coal mainly consists of carbon atoms that come from plant material from ancient swamp forests. Some of the advantages of coal are that it is relatively cheap, there are large deposits left that are reasonably easy to obtain, and some coal deposits are close to the surface. It is relatively easy to
transport because it is a solid. However, the disadvantage associated with coal mining is that this is a non-renewable resource and will eventually run out. Furthermore, burning coal without first purifying it contributes to global warming, as well as to the production of smog (smoke and fog), which is harmful to health (Environmental Science Activities for the 21st Century 2011).

In Botswana mineral resources have been largely responsible for the transformation of the Botswana economy and for improvements in living standards. Besides diamonds, Botswana holds large reserves of coal. Even though Botswana has large volumes of coal which will take a very long time to deplete, improved efforts for a sustainable management of mineral resources should be priority in the country so that they continue contributing to continued growth and poverty reduction.

Mining coal is associated with the risk of occurrence of sulfides to air and water, atmospheric sulfur oxides and subsequent acid deposition (such as acid rain), contaminated quality of surface and ground water as a result of disposal of the ash and sludge from the burning of coal and cleaning of flue gases (Environmental Science Activities for the 21st Century 2011). These are some of the serious environmental externalities associated with emissions of carbon dioxide (CO₂) and nitrogen oxides (NOₓ), during coal mining processes constituting two of the so-called "greenhouse gases." The greenhouse gas problem requires a broader solution than just reducing the use of coal. Research has been conducted in countries like the U.S. on the reduction and that CO₂ will peak by the year 2020 and at the same time fossil fuels will make up a total one third of the energy sources by 2030 (World Energy Outlook 1999).

Research has suggested new methods to reduce the extent of the threats brought about by mining the coal such as fluidized-bed combustion (FBC) of coal, used for controlling sulfur emissions, and is gaining wide acceptance (Energy Information Administration 2006). In this system, finely ground coal is mixed with finely ground limestone. Both are fed together into a furnace in a constant stream onto a horizontally moving grate. Air is forced up through the grate and the entire mass is ignited at relatively low temperatures. The forced air causes the ground coal and limestone to be mixed with the hot gases of combustion, which in turn promotes the conversion of any SOₓ to gypsum as the burning mass moves along on the grate. The high-sulfur coal may
be burned in this way while simultaneously capturing up to 95 percent of the SO\textsubscript{x} and most of the NO\textsubscript{x} emitted (Energy Information Administration 2006).

**Botswana’s Coal reserves and their location**

According to the 2007 Survey of Energy Resources, Botswana had 40 million tons of proven recoverable coal reserves. But, the country produced only 1 million tonnes of coal in 2005 from the Morupule Mine near Palapye in the eastern part of the country. The quality of coal in these deposits is suitable for power generation (Botswana Survey of Energy Resources, 2007). The Morupule Mine is owned by Debswana and supplies coal to Botswana’s coal fired power station, the Morupule Thermal Power Station, as well as to the mining operations at Selebi Phikwe and to the Sua Pan soda ash plants. Available literature also indicates that there are large untapped reserves in the greater Morupule and Mmamabula coal fields of eastern Botswana. A large deposit of thermal coal was also discovered at Sese in north-eastern Botswana in 2010 [BIDPA, 2011]. According to the African Energy Resources (2010) the Sese project had an initial resource estimate of 2.73 Gt coal in September 2011. Further, Hodges Resources Limited [2011] has identified numerous shallow thick coal seams at its Moiyabana project, where drilling and testing is ongoing. There is also potential for the recovery of natural gas from the coal-bearing sedimentary rocks of the Kalahari and Karoo Basins (MBendi Information Services, 2012).

**Figure 9: Coal Deposits in Botswana**

![Coal Deposits in Botswana](image.png)

Source: BIDPA (2011)
Coal Production and Prospects for Future Coal Mining In Botswana

Figure 10: Coal Production in Botswana: 1997 to 2008

![Bar chart showing coal production in Botswana from 1997 to 2008.]

Source: Department of Minerals (2008)

The Figure 10 above shows that coal production was nearly stable around 900,000 tonnes over years from 1997 to 2008. Botswana coal is exported to Zimbabwe, Zambia and the Democratic Republic of the Congo (BIDPA 2011).

Debswana operated the Morupule Colliery at Palapye. Much of the company’s coal production was sold to the adjacent Morupule Power Station (MPS) of Botswana Power Corp. (BPC). Record coal sales in 2005 were 967,242 t, which was an 8% increase compared with the total in 2004 (Newman 2010).

Current and future investment in coal mining in Botswana is also promising as JSW Energy Ltd. of India offered $414 million for all the shares in CIC Energy Corp., which was developing the Mmamabula coal deposit and power station, and both companies had approved the transaction (Newman 2010). Mmamabula has an estimated resource of 2,800 Mt of coal. The Mmamabula energy project consisted of the development of a 6-Mt/yr mine and the construction of a 1,200-megawatt power plant. All the energy produced was for export (US Geological Survey 2010).
Given the country’s extensive coal resources and the projected regional power demand, additional coal-fueled electricity-generating plants are likely to be constructed to supply power to Botswana and the southern African power pool, and additional coal resources are likely to be developed (Newman 2010). When Mmamabula coal project is implemented, it is expected to improve stability and reliability of power supply, promote productivity and contribute to increased economic growth.

Linkages developed in the country and the spin-offs from coal mining
The Morupule Colliery was expanded in 2010/2011 with the primary purpose to supply coal to the adjacent Botswana Power Corporation B phase 1 power station (600 MW) that was constructed in 2010 and 2011. The power station is required to allow Botswana to become self-sufficient in power generation. The colliery expansion expectation is to see production levels increase from just under 1 million tonnes per annum to 2.8 million tons per annum (Morupule Colliery (Pty) Ltd 2011).

The demand for energy in the southern Africa and other emerging countries like China and India is phenomenal. Coal mining is likely to attract unlimited demand, but Botswana will face competition from many other suppliers including developed countries such as Australia. Given that coal will be exported to overseas markets such as India and China, a railway link to the sea will need to be developed. There are already three options available; being the Durban port, the Namibian port and the Mozambique port. Already Botswana has access to the Durban port, but there are reported problems of congestion which cause delays that increase the costs of transport. In Namibia, Botswana has land which is available for development, but the distance is long which makes the investment very expensive. The last option is the Mozambique sea port which has a short distance. The country has already started exploring this option, and should consider this as an alternative and cheaper investment given most coal is likely to find the market in the east.

The Department of Geological Survey in coal bed methane study (Government of Botswana, 2010) articulates that it is doubtful whether Botswana will have significant CMM emissions in the foreseeable future. This is because there are abundant reserves of coal at relatively shallow
depths and the overall demand for coal in the country is limited. Currently, the prospects for exporting coal are not good, given the distances to available ports in South Africa and limited rail infrastructure. It has to be however noted that, in cooperation with the government of Namibia, Botswana is considering the construction of a $6 billion, 1,500-mile rail link between the Mmamabula Coalfields of southeastern Botswana to either the ports of Walvis Bay or Luderitz in Namibia. There is also a potential route to Ponto Techobanine in Mozambique and the Trans-Kalahari to Walvis Bay. Both routes entail environmental risks. The route to Mozambique is closer (1100km) and it is to the Indian ocean facing Botswana’s potential markets in India and China. The second is the development of national water grid using water from Zambezi. A 90mt/a coal export industry, based on current estimates will require 40Mm$^3$/a of bore water. Over a period of 20-30 years this level of abstraction is of the most doubtful sustainability. Bore water is currently gratis in Botswana and large abstraction activities such as mining needs to be priced to reflect opportunity costs.

**The Impact of Coal mining on poverty eradication and employment creation**

Research shows that there is a close link between efforts towards poverty reduction and the performance of and framework for the mining sector (Sachs and Warner 1997). Policymakers, Economists, and Environmental Economists, might want to consider both opportunities and risks for the poor that will evolve in the context of mining operations so as to design appropriate interventions and frameworks that maximize the positive impact from mining for poverty reduction. The World Bank considers the following points:

i. Potential positive impacts affecting the poor or other vulnerable groups

ii. Potential negative impacts affecting the poor or other vulnerable groups

iii. What countries can do to maximize the benefits of mining for poverty reduction

Coal mining processes are distinguished by whether they operate on the surface or underground. Many coals extracted from both surface and underground mines require washing in a coal preparation plant. Other factors to be considered before a mine can be opened include land use and ownership structure surface drainage patterns and ground water conditions.
Morupule coal mine explicit intention are to maximize the Total Value Proposition for Botswana through maximizing local employment (construction and operations) local spend, local business participation training and skills transfer citizen secondments, project capacity building, creation of new business opportunities, community involvement programs, and enhanced employee value proposition. The expansion of Morupule coal mine has presented huge benefits to Palapye and surrounding villages in terms of jobs, business opportunities and development. Operations readiness manager for the mine, Koolatotse (2010), has told Mmegi Business that the facility has a workforce of 320 people, but after expansion, the number will increase to 500. In addition, the Morupule Coal Mine has maintained a community hall in Palapye with a total expenditure of P2million. Koolatotse (2010) stated that the mine is committed to give priority to locals in employment, especially those with skills and emphasized that for unskilled labour. Additional benefits from the expansion of the coal mining activities will be the development of real estate which will increase jobs in the construction industry, jobs in the service sector, and improved land values in the surrounding areas which has potential to increase economic growth and generate more jobs for the unemployed.

**Gold**

Mupane Gold Mine is the sole producer of gold in Botswana and located in the eastern part of the country. It is 100 percent owned by Toronto-based gold miner IAMGOLD. Mineralization at the Mupane Gold Mine comprised three separate orebodies (Tau, Tholo and Kwena), consisting of zones of intense grey quartz veining and more pervasive silification developed within a suite of variably carbonaceous metapelites, semi pelites and meta-carbonates (Tomkinson and Putland, 2006). Open pit mining commenced at Tau in 2004 and full gold production was achieved in January 2005. The life of the mine was initially expected to end in 2011 due to declining reserves and resources.

Figure 11 depicts trends in gold production in kilograms (Kgs) from 1990 to 2008. During the period 1990 to 2004 there was stagnant growth in gold production. The gold production increased in 2005 after the first full production from the Mupane gold mine. Production declined in 2007 mainly to the effect of global financial crisis of 2008. However, there was a positive sign in 2008 where we experienced an increase in gold production. According to BIDPA (2010), the
mine produced 57,000 ounces of gold in 2010, enabling it to capitalize on gold prices which rose by 25 percent during 2010.

Figure 11: Trends in gold production (KGs)

![Graph showing trends in gold production (KGs)](image)

Source: Department of Mines, 2008

Figure 12 shows trends in total employment by citizenship for the period 2004 to 2008. Clearly the majority of Batswana accounted for the highest share of the total employed, recording 84 percent in 2008 (a decline of 4 percent from 2007). The Figure exhibits an increasing trend till 2007 where we observed a sharp decline. The decline could be attributed to the global financial crisis that impacted negatively on the mineral sector.

Figure 12: Trends in gold production (KGs)

![Graph showing trends in gold production (KGs)](image)

Source: Department of Mines (2008)

**Impact on the Environment**

There are quite a number of environmental issues associated with the Mupane Gold Mine. Since mining activity is conventional open pit mining, it utilizes big machineries such as diesel
hydraulic excavators and caterpillar open pit dump trucks and also the pits require drilling and blasting, which generate a lot of noise for both the community and their livestock. Other significant environmental aspects include the potential for a large spill of cyanide during transportation resulting in water or soil contamination, or harm to the community members. There is also a possibility of localized contamination of groundwater by waste-water produced through the septic and sullage system (Tonkinson and Putland, 2006).

**Soda Ash and Salt**

Soda ash and salt are produced at the Sua Pan project, which was commissioned in 1991. The salt and soda ash are extracted from concentrated brine. The brine reserves are estimated at 16Mm$^3$. Figure 13 depicts trends in production of soda ash and salt for the period 1991 to 2008. In the late nineties, Sua Pan plant operated below capacity, producing 195,000 tonnes per year of soda ash and 214,000 tonnes per year of salt instead of full capacity of 300,000 and 650,000 tonnes per year of soda ash and salt, respectively. This has been due to poor demand for soda ash and salt in Southern Africa (Republic of Botswana, und). However, since 2000, production for both soda ash and salt has been on the increase, reaching 279,085 tonnes (soda ash) and 243,945 tonnes (salt) in 2005 (Figure 13).

*Figure 13: Trends in production of soda ash and salt (tonnes)*

![Graph showing trends in production of soda ash and salt](image)

Source: Department of Mines (2008)

In addition to soda ash, Botswana Ash produces the following waste products; Bitterns; these contain a number of salts. It contains sodium sulphate in quantities that can be exploited economically which can be used to produce salt and other by-products. Bitterns also
contain potassium chloride and sodium carbonate, which can be used as inputs in industrial production (BIDPA 2011). The production of soda ash is also a boost to the upcoming glass plant in the Central Palapye area which is currently under suspension. Once completed, the glass plant will employ 500 or more people directly and indirectly. The mine also gave business to companies that are involved in transportation of goods and services including the Botswana Railways. Trucks are now transporting salt from Sowatown to neighbouring countries such as Zambia and Zimbabwe. The railway line is used to transport soda ash from Sowatown to South Africa and Zimbabwe for processing into glass.

**Employment**

Figure 14 depicts trends in total employment by Botswana Ash. Overall employment in Botswana Ash has been on the decline. Total direct employment increased from 754 in 1998 to 960 in 2000 after which it experienced a decline to 439 in 2008. The decline could be attributed to among other things, the poor demand for soda ash and salt, which resulted in low levels of production and also the 2008 financial crisis might have had an impact on employment levels. However, even though the level of employment has been declining overtime, the mine employs a higher proportion of Batswana, accounting for 96 percent in 2008.

**Impact on Livelihoods**

The mine has impacted at both individual and community level. Currently there are about 605 Botswana Housing Corporation houses of which 504 are leased to Botash for their employees.
There are some economic activities going on in the town including banking and retailing. The mine also participated in improving the lives of the residents by providing them with library, gymnasium and sporting facilities for golf, swimming, tennis and squash and a modern stadium. Furthermore, the town has schools and hospitals to serve the needs of the employees and relatives. Sowatown is also a heaven for most of wildlife and birds.

**Impact on the environment**

Though the mine brings good things with it, it should be accepted that there are some consequences. The mine is located in the breeding place of flamingos and this ultimately means there will be reduction in the number of flamingos due to increased disturbance by the presence of humans and vehicular traffic. Moreover, changes in volumes and chemical compositions of the water and increased presence of predators are other important factors to consider. Destroy in the tourism appeal of the Sowatown due to loss of wilderness quality hence negatively affecting contribution of tourism to GDP. Lead to increased environmental degradation and pressure on natural resources such as fuel wood and water. Lead to increased pollution from soda ash plant by products and waste from the urban centre. Affect the health of the local people and lead to increased incidences of respiratory diseases.
5. Renewable Natural Resources

Key findings: Agriculture & Veld Products

- Arable land accounts for only 0.7% of Botswana’s land and 85% of this area is used for traditional agriculture with yields of some 400kg/ha.

- In 2004 121,000 households practiced traditional agriculture, primarily for own food production. This is a vital component in the livelihood strategy of the poor. Lack of water and labour are the main constraints faced.

- Subsidies from the ARAP and ALDEP programmes and good rains doubled yields between 1983 and 1990 but this was not sustainable and most benefits went to non-poor households. By 2004, yields had fallen back to below the 1983 level.

- ISPAAD was introduced in 2008 as it was recognized that previous interventions had not significantly improved the food security situation in the country. Subsidised ploughing and seeds have proved popular although there has been very limited uptake of fertilizer. The impact of ISPAAD on the poor is yet to be evaluated.

- Increasing the productivity of small-scale arable agriculture does offer the potential for pro-poor growth. Poverty levels in this sector are significantly higher than the average and so increased yields are expected to reduce poverty if these are obtained by poor farmers. It is important to consider whether investments in soil and vegetation conservation, land rehabilitation, water conservation and rain water harvesting and use of drought resistant crop varieties offer an advantage in terms of poverty eradication over traditional support to agriculture.

- It is possible to draw on some evidence from around the region to begin to address this question. In Tanzania, rainwater harvesting (RWH) in semi-arid areas with high levels of evapotranspiration and irregular rainfall has been demonstrated to significantly increase maize, maize/lablab and sorghum yields and to reduce poverty. This RWH does involve additional labour, both to create structures to capture the rain and to undertake additional weeding. In Botswana, unlike Tanzania, on-farm labour for this kind of work is in very short supply and is relatively expensive. Hence in Botswana, new approaches are likely to be needed to tackle the twin limiting factors of water and labour availability. One option the Government might consider piloting is to allow work permits for foreign farm labourers where farmers commit to introducing RWH. We will examine this in more detail at the next stage of this study but note here that the urban rather than rural poor may be more likely to gain as a result (from decreased food prices as supply increases) given the poorest farmers are unlikely to take the risk of contracting labour.

- Horticultural production and yields in Botswana have risen more than 500% since 1998, in part, as more literate farmers have moved into this area. Yet imports have risen even faster in response to rising urban incomes.
• Vegetable selling is dominated by women and there is significant potential for poor women to gain from horticultural production as well. However, experience from Malawi suggests that this was only realized following NGO support over a number of years to build the capacity of low-income female producer groups.

• Up to 3000 veld products are used across Botswana and play an important role in reducing vulnerability and, in some areas, are a source of cash income. For example, in the Makgadikgadi, veld products generate far more income for livelihoods than does arable or livestock agriculture. The value of this production is not recorded in national accounts. There is potential for further commercialization of veld products to benefit low income rural producers but effective governance arrangements need to be place beforehand to avoid over-exploiting and degrading the natural resource.

• Total cattle numbers in Botswana have fluctuated from 2-3 million over the past two decades depending mainly on rainfall. On average 62% of households do not own cattle (an increase from 50% in 1986). Approximately 80% of cattle are held on open-access communal land and 20% on commercial farms. Small stock numbers peaked at 3 million in 1997 but fell back to 2 million in 2004.

• Overall, the contribution of livestock to the national economy declined by some 20% in real terms between 1994 and 2004. Despite very large subsidies, livestock has contributed a declining share of agricultural GDP over time: falling from about 74% in 1994 to 48% in 2009.

• (DEA/CAR, 2007) compare regional herd sizes against potential carrying capacity across village grazing (VGA) and cattle post areas (CPA) and conclude that overgrazing and degradation are mostly local and sometimes regional problems. “Local problems are found in the village grazing areas (VGA) and around boreholes. Regional problems are found in small districts such as North-East and South-East, which do not have space for CPA and where VGA are small and overcrowded” p9. Moreover, they find that the VGA are most important for small herd owners (some 60 000 with an estimated 1 million LSU), but they suffer from the highest grazing pressure (9 ha/ LSU in 2001).

• Although policy interventions such as LWDP give lower rates of subsidy to large herds we have not been able to find specific evidence on the impact this has had on poverty. We do know that cattle ownership rises with income across most of the income range and so policies that subsidise up to half of the private production cost will favour the non-poor.

• Most (58%) of the poorest 17% of households do not own any cattle, but those that do are highly dependent on them for their livelihoods. For poor households that do rely on livestock in areas where overgrazing is a problem, low levels of productivity make it very difficult to use livestock production as a strategy for moving out of poverty. More research is needed if policy makers are to better target this group. However, we do know
that livestock livelihoods of the poor are likely to be particularly vulnerable to climate change: tackling over-grazing will help to improve resilience.

**Key findings: Tourism & Fisheries**

- Tourism in Botswana is overwhelmingly wildlife-based with Chobe and Moremi wildlife parks accounting for 90% of visits.
- The tourism sector has grown strongly in recent years: visitor numbers rose from 1 million in 2000 to 2 million in 2010 and the NDP target is for tourism to increase its current share of GDP from approximately 6% to 9% by 2016. While this is feasible, Botswana needs an effective strategy to win share in the competitive international market.
- Most (54%) of employees in this sector are local women and, as formal qualifications are generally not required, this has provided one route out of poverty for rural households.
- Community-based natural resource management (CBNRM) offers the potential to incentivize good local NR management (as local people profit), ensure a higher proportion of tourism spend goes to the local community and develop local businesses. Where poor members of the community share in this, CBNRM is an effective means of poverty reduction.
- CBNRM has produced some notable success stories generating 8000 jobs and 52.5 million Pula from 2006 to 2009. The case study of Sankuyo illustrates what CBNRM can achieve. However, nationally, the potential of CBNRM for poverty reduction has not been realized. Some 88% of CBRNM revenues have been concentrated in 8 CBOs and nearly 2/3 of revenues have come from trophy hunting which will be lost with the move to photographic tourism. The failure of CBO governance has meant that a small number of Board members rather than poor communities have gained most from CBNRM. This failure results, as research from the Makgadikgadi shows, in local people feeling they have no stake in tourism.
- The evidence from Namibia suggests that there are three categories of CBNRM communities: those that are resource rich (relative to the number of inhabitants), a medium resource/beneficiary and a low resource/beneficiary category. For resource-rich communities CBNRM can provide a route out of poverty but only if there is sustained and significant NGO and Government support over a number of years to build local capacity and if the appropriate legal framework is in place.
- Fisheries has been a somewhat neglected sector: there is no national fisheries policy and it is not included in NDP10. Approximately 19 million Pula/year is spent on imported fish yet only a small fraction Botswana’s fish production is realized. There is potential to
increase sustainable commercial and sport fishing in natural waters as well as increasing the sustainable catch from dams (which can all contribute to poverty eradication).

- One of the constraints to developing this sector is the weak regulatory framework. Currently, some 80% of fish output is from the Okavango aquatic system where there has been a long-running conflict between commercial fishers and recreational fishing promoters. Failure to join up fishing policy across borders allows fishing on the Namibian side of the Chobe river but bans it in Botswana (within the National Park).

- Survey evidence confirms that subsistence fishing provides an important social safety net for many households in the Okavango Delta and that the majority of subsistence fishers are single women heading households. Sustainable development of the fisheries resource will need to take the interests of this stakeholder group into account.

**Key findings: Water, Energy & Waste Management**

- Groundwater supplies two-thirds and surface water one-third of national water consumption.

- Supply has struggled to keep pace with rapidly increasing demand for water (reflecting urbanization, rising real incomes and growing industrial use). Serious water supply shortage problems have emerged in districts such as Goodhope, Kweneng East, Kgalagadi, North West and Okavango sub districts. In addition, water quality (salinity) is a problem in the western district of Kgalagadi.

- Tackling excess demand for water is very costly: SIDA (2008) estimates that inter-basin water transfers and water purchase from neighbouring countries as well as internal recycling of water, and water conservation will add an estimated 300 million Pula to annual water supply costs in Botswana.

- Declining water use in agriculture has been outweighed by increasing use by households (88% of whom now have piped water) and the tourism and mining sectors. A number of conflicts over limited supplies have been documented. For example, groundwater use by the Orapa mine is likely to restrict the groundwater available for local households and livestock in the Makgadikgadi. As water from privately-owned boreholes has no price per unit consumed, users have no incentive to conserve water if they believe there is sufficient supply to meet their needs. This use can impose a cost on society more generally (an “externality”) and government intervention is likely to be required to solve this problem (through market-based instruments or regulation).

- GOB has undertaken to promote re-use of wastewater for agriculture. The approach is to put the available land within close proximity of wastewater generation under irrigation. Crop production using irrigation is also being expanded using fresh water extracted from sand rivers where practicable
• According to (Ketlogetswe et al., 2006), 23% of the urban population and 77% of the rural population rely on fuel wood for cooking; the highest proportion of fuel-wood users being the poorest 20% of households. The average distance for fuel wood collection is 6 km, and the time for collection is about 3.5 hours, constraining particularly women from participating in other activities (SIDA, 2008).

• Waste management will require very significant investment in the coming years. Requirements include trade effluent standards and agreements, licensing water of sewer networks and treatment facilities, proper legislation and monitoring protocols.

• The current waste management experience demonstrates that formal organizations alone cannot deal adequately with the increasing volumes, complexity and diversity of urban wastes. The waste management challenge in Botswana requires sustained waste recycling, re-use and composting programs via a partnership approach with a framework that will clearly outline the responsibilities of all parties involved. This calls for the development of Integrated Waste management Systems in urban centres of Botswana.

Arable Agriculture, Economic Growth and Poverty Eradication

Arable land in Botswana constitutes less than one percent (about 0.7%) of the total land area. Most of the land resource in the country is characterized by semi-arid climate and erratic rainfall. The most practiced arable agriculture in Botswana is rain fed and occurs under two production systems; the traditional and the commercial system. The traditional system dominates crop farming and accounts for 85 percent of total cultivated area and the commercial sector accounts for the remaining 15 percent (Seleka 2005). The traditional system is characterized by the use of low levels of technology and traditional methods of farming and low productivity (TRANSTEC and BIDPA 2010). The commercial sector uses modern agribusiness operations. In general, yields are typically limited to less than 400kg/ha under traditional system and to about 2000kg/ha in commercial system (Ministry of Finance and Development Planning 2008).

Figure 15 depicts trends in total area planted. The total area planted in Botswana shows some association with availability of government programmes that provide draught power support and amount of rainfall. For instance, between 1983 and 1990, the increase in area ploughed as shown in Figure 15 occurred during the implementation of Accelerated Rainfed Arable Programme (ARAP). The area planted rose from about 204,000ha in 1982 to about 409,000ha in 1989,
during the implementation of the first phase of ARAP. The decline was observed immediately after the termination of ARAP between 1990 and 1993. However, the trend increased from 279,000ha in 1993 to about 380,000ha during the second phase of the implementation of ARAP. Due to its termination in 1995/96, trends in area planted continued to decline, recording about 158,000ha in 2004. Thus for the poor, if there are no input subsidies from government, most of the land they are allocated to use lie fallow, with no production taking place even when it is a good rainfall year and such land would not be used to contribute to poverty eradication.

Figure 15: Total Area Planted (ha); 1979-2004

![Graph showing total area planted (ha) from 1979 to 2004.

Source: CSO (Various)

Figures 16 and 17 show trends in area planted in traditional and commercial sector, respectively. They both show similar trends as with the total area planted. Both production systems experienced a decline in area planted during the termination of ARAP.
Agriculture and Poverty Eradication

All Botswana citizens are entitled to apply for free arable land for use anywhere in the country. Traditional arable agriculture is the most practised in rural areas. It is also a safety net for the poor and the less educated who cannot be absorbed in the modern sector. In general, traditional agriculture contributes to food security of the poor households through own production and this often is not recorded in the national accounts. Therefore, while records of sales from this sector suggests that agriculture contribution to household food security is very small, the amount of food consumed from own production and informal sale of other crop output such as melons and relish from beans’ green leaves potentially provides substantial contributions to food availability in poor households.
Previous household income and expenditure studies revealed that poverty in Botswana is more concentrated in rural areas than in urban areas (Central Statistics Office Botswana 1994; 2004; Ministry of Finance and Development Planning 2008). Figure 18 shows trends in traditional agricultural holdings to shed more light on the significance of agriculture as a livelihood source. The figure shows that in 1979 there were 78,000 agricultural holdings operating under the traditional system. Holdings rose to about 131,000 in 1997 and declined to about 121,000 in 2004. The decline is an indication that there may have been some outmigration from the sector. However, there still exist 121,000 households who engage in agriculture to derive part of their livelihoods (Central Statistics Office 2008). This translates to about 555,000 individuals from these agricultural households, and thus agriculture still serves as an important sector that can be used to eradicate poverty by many rural households who engage in it.

Figure 18: Traditional Sector Holdings; 1979-2004

Source: CSO (various)

Arable Agricultural Support Programmes and their Impact on the Environment
Despite its poor performance, rainfed arable agriculture in Botswana has also received tremendous support through a number of public support programmes geared at improving output and productivity growth (Transtec and BIDPA 2010). In the early to mid 1980s, two most significant programmes, Arable Lands Development Programme (ALDEP) and Accelerated Rainfed Arable Programme (ARAP) were introduced to address food insecurity and to promote food self sufficiency. In 2008, Integrated Support Programme for Arable Agriculture Development (ISPAAD) was introduced to replace ALDEP III (third phase) to improve performance of the arable agriculture through the operation of the Agricultural Services Centres
(ASCs). The National Master Plan for Arable Agriculture and Dairy Development (NAMPAADD) was introduced in 2002, as a programme to commercialize rainfed arable agriculture, irrigated agriculture and dairy (Republic of Botswana 2002). This section provides a detailed discussion of the agricultural support programmes and their impact on the environment.

**Arable Lands Development Programme (ALDEP)**
ALDEP (1981-2008) was targeted at resource poor farmers. The programme provided beneficiaries with input (seeds and fertilizer), animal draught power (donkeys, mules and oxen) and animal drawn implements (ploughs, planters, cultivators and harrows). The programme also emphasized on strengthening of agricultural extension system and technology transfer on the second and third phases (Seleka 1999; Parida and Moalafhi 2008; TRANSTEC and BIDPA 2010). Free fencing materials were provided to the farmers without any proper survey and alignment of fields. Hence, fencing by individuals often resulted in the mismatch of fences making through-access problematic (TRANSTEC and BIDPA 2010). Provision of inputs through this programme to small holder farmers had not changed overall production significantly owing to observed trends that the productivity in rainfed agriculture is associated with the amount and spread of rainfall in a year. The fencing of fields impedes wildlife movement and can often lead to serious environmental perturbations in those areas left outside the enclosures. Another environmental challenge resulted from land clearance, tree felling and destumping resulting from land preparation for crop production which could lead to soil erosion and the loss of biodiversity, especially when land is left fallow.

**Accelerated Rainfed Arable Programme (ARAP)**
ARAP was a blanket coverage programme that provided grants for ploughing, row planting, destumping, weeding and inputs (seed and fertilizer), during the period from 1985/86 to 1989/90 and 1992/93 to 1995/96. The programme was intended to demonstrate the use of improved technologies and, hence, promote sustainable technology adoption and productivity growth in the subsector. ARAP led to an increase in cultivated area, output and yields, which rose by 27, 120 and 74 percent, respectively (Seleka 1999). When the programme was ultimately terminated, farmers disengaged from rainfed arable farming, signifying that ARAP had not yielded sustainable technology adoption and productivity growth. Among other factors that led to failure
of the ARAP was poor targeting, where blanket targeting system allowed many people who were not keen and regular farmers to benefit, and some of these did not take care of their fields once they had received the subsidy. The other factor that is associated with the failure of ARAP is a regular recurrence of drought which contributed to crop failure in many years. Finally, another major problem in arable agriculture is lack of labour in rural Botswana as many able bodied tend to be absorbed in the modern sector. The programme is also thought to have benefitted tractor owners more as it led to a switch from the use of animal draught power to tractors.

Studies on ARAP have revealed major adverse effects on the environment and productivity incentives. Land clearance for crop production is viewed as a contributory factor to greenhouse gas emission (Republic of Botswana 2002). Farmers’ developed a dependency syndrome that for them to plough, government was expected to pay for all the inputs including requests for government to pay for maintenance of fields such as weeding. Overtime, such expectation led to a large amount of area planted falling after the closure of the ARAP (Figure 15). As with ALDEP, preparation of land for crop production which involves land clearance, tree felling and destumping may lead to the loss of biodiversity. The same study found that when natural vegetation is lost to cropland, the carbon content of the soil declines over a period of time and eventually lost from the soil as carbon dioxide (CO$_2$).

**Integrated Support Programme for Arable Agriculture Development (ISPAAD)**

ISPAAD was introduced in 2008. The primary objectives of this programme are; to promote food security at household and national levels through increased grain production, to commercialize rainfed arable agriculture through mechanization, access to farm inputs, credit and improved extension approach (TRANSTEC and BIDPA 2010). The programme provides several components including cluster fencing of arable fields at village or community level, provision of portable water at cluster level (borehole drilling and equipping), free inputs (food-grain seeds, fertilizer and ploughing/planting grant) for limited acreage. This programme is also based on blanket coverage targeting with a maximum support of 5ha for free seed and draught power support to each farmer for ploughing and planting purposes.

ISPAAD has been well received by farmers (Figure 19) and the ploughing component was the most utilized with about 96,000 beneficiaries, followed by seed distribution with about 78,000
beneficiaries. This has contributed to increased production especially that during its implementation, all the years between 2008 and 2010 ploughing seasons were non-drought. However, some concerns were raised by farmers that are thought to have contributed to inadequate effectiveness of this programme. These include lack of adequate tractors and crowding out of the private sector with promises of supply of government owned tractors. Even when tractors were available, there were unconfirmed reports of inadequately trained tractor drivers, and lack of appropriate tools to facilitate the implementation of row planting technology. Thus, the fertilizer component was not widely utilized with only about 8,000 beneficiaries.

Figure 19: Number of ISPAAD Beneficiaries

![Number of ISPAAD Beneficiaries](image)

Source: MoA (2010)

As seen from Figure 20, the majority of the fertilizer beneficiaries came from the Southern district (78%) followed by Kweneng (5.5%), Central (5.4%) and Kgatleng (3.2%) districts, respectively. With regard to its impact on the environment, the use of chemical fertilizers under ISPAAD may have adverse environmental impacts. As with ARAP and ALDEP, land clearance in preparation for cultivation may result in the loss of biodiversity, reduced productivity of the land, reduced output per unit of land and reduced own production outputs and opportunities for income from sale of surplus.

Figure 20: Share of ISPAAD Beneficiaries by Districts
**National Master Plan for Arable Agriculture and Dairy Development (NAMPAADD)**

This programme was introduced in 2002 to commercialize rainfed arable agriculture, irrigated agriculture and dairy (Ministry of Agriculture 2002). In field crop production, the plan was to promote the adoption of mechanized farming and improved farm management practices emphasizing on commercialization of the traditional crop production, development and operation of large-scale commercial farms and service centres by the private sector to provide inputs and advisory/extension services (Ministry of Agriculture 2002; TRANSTEC and BIDPA 2010). NAMPAADD has a cluster model approach, which is seen to enhance productivity through input procurement, production scheduling and marketing. The second phase (Phase II) of programme was to establish the Production Training Farms (PTFs) to share better technologies with farmers. Three PTFs have been established; for horticulture dairy and rainfed arable agriculture. The rainfed PTF at Ramatlabama performed above target for all the crops (sorghum, maize, sunflower, wheat), except for maize silage which was below the target. The increase in yields was attributed to the application of the recommended technologies (Ministry of Agriculture 2010).

However, the horticultural PTFs did not do well because of unfavorable climatic conditions like frost and pest infestations, and failure to adequately adopt recommended technologies (Ministry of Agriculture 2009). NAMPAADD is now in the third phase (Phase III), (last three years) of the 10 years of the implementation plan. Phase III embraces rolling out technologies by local staff, continued operation of the PTFs and extension support targeting 215 commercial farmers (100 Rainfed, 100 Horticulture and 15 Dairy (Ministry of Agriculture 2010). The rainfed section currently has 72 farmers (out of the 100 targeted) who cultivated 61,294 hectares in 2008/09 cropping season. The targeted average grain yield for maize was met while the sorghum yield
was not met. The increase in yield was attributed to the adoption of NAMPAADD recommended technologies by farmers (Ministry of Agriculture 2010). In Horticulture commercial farmer program, 55 farmers out of the targeted 100 farmers worked with NAMPAADD. Of the crops produced under horticulture, tomatoes under the net shade had the highest average yield (above the target) compared to the tomatoes on the open field. The low yield of crops on the open field was due to frost damage and poor management practices by farmers. The environmental impacts of NAMPAADD result from irrigation under the horticultural sector. These include, among others, water pollution from nutrients and pesticides and salination of ground water sources. Other environmental impacts of NAMPAAD include the loss of biodiversity and soil erosion which can lead to unsustainable use of the arable land resource and result in increased loss of production and poverty, once this programme can not increase employment opportunities in this sector.

**Arable Agricultural Sector Output and Poverty Eradication in Botswana**

Programmes supporting the agricultural sector aim to increase output and productivity which is critical to contributing to GDP and increasing economic growth and ensuring national food security which is required to eradicate the worst form of poverty; hunger. Figure 21 shows trends in cereal output measured in metric tonnes in both the traditional and commercial systems. The cereal requirement in Botswana has remained constant since 1979 as shown by the black and white bars in Figure 7. Generally, cereal output has hardly reached 50 per cent of the national cereal requirement since 1998. The cereal output also reveals fluctuating trends most likely due to the varying rainfall amounts over the years. Despite continued importance of arable agriculture, the support for this sector to date has not produced notable returns that have promoted economic diversification, economic growth and poverty eradication (Moepeng 2010). Despite this history, increasing the productivity of small-scale agriculture does offer the potential for pro-poor growth. Poverty levels in this sector are significantly higher than the average and so increased yields are expected to reduce poverty if these are obtained by poor farmers. It is therefore important to consider whether investments in soil and vegetation conservation, land rehabilitation, water conservation and rain water harvesting and use of drought resistant crop varieties; as well as a policy encouraging sustainable carrying capacity of land for livestock offer an advantage in terms of poverty eradication over traditional support to agriculture. Figure 21
demonstrates that traditional support in agriculture over the last 30 years has not improved production to levels near 50 percent of the national cereal requirements, even during most of the years when ARAP was implemented in the 1980s.

Figure 21: Trends in Cereal Production relative to Cereal Requirements in Botswana 1979 – 2006

Source: CSO and Early Warning Technical Committee Reports (Various)

**Horticulture**

The data on horticultural production in Botswana is very scanty. However, data from MoA indicates that horticultural production rose dramatically from 1997/98 to 2007/08 (Figure 22). Production increased by more than five-fold during this period, suggesting that a lot of progress has been made to increase output growth, as a result of rapid urbanization that could have influenced increased demand for horticulture, increased health awareness and demand for vegetables consumption, increased human capital and investors in horticulture production, improved road infrastructure, and improved marketing infrastructure. Horticultural yields have also grown remarkably over the same period, increasing by more than five-fold (Figure 23). The increase was from 6.5mt/ha in 1997/98 to 35mt/ha in 2007/08 However, due to unlimited data the analysis by spatial distribution could not be done to identify the source of productivity growth.

Figure 22: Horticultural Production (mt)
Trade Balance in Horticulture vs Economic Growth and Poverty Eradication.
Trade balance shows the difference between the amount of imports and exports of a particular commodity for a specific period using the same currency. The trade balance for horticulture in Botswana has been negative for some time and indicates that despite increasing local production, imports have risen even faster (Figure 24). This is likely to reflect rapidly rising urban incomes.

Figure 24: Trends in Trade Balance for Horticulture in Botswana 2003 -2010
Some of these imports service the informal sector business in catering and women in towns and urban villages who sell horticulture products whilst fresh. Availability of horticulture imports in the country influences the supply side and therefore has helped to stabilize prices and access for the poor. In addition, since many poor women are involved in the sale of horticulture in the informal markets, horticulture imports are an important source of cash income for poor households. There may as well be an opportunity for small-scale vegetable production by the peri-urban poor to meet the burgeoning demand for vegetables. Indeed, a recent study in Malawi identified low-income women as benefiting from urban agriculture (through insurance against income losses and supporting their livestock farming) but noted the key initial role of NGOs in promoting this activity (Mkwambisi, Fraser et al. 2010)

**Risks in arable agriculture and the Environment in Botswana**

The major issues associated with the environmental impacts of agricultural activity are related to competition of land resources, displacement of biotic community, and the release of chemical pollutants into the environment. This section gives a brief discussion of the environmental impacts of arable production. The major impacts of arable crop production are related to among others; recurring droughts, soil erosion, pollution by pesticides and loss of organic matter leading to poor structure. Land clearing in preparation for cultivation may result in the loss of biodiversity as a result of the intensification of arable farming. Another factor that may harm the environment is the emission of the greengases (NO₂ and CO₂). In case of irrigated agriculture like horticulture, the use of chemicals like nitrates and phosphates may results in the
eutrophication of water bodies by such nutrients especially phosphate. This is compounded by the fact that there is minimal regular monitoring of the agro-chemicals used in such projects and the extent to which it affects the immediate environment including dams (TRANSTEC and BIDPA 2010). The environmental pollution may also occur where irrigation process are situated next to the rivers or streams. In Botswana there are cases of dugout wells found along the ephemeral streams in eastern Botswana along the Shashe and Motloutse rivers (TRANSTEC and BIDPA 2010).

Veld Products

Population of Selected Veld Products by Type, Location and Use

Veld products, which include many different indigenous fruit trees, play an important role for sustaining livelihoods and income of the poor in many countries including in Botswana. In southern Africa, veld products are widely used in rural areas as a source of food and nutritional security, especially in times of drought and food shortage (Tibe, Modise et al. 2008). In Botswana, problems of low rainfall amounts and poor distribution over the ploughing and planting season are known to encourage the use of veld products among the rural poor as a major source of livelihood, as a food and nutritious supplement and markets goods that are harvested and sold in various informal and formal sector markets.

In Botswana, there are over 2300 to 3000 species of veld products that are available in different regions of the country (Motlhanka 2008). Some of the most popular veld products that are used for livelihoods purposes include mophane (Mopane Research Group) tree and phane caterpillar, morama (esculentum), sengaparile (procumbens), mosukujane (javanica), mokolwane (petersiana), morula, moretwa/mogwana and maragoabahumagadi (grewia species), mogwagwa (strychnos), etc.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Veld Resource</th>
<th>Use of the veld Product</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mophane tree</td>
<td>Ambrosia</td>
<td>Fuel wood</td>
<td>Overharvesting for commercial</td>
</tr>
</tbody>
</table>

6 This is a process where water bodies receive excess nutrients that stimulate excessive plant growth.
### Various Uses of Some Popular Veld Products and their Market Opportunities.

Table 6 above displays a summary of some of the popular veld products in Botswana by their uses, and environmental threats. Most veld products are used as food such as phane caterpillar, source of energy such as mophane tree. In Botswana, the mophane tree is found in the central, northeast and Ngamiland districts. Mophane tree leaves are used to host and as fodder for the phane caterpillar. Currently, the phane caterpillar (Gonimbrasia belina) is harvested, mostly by women, when it is in season during the December period or fist rains and the second time around May. Phane caterpillar is a popular food source in most of the southern Africa region including in the Democratic Republic of Congo (DRC), Zimbabwe, Botswana and South Africa. It is also used as an important source of nutritional feed for cattle. The market for the phane caterpillar in Botswana and neighbouring countries is nearly unlimited as it is also used as a delicacy in some restaurants. The mophane tree is used widely as an input for building materials and a good quality source of energy (Nsinamwa, et al 2005). It is an ideal input as fencing poles. As fuel wood, it produces very small smoke and liked by many users for good quality fire output. In Botswana, mophane fuel wood is harvested for sale especially for market that include government schools, bereaved families that used it in night vigils before burials, and other ceremonies such as marriages and government functions by different institutions.

Some veld products such as sengaparile (Procumbens or devil’s claw) is found in the sand veld of Botswana, especially in the Kalahari region. These products are harvested for their medicinal properties that are useful in different ailments. This plant has been very important for sustenance of livelihoods of people who were far from modern health facilities. In Botswana, Thusano Lefatsheng (a non-governmental organisation) has promoted the marketing of raw sengaparile.

<table>
<thead>
<tr>
<th></th>
<th>Phane caterpillar</th>
<th>Food</th>
<th>Extinction if regulation is weak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moretwa/mogwana</td>
<td>Grewia flavescens</td>
<td>Fruits /medicine</td>
<td>Overharvesting</td>
</tr>
<tr>
<td>Sengaparile</td>
<td>Procumbens</td>
<td>Medicine</td>
<td>Lack of patent</td>
</tr>
<tr>
<td>Mosukujane</td>
<td>Javanica</td>
<td>Herbal Tea</td>
<td>Regeneration</td>
</tr>
<tr>
<td>Mokolwane</td>
<td>Petersiana</td>
<td>Fibre, food and medicine</td>
<td>Overharvesting</td>
</tr>
</tbody>
</table>

Source: Mogotsi and Ngwako 2011.
and semi-processed forms (Mogotsi, Balole, et al, 2008). Most of the sengaparile harvested for the international market in Botswana is dried and exported to Germany and France for processing and re-export to the USA. The market product is of high value and if it is commercially produced can contribute high quality employment and income to people living in rural areas as farmers, harvesters and workers in processing plants.

Mokolwane (hyphaenea petersiana) plant is found in the Central, North West and Chobe Districts. It is used as fiber input for basket weaving, wine production, construction of shades and as a source of fruits. Mokolwane is a major natural resource input to the weaving basket sector which is popular in the tourist areas of Botswana. It is a major source of livelihood for the poor, especially the women in remote and wildlife populated areas. In the Okavango for instance, women weave baskets using mokolwane and sell their products in curio shops located in hotels and lodges. The market for the basket is very wide and currently these baskets are displayed and sold in the different embassies and high commissions of Botswana across the world. The contribution of this natural resource is not fully recorded in the national accounts statistics.

However, some women who were contacted in remote areas such as Sankuyo in the Okavango Delta have indicated that it was one of their major sources of livelihood. However, there are no known efforts to regenerate mokolwane in large amounts to promote large scale production of these baskets for the world markets. If this veld product can be mined extensively to supply a growing market, this veld product can become extinct, unless regulations are put in place to harvest it sustainably and that efforts are made to undertake research and ensure that this plant is grown and made available to those who need it at a cost.

Morula plant is found in eastern Botswana and it is a medium to large deciduous tree with an erect trunk and spreading, rounded crown, occurring in bushveld and woodland (Mothanka 2008). The fruit is fleshy, round and yellow when ripe after falling to the ground and is rich in Vitamin C. The morula fruit and juice provides about 2 mg of Vitamin C per gram of fresh juice, which is approximately four times the Vitamin C content of the average orange juice (Shackleton 2001) It has a nut inside its kernels which is rich in oil and proteins. The morula plant produces fruits which are eaten fresh when ripe or mixed with milk and contribute to the food security of
households that are poor. The morula seeds can be removed from the fruits and a seedless pulp (ditsheru) can be sun-dried and the dry mash eaten in winter and contribute to food availability in households. Morula fruit is also used as preparation formula Jam and produces tasty brown jam. It is also used to make popular alcoholic morula beer and a completely commercial morula liquor is known as amarula (Motlhanka 2008).

**Commercialization of Veld Products and Unsustainable Use**

There are obvious and demonstrable evidence along the highway roads of Botswana and many places where the informal sector are dominant that commercialization of veld products directly provides income to the poor members of society, especially women. In addition, some large scale trials have been tested by the NGO community such as Thusanyo Lefatsheng with grapple plant, Veld Product Research and others. However, some have also observed that there are many potential risks and dangers in the commercial exploitation of NTFPs. For instance, Rossiter, Pellegrin et al (2004) have identified that commercialization of veld products is associated with overexploitation of these natural resources, and that within a relatively short time, the resource is either wiped out or placed under severe pressure. The experience of a very successful basket industry in Ngamiland, Botswana, is known to have threatened the palm *Hyphaene benguellensis* var. *ventricosa* (Kirk) Furtado, and the woodcarving industry in eastern Africa has all but wiped out the black hardwoods.

The market demand often put pressure on gatherers put themselves at risk, by exploiting the natural resource on which they are dependent through un-sustainable exploitation to maximize returns and this has potential to destroy natural resources and leave the most needy people worse off than ever before, unless it is carefully controlled (Taylor, Mateke et al. 2011). In addition, most commercialization of veld products often take place in midst of ignorance of the resource base, its size and its characteristics; ignorance of the rural people, their needs and aspirations and their traditional natural resource management practices; and, finally, ignorance of the market forces

**Livestock Production**
This section is divided into four subsections. The first subsection discusses production by showing the trends in livestock population over time. In the second subsection, we present a discussion on the effect of livestock production on economic growth. The third and fourth subsections discuss the effect of livestock on the environment and on poverty eradication respectively.

Livestock Population, economic growth and environment degradation

Livestock (cattle, small stock, piggery, and poultry) production in Botswana is done under two systems; communal (traditional) and commercial. The communal system is dominated by open access property system where communal water resources are used, but in areas where private water rights used, control of grazing is linked to access to water rights. Open access system that is practiced in communal grazing lands often result in conditions similar to those explained by the “tragedy of commons” phenomenon (Moepeng 2010). Commercial production system in livestock is also known as ranching, where farmers possess some rights over the utilization of range resources and are allowed to fence their allocated ranches. According to TRANSTEC & BIDPA (2010), ranching accounts for about 13 percent to the total land use. Of these, freehold farms and TGLP ranches account for about 3 percent each while the fencing component ranches and leasehold farms account for about 4 and 2 percent respectively. Figure 24 shows the trend in the number of cattle in Botswana by production system for the period from 1979 to 2004. Cattle population trends have been stable over time in Botswana, with reported fluctuations associated with the occurrence of drought. The traditional subsector has consistently had larger number of cattle than the commercial subsector, accounting for more than 80 percent during the period being reviewed. Cattle population under the commercial sub-sector was consistently lower than 500,000 cattle.

Figure 25: Cattle Population by Production System; 1979-2004
Source: CSO (Agricultural Statistics): various

Small Stock

The total number of goats and sheep experienced a consistent rise from 1979 to 1997 with the exception of 1993 and 1995, which saw a decline in population (Figure 25). However, the period from 1998 to 2004 experienced a consistent decline. The traditional sub-sector holds higher small stock population than that of its commercial counterpart.

Figure 26: Small stock population; 1979-2004
Piggery

Figure 27 shows the trend in pig population for the period 1979-2004. Pig population decreased from 6 thousand in 1979 to 5 thousand during 1981 to 1983. This was followed by a continuous population rise to about 16 thousand pigs in 1990 as a result of support from the FAP programme, which was introduced in 1982 (TRANSTEC and BIDPA 2010). However, a drastic decline was experienced from 1990 to one thousand pigs in 1993 representing a decline of about 94 percent. One of the major reasons was a result of lack of slaughter facilities and problems of marketing arising primarily from non-tariff barriers from local market outlets that were linked to vertical market structures associated with the dominant South African Chain Stores (Moepeng 2003). The population has since 1993, been lower than 6 thousand pigs. Most of the pig population are raised in the communal tenure system. Until 2004, the communal system was home to about 85 percent and this implies that agriculture support under the FAP was not targeting commercialization of pig production.

Source: CSO (Agricultural Statistics): various
Poultry (Chicken Population)

Poultry population in Botswana has grown tremendously and the country is currently self-sufficient in poultry. A major concern is that poultry ownership is concentrated among the few poultry farms which might not even be 10 companies. As a result, the poultry sector is highly capital intensive, and largely found around the urban areas and not a rural concept. The primary benefit of the poultry industry is its reduction of the trade balance, employment of women in rural urban villages and cities. But most of the inputs in the poultry industry are imported from outside. Botswana could use lessons from the poultry industry to replicate the achievements made by the few companies involved to rural settings, establish appropriate marketing structures and target the poor to benefit more from this sector.

Livestock Production and Economic Growth

To assess the role of livestock production in economic growth, Figure 28 presents value added for livestock, crops and other to agricultural gross domestic product. Livestock production outperformed other subsectors in value added in all the years. However, the share of livestock value added also declined over time, from about 74 percent in 1994 to 48 percent in 2009 and crops gained share over time (Figure 28).

Livestock activities here include the sales of cattle and net increase in livestock, crop activities include the sales of traditional crops while “other” includes hunting, fishing, forestry, poultry and horticulture.
Livestock Production and the Environment

According to TRANSTEC & BIDPA (2010), livestock production in Botswana brings challenges on the environment including disposal of dead animals, rangeland degradation, the use of pesticides and pressure on water resources. During a disease outbreak period government may decide to kill all animals affected by a disease with the view to control the spread of such a disease. A case in point is what happened during an outbreak of Contagious Bovine Pleuropneumonia (CBPP) in 1996 in Ngamiland region and Foot and Mouth Disease in Ghanzi in 2009. During those periods the culled animals were buried, which posed a health hazard as it may result in pollution of underground water (TRANSTEC and BIDPA 2010).

According to Abel (1993) rangeland degradation is “an effectively permanent decline in the rate the land yields livestock products under a given system of management”. Rangeland degradation result in productivity loss through weight loss and mortality, which attracts less income for farmers when they market their animals to outlets such as the Botswana Meat commission. When it happens for prolonged periods of time, farmers stock depletes and is not replaceable from own production and this can eventually lead to asset loss and poverty to those who depend on livestock for livelihoods. Overgrazing accounted for 45 percent in 1990-1999 and 25 percent in 2000-2003 to total land degradation (Republic of Botswana, 2004). Overgrazing is likely to be more prevalent under the traditional production system where there is uncontrolled grazing and hence higher possibilities of over stocking. The Botswana government established Tribal Grazing Land Policy (TGLP) in 1975 to address land degradation and when it was reviewed, results revealed that the objectives were not met (Frimpong 1995). In some cases, commercial
farmers practiced dual grazing (Frimpong 1995). Therefore, communal areas continued to be over grazed rendering the policy ineffective. Such was as a result of the policy lacking the mechanism for compliance.

As part of management practice, farmers acquire pesticides to control animal diseases and ticks. While this is good for livestock management there appears to be no mechanisms to ensure a proper disposal of empty containers and expired vaccines to minimise environmental pollution. Although cattle population was characterized by cyclical trends, an increase in population implies additional water resource utilization. The boreholes are owned by farmers either as individuals or syndicates and can result in increased utilization of underground water during periods when there are no rains.

**Livestock Production and Poverty Eradication**

The Botswana government has introduced programmes to enhance the performance of the livestock subsector including its role in poverty eradication. Such programmes include the Services for Livestock Owners at Communal Areas (SLOCA), Livestock Water Development Programme, and Livestock Management Infrastructure Development Project (LIMID) and Citizen Entrepreneurial Development Agency (CEDA). Services for Livestock Owners at Communal Areas (SLOCA) was introduced in the 1970’s to enhance productivity at farm level in communal areas. A review of the programme conducted by BIDPA to assess the cost and benefits of SLOCA found that about 93 percent of respondents felt that the programme was beneficial to them (BIDPA, 2006b). However, only 4 percent said it improved their standard of living.

Livestock Water Development Programme (LWDP) was introduced in 1980s to provide grants to farmers to purchase water supply facilities. Targeting was based on herd size ownership. Farmers with herd size of 61-200 were given 60 percent grants while those with 201-250 cattle received 40 percent grants subsidy for drilling purposes (Seleka 2004). Livestock Management and Infrastructure Development (LIMID) was introduced following the termination of SLOCA and LWDP (TRANSTEC and BIPDA, 2010). This programme aimed to (i) promote improved food security through increased livestock productivity, (Cornia, Addison et al.) improve livestock
management practices, and enhance sustainable utilization and conservation of ranges. TRANSTEC and BIDPA (2010), argue that the introduction of LIMID emphasized that poverty eradication objectives should inform targeted support programmes for livestock producers in Botswana instead of near blanket coverage programmes that are in operation. The project`s major components are (1) support for animal husbandry and fodder production, (2) borehole drilling and well equipping, (3) support for reticulation and purchase of boreholes and wells, (4) support for the development of cooperative poultry abattoirs (5) support for guinea fowl production and (6) support for Tswana chickens and small stock production.

Citizen Entrepreneurial Development Agency (CEDA) offers grants at subsidized rates depending on the scale of the project. Government introduced CEDA Young Farmers Fund in 2004, to increase youth participation in agriculture and address youth unemployment to pursue poverty eradication objectives. In Botswana, poverty is highly associated with unemployment. In 2008/09 horticulture accounted for 30 percent of total funding followed by cattle breeding (24%), poultry (17%) and smallstock (14%) (CEDA 2009). Further indications are that these projects were able to generate employment for 378 individuals or 54 percent employment rate. This suggests that the programme may have some potential for poverty eradication.

**Tourism Sector**

Botswana is endowed with diverse and abundant wildlife and natural resources such as the Okavango Delta and Chobe River Plains in the north, to the Kgalagadi Desert in the south, as well as the flaval diversity of vegetation. According to BIDPA and World Bank (2006), the diversity in Botswana’s wildlife and natural resources provides the country with comparative advantage in the tourism sector. Thus, tourism as a major potential sector in the country can bring about shared economic growth and thus hasten the diversification of the economy. It should be noted however, that wildlife based tourism also has strong competitors in the countries sharing borders with Botswana, such as Zambia, Zimbabwe, Namibia and South Africa; as well as additional competitors in Southern Africa. The share of tourism in GDP has consistently increased overtime (Department of Tourism, 1999), and in 2010, it (Ministry of Environment Wildlife and Tourism) contributed about 5 per cent to the GDP of Botswana. It is now the third
most important source of government revenue in the country after minerals and customs and exercise sectors.

Since the growth of Botswana’s economy is driven by mining, in particular, diamond mining, the levelling out of diamond production, has made the need to diversify the economy more urgent. The 2009 tourism statistics estimates indicated that in 2004/05, the tourism direct gross value added as a percentage of GDP stood at 3.4 per cent. The tourism sector’s share in GDP suggests that tourism already makes a significant contribution to the growth and economic diversification of the Botswana economy. Moreover, the employment intensity in tourism sector is relatively high compared to mining and so total direct employment in tourism is higher than that of mining. The BIDPA and World Bank (2006) study suggested that Botswana can still sustain its national wilderness areas and at the same time, increase visitor numbers. This implies that there is potential to invest in the tourism sector and increase the sector’s contribution to the diversification and growth of the Botswana economy.

**Wildlife and Parks**

There are numerous wildlife and game reserves throughout Botswana which are its primary source of revenue from tourism. In the western part of the country there is the Kgalagadi National Park, Mashatu Game Reserve in the east, and the well known Chobe National Park and Okavango Delta Region in the north, with the Central Kalahari Game Reserve in the center of the country. The wildlife parks and reserves in Botswana are protected areas that constitute 17 percent of total land and are central to the tourism activity in the country (See Figure 29 below).

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8 Based on African Economic Outlook 2011 and IPC and BIDPA (2005), Bank of Botswana 2010.
There are two main types of tourism in Botswana; environmental tourism and to a lesser extent, cultural tourism. Environmental tourism consists of visits by people who wish to view geographical features and wildlife while the cultural tourism includes visits to ‘exotic peoples’ communities’ in order to see the traditional activities and customs. Cultural, archaeological and historical attractions do not play a significant role in the current tourism product. Although there are a number of such sites in Botswana, it is felt that they are not in themselves sufficiently attractive to motivate tourists to visit Botswana for this reason alone Department of Tourism (Department of Tourism 2011).

However, these sites can be used to add value and lengthen the average duration of stay to the existing ‘mainstream’ wildlife vacations. In addition, some sites and features could become the basis for special interest tours. With the intention of ensuring that tourism development is spread as widely as possible throughout the country, tourism offices were opened in Selebi Phikwe,
Tsabong, Francistown and Ghanzi, (Ministry of Finance and Development Planning 2003). Moreover, the target of NDP 10 is to increase the tourism sector’s contribution to GDP from 6% to 9% by 2016 (Ministry of Finance and Development Planning 2009). This suggests how important the tourism sector is to Botswana.

**Wildlife population of Significance by Type, Location/region and Use**

There is a unique feature of a reserve in Botswana, the Khama Rhino Sanctuary which was established in 1992 under the patronage of the Paramount Chief of the Bamangwato Lt. General Ian Khama to preserve the populations of both white and black rhinos in Botswana. It is located 25 km north of Serowe and is protected by members of the Botswana Defence Force and is managed by a team of conservationists. Further, the Mokolodi Nature Reserve, established in 1994 and managed by the Mokolodi Wildlife Foundation, is a small park only 10 kilometers from Gaborone. It is one of the few privately run reserves in Botswana and is home to a very diverse fauna, including cheetah, giraffe, zebra, red hartebeest, sable, elephant, kudu, impala, hyena, leopard, and the endangered white rhino. The reserve features an elephant walk that allows guests to walk literally with the elephants for several hours at a time.9

The Mashatu Game Reserve is the largest private reserve in southern Africa, and it is home to the largest elephant population on the planet (almost 900). It is geographically diverse, including savannah, wetland forests, marshes, and outcroppings of sandstone. Game rangers provide guests with their expertise on the area and oversee all excursions. On the other hand, the Central Kalahari Game Reserve, established in 1961, is the second largest game reserve in the world, spreading over 52,800 square km. The park is populated, in addition to its diverse animal life, by several tribes of Bushmen, known locally as Basarwa or San.

The popular Okavango Delta is one of the world’s largest inland water systems, starting in Angola, coursing through Namibia, and finally drying up in Botswana. During the high volume

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season, the delta can cover over 16,000 square km, while it shrinks to less than 9,000 square km during the low volume season. Safaris here are most popular by water; with tourists traveling in a dugout canoe poled across the water by a native guide. Travel here is very expensive due to government intervention in the region in an effort to deter “budget travellers” and protect the fragile ecosystem. This is the result of the government strategy of “low volume, high value” tourism in the region. The intent is that, by making travel to the Okavango difficult and expensive (high value), the government can limit the number of tourists visiting the region (low volume) and therefore reduce the effects of tourism on the environment.

Chobe National Park was established in 1960 and is one of the most popular and well-known protected parks in the Okavango Delta and is made up of four separate regions: Serondela, the Savuti Marsh, the Linyanti Swamps, and the hot, dry hinterlands in the center. It is one of the most densely populated parks in Botswana and is home to giraffe, zebra, impala, wildebeest, buffalo, warthog, lions, hyenas, cheetahs, and a large elephant population. One of its best known features is its elephant population, which is part of what is one the largest surviving continuous elephant population in the world. Further, Makgadikgadi and Nxai Pan National Parks were both established in the 1970s to preserve the entire ecosystem contained within both parks. There are no distinct lodges or hotels for tourists, but there are designated campsites throughout the parks and are easily reached via four wheel drive vehicles.

Botswana is one of the few countries in Africa that are still blessed with an abundance of natural resources such as wildlife resources, natural forests, birds, insects, reptiles, fish and countless other organisms [source]. Historically, natural resources like wildlife in Botswana were communally owned resulting in sharing them in terms of utilization. Wildlife resources played a significant role in sustaining the livelihoods of traditional societies. Apart from meat, game animals provided people with skins and fur for clothing, sinews for rope and thread, fat for fuel, antler for tools, horns for drinking vessels and musical instruments and bone for all sorts of purposes from tools to weapons (Mbaiwa 2011). The use of wildlife and natural resources for

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consumption is no longer sustainable and tourism is now a more sustainable method of utilizing these abundant natural resources to contribute to economic growth through foreign earnings for services and poverty eradication through employment creation in the sector.

**Tourism Arrivals**

Tourist arrivals have been on the increase in Botswana as shown by Figure 29. An estimated over two million tourist arrivals in Botswana was experienced for the period 2008 to 2010.

Figure 30: Tourist and Day Arrivals; 1994-2010

![Tourist and Day Visitor Arrivals (1994-2010)](image)

Source: Department of Tourism (2011)

The overall increase in tourism doubled from about a million in the year 2000 to over 2 million in 2010 (Department of Tourism, 2011). The growth in the number of tourists in Botswana has positive implications for economic growth because, as more tourists come, they are expected to spend their foreign earned incomes in Botswana thereby increasing revenues for goods and services provided in Botswana and the tax base for contributions to the government sources of revenue.

The Chobe and Moremi National Parks are the principal national tourism attractions which together account for 90% of the primary tourism market segment. The Chobe National Park received almost two thirds of Botswana’s park visitors. Due to increased awareness of Botswana
as a tourist destination and significant growth in tourism in Southern Africa, tourism in Kasane and Maun has grown rapidly during the past ten years. Between 1998 and 2003, day visitors into the Chobe National Park increased from 4333 to 15587, representing a 360 per cent increase. As a result of increased demand for tourism, bed-nights in Kasane increased by 61 per cent between 1998 and 2003.

Tourist Expenditure and its impact on poverty eradication

Tourists from different countries spend some of their monies in the country visited. Most expenditure is for accommodation, food, transport, recreation, shopping and others. Table 7 shows average spent per tourist per night.

Table 7: Average Spend per tourist per night: African Markets (BWP)

<table>
<thead>
<tr>
<th></th>
<th>Namibia</th>
<th>RSA</th>
<th>Zimbabwe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodation</td>
<td>240</td>
<td>174</td>
<td>30</td>
</tr>
<tr>
<td>Meals/ Drinks</td>
<td>54</td>
<td>34</td>
<td>29</td>
</tr>
<tr>
<td>Transport</td>
<td>46</td>
<td>33</td>
<td>29</td>
</tr>
<tr>
<td>Recreation</td>
<td>5</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>Shopping</td>
<td>27</td>
<td>16</td>
<td>126</td>
</tr>
<tr>
<td>Other</td>
<td>102</td>
<td>89</td>
<td>17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>474</strong></td>
<td><strong>358</strong></td>
<td><strong>235</strong></td>
</tr>
</tbody>
</table>

Source: Adopted from Tourism statistics 2006-2009

It can be noted that tourists from Namibia spent more than those from South Africa (P474 compared with P358). Tourists from Zimbabwe spent an average of P235 per night. Tourists from the United States spent P1178 per night, with those from the United Kingdom spending P1011 and Australia spending P880 (Table 8). Tourists from Germany spent P248 per night.
The largest share of tourist average expenditure per night is on accommodation (Table 8). The total number of people employed in the accommodation sector was about 9800, of whom 54 percent were female Botswana nationals and 41 percent were male Batswana nationals (Table 9). Only 4 percent of employees in the tourism sector were foreign nationals, dominated by male employees. Therefore, in terms of providing jobs, the tourism sector employs many Botswana nationals and as a result has a significant contribution to poverty eradication.

<table>
<thead>
<tr>
<th>Botswana Nationals</th>
<th>Employees</th>
<th>Proportion to total employment</th>
<th>Cumulative Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>4016</td>
<td>0.41</td>
<td>0.41</td>
</tr>
<tr>
<td>Female</td>
<td>5354</td>
<td>0.54</td>
<td>0.95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Foreign nationals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Total Employees</td>
</tr>
</tbody>
</table>

Source: Department of Tourism (2011)

The foregoing is based on the observation that the majority of tourism sector employees are women (Table 9) and in Botswana, high incidence of poverty is associated with females (Moepeng 2010). In addition, most jobs in the accommodation sector do not require high levels of education. Thus for many rural women who would otherwise be poor, finding employment in the tourism accommodation sector has an immediate impact on poverty eradication.
Table 10 shows the total tourist expenditure by type of spend in Botswana between 2006 and 2009. It is demonstrated here that expenditure on accommodation increased by about 27 percent followed by increases in transport expenditure by 16 per cent, other at 14 percent and 11 percent increase in food spending. While the accommodation sector contributes employment in terms of services including cleaning and homemaking, there is a significant leakages from the tourist expenditure in Botswana to other countries.

Table 10: Total Tourist Expenditure in Botswana

<table>
<thead>
<tr>
<th>Type of Spend</th>
<th>Pula (million)</th>
<th>Pula (million)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>2009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accommodation</td>
<td>1,028</td>
<td>2,087</td>
<td>26.6</td>
</tr>
<tr>
<td>Food/drink</td>
<td>277</td>
<td>382</td>
<td>11.3</td>
</tr>
<tr>
<td>Transport</td>
<td>258</td>
<td>399</td>
<td>15.6</td>
</tr>
<tr>
<td>Recreation</td>
<td>219</td>
<td>205</td>
<td>-2.2</td>
</tr>
<tr>
<td>Shopping</td>
<td>403</td>
<td>443</td>
<td>3.2</td>
</tr>
<tr>
<td>Other</td>
<td>813</td>
<td>1,207</td>
<td>14.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,998</strong></td>
<td><strong>4,723</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

Source: Department of Tourism (2011)

For instance, nearly all the capital and materials used for accommodation such as blankets, towels, beds, upholstery services are imported from outside the country. Most of the food eaten in the tourist facilities is important from other countries as is the case with most shops in Botswana who import food. Thus most of the total tourist expenditure in Botswana is not linked to the local economy through indirect jobs, but is leaked to outside countries where production of furniture, apparel and toiletries are produced. There is a need to reconsider linking the growth of expenditure in the tourism sector in Botswana to the diversification drive which will create more employment, increased production, jobs and poverty eradication. In particular, considerations should be made to the development of the horticulture sector to supply the local tourism country.
**Community Based Natural Resource Management (CBNRM)**

**Contribution of sustainable natural resource management to economic growth**

With more emphasis and sustainability of wildlife in Botswana has also embarked on wildlife conservation and Community Based Natural Resources Management (CBNRM). According to Mbaiwa (2011), CBNRM program is carried out in various districts of Botswana and in zoned areas known as Wildlife Management Areas (WMAs) which are further divided into Controlled Hunting Areas (CHAs) where community management of natural resources is an integral part of conserving and sustainable management of the natural resources. In return, the community benefit from the sale of services to tourists who visit their areas for leisure and other tourist related reasons.

Table 11 below shows some of the number of wildlife species allocated to CBOs in Ngamiland District or the Okavango Delta located in the northwest part of the country. Wildlife quotas are mostly allocated to CBOs in the Chobe and Okavango regions. Only a few quotas are allocated to CBOs in Kgalagadi and Ghanzi. The central, southern, Kgalagadi, Ghanzi and eastern Botswana has limited wildlife resources when compared to Okavango and Chobe areas (Mbaiwa 2011).

**Table 11: Annual Wildlife Take Off Quota for Ngamiland (2000 to 2011)**

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Baboon</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>80</td>
<td>80</td>
<td>74</td>
<td>56</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>25</td>
<td>12</td>
</tr>
<tr>
<td>Buffalo</td>
<td>12</td>
<td>40</td>
<td>12</td>
<td>40</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>37</td>
<td>29</td>
<td>38</td>
<td>20</td>
</tr>
<tr>
<td>Elephant</td>
<td>24</td>
<td>78</td>
<td>24</td>
<td>78</td>
<td>78</td>
<td>86</td>
<td>94</td>
<td>94</td>
<td>101</td>
<td>109</td>
<td>132</td>
<td>103</td>
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<tr>
<td>Gemsbok</td>
<td>0</td>
<td>60</td>
<td>3</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>24</td>
<td>28</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Hyaena spotted</td>
<td>20</td>
<td>80</td>
<td>6</td>
<td>13</td>
<td>11</td>
<td>9</td>
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<td>12</td>
<td>11</td>
<td>10</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Impala</td>
<td>110</td>
<td>274</td>
<td>90</td>
<td>223</td>
<td>219</td>
<td>219</td>
<td>219</td>
<td>219</td>
<td>219</td>
<td>217</td>
<td>171</td>
<td>168</td>
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<tr>
<td>Kudu</td>
<td>30</td>
<td>195</td>
<td>20</td>
<td>58</td>
<td>58</td>
<td>58</td>
<td>58</td>
<td>58</td>
<td>55</td>
<td>29</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Lechwe</td>
<td>40</td>
<td>272</td>
<td>60</td>
<td>93</td>
<td>93</td>
<td>93</td>
<td>85</td>
<td>85</td>
<td>53</td>
<td>48</td>
<td>43</td>
<td>10</td>
</tr>
<tr>
<td>Leopard</td>
<td>7</td>
<td>20</td>
<td>4</td>
<td>9</td>
<td>9</td>
<td>8</td>
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<td>8</td>
<td>7</td>
<td>5</td>
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<td>Lion</td>
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<td>8</td>
<td>8</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ostrich</td>
<td>6</td>
<td>65</td>
<td>7</td>
<td>52</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>51</td>
<td>43</td>
<td>22</td>
<td>15</td>
<td>0</td>
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<tr>
<td>Reedbuck</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Sable antelope</td>
<td>1</td>
<td>4</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Steenbok</td>
<td>15</td>
<td>525</td>
<td>45</td>
<td>198</td>
<td>198</td>
<td>167</td>
<td>129</td>
<td>133</td>
<td>140</td>
<td>69</td>
<td>55</td>
<td>0</td>
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<td>Tssesebe</td>
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<td>113</td>
<td>45</td>
<td>103</td>
<td>102</td>
<td>99</td>
<td>80</td>
<td>80</td>
<td>51</td>
<td>31</td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td>Warthog</td>
<td>15</td>
<td>207</td>
<td>20</td>
<td>74</td>
<td>74</td>
<td>71</td>
<td>74</td>
<td>74</td>
<td>70</td>
<td>37</td>
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<td>10</td>
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<tr>
<td>Wildebeest</td>
<td>9</td>
<td>35</td>
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<td>29</td>
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<td>13</td>
</tr>
<tr>
<td>Zebra</td>
<td>2</td>
<td>13</td>
<td>4</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>12</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>357</td>
<td>207</td>
<td>369</td>
<td>1090</td>
<td>1079</td>
<td>1049</td>
<td>980</td>
<td>956</td>
<td>881</td>
<td>646</td>
<td>605</td>
<td>228</td>
</tr>
</tbody>
</table>
Spin-off activities that generate jobs from sustainable natural resource management

On the other hand, the following Table 12 shows the number of wildlife species allocated to NG 34 which is a CHA leased by the Sankuyo Tshwaragano Management Trust. The village of Sankuyo, which only has about 272 inhabitants (2001 data), is one of the most successful projects so far (World Travel and Tourism Council 2007). The village has been aided by its strategic location between Maun and the Moremi Game Reserve, and the village’s management trust has successfully diversified away from its sole dependence on crop agriculture to hunting and photographic safaris. This has been achieved through both joint ventures and direct management of the Santawani Lodge and Kazikini campsite. Employment in these operations now tops 100 jobs (World Travel and Tourism Council 2007). Environmental management practices have improved, and operating surpluses have made it possible to undertake a series of highly visible community development initiatives, and thus impacting on poverty eradication. For instance, women in the village hand craft baskets for sale in the Kazikini campsite and use the revenue generated as a source of livelihood.

Table 12: Annual Wildlife Take off Quota for NG 34 (2000 to 2006)

<table>
<thead>
<tr>
<th>Name</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baboon</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Buffalo</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Elephant</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>Spotted hyena</td>
<td>10</td>
<td>10</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Impala</td>
<td>100</td>
<td>100</td>
<td>80</td>
<td>74</td>
<td>74</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>Kudu</td>
<td>15</td>
<td>15</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Lechwe</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>21</td>
</tr>
<tr>
<td>Lion</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Leopard</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ostrich</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Steenbok</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td>Reedbuck</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tsessebe</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>36</td>
<td>34</td>
<td>34</td>
<td>27</td>
</tr>
<tr>
<td>Warthog</td>
<td>15</td>
<td>15</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Zebra</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Sable</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wildebeest</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>287</strong></td>
<td><strong>284</strong></td>
<td><strong>245</strong></td>
<td><strong>211</strong></td>
<td><strong>209</strong></td>
<td><strong>210</strong></td>
<td><strong>197</strong></td>
</tr>
</tbody>
</table>

Source: Mbaiwa, (2011)
CBNRM engages wildlife-based and non-wildlife based activities, and members of Sankufo Community Based Natural Resource Management argued that wildlife-based activities used to be the main revenue generating CBOs in Botswana from the following sources through:

- sub-leasing of the hunting area,
- wildlife quota fees for game hunted
- meat sales,
- CBNRM enterprises such as Santawani lodge and Kaziikini Camp (catering to photographic tourists), and
- Other sources such as camping fees, vehicle hire, and donations.

Mbaiwa (2011) notes from Johnson (2009) that at least P 52,486,472 million has been generated through various CBNRM activities cumulative during the period 2006 to 2009 in the country. Of this amount, 88% (P46, 305,245) was generated by only 8 CBOs in the Okavango Delta and Chobe Districts. Figure 28 below indicates that CBNRM generates aggregated revenue from activities carried by CBNRM organizations from 2006 to 2009.

**Figure 31: Revenues from CBNRM Activities for 2006 – 2009**

Most of the revenue was generated from trophy hunting activity followed by donations from different sources (Figure 31). The third most important activity as a source of revenue was photographic safari, followed by land rentals, mokoro trips, veld products harvesting and
revenue from campsites. Other activities that generate revenue but are very small include walking safaris, crafts and cultural tourism. Veld products and crafts are among the least attractive in revenue generation, they have employed many people with at least 3100 to 4000 people in different parts of the country, the majority of whom are poor women. Overall, only trophy hunting has been a major source of revenue for wildlife based CBNRM. With the current policy diversion to photographic tourism, CBNRM revenue generation is expected to fall significantly and this is likely to affect the sustainability of the different organizations especially those in wildlife management areas, and their contribution to sustainable wildlife management. Until recently, CBNRM has generated large amounts of revenue which made strong contribution to the economic growth of most rural communities residing in natural resource rich areas like in the Okavango Delta and Chobe regions.

**Sustainable Wildlife and Natural Resource Management and Employment Creation**

In southern Africa, CBNRM was introduced in response to problems of unsustainable depletion of wildlife species, conflicts in land-use, and scarcity of wildlife resources (Mbaiwa 2011). Wildlife resources traditionally played a significant role in sustaining the livelihoods of traditional societies as a source of food. Apart from meat, game animals provided people with skins and fur for clothing, sinews for rope and thread, fat for fuel, antler for tools, horns for drinking vessels and musical instruments and bone for all sorts of purposes from tools to weapons (Mbaiwa 2011). With the introduction of the market and changes in consumption patterns among the Botswana citizens, the use of wild animals as a source of food is unsustainable. Other more sustainable methods of utilizing wildlife and natural environment resources are required to address the issues of economic growth, sustainable management of natural resources and poverty eradication.

Photographic and safari hunting tourism activities have characterized most of the CBNRM activities for some time in rich wildlife regions like the Okavango Delta and Chobe. Moreover, households in CBNRM villages generally benefited from the proceeds of meat from safari hunting. The meat of the most preferred animal species (e.g. buffalo, impala, and Kudu) is usually given to destitutes and some of it auctioned, whereas that of less preferred animal species (elephant, baboon, hyena and lion) is usually given to people free of charge. Although hunting
leases from Community Based Organizations is considered the most effective and least cost method of generating funds among the CBNRM, the current government direction is to do away with hunting and focus on photographic tourism.

Mbaiwa also indicated that employment was found to be one of the main benefits that have improved livelihoods in CBNRM areas. CBNRM has increased employment figures in participating villages in different parts of Botswana. According to Schuster (2007) and Mbaiwa (Mbaiwa 2011), in 2006, there were more than 8,000 local people employed in a wide range of CBNRM projects and activities in Botswana (Table 13).

Table 13: CBNRM Projects’ Employment

<table>
<thead>
<tr>
<th>Activity</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trophy Hunting</td>
<td>560</td>
</tr>
<tr>
<td>Photographic and cultural tourism</td>
<td>420</td>
</tr>
<tr>
<td>Veld Marketing</td>
<td>At least 3,100</td>
</tr>
<tr>
<td>Crafts</td>
<td>At least 4,000</td>
</tr>
<tr>
<td>Total</td>
<td>At least 8,800</td>
</tr>
</tbody>
</table>

Source: Schuster (2007)

Employment opportunities estimated at 8,000 people in CBNRM projects represents an extensive number of people as the majority of the CBNRM projects are mostly carried out in remote parts of Botswana where there is no industrial and manufacturing sectors to create employment opportunities for local people. It can then be argued that CBNRM in Botswana improves rural livelihoods through employment and is an active factor in poverty eradication.

The Impact of CBRNM in Sustainable Natural Resource and Environmental Management

CBNRM play an important and central role in sustainable natural resource management and utilization of the environment to contribute to rural economic growth and poverty eradication. Some of the activities of CBNRM such as Sankuyo in the Okavango Delta include development of fire breaks to reduce the risk of wild fires, prevention and collection of litter, and community participation in monitoring and anti-poaching programmes to conserve the wildlife habitat. Communities living in wildlife populated areas have proved to have strong traditions of
conserving wildlife. For instance, Tlou (1985) and Campbell (1995) have both shown that even before the introduction of strong CBNRM organization, sustainability in harvesting of natural resources was partly achieved because each individual was expected to observe traditional institutions and religious practices that governed the use of natural resources in their local environment. That is, each member of the community was also expected to act as a “game ranger”, reporting any over-harvesting of resources and illegal hunting activities to the chief, and heavy fines were imposed on anyone caught hunting illegally or involved in resource destruction (Mbaiwa, 2011). There were societal norms, religious practices and institutional structures like the kgotla (village square which provides a forum for decision making) headed by the chief to make resource management laws. Hence, CBNRM is built upon strong and tested sustainable natural management system that worked well before the introduction of markets.

CBNRM operates as an extension and improvement of the Wildlife Conservation Policy of 1986. Botswana introduced the Wildlife Conservation Policy of 1986 as part of the re-introduction of community involvement in wildlife conservation (Mbaiwa, 2011). The Policy is also considered a predecessor of most changes in wildlife conservation activities in Botswana. This Policy was designed to endorse economic development of rural areas and promote economic growth through the implementation of tourism projects. The policy recognizes the potential value of both consumptive and non-consumptive use of Botswana’s wildlife resources by the people living in wildlife areas. As a result, the policy called for the establishment of Wildlife Management Areas (WMAs) and Controlled Hunting Areas (CHAs) which have become the lands and concession areas where CBNRM is largely implemented in Botswana. Controlled hunting has provided communities in CBNRM areas with access to meat as staple food and hunting concessions for lease professional hunters which was the most effective and least cost method of generating revenue.

CBNRM has successfully contributed to sustainable management of natural resources in Botswana by ensuring:
• That the threat of species extinction due to over utilization of wildlife resources through poaching is minimized as communities now consider these natural resources as part of their sources of livelihoods that they should contribute to protect and make a living from.
• That the central government receives necessary and timely signals and information to protect effectively the declining wildlife populations.
• That land use conflicts between rural communities and the Department of Wildlife and National Parks are minimised.
• That future plans about wildlife conservation are linked to rural economic development.

CBNRM Concept and Identification of Specific Beneficiaries

Good governance is a challenge which really needs serious attention as it contributed to the failure of the first implemented policy of Wildlife Conservation Policy before the formation of CBNRM. The main idea of CBNRM is that the value of natural resources should be maximised to the local people if it is to survive. The “C” which stands for Community primarily involves the transfer of rights over valuable natural resources from central government to democratic communities. This programme believes that the takeover will build up a community which is responsible and can extract profitable benefits from these natural resources for improved livelihoods and human development for future generation. The evidence from Namibia suggests that there are three categories of CBNRM communities: those that are resource rich (relative to the number of inhabitants), a medium resource/beneficiary and a low resource/beneficiary category. For resource-rich communities CBNRM can provide a route out of poverty but only if there is sustained and significant NGO and Government support over a number of years to build local capacity and if the appropriate legal framework is in place. A formal-sector tourism partner is often involved. Communities with lower resource endowments/capita can still gain from CBNRM but there are likely to be new livelihoods for a minority of community members and it takes longer to build commitment to agreed resource use from the whole community.

For sustainability, stretching from wild animals, forestry, landscapes, cultural sites to their derivatives like fruits, leaves, honey and roots, these communities are given proper skill

IRDNC (2009)
enhancement, empowerment and incentives (revenues from resource utilization) to successfully use natural resources. To achieve successful management of natural resources, there is decentralization through CBNRM as a way to promote the conservation of the country’s resources by involving rural communities in their management and sustainable use. The community also set some rules governing how, when or in what quantity a resources can be used.

Blaikie (2006) argues that CBNRM means different things to different audiences and that the evidence for community benefits claimed for CBNRM does not exist. It can certainly be said that when he was writing, the claims for CBNRM went beyond the available evidence and that as Child and Barnes (2010) write “…like democracy, CBNRM is both an imperfect process and a conceptual goal”. Nonetheless, analysis of the CBNRM experience in Namibia by Yaron (2010) demonstrates that the economic returns both to the Government and to donors far exceed economic costs. It is quite possible that similar findings would apply in Botswana although this is not the same as demonstrating livelihood benefits to a broad range of community members. Looking at the Namibian evidence, Suich (2009) also finds that there is insufficient evidence to say who within communities actually benefit.

**CBNRM Contribution to Poverty eradication**

Interviews with stakeholders from different CBNRM communities’ leaders in the Okavango Delta and Chobe District suggest that most Community Based Organisations are not thought to have benefitted the poor except the one in Sankuyo. In general, CBNRM organizations suffer problems of governance and most benefits are enjoyed by board members. Some of the benefits of board membership in CBNRM organizations include sitting allowances, travel allowances, including some new initiatives such as “golden handshake” which describes a lump sum of funds claimed by a board member at the end of their term. Other issues of governance include that institutional set-up of CBNRM programme and the role of government sometimes are affected by poor coordination systems. For instance, government representatives are thought to be responsible for appointing community representatives to become CBNRM Board members outside the democratic processes and this can result in communities being represented by people who are not accountable to their views. The CBNRM Boards coordinate trusts and links the CBOs to government, and the practice of appointing board members is not thought to promote
the interests of CBNRM and the concept’s primary role of facilitating sustainable natural resource management and poverty eradication. Thus, representation of the community in the CBNRM Board is thought to be not connected to the interests of the community and simply a top-down approach that could lead to the eventual dilution or elimination of the CBNRM concept to serve other interest outside sustainable natural resource management and poverty eradication.

However, for a specific community of Sankuyo, CBNRM has successfully led to the introduction of community support programmes that include:

- Eight houses built for the poor households as identified through the government social welfare system.
- Provision of a P1, 200.00 quarterly allowances for the elderly starting at the age of 55 years.
- Provision of economic empowerment start-up capital for business to community members with convincing business proposals to the CBO Board.

**CBNRM Information Gaps and Risks**

CBNRM, especially in wildlife management areas face a difficult future where sources of revenue are expected to shrink substantially in a short period. This is a result of the current hunting ban with photographic tourism. Some community representatives in these areas the hunting ban is imposed on them and no adequate consultations were made to take on board the circumstances of the local communities. As shown in the above sections, hunting related ventures was a major source of fundraising for the CBNRM communities. However, the hunting restrictions laws constrain the community based organizations to maximise benefits associated with what they say is sustainable hunting practices. Government is promoting various strategies, such as promoting non-consumptive use of wildlife resources that include photographic activities and provision of water within protected areas, in order to promote the growth of wildlife populations (MFDP, 2010). A major limitation with the new government approach is that, for communities, photographic tourism attracts small amounts of revenue filtering in over a long
period of time compared to hunting which can attract huge amounts of funding in a short period of time with limited advertising and input expenses.

The current CBNRM policy does not have guidelines that provide a framework and criteria required for harvesting natural resources. As a result, most CBNRM do not have guidelines that inform stakeholders and harvesters of natural resources about sustainable natural resource harvesting. Thus most CBNRM organizations are involved in the utilization of natural resources to maximise their revenue and give minimum attention to documenting guidelines of harvesting that are currently based on traditional conservation knowledge. Should the situation of lack of documented guidelines for harvesting natural resources continue, the country could start observing accelerated depletion of natural resources to unsustainable levels. For instance, current harvesting practices of phane caterpillar are influenced by the market availability and traditional methods of conserving the natural resource are ignored or not known. As a result, harvesters start to harvest the caterpillar at very small stages and very few are left to grow to the next development stages, and leading to unsustainable use of natural resources which can lead to the resource’s extinction.

As shown by data on annual wildlife culling quota (Table 10), elephants quotas are the highest represented because, Botswana has very unsustainable elephant population that create environmental damage to the biodiversity of the wildlife areas, especially in the Chobe National Park. Although community based organisations benefit from harvesting these natural resources for their fund raising activities, sometimes the harvesting practices based on market demand lead to unsustainable use of natural resources, which can lead to extinction of specific species if appropriate guidelines and monitoring are not implemented. For instance, elephant hunting generates the highest returns for those who kill male elephants compared to female elephants because of their tasks. Some CBOs are reported by stakeholders contacted in this study, to bias their culling of elephants to male ones and thereby causing unsustainable use of this natural resource if the productive cycle of the elephant population is disturbed.
Fisheries

Botswana is a landlocked country but contains a large surface area of water offering substantial potential for fisheries development. The most productive systems as regards to fishing include the Okavango Delta in North-West district and the Chobe River in Chobe district. Other areas with fish potential in the country are all in the eastern Botswana and include Gaborone dam in the capital city, Shashe and Letsibogo dams in the Central District and Bokaa dam in the Kgatleng District. The National Development Plan 10 does not provide guidance on the role of fisheries as a contributor to economic growth in Botswana, and neither does it indicate this sector as having a significant role in economic diversification and poverty eradication in Botswana (Ministry of Finance and Development Planning 2009). Although there is no Fishery Policy, the Fish Protection Regulations of 2008 provide instruments through which, government has put in place to conserve the fish species in Botswana by regulating fish harvesting (Republic of Botswana 2008). These regulations require that fishing is an economic activity reserved for Botswana citizens. In addition, any person who engages in commercial fishing is required to have a license that is issued by the Ministry of Environment, Wildlife and Tourism at a fee. But, citizens who engage in subsistence fishing are not required to obtain fishing licenses.

Fish Production and Types of Fish in the Okavango Delta Fishery

This is the largest aquatic system in the country, with a potential annual fish yield estimated between 5 000 and 8 000 tonnes, representing approximately 80% of the national catch (CSO 2004). The main exploited stocks and principal species in the Delta are Tilapia (commonly known as Bream) and these include in order of importance; Oreochromis andersonii, tilapia rendalli and Oreochromis macrochir. The other bream species which are also harvested, but at low levels are several Sargochromis species (S. carlottae, S. greenwoodi, S. codringtonii), several Serranochromis species (S. robustus, S. angusticeps, S. altus, S. macrocephalus). Based on the 2004/2005 period, these constituted approximately 64 per cent of the total national fish production figures. Other exploited stocks are the Clarias species (Clarias gariepinus and C. ngamensis, Hydrocynus vittatus, and S. Intermedius).
**Fish Production in the Chobe River**

This is the second largest waterway for fishery production but most productive fishing grounds like Lake Liambezi dried out several years ago. Thus, due to the limited fishing grounds available as well as the Chobe National Park where any form of fishing is prohibited, there is very little off-take from the Chobe River. Infact, most of the fishing is done across the border in Namibia and then brought to Botswana for sale in Chobe district, particularly, Kasane. Despite all these, significant hook and line fishing continues in this area and mostly tiger-fish and the large sized tilapia are caught. Concerns have been expressed among CBNRM communities that some of the conservation laws such as that for fish production neither encourage sustainable use of natural resources nor contribute to poverty eradication. For instance, in the Chobe River system, despite prohibited fishing on the Botswana border side, unsustainable harvesting of fish occurs in the same river by residents on the Namibia border side and sell the same fish to Botswana citizens with no restrictions throughout the year.

**Other Fish production Reservoirs**

There are four small reservoirs/dams in south-eastern Botswana as already mentioned above, which annually give out about 11 commercial fishing licenses. Based on the 2004/05, the total catch from these dams contributed to 20% of the total national catch. The principal species harvested in these dams are *Labeo lunatus* in Shashe Dam, bream species (with *Oreochromis mossambicus* as the most dominant species) in Gaborone and Letsibogo dams, and catfishes (especially *Clarias gariepinus* as the dominant species) in Bokaa Dam (FAO 2007).

**Fish Demand and Production and Fishing Areas in Botswana**

The demand for fish in Botswana far exceeds supply from local sources as demonstrated by the annual national fish import bill of around P19million (DWNP, 2008). This implies that the demand for fish in Botswana is met by fish supplies sourced from outside the country. Some estimates from the literature suggest that at least 4000 tonnes of fish is consumed in Botswana each year. Of this amount, only 8 per cent is produced locally, while 92 per cent of our fish needs are met by imports.
Table 14 reflects the fish catch statistics from gill nets only and no catch statistics are collected from other fish sectors such as women basket fishers, hook and line fishers, the recreational fishery among others. This Table, is based on a cross-sectional study of 2004/05, and indicates fish production estimates in Botswana. Although, the catch statistics indicated in this table excludes fish catch data from subsistence fishery, the amounts indicated are much higher than the annual fish demand in Botswana. It is shown in Table 14 that Botswana can produce an estimated 161,000 tonnes of fish in a single fishing season. About 64 per cent of the fish produced in Botswana is the bream species, which is available in all the districts of Botswana where there is fishing potential. Although no fish catch statistics are reported for the Chobe fishing area, some fishing has also been observed in the Chobe River, which strengthens suggestions that fishery potential in Botswana is a potential contributor to economic diversification, poverty eradication and sustainable environmental use. Increased research funding in the fishery sector of Botswana could unlock undiscovered comparative advantage that Botswana could have to contribute to the Botswana Vision 2016 goal of a productive and innovative nation.

Table 14: Main Fishing Areas in Botswana and Fish Production in Tonnes by Species Groups for the 2004/05 Fishing Season

<table>
<thead>
<tr>
<th>Fishing Area</th>
<th>Bream</th>
<th>Catfishes</th>
<th>Silver Catfish</th>
<th>Tiger-fish</th>
<th>Carp</th>
<th>Labeo</th>
<th>Other species</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Okavango Delta</td>
<td>88604.7</td>
<td>32081.8</td>
<td>2006.5</td>
<td>4824.2</td>
<td>0</td>
<td>0</td>
<td>2095.9</td>
<td>129613.1</td>
</tr>
<tr>
<td>Gaborone Dam</td>
<td>2783</td>
<td>1550.9</td>
<td>72</td>
<td>0</td>
<td>226.9</td>
<td>0</td>
<td>0</td>
<td>4632.8</td>
</tr>
<tr>
<td>Bokaa Dam</td>
<td>3876.6</td>
<td>4668.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8545.4</td>
</tr>
<tr>
<td>Shashe Dam</td>
<td>2884.7</td>
<td>1439.7</td>
<td>1756.9</td>
<td>0</td>
<td>0</td>
<td>7250</td>
<td>0</td>
<td>13331.3</td>
</tr>
<tr>
<td>Letsibogo Dam</td>
<td>4139.6</td>
<td>361.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4500.8</td>
</tr>
</tbody>
</table>
The Role of Fishery in Economic Growth and Poverty Eradication

Fishery is currently not among the main contributors to GDP in Botswana. However, it is an important natural resource country-wide as a healthy food source and in some communities it is a staple food. Fishery in Botswana is categorized into subsistence, commercial harvesting and sport/recreational fisheries. Subsistence fishery is seasonal and involves a large number of women and children who use simple fishing technology such as spears, traps and baskets (Department of Environmental Affairs 2008).

Indeed (FAO 2007) find that:

“Recent socio-economic research in the Okavango Delta’s subsistence fishery has shown that the majority of subsistence fishers are single parent households headed by females. Generally, households have 7 individuals on average, and are also characterized by a relatively high prevalence of young children (i.e. age range of 0-60 months old). These households regard fish as their major livelihood strategy where the majority of them increase fish catches as a major strategy to offset food shortages. Moreover, there is a high proportion of females (53 per cent based on a 2006 frame study of the Delta’s fishery) in the Okavango delta’s fishery which attests to its importance as a major source of protein to young children. This is based on the observation that female basket fishing harvests mostly low value fish species (small sized fish species) which do not have any market value, either for barter or for selling, and is rather consumed within the household. Moreover, research has shown that most people turn to fishing during lean economic years and then pursue other livelihood activities during good years, which makes the fishery a social safety net for most households” p7

Subsistence fishery is a very important source of livelihood in the Okavango Sub-District and provides poor households with access to fish meat as a basic staple food in the area. When there is excess fish harvested, it might be sold and provide cash income opportunities to households that facilitate exchange and investment at the household level. Therefore, subsistence fishery is important in contributing to an increase in the amount of goods and services produced in this Sub-District and hence local economic growth. In addition, subsistence fishery is a major contributor to household food security, which is critical to the MDGs and NDP 10 objectives of poverty eradication. Further, technology employed in subsistence fishery is sustainable and has proved to be successful in ensuring fish re-generation.
Commercial fishery is practised in different districts whose local economies have comparative advantage in fishing opportunities such as dams, river systems and the Okavango Delta. Commercial fishery is dominated by the use of modern fishing technology such as powered boats, gill-nets, refrigeration facilities and a ready high market demand (Department of Environmental Affairs 2008). Commercial fishery in Botswana targets Cichlid (Bream), Catfishes, Tiger fish and Silver catfish species which are the most preferred in the market. Initial commercial fishery development was promoted by the Financial Assistance Policy (FAP) of 1982. Despite such initiatives, investment in fishery has been very low in Botswana for a long time. For instance, between 1997 and 2003, the government budget allocation for fishery accounted for only 0.1 per cent of the total budget for agriculture in the Ngamiland District. This was despite the District’s comparative advantage in this natural resource. Further research on the potential of commercial fishery as an integral part of economic diversification strategy in Botswana is recommended. Investing in fishery would increase the efficiency of utilising increasing availability of water resources as a result of the implementation of the National Water Master Plan of 1993 (Department of Water Affairs 1993). Promotion of commercial fishery in Botswana has the potential to promote linkages to the growing tourism sector and become a basis for increasing the amount of goods and services produced in Botswana and thereby reducing the trade deficit for fish products and hence a positive contribution to the national balance of payments. In the process, more employment opportunities for those who would otherwise be poor would be created.

Recreational fishing is characterized by the use of a fishing rod for catching fish (Department of Environmental Affairs, 2008). In the Okavango for instance, recreational fishing is undertaken by fishing camps established in the delta. In general, sport fishers practice a catch and release technique. Hence small fish that are caught and released alive back into the river. Sport fishing has a potential to promote tourism and bring the much needed employment and incomes to the country. A wider promotion of this activity would lead to a sustainable utilization of the environment and natural resources and at the same time create employment and contribute to economic growth.
Observations

Botswana has a growing fish population than current demand levels and this current stock could be considered possible sustainable harvesting which will contribute to economic growth and poverty eradication. Therefore, if harvested at optimal levels, local fish population could contribute to provision of jobs in rural areas as fishermen, economic growth and economic diversification. Currently, fishery in Botswana takes the form of subsistence fishery, commercial fishery and recreational or sport fishing. Although fishery has very little impact on the national economy, it has relatively high socio-economic impact at regional level. Currently, fishery is a major contributor to household food security in poor households found in fishing areas, and contributes to household cash income when excess catch are sold to a ready market. Commercial fishery has potential to contribute to economic growth and economic diversification to create sustainable employment opportunities. The regulation instruments of commercial fish harvesting require adequate monitoring and evaluation to ensure that they do not just promote conservation of the natural resources, but also promote the utilisation of the natural resources to ensure sustainable use of the environment, provide incentives for investment in fishery and develop linkages with the rest of the economy that will promote economic diversification.

The major challenges of the fisheries in Botswana include that there is no policy focusing on this sector as a potential major contributor to economic growth, economic diversification, poverty eradication and the achievement of the NDP 10 goals. The political will to promote fishery compared to other sectors such as agriculture and wildlife utilisation is very low. Except, for the time of FAP (1982), government support in this sector is shown through a fishing restrictions regulation aimed at conserving the fish species and minimising potential overharvesting. A minimal government intervention in this sector hinders the development of a vibrant fishery sector in Botswana. There is a much greater need for government to consider the risk that fishing is most likely to cause if it occurs at unsustainable levels when effort is increased and that more work needs to be undertaken to determine the optimal fishing levels and potential monitoring of fish harvesting as a new economic diversification approach. Thus the full economic value of the both recreational fishery and food production needs to be considered in the government plans and exploited to generate employment and improve food availability from own effort as an important contributor to poverty eradication. Currently the main constraints are an incomplete
zoning and definition of user rights, unfair conservation practices and rules that favour foreigners and disadvantage locals where a river such as Chobe is commonly owned between two countries, lack of clear management procedures and a lack of clear monitoring system constructed to gauge progress to ensure fish populations meet set levels (Department of Wildlife and National Parks, University of Botswana et al. 2007).
Forestry, Livelihoods and Poverty Eradication

Forestry is a scientific approach of sustainable management and utilization of natural resources associated with, and derived from forest lands. These resources include timber, water, fish, wildlife, soil, plants, and recreation. Forest lands are instrumental in the beauty and spiritual impact of landscape. The utilization of all of these resources is part of the cultural heritage of many countries. Finding a balance between these multiple uses, while sustaining and conserving forest resources is very vital.

The U.N. (FAO) indicates that 20.0% or about 11,351,000 ha of Botswana are forested. FAO elaborates that change in Forest Cover is as follows: between 1990 and 2010, Botswana lost an average of 118,350 ha or 0.86% per year. In total, between 1990 and 2010, Botswana lost 17.3% of its forest cover or around 2,367,000 ha. Botswana's forests contain 646 million metric tons of carbon in living forest biomass. As far as Biodiversity and Protected Areas are concerned: Botswana has some 900 known species of amphibians, birds, mammals and reptiles as shown by the statistics from World Conservation Monitoring Centre. Of these, 0.8% is endemic, meaning they exist in no other country, and 1.7% is threatened. Botswana is home to at least 2151 species of vascular plants, of which 0.8% are endemic.

Availability of Forest Reserves by Location

A good example of forests found in Botswana include the Chobe Forest Reserve which is an enclave largely surrounded by the Chobe National Park. The Chobe Forest Reserve and the area to the north of it, concessions known as CH/1 and CH/2, are areas designated for community-managed livestock and hunting. The carefully managed hunting of this is currently administered by a company, Rann Safaris, which has a few small hunting camps. The 'hunting' aspect of this should not deter photographic guests from visiting, as the reserve contains good populations of wildlife that are managed sustainably by the community and Rann Safaris. Many visitors simply pass through this reserve en route between Kasane and Savuti. See the route described above Driving from Kasane to Savuti: Western Route – via the Riverfront for more details of the drive through the area.
Forestry Sustainability in Botswana

Tree planting initiatives and sustainable forest management programmes in Botswana started in the 1940s and gained momentum in the late 1970s and early 1980s. The development of forestry in Botswana ushered in a number of projects and programmes that were meant to instill conservational ethics, create awareness on the importance of the natural resources, as well as create socio-economic opportunities to derive benefit from them. Such programmes and projects were mainly driven by government and environmental NGOs. When Botswana gained middle economic status in the early 1990s, foreign donor funding dwindled, resulting in the demise of key environmental NGOs. As a result, currently, most of the forestry projects and programmes are funded by the Government of Botswana. Many projects and programmes were undertaken during the implementation of the National Development Plans (NDPs) to achieve the focus of sustainable forest management. It should be noted that, cognisant of the fact that the impact of most forest and range resources projects and programmes are long term, some achievements were made against a back-drop of institutional constraints (Department of Forestry and Range Resources, 2010).

To date, the development of forestry in Botswana has resulted in the establishment of fifty two (52) woodlots of mainly exotic *Eucalyptus* species, with a total area of 220 hectares. Furthermore, as a way of promoting reforestation by bringing tree seedlings closer to the communities, the Department of Forestry and Range Resources (DFRR) has established twenty one nurseries across the country with an annual average production of 500 000 tree seedlings. The major focus is on production of assorted indigenous tree seedlings at subsidized prices to the public. The DFRR also supports the establishment of backyard nurseries so as to bring the tree seedlings even closer to the communities, and at the same time economically empower the rural communities. The annual National Tree Planting Day (NTPD) promotes reforestation by issuing free tree seedlings to the communities. The NTPD issues about 50 000 tree seedlings to the public annually as part of the National Tree Planting Programme. A major reforestation initiative was the establishment of the National Tree Seed Centre (NTSC) in 1998. The NTSC provides about 150 kg tree seeds of high physiological and genetic quality to the government tree nurseries and the public annually. Other projects and programmes include Forest Resources Inventories that are meant to generate essential information for informed decision making and to
guide formulation of management plans; the Community Based Natural Resources Programme is premised on benefits derived from the resources and the resultant desire to conserve them; the Tropical Forest Conservation Fund providing funding for forest conservation, protection and Management; the Millennium Seed Bank Project that acts as an umbrella for a number of national MSB programmes. Other major projects that have been implemented in the past include: Botswana Range Inventory and Monitoring Project (BRIMP), Indigenous Vegetation Project (IVP); Okavango Delta Management Plan – Vegetation Component, Community Forestry Development Project (CFDP), Forest Protection and Development Project (FPDP). A Research Action Plan was developed under the SADC programme initiative in NDP 7 with the aim to prioritise and streamline research towards species trials, silvicultural treatments, and investigations of the potential of indigenous forest and veldt resources. Agro-forestry and community activities are however yet to be improved to arrest the rate of deforestation and fuel-wood extraction especially in wood resource-poor areas and populated settlements. Furthermore, administrative initiatives have been made to improve channeling of financial and other assistance to the NGOs to undertake those activities necessary to achieve the objective of sustainable utilization and development of the sector. (Dept of Forestry and Range Resources, 2010; 2012.)

**Fuel Wood**

Figure 32 shows the trend of fuel wood energy source has declined in relative importance between 1981 and 2001 in Botswana. Fuel wood use remained the same between 1993 and 2003, while other energy sources relative importance increased during that period. Of note is that government, as well as the industrial and commercial sectors in rural areas rely predominantly on fuelwood as an energy source. However, there has been some decline in the use of fuelwood as indicated by a drop between 1993 and 2003 from 35 to 29% for primary energy supply (PES) and from 45 to 34% for both net energy supply (NES) and FED. The decline in the use of fuel wood in Botswana could be associated with past unsustainable use of this resource particularly around settlements and that it is no longer cost effective to use this energy source compared to other sources available in the market. Figure 32 also depicts the percentage distribution of households by principal source of energy used for cooking in 1981, 1991, and 2001.
Throughout the 20 year period shown in Figure 32, LPG Gas has been the most prominent growing source of energy for households in Botswana. This gas is easily accessible in Botswana but can disrupt households when it is finished because it is supplied in unmetered bottles, which are heavy to transport and has a high risk of causing fire explosions which can cause irreparable harm to the environment.

**The impact of Forestry on Poverty Eradication Objectives**

In general the expansion of sustainable forestry from small-scale community harvesting to large-scale forest and plantation management is a means to large-scale economic growth in developing countries, and has potential to ultimately reduce poverty and supporting livelihoods. However, Arnold and Bird (1999) in their study found that linkages between the poor and the forest resources are complex. In using and managing forests to maintain flows of material and environmental inputs into their livelihood systems, people often transform the resource. While pressures of poverty can mean that this leads to deforestation, it is incorrect to assume that this will necessarily happen. Further, the existence of multiple categories of user, with different and often competing interests, can mean that developing equitable and effective systems of participatory control and management of forests can be difficult. In particular, the needs of the poor to have continued access to forestry to sustain subsistence and coping livelihood strategies are likely to conflict with the interests of the wealthier and industry in privatizing forest product flows in order to exploit market opportunities.
When considering the link between livelihoods and forests, one may argue that trees and forests provide a range of benefits in the form of goods and services that arise from direct and indirect use. These may be tradable goods, such as timber, fuelwood, non-timber forest products (NTFPs), and those that cannot be traded, the latter mainly being services such as a regular supply of clean water or the conservation of soil fertility. The main features of forest output/livelihood relationships, and the ways in which they are impacted by change, are outlined in Table 15 below.

**Table 15: Forest Outputs and Rural Livelihoods**

<table>
<thead>
<tr>
<th>Livelihood</th>
<th>Inputs</th>
<th>Characteristics Impacts Of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsistence goods</td>
<td>Supplement/complement inputs of fuel, food, medicinal plant products, etc., from the farm system; often important in filling seasonal and other food gaps; forest foods enhance palatability of staple diets, and provided vitamins and proteins</td>
<td>• Can become more important where farm output and/or non-farm income declines • Likely to decline in importance as incomes rise and supplies come increasingly from purchased inputs; or as increasing labour shortages/costs militate against gathering activities, or divert subsistence supplies to income generating outlets</td>
</tr>
<tr>
<td>Farm inputs</td>
<td>On-farm trees provide shade, windbreaks and contour vegetation; trees/forests also provide low cost soil nutrient recycling and mulch Arboreal fodder and forage, fibre baskets for storing agricultural products, wooden ploughs and other farm implements, etc.</td>
<td>• Trees can become increasingly important as a low capital means of combating declining site productivity, and a low labour means of keeping land in productive use (e.g. home gardens) • Increased capital availability, and access to purchased products, likely to lead to substitution by other materials (e.g. by pasture crops, fertilizer and plastic packaging)</td>
</tr>
<tr>
<td>Income</td>
<td>Many products characterised by easy access to the resource, and low capital and skill entry thresholds; mainly low return activities, producing for local markets, engaged in part-time</td>
<td>With increasing commercialization of rural use patterns some low-input low-return activities can grow; however, others are inferior goods and decline, some are displaced by factory</td>
</tr>
</tbody>
</table>
by rural households, often to fill particular income gaps or needs (though they can be major sources of employment and income for forest dwelling populations); overwhelmingly very small, usually household based, enterprises (with heavy involvement of women, as entrepreneurs as well as employees);

Some forest products provide the basis for more full time and higher return activities; usually associated with higher skill and capital entry thresholds, and urban as well as rural markets

Some low input gathering activities involve raw materials for industrial processes and external markets

Reduced vulnerability

Can be important in diversifying the farm household economy - e.g. providing counter seasonal sources of food, fodder and income.

Also important in providing a reserve that can be used for subsistence and income generation in times of hardship (crop failure, drought, shortage of wage employment, etc); or to meet special needs (school fees, weddings, etc.)

The "buffer" role of forests and trees can continue to be important well into the growth process.

Likely to decline in importance as government relief programmes become more effective, or new agricultural crops, or access to remittance incomes, make it less necessary to fall back on forest resources

Forest products and urban livelihoods

While the strongest role for forestry lies in the rural context and poverty is predominantly a rural phenomenon, a substantial proportion of urban households continue to draw on the plant and animal products of forests to meet some part of their basic needs, such as construction, energy, nutrition and medicine. Though the contribution of forest products will decrease as the income levels of urban households increase, many low-income families continue to depend at a minimum on wood for fuel. And for the growing numbers living in slum and marginalized communities in urban areas, gathering wood-fuel may continue to be one of the few options open to them to generate income. The importance of forests to the urban poor is demonstrated by evidence that an increase in urban poverty temporarily increases demand for low cost forest products which normally would have been displaced in urban markets. The other link between urban communities and forests that deserves consideration is the influence of urban markets on traded forest goods. Expanding and growing forest product activities are more likely to be found
where per capita incomes are rising, and there is growing demand from markets (Nguyen Thi Yen et al. 1994).

**Forest products as a source of income and employment**

Production and trading of forest products are important sources of income, for both the landless those with access to the land. Small enterprise surveys investigating non-farm components of rural income have shown that forest product activities generally rank among the three largest sources of employment in rural manufacturing and trading (Fisseha 1987). For example, in Botswana, poor rural communities and Makomoto and Sese settlements along the A1 Francistown to Gaborone road depend on wood harvesting and sales to earn an income and employment. The potential for such activities rests in part on there being an overall regulatory environment that does not discriminate against the informal sector. There may also be need to ensure equal opportunity with formal sector industrial enterprise activities in particular forest product sub-sectors. For instance, measures taken in Indonesia some years ago to curtail export of rattan, in order to encourage the development of industrial scale manufacture of rattan products domestically, severely curtailed a trade that had provided outlets for large numbers of smallholder producers of rattan (Arnold and Bird, 1999).

Multitudes of people who succeed in setting up new small-scale commercial forest product activities suggest that in general there is little need for measures to attract new entrants. However, the high rate of attrition, particularly amongst new enterprises, indicates the need that can exist for intervention to encourage entrants to concentrate on the more viable and sustainable kinds and levels of activity. The concentration of the poorer of those engaged in generating income from materials from forests in low-return product activities that can offer no more than marginal, unsustainable livelihoods, presents particular issues. Support to such activities once higher return or less arduous alternatives emerge could impede the emergence of better livelihood systems for the participants. That being the case, it may be more fruitful to help people move into other more rewarding fields of endeavor rather than seeking to raise their productivity in their current line of work. The alternatives may be other forest product activities, but could equally well be activities not associated with forests or trees. In either case, care needs
to be taken to ensure that future growth prospects are indeed better in the alternative product lines to which people are being encouraged to move (Arnold et al. 1994).

In recent years a number of initiatives have been launched to encourage trade in particular forest products for industrial or niche export markets. However, such product trades have often proved to be susceptible to change in market requirements, to domination by intermediaries, and to shifts to domesticated or synthetic sources of supply, and have consequently not been sustainable. They can therefore expose rural households to high levels of risk, particularly where the trade has encouraged people to move away from more diversified and less risky agriculture-based livelihoods; as has happened with some of the extractive product trades from the Amazon region (Browder 1992). Similarly, interventions have sometimes led to product expansion on a scale that has resulted in depletion of the raw material resource - as happened, for example, with a programme that successfully expanded export demand for decorative baskets made by households in Botswana (Terry 1984).

Trades that serve domestic rural and urban demands for forest products can often provide less volatile market opportunities. However, governments frequently intervene in these trades, in ways that can impede participation by smallholders. Forest departments may impose charges, in order to capture a share of the value. Producers may be obliged to sell to government marketing bodies, or to traders to whom concessions have been granted. In many countries the government also intervenes in the market directly, as a producer from State forests. Some products are made available at deliberately subsidised prices, because of their importance to the poor. Others are effectively sold at below-cost prices because the process of setting and collecting royalties fails to capture an appropriate share of the economic rent. The result is to confront the private producer with competition from subsidised sources (Arnold and Bird. 1999).

When one looks closely to policy issues, a fundamental policy concern that many governments need to address, therefore, is the conflict within their overall strategy to provide forest products. While providing support to production by smallholders through one part of its forestry programme, they compete with them through the industrial forestry component. A logical long-term solution could be to phase out countries production in those markets where small holder
production has a comparative advantage. In the short term the scope for improving the position of the latter probably lies mainly in removing or relaxing regulatory constraints that reinforce the structural and scale advantages that the Government, through its forest department, possesses as a producer of many forest products.

Water

Water availability in Botswana relative to demand

Most of Botswana’s land is in the Kalahari Desert where the climate is semi arid. The area is subject to sustained periods of severe droughts, where annual rainfall is about 400mm varying between 250mm in the southwest to about 650mm in the northeast (DEA, 2006). Botswana relies on both groundwater and surface water. Groundwater supplies two-thirds of the water consumption whereas dams, rivers and other surface water contributes about one-third to national water consumption (FAO, 2008). Most rural areas depend on groundwater resources whilst urban areas depend mostly on dams for water consumption. Water is a scarce resource in Botswana. Botswana is among the four countries in Southern Africa already experiencing so-called ‘water stress’, having fresh water resources between 1000 and 1700m³ per person per year (UNEP, 1999). One of the factors related to water scarcity in Botswana is the rapidly increasing urban population associated with changes in the demand for water. Already, there are serious shortages of water in the south and water is being provided from Letsibogo and Dikgatlhong Dams and some of the water supplying Gaborone Dam is imported from Molatedi Dam in South Africa.

Water supply and demand

The total water demand for Botswana is determined by a number of factors such as population, price, incomes, level of commercial and industrial activities, and weather conditions (du Plessis and Rowntree, 2003). Figure 33 depicts water supply and demand by districts councils. Although a majority of the districts councils are able to supply enough water to meet the demand, there is still serious water supply shortage problems in districts such as Goodhope, Kweneng East, Kgalagadi, North West and Okavango sub districts. Currently, most Districts engage in identifying and drilling of new boreholes, and gradually they experience re-charge problems especially in dry seasons.
Figure 33: Water supply and demand by district councils

Source: Central Statistics Office (2008)

**Water quality**

According to CSO (2008), water quality standards are designed to provide the understanding of the critical importance of adequate supplies of clean, available fresh water for the environment, the country’s economy and the quality of life. Botswana Bureau of Standards (BOBS) has established upper limits and ranges for chemical levels allowable in drinking water. Routine water quality monitoring is carried out at dam catchment areas, treatment and distribution systems Water Utilities Corporation (WUC) (2008). According to WUC (2008) samples are collected and analyzed for various microbiological and chemical constituents. Following a Sulphate Reducing bacteria (SRC) scare in the previous review period, testing for this bacterium became part of the routine water quality monitoring programme with an analysis of one sample per month. After all these tests and more, the water supplied to WUC operational areas continued to meet the requirements of the National Drinking Water Quality Standards (BOBS 32:2000) for chemical quality. For microbiological quality, the results in the first quarter of the review period showed that 97 percent of samples taken were in compliance with the standards (WUC, 2008). However, there remain problems of water salinity in western Districts such as Kgalagadi. The District uses a desalination plant in Tsabong to reduce levels of desalination. When contacted, during this study, the District Commissioner for the District indicated that demand for water has outgrown the current plant and it was now operating beyond its capacity. The District was in the process of replacing the current desalination plant with a larger one and also importing water from South Africa to address problems of water shortage.
**Water Use Account**

Figure 34 shows the country’s water use account. Water use account increased from about 140 million cubic meters in 1992 to about 170 million cubic meters in 2003. Even though the growth in water use account has been minimal, a rapid increase was observed in the mid 1990s due to among other things the expansion of the mining sector. As indicated in the mineral sector, most minerals use bore water free of charge, and although this has serious implications on the sustainable use of the water resource, currently all the water used in the mines is less than the water available in their sources of supply (Central Statistics Office 2008).

**Figure 34: Total water use account; 1992-2003**

![Bar chart showing total water use account from 1992 to 2003.]

Source: DEA (2006)

**Water use by sector**

Figure 35 depicts water use by sector. Clearly, agriculture is the largest water user followed by household and mining sector, respectively. However, the agricultural share in water use experienced a decline over the years. This may be attributed to the expansion of the mining sector and the increase in population of households, where we observed increasing trends in shares of both in mining and household water use. The declining share of water use in the agricultural sector could be associated with stagnation of this sector in terms of technology adoption and limited productivity. Currently, there is increasing production of water, including waste water from the mines and rapid urbanisation. There is a need to support and implement new approaches for sustainable water management and ensure that all water in Botswana is conserved, distributed by need through efficient methods to deserving sectors, and that sanitation
and health needs take priority to protect the environment, the poor and facilitate employment generation.

Figure 35: Share of total water use account by sector; 1992-2003

Source: DEA (2006)

**Water for consumption and Poverty Eradication**

Table 16 shows access to water by type and location according to the 2001 population and housing census. About 88 percent of the households in Botswana had access to piped water, which is also considered clean water for human consumption to the point it leaves the pipe. Only 1.6 per cent of Botswana is known to be depending on rivers as a source of water. Thus significant progress has been made to address problems of poverty associated with lack water access. The major problems are in Kgalagadi District where saline water is difficult for humans being to consume except for use in watering livestock and general washing.

<table>
<thead>
<tr>
<th>% of HH</th>
<th>Urban Areas</th>
<th>Rural areas</th>
<th>Total</th>
<th>Cum. Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piped house</td>
<td>31.6</td>
<td>7.1</td>
<td>21.3</td>
<td>21</td>
</tr>
<tr>
<td>Piped yard</td>
<td>37.8</td>
<td>16.1</td>
<td>28.7</td>
<td>50</td>
</tr>
<tr>
<td>Standpipe</td>
<td>28.7</td>
<td>50.2</td>
<td>37.7</td>
<td>88</td>
</tr>
<tr>
<td>Well</td>
<td>0</td>
<td>4.2</td>
<td>1.8</td>
<td>90</td>
</tr>
<tr>
<td>Borehole</td>
<td>0.1</td>
<td>12.2</td>
<td>5.1</td>
<td>95</td>
</tr>
<tr>
<td>River</td>
<td>0</td>
<td>3.9</td>
<td>1.6</td>
<td>96</td>
</tr>
<tr>
<td>Other(^{13})</td>
<td>1.7</td>
<td>6.6</td>
<td>3.8</td>
<td>100</td>
</tr>
</tbody>
</table>


\(^{13}\) Includes Bowsers, rainwater tank, spring water, dam
Utilization of waste water

Figure 36 depicts trends in wastewater use account by sector. The environment consistently accounted for the largest share of wastewater usage. Most of the wastewater used by the environment is discharged in rivers and the rest is lost in evaporation or treatment losses. Although agriculture was the second largest user of wastewater, it accounted for a small proportion of waste water extraction that was available. However the trend has been slightly increasing in agriculture, from about 320,000 m$^3$ in 1992 to 600,000 m$^3$ in 2003.

Figure 36: Wastewater Use Trend in Botswana; 1992-2003

![Graph showing wastewater use trend in Botswana](image)

Source: DEA (2006)

Figure 36 indicates that little use is made of wastewater and that an increasing amount is discharged into the environment. Given Botswana’s water shortage, additional uses for wastewater should be considered. Some could be recycled for drinking, brought to a sufficient standard to irrigate crops or used to provide water to wood lots and so on.

Water Management Approach

The provision of water has been a policy priority in Botswana since the early seventies. Government supply water to urban areas and rural villages through the Department of Water Affairs (DWA), District Councils (DCs) and the Water Utilities Corporation (WUC). District Councils provide water for Remote Area Dwellers (RADs) with both portable and livestock drinking water. DWA is responsible for supplying groundwater to seventeen major villages and settlements through the DCs. It is also responsible for the protection of surface water resources from pollution aquatic weeds and for administering the water legislation (CSO, 2009). DCs, on
the other hand, are responsible for the operation and maintenance of water schemes in medium villages and smaller settlements.

**Energy, Environment and Poverty Eradication**

a) **Sources of Energy**

Both traditional and conventional sources of energy are used in Botswana. The most widely used traditional source of energy in the country is fuel wood while conventional sources of energy and their use vary from sector to sector. Examples of conventional energy sources by use include liquefied petroleum gas (LPG) and paraffin for households, diesel for agriculture, coal for industry and petrol for the transport and government sectors. Figure 37 below shows final energy demand (FED) in terajoules by energy source from 1990 to 2003.

**Figure 37: Final Energy Demand (Terajoules) by energy source**

![Figure 37: Final Energy Demand (Terajoules) by energy source](image)


**Coal**

Botswana has abundant coal reserves estimated at 212 billion tonnes. The country has only one operating coal mine at Morupule which contains 5 billion tonnes but has a production capacity of less than 1 million tonnes per year. More than half of the locally produced coal is used to power the BPC public thermal plant. Botswana is likely to depend on coal for power generation for the foreseeable future, making it necessary to explore clean coal technologies. There is some coal
bed methane and there are some plans to include the resource in the energy mix once commercial viability has been verified. Recent studies place estimates of coal bed methane at over 190 trillion cubic feet.

**Petrol and Petroleum Products**
All petroleum products are imported through South Africa as there are no refineries in the country. Petrol and diesel are used mainly by the transport sector contributing 18.6% and 21.8% respectively to FED in 2003. Paraffin is mainly used for lighting in households nationally at 53% (49% in urban and 59% in rural areas). LPG or gas is mainly used for cooking in urban households and major villages (with more than 5000 people). As can be seen in Figure 32, the use of LPG for cooking in these areas is on the increase. More than half of the country’s electricity is imported.

**Renewable Energy**
Botswana is abundant with sunshine and hence solar potential. The source is already being exploited for off-grid systems. However the country still relies predominantly on fossil fuels which are non-renewable. Only about 1 terajoule of FED comes from renewable energy sources mainly solar. This comes from 0.23% of households nationally 73% of which are rural households who use it mainly for lighting. The country has no hydro potential and limited wind and biomass potential for power generation although trials are underway to explore the potential for growing Jetropha in the country.

**The Relationship between Energy Harvesting and the Environment**
As stated earlier the poor rely disproportionately more on the environment for energy especially on the harvesting of fuelwood. Because they have free and unrestricted access to forests and woodlands in the areas where they reside, this has meant that over the years trees have been cut down without any replanting taking place alongside this activity. This means that large expanses of land have been left bare with no protection from runoff which has exposed the soil more to soil erosion and impacted negatively on soil fertility and therefore agricultural productivity in an already fragile agroecological ecosystem. The fact that trees surrounding villages have been decimated means that the search (time taken to find adequate firewood) and actual cost for
fuelwood has increased in economic terms. For example, it takes almost 3.3 hours now to find a suitable tree to cut down and individuals have to travel at least 5km on average before they find a suitable tree to cut down. All this in its entirety means that time which could have been spent in other productive economic activities is lost in search for fuelwood, time. This means that labour productivity is reduced. The areas that are most affected by this phenomenon (deforestation) include all areas around villages and settlements. This could imply increased problems of soil erosion, deforestation, and overgrazing.

The rate of deforestation is estimated at around 0.9% per annum with at least 69% of the country’s land being classified as being degraded (Ministry of Environment Wildlife and Tourism 2006). The problem is now also spreading to major villages and some urban areas because the rapid rate of urbanization means that pockets of urban poverty are beginning to exist and the fact that the urban poor rely on fuelwood for cooking means that they will also begin to cut down trees in their vicinity. The burning of wood for cooking is a major cause of indoor pollution causing respiratory problems for users. Women and children are generally the ones who are mostly affected as in many cases they are the ones collecting fuelwood and doing the cooking in rural settings. Tackling the issues of access to energy, poverty and deforestation are linked. Therefore there is a need to invest in activities which will increase energy efficiency and improve access to cleaner energies that will benefit the poor, reduce women and children’s workload and also reduce deforestation and land degradation.

The country also relies disproportionately more on the extraction of coal and its thermal conversion to electricity in order to meet its electricity needs. In fact recently when the country experienced power shortages as a result of increased demand in South Africa the country saw it fit to expand the generation capacity of Morupule Power station. While this makes economic sense because the country has an abundant supply of coal it places the country in a serious position in terms of its contribution to carbon dioxide emissions into the atmosphere. Carbon emissions have been identified as the main culprit in terms of their contribution to global climate change. Furthermore, there has been a proposition that the severity of a country’s contribution to climate change should be measured in terms of carbon emissions per capita. This new measure if
adopted will place Botswana very high on the list of offenders because the country has a small population relative to a country like China.

The country needs to look at alternative sources of energy which are also sustainable for example the possible use of biofuels like Jatropha and other renewable sources of energy like solar energy. Currently the country is exploiting less than 1% of this energy source. The cost of these new energy sources has been cited as one of the reasons why adoption and use is so low in the country. Perhaps for now we need to focus on the adoption of using cleaner technologies in coal extraction as a short term strategy and then focus on the development of renewable energy as a long term strategy. Currently plans are underway to explore the feasibility of growing Jatropha as a biofuels in the Central District under the Energy Hub. The plant has great potential as it is suitable to the agrecological climate of the country it can grow in arid places where it would not be in competition with other crops such as maize and other small grains. In addition, since it is a cash crop it will generate employment and thus incomes and also contribute towards the sustainable diversification of the economy.

A key part of any strategy designed to improve the current situation will necessarily involve looking at the current incentives and disincentives and the behaviour they are rewarding and punishing. It is important to ensure that policies and regulatory rules or laws are not contradicting one another. If loopholes exist they must be corrected as these will be exploited by human beings for their own benefit to the detriment of the environment.

People will have to be sensitized and their awareness increased about the linkages between their existence and the environment. It is important that the environment is not appreciated only in terms of the costs that are associated with it but also that it is an asset whose outputs can be harnessed into good viable projects that can generate employment and much needed incomes. For example, waste water which is an output from economic activity is usually viewed as bad, which must be disposed off in a particular way which is viewed as being costly by many. However, the suggestion here is that this output must be viewed as a good or opportunity which can potentially generate employment and thus income in terms of its potential for reuse in agriculture as grey water. Recycling presents us with many opportunities for reusing outputs from the environment.
Generation of Waste, and Its Contribution to Growth, Environment and Poverty Eradication

As a country develops and rapid urbanization occurs, the amount of waste it generates also increases. Waste can be a source of employment through its management such as landfills, transport and plant machinery jobs, and can also lead to recycling activities that contribute to growth and employment generation. Waste can also lead to problems of pollution if not well managed. Dealing with such waste is usually seen as a cost and very rarely is the waste management problem viewed in terms of the development opportunities it holds for the country’s development. Ignoring or downplaying the problem of waste can be very costly in the long term since the accumulation of waste can stifle development and be harmful to the environment, particularly where damage is irreversible.

The estimates of the types of waste and quantities of Botswana’s annual waste generated are presented in the Table 17 below:

Table 17: Estimation of Botswana’s annual waste quantities

<table>
<thead>
<tr>
<th>Waste Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Selected solid waste (tonnes/yr)</strong></td>
<td></td>
</tr>
<tr>
<td>Solid waste at landfill</td>
<td>270 425</td>
</tr>
<tr>
<td>Solid hazardous waste</td>
<td>1 560</td>
</tr>
<tr>
<td>Hazardous clinical waste</td>
<td>2 500</td>
</tr>
<tr>
<td>Scrap metal waste</td>
<td>20 000</td>
</tr>
<tr>
<td>Household waste</td>
<td>250 000</td>
</tr>
<tr>
<td><strong>Miscellaneous waste</strong></td>
<td></td>
</tr>
<tr>
<td>Liquid hazardous waste</td>
<td>34 610</td>
</tr>
<tr>
<td>Tyres (number)</td>
<td>90 651</td>
</tr>
<tr>
<td>Household dry cell batteries (number)</td>
<td>24 000</td>
</tr>
<tr>
<td>Lead acid batteries</td>
<td>46 000</td>
</tr>
<tr>
<td>Oil waste (000 litres annually)</td>
<td>5 600</td>
</tr>
</tbody>
</table>

Source: CSO (1996)
Solid waste includes domestic or household waste, human waste such as night soils, ashes from incinerators, septic tanks, septic tank sludge from sewage treatment plants, commercial and industrial waste, hazardous waste, hospital waste street sweepings, demolition and construction debris, and excavation waste. The consumption of canned foods generates about 6500 tonnes of metal waste per year with 90% of all cans generated coming from beverage cans. Most of the solid waste in the country is sent to landfill depots for disposal. This is an expensive and traditional approach.

As can be seen from Table 18 below urban areas are the main waste generators. This is mainly because of higher consumerism and higher population densities concentrated in the urban areas.

Table 18: Mean per capita waste generation by locality

<table>
<thead>
<tr>
<th></th>
<th>Waste disposed ((m³/person/year))</th>
<th>Waste disposed (kg/person/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>2.32</td>
<td>1.32</td>
</tr>
<tr>
<td>Rural</td>
<td>0.36</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Source: CSO (2000)

When it comes to waste including radioactive waste, which poses a threat to human health and the environment, there is growing concern about the handling of such waste as well as its amount that might be illegally entering the country. Serious environmental problems that are posed by the inappropriate disposal of waste include the infection caused by deficient disposal methods of hospital waste, contamination of water due to chemical waste and the pollution of underground water from waste oils (Vander Post 1991; Bolaane and Kgathi, 2001).

Proper and adequate waste facilities are usually found in upper income urban areas. Waste that is not collected is usually dumped and burned in the open releasing CO and CO₂ emissions. In rural areas the problem of waste disposal is much worse with medical waste often disposed of by inefficient incineration methods that also contribute to CO and CO₂ emissions. In some cases incineration is unsupervised in low-income and rural settings (Gwebu, 2003).
The current waste management situation is characterized by the inability of local authorities to collect all the waste generated. It is estimated that only 40% of the waste generated is collected for disposal. In the larger villages 60% of residents have their refuse collected by the local authority compared to only 70% in the rural villages. The use of economic instruments such as
the implementation of the polluter pays principles has not yet matured although the Green Police have been deployed in many villages to punish violators. The effectiveness of the Green Police in being able to punish violators from government institutions has been questioned.

Waste collection and transportation is limited by inadequate equipment, personnel and financial resources that are available to financial authorities. Often time in budgets environmental investments get low priority compared to other projects with immediate impacts. Consequently, hazardous materials do eventually find their way to dumping sites where they a mixed up with municipal waste.

Population growth in major centres and extended sewerage systems have led to an exponential increase of return flows of waste water. Inappropriate designs of treatment facilities have resulted in spillage and damage to the environment. There are approximately 75 treatment facilities nationwide that use different technologies (pond systems, activated sludge, trickling filters, RBC and wetlands) each with varying quality, treatment and discharge compliance rates. Urban centres have good sewage coverage; focus should be on the rural areas.

The amount of wastewater will increase significantly in the next 25 years and water reuse strategies need to be developed. Other requirements include trade effluent standards and agreements, licensing water of sewer networks and treatment facilities, proper legislation and monitoring protocols. Work has been done on vulnerability mapping, case studies on hazardous waste, landfill studies and the country is a member of the Basel Convention.

Problems of waste management and pollution control also include pollution due to spillage of used oil on to the ground which may eventually contaminate water and the improper disposal of hazardous waste. There is a clear need to undertake analysis and provide evidence on the costs and benefits of safe and sustainable waste management in Botswana as well as mechanisms to reduce and avoid pollution from waste.

Currently there are no recycling plans in Botswana. However, a number of Non-governmental Organizations such as Somarelang Tikologo (ST) are engaged in awareness raising campaigns
about recycling opportunities in the country. ST is an NGO based in Gaborone which deals mainly with waste management, resource management and environmental planning. It carries out its responsibilities by conducting demonstrations in schools (e-schools), providing alternative solutions to government landfills that are used for solid waste disposal and providing proper recycling. ST is funded through the Corporate Social Responsibility (CSR) initiatives of private companies (like Barclays, Debswana, Kgalagadi Breweries Limited, etc). In recognition of the role that the media can play in sensitizing the public about environmental awareness ST has in the past ran environmental journalism awards for a period of two years before running out of funds. ST also has some outreach programmes for remote area dwellers. Additionally, ST has lobbied members of parliament to get them to buy in to their activities.

Some of the successful projects that ST has done include a project for greening the city for town planners; training workshops for teachers and the production of an environmental educational documentary. The problem that ST has faced in doing this was that the Ministry of Education and Skills Development has no buy in or ownership of environmental programs. Although the environment was included in the teaching curriculum, the teachers were not trained. This greatly affected their effectiveness and ability to deliver to learners. One major milestone for ST was successfully getting the regulation of plastic bags legalized. It took ST together with other stakeholders 10 years to get the regulation through the Ministry of Trade and Industry.

The main challenge or obstacle for ST is the lack of funding since Botswana became a middle income country. NGOs spend time competing for scarce funding and this renders them less able to work independently and collectively to deliver on their mandates. ST realises that it is important for Batswana to understand how their day to day activities impact on the environment. Existing policies needed to be translated to the local dialect to enable the average person to read and understand them. Concerns have also been raised about the management of the EF. Smaller NGOs felt that they had no voice in the policy making process. In addition, it was observed that the Green Scorpions were effective at policing big companies but not able to police government institutions. In order to make them more effective ST suggested that perhaps a separate regulatory body which could be given more powers and autonomy was needed to serve as the environmental watchdog.
The key poverty and environment issues when it comes to waste relate to the high burden of environmental health upon the poor who suffer most due to poor access to clean water and sanitation, indoor air pollution from burning un-clean fuels, diseases spread by factors such as malaria, etc. Whilst the burden upon the poor and indeed, the economy is high the costs of preventing such health problems tends to be considered high with politicians and decision-makers preferring to provide funds to tackle a visible problem rather than preventing an unforeseen one.

In Botswana access to good sanitation is often confused with the provision of water. Many people still do not have access to a toilet. The issue of sanitation often slips through the cracks because clean water is ranked higher on the list of priorities than sanitation. The problem is exacerbated by water scarcity so more often than not pit latrines are used. Contamination of drinking water from poorly constructed latrines and waste dumps is a major concern and persistent because of high cost of safer alternatives. In 2006, 532 children died from diarrhoea mainly because their drinking water was contaminated by E.coli which means that human waste was found in the drinking water where the people were living. Another problem is that water hygiene is low in Botswana. People use plastic containers or bottle to store water. These water tanks are not properly covered.

At the local level it is Councils that deliver on health related matters and have the mandate on sanitation issues but often have insufficient resources. The funding of environmental investments will become more serious with the 7% budget cut that is required across all ministries for NDP10. It is important that a holistic system is developed to deal with waste management rather than the fragmented way in which it is dealt with. The Department of Environmental Health has problem getting assistance from donors because Botswana is regarded as a middle income country. In Botswana 1 person creates 2kg of waste per year. This figure is very high because Botswana is still developing.
Achievements in Waste Management

Stakeholder participation in waste reduction and prevention in Botswana is an emphasized strategy in sustainable waste management. All stakeholders must participate in ensuring that waste is managed because government cannot do this on its own. There is involvement from government, NGOs, the private sector and the community. The country formulated its waste management strategy in 1998 under the Department of Waste Management and Pollution Control. The country also has a Waste Management Bill which is being implemented and the movement of all waste in the country is subject to the Basel Convention. The establishment of medical waste incinerators is also being vigorously pursued to reduce the risk of infection resulting from poor disposal of medical waste. The government has also constructed a facility in Selebe Phikwe with a 50 year life span for the interim storage of disused or orphan radioactive sources to properly manage and control radioactive waste. The facility will store the radioactive waste until it can be safely be disposed in a landfill.

Table 19: Stakeholder Participation in Waste Management

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Examples</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Governmental Organizations</td>
<td>Somarelang Tikologo, Kgalagadi Conservation Society, Environmental Heritage Foundation.</td>
<td>Plastic Legislation</td>
</tr>
<tr>
<td>Private Sector</td>
<td>SHELL, Barclays, Coca-Cola, Kgalagadi Breweries, Scrapcor.</td>
<td>Funding through CSR initiatives of private companies; Re-use of soft drink bottles; Deposit scheme to encourage return of bottle; Purchasing of scrap metal.</td>
</tr>
</tbody>
</table>

The involvement of Private Sector partnership with local communities in solid waste management has created employment and job opportunities to a substantial number of jobless people, many of whom were previously unemployed women and youth. The current waste management experience demonstrates that formal organizations alone cannot deal adequately with the increasing volumes, complexity and diversity of urban wastes. The waste management challenge in Botswana requires sustained waste recycling, re-use and composting programs via a
partnership approach with a framework that will clearly outline the responsibilities of all parties involved. This calls for the development of Integrated Waste management Systems in urban centres of Botswana.
6. The Makgadikgadi Pan

Key findings

- The Makgadikgadi Pan is a unique saline wetland ecosystem.

- Arntzen et al. (2010) estimate direct and indirect use values to Botswana from the Makgadikgadi management area (MFMP) of more than a thousand million Pula a year in 2010 prices. Putting these into the TEEB ecosystem service framework tell us that the annual value of provisioning ecosystem services account for nearly 2/3 of the total estimated value (with soda ash and salt being the most important component). Although regulating services only account for 14% of total economic value, their ecological value in terms of ensuring the MFMP is sustainable will be much higher.

- Although there is little evidence on how these economic values relate to poverty in this area we do know that local livelihoods derived directly from the natural resources of the MFMP are small in comparison to the economic benefits gained by the country as a whole (22% of the total).

- The share of total tourism income that goes directly to support local livelihoods is particularly low (6%). Consequently, local people prioritise livestock use on marginal land that is far better suited to wildlife-based tourism (McCulloch, 2010). Unless CBNRM is developed to benefit the community as a whole, local people will continue to feel they lack a stake in developing tourism in this area.

- Veld products generate far more income for livelihoods than does arable or livestock agriculture. This is true at a local level and even more evident at a national level once the cost of subsidies are taken into account: every Pula of household income from agriculture costs the Government money but this is not the case with wild foods or grasses. Despite this, there is little in the way of policy to secure sustainable use of these natural resources and realise their potential for income generation.
• The carbon sequestration value of the Makgadikgadi is very high – 136 million Pula/annum – but this is currently a notional value. It makes sense to consider the scope for local communities to benefit from payment for environmental services as there is a significant potential return per household which has a good chance of influencing local behaviour.

The Makgadikgadi Pan Environment and ecosystem

This section of our report is based on the Makgadikgadi Framework Management Plan (MFMP) Volume 2, technical reports. These MFMP annexes are exceptionally detailed and are the recommended source for readers looking for further information in this area.

Overview

The predominant (but by no means the only) wetland type within the Makgadikgadi Wetlands System (MWS) and MFMP area is seasonal/intermittent saline/brackish/alkaline lakes and flats. The major land systems within the MFMP area include the Kalahari Sandvelt, the sandridges, the back barrier flats, the paaelaeolake bed deposits, the fluvial systems and the Eastern Hardvelt.

A GIS analysis for the MFMP of the predominant terrestrial vegetation types throughout the MWS identified six main vegetation types: Saline Grassland, Shrubbed Grassland, Mixed Mopane, Mixed Acacia, Mixed Terminalia, and Mixed Combretum.

MWS wildlife contains species well-adapted to the unique and often extreme conditions of this saline and highly variable wetland ecosystem. The rich and diverse fauna community has been identified as a biodiversity hotspot in the country’s 2003 Biodiversity Strategy Action Plan. In order to cope with the dramatic variation in water availability within this ecosystem, fauna has to migrate and this requires connectivity with external ecosystems.

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14 This section is drawn from McCulloch, G., (2010), Centre for Applied Research and Department of Environmental Affairs, Makgadikgadi Framework Management Plan, Chapter 4, Volume 2, technical reports, Gaborone.
Despite high salinity and variation in salinity, the MWS is one of the most productive lakes in Africa, particularly for shrimp. This supports abundant seasonal birdlife: one hundred and four water bird species migrate to the pans each rainy season to feed and, on average, there are more than 30,000 water birds in the MWS each year.

As well as invertebrates, fish, reptiles and amphibians are important components of the ecosystem and are of value to the remote-area communities in Botswana. Eighteen species of amphibian and fourteen families with seventy-one species of reptiles have been identified to occur in the MWS.

The rangeland that surrounds the MWS is a very important habitat for many species of mammals including charismatic species that are particularly valuable for tourism. These include Wild Dog, Lion, Leopard, Cheetah, Elephant, Hippopotamus, White Rhino, Brown Hyaena and the Black-footed Cat.

According to McCulloch (2010), “rapid development of Botswana has led to increasing loss of habitats. In addition, non-sustainable harvesting, changes to the hydrology of wetlands, fire, alien invasive species, climate change and overgrazing threaten wild plants. The main threat to the flora of Botswana, according to the Red Data List is, however, livestock grazing. Most of the MWS’s rangelands are used for communal grazing and high livestock numbers around watering points and settlements is putting pressure on the indigenous flora”. p12

While there is a trade-off between livestock grazing and tourism, McCulloch notes that some mammal species are important flagship species that are used to rally conservation efforts, e.g. Elephant, and Lion, while also being responsible for most of the human-wildlife conflicts. Single species conservation efforts can, therefore, have significant land use conservation benefits.
Hydrology
Average annual rainfall for the Makgadikgadi ranges from 359mm in the southwest to 545mm in the northeast with an average of 450mm. This, however, varies a great deal from year to year. As the amount of surface water in the pan is small relative to the rainfall in the area, even taking high levels of evaporation into account, the MFMP analysis concludes that most of this rain goes to recharge groundwater.

There are existing conflicts over water off-take and McCulloch (2010) identifies that these are likely to be of particular concern in northern Sua and to some extent central Sua areas. “Extraction from the BotAsh wellfield, alongside significant surface water inputs by the Nata River play out north of Sua spit. In addition this area has the potential for surface dam construction in the Mosetse catchment and is subject to ongoing groundwater extraction in the Dukwe wellfield within the Semowane catchment. It is also the most visited area by tourists due to the proximity to the tar road the Nata Camp and Nata Bird Sanctuary”. p48

Abstraction of groundwater by the Orapa mine is also highlighted. “Continued mining of this groundwater at current rates may not only reduce the long-term water supply to the mine but also affect supply of other uses (e.g. domestic water in Lethakane and surrounding villages and the numerous cattle posts in and around the mine well fields); moreover it may eventually lead to ingress of saline water especially from the north as regional groundwater flow gradients are changed” p49

Ecosystem services
McCulloch (2010) follows the Millennium Ecosystem Assessment (2005) characterisation of ecosystem services while our conceptual framework uses the slightly different TEEB (2010) characterisation which is better aligned with economic valuation. The purpose of illustrating how ecosystems contribute to human well-being remains the same and both categorisations face the same problem: there is little quantitative evidence on how changes in management affect ecosystem services. Nonetheless, following our conceptual framework, the description of ecosystem services is a key input to economic valuation and we reproduce Table 20 from McCulloch (2010) below.
Table 20: Ecosystem services provided by the MFMP area

<table>
<thead>
<tr>
<th>SERVICE CATEGORIES</th>
<th>SPECIFIC SERVICES</th>
<th>Services provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provisioning</td>
<td>Food</td>
<td>Rangeland and woodland provides wild game, fruits, and grains; Rivers provide fish</td>
</tr>
<tr>
<td></td>
<td>Fresh water</td>
<td>Surface water in rivers and small pans is an important freshwater resource both seasonally, and in the case of the Boteti annually; Storage and retention of water in the groundwater table provides an important freshwater resource for domestic, industrial, and agricultural use; Karstic formations in the palaeo lake floors provide both important freshwater sources and groundwater recharge foci</td>
</tr>
<tr>
<td></td>
<td>Fibre and fuel</td>
<td>Woodlands provide logs, fuelwood, and fodder for livestock; Rangelands provide an important source of thatching grass</td>
</tr>
<tr>
<td>Biochemical</td>
<td></td>
<td>Deepwater brines under Sua Pan provide the raw material for the production of soda ash and salt, and sustaining a local economy; Salt mineral precipitation on the pan surface provides salt for salt licks and domestic use</td>
</tr>
<tr>
<td>Genetic materials</td>
<td></td>
<td>Unique biological assemblage in the MWS provides genes important in evolutionary as well as population viability; MWS may hold potential for biotechnology development and resistance to plant/animal pathogens etc; Flamingos and Zebra are keystone and flagship species of the MWS</td>
</tr>
<tr>
<td>Regulating</td>
<td>Climate regulation</td>
<td>Rangelands and Woodlands in particular are a carbon sink for greenhouse gases; MWS also influences local and regional temperature, precipitation, and other climatic processes</td>
</tr>
<tr>
<td></td>
<td>Water regulation (hydrological flows)</td>
<td>Groundwater recharge/discharge is an important process in controlling the hydrology of the MWS; pan flood extent and flood period is influenced by surface drainage and groundwater input</td>
</tr>
<tr>
<td></td>
<td>Water purification and waste treatment</td>
<td>Retention, recovery, and removal of excess nutrients and other pollutants occurs along ephemeral rivers, mainly in the deltas and associated reed beds, and with movement through sand</td>
</tr>
<tr>
<td>Erosion regulation</td>
<td></td>
<td>Grass and woody vegetation cover contributes to retention of fine lacustrine soils and sediments; Riverine habitat is particularly prone to erosion by sheet wash, if undercutting is removed; Groundwater level and capillary fringe maintains pan surface erosion/deposition equilibrium</td>
</tr>
<tr>
<td>Natural hazard regulation</td>
<td></td>
<td>Wetland vegetation and riverine woodland contributes flood control, storm protection</td>
</tr>
<tr>
<td>Pollination</td>
<td></td>
<td>MWS provides a varied habitat for pollinators</td>
</tr>
<tr>
<td>Cultural</td>
<td>Spiritual and inspirational</td>
<td>Source of inspiration for scientists, and entrepreneurs; cultural and spiritual attachment to some of its features, e.g. Kuku Island religious values to aspects of wetland ecosystems, e.g. freshwater pools and springs at respectively Mea and Mosu</td>
</tr>
<tr>
<td></td>
<td>Recreational</td>
<td>Opportunities for recreational activities on the pan are abundant</td>
</tr>
</tbody>
</table>
Local livelihoods

The population in the MFMP area was 31,406 according to the 2001 census, approximately 7200 households. Households typically rely on a range of livelihood sources to reduce risk and these are largely based on natural resource use. Livestock is the most important source of income for most households although more than three-quarters of households are engaged in crop production (primarily for subsistence use). In addition, households make extensive use of veld products (for own use and, in some areas, for trade).

Tourism provides employment (mainly in lodges) but local people did not feel they really participated in this sector. In principle, village trusts manage CBNRM but few community members felt they benefited.

Arntzen et al. report that most villages rely heavily on government welfare assistance programmes. Given the critical importance of mining and tourism for central government revenue, even this component of income can be said to be largely natural resource dependent.
Economic valuation

Ecosystem and economic values

In order to conceptualise the different types of values people gain from a natural resource and to avoid double counting, environmental economists allocate total economic value (TEV) into values from using the resource (direct and indirect use value and holding an option on future resource use) and those from not using it (values from knowing it exists, other people have access to it or being able to bequest access to future generations). TEEB (2010) highlights the links between ecosystem services and TEV as follows:

Table 21: Typology of TEV values

<table>
<thead>
<tr>
<th>Value type</th>
<th>Value sub-type</th>
<th>Value derived from</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use value</td>
<td>Direct use</td>
<td>Direct human use of biodiversity (consumptive or non-consumptive)</td>
</tr>
<tr>
<td></td>
<td>Indirect use</td>
<td>Regulation services provided by species &amp; ecosystems</td>
</tr>
<tr>
<td></td>
<td>Option</td>
<td>Having the option of using ecosystem services in future</td>
</tr>
<tr>
<td>Non-use value</td>
<td>Bequest</td>
<td>Knowing future generations will have access to ecosystem services</td>
</tr>
<tr>
<td></td>
<td>Altruist</td>
<td>Knowing others in present generation have access</td>
</tr>
<tr>
<td></td>
<td>Existence</td>
<td>Just knowing that ecosystem services continue to exist</td>
</tr>
</tbody>
</table>

Source: adapted from TEEB (2010)

With this typology in mind we can consider the economic values placed on the ecosystem services in the MFMP area. As with most total economic valuation (TEV) studies, only a minority of the ecosystem services described in the Table above could be valued by Arntzen et al. (2010). Hence we can say with a great deal of certainty that the total value of ecosystem services provided by the Makgadikgadi significantly exceeds those presented in Table 23.

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Following TEEB (2010), cultural services provide direct use values whereas Arntzen et al. (2010) describe these as indirect use values and we reclassify these in Table 22 below. The soil formation and nutrient cycling services identified by McCulloch (2010) as “supporting” services are best thought of as regulating services with potential for indirect use valuation within the TEEB framework.\(^{17}\)

**Table 22: MFMP area ecosystem services which are given an economic value**

<table>
<thead>
<tr>
<th>Category</th>
<th>Service</th>
<th>Direct use</th>
<th>Indirect use</th>
<th>Option</th>
<th>Non-use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provisioning</td>
<td>Food</td>
<td>Yes</td>
<td>N/A</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Fresh water</td>
<td>No</td>
<td>N/A</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Fibre &amp; food</td>
<td>Yes</td>
<td>N/A</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Biochemical</td>
<td>Yes</td>
<td>N/A</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Genetic materials</td>
<td>Yes</td>
<td>N/A</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Regulating</td>
<td>Climate regulation</td>
<td>N/A</td>
<td>Some</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Water regulation</td>
<td>N/A</td>
<td>Some</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Water purification</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Erosion regulation</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Natural hazard regulation</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Soil formation</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Nutrient cycling</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Pollination</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Cultural</td>
<td>Spiritual</td>
<td>No</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Recreational</td>
<td>Yes</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Aesthetic</td>
<td>No</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Educational</td>
<td>Yes</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

The direct and indirect use values produced by Arntzen et al. (2010) can be expressed in the TEEB ecosystem service framework as shown in Table 23 below and the balance between types of ecosystem values estimated is shown in Figure 40. In terms of the value of ecosystem services

\(^{17}\) It is debateable whether soda ash and salt can really be considered a product of the current ecosystem but they certainly do have a direct use value and in order to capture this within the TEEB framework we include them as a provisioning service.
to Botswana\textsuperscript{18}, provisioning services account for nearly 2/3 of the total estimated value (with soda ash and salt being by far the most important component). Although regulating services only account for 14\% of total \textit{economic} value, their ecological value in terms of ensuring the MFMP is sustainable will be much higher\textsuperscript{19}.

Table 23: Direct & indirect use values of MFMP area ecosystem services

<table>
<thead>
<tr>
<th>Category</th>
<th>Service</th>
<th>Direct use value (Pula/annum)</th>
<th>Indirect use value (Pula/annum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provisioning</td>
<td>Food (agriculture &amp; wild food)</td>
<td>125,971,188</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fibre &amp; food (grasses &amp; firewood)</td>
<td>60,884,520</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biochemical (soda ash &amp; salt)</td>
<td>467,000,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Genetic materials (wildlife refuge)</td>
<td>5,919,200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sub-total</td>
<td>659,774,908</td>
<td></td>
</tr>
<tr>
<td>Regulating</td>
<td>Climate regulation (CO2)</td>
<td></td>
<td>136,451,100</td>
</tr>
<tr>
<td></td>
<td>Water regulation</td>
<td></td>
<td>10,800,000</td>
</tr>
<tr>
<td></td>
<td>Sub-total</td>
<td></td>
<td>147,251,100</td>
</tr>
<tr>
<td>Cultural</td>
<td>Recreational (tourism)</td>
<td>226,718,400</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Educational</td>
<td>2,256,900</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sub-total</td>
<td>228,975,300</td>
<td></td>
</tr>
</tbody>
</table>

Source: Derived from Arntzen et al. (2010)

\textsuperscript{18} Carbon sequestration is more accurately a global benefit.

\textsuperscript{19} The TEV approach focuses on how high a source of economic value is but not how reliable it is.
Linkages with livelihoods, economic growth and poverty eradication

A big advantage of the approach used by Arntzen et al (2010) over that advocated by TEEB (2010) is the analysis of the contribution of the Makgadikhadi to local livelihoods as distinct from the broader economy (see Table 24). This enables us to compare the financial return at the community and national level to various NR uses. While this is certainly useful it does not tell us how financial returns (or access to NR) are distributed within the community and how this impacts on poverty. This is an area where further research is needed.
Table 24: Livelihood and economic use values for the MFMP area (Pula/annum, 2010)

<table>
<thead>
<tr>
<th>Category</th>
<th>Local livelihoods contribution*</th>
<th>Direct gross value added**</th>
<th>Total gross value added***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture and natural resources use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livestock</td>
<td>15 380 537</td>
<td>10 656 741</td>
<td>20 780 645</td>
</tr>
<tr>
<td>Crops</td>
<td>19 209 452</td>
<td>14 707 613</td>
<td>28 679 864</td>
</tr>
<tr>
<td>Grasses</td>
<td>31 953 922</td>
<td>33 565 717</td>
<td>55 047 776</td>
</tr>
<tr>
<td>Wild Fruits</td>
<td>29 075 714</td>
<td>35 659 475</td>
<td>58 481 539</td>
</tr>
<tr>
<td>Firewood</td>
<td>2 689 926</td>
<td>3 558 990</td>
<td>5 848 914</td>
</tr>
<tr>
<td>Mopane worms</td>
<td>9 851 101</td>
<td>10 993 389</td>
<td>18 829 190</td>
</tr>
<tr>
<td>Subtotal</td>
<td>108 160 653</td>
<td>109 141 926</td>
<td>186 855 708</td>
</tr>
<tr>
<td>Tourism</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serviced hotels/motels</td>
<td>Not measured</td>
<td>7 087 700</td>
<td>31 086 500</td>
</tr>
<tr>
<td>Game lodges/camps</td>
<td>Not measured</td>
<td>36 362 900</td>
<td>159 487 800</td>
</tr>
<tr>
<td>Safari hunting</td>
<td>Not measured</td>
<td>5 807 700</td>
<td>25 472 600</td>
</tr>
<tr>
<td>Campsites</td>
<td>Not measured</td>
<td>82 800</td>
<td>145 300</td>
</tr>
<tr>
<td>Mobile operators</td>
<td>Not measured</td>
<td>5 999 900</td>
<td>10 526 200</td>
</tr>
<tr>
<td>Subtotal</td>
<td>14 732 000</td>
<td>55 341 000</td>
<td>226 718 400</td>
</tr>
<tr>
<td>Mining</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soda ash and salt</td>
<td>74 250 000</td>
<td>190 000 000</td>
<td>467 000 000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>197 142 653</td>
<td>354 482 926</td>
<td>880 574 108</td>
</tr>
</tbody>
</table>

*Income to households within the MFMP area
**Gross value added directly to gross national income within MFMP area
***Gross value added within MFMP area as well as in wider economy as a result of use activities in MFMP area

It is important to note that:

1. Local livelihoods derived directly from the natural resources of the MFMP are small in comparison to the economic benefits gained by the country as a whole (22% of the total). While no estimate is provided of government funding to local communities that is financed by tax revenues from tourism and mining “through the focal group discussions it was found that in most villages government assistance programmes, such as Ipelegeng, the destitute and orphans programme, the Old Age Pension programme, and the Remote Area Dweller Programme are very important” p6. Transfers financed by natural resource rents (in general) therefore play a key role in the livelihoods of the poor in this area.

2. The share of total tourism income that goes directly to support local livelihoods is particularly low (6%). This reflects the relatively small number of “up-market” establishments in this area and strong linkages between local tourism spending and national benefits (indirect and induced expenditure). The annual local value of CBNRM
activities is just under 1 million Pula (7% of local tourism value) and achieving an increase in CBNRM is recognised by Arntzen et al. as the most promising option for increasing the local share of total NR value added.

3. Veld products generate far more income for livelihoods than does arable or livestock agriculture. This is true at a local level and even more evident at a national level once the cost of subsidies are taken into account: every Pula of household income from agriculture costs the Government money but this is not the case with wild foods or grasses. Despite this, there is little in the way of policy to secure sustainable use of these natural resources and realise their potential for income generation.

4. The carbon sequestration value of the Makgadikgadi is very high – 136 million Pula/annum – but this is currently a notional value. It makes sense to consider the scope for local communities to benefit from payment for environmental services as there is a significant potential return per household which has a good chance of influencing local behaviour.

McCulloch (2010) also emphasises that existing policies for natural resource management have compromised optimal land use planning around Makgadikgadi and threaten sustainability. In addition to the threat to domestic water supplies from excessive abstraction of groundwater by the Orapa mine, he identifies (with our emphasis in italics):

“(i) the excessive concentration of cattle on marginal land with very little gain to the livestock sector and rural livelihoods, while incurring a heavy, if not fatal blow, to the potential to develop wildlife based economies over extensive areas.

(ii) the exclusion of wildlife from key refuge areas, along the Boteti and northern Ntwetwe pan, by the utilisation of the available water by livestock.

(iii) a dearth of economic diversification potential around the margins of Makgadikgadi Pans National Park due to the polarisation of land uses between wildlife benefits that accrue entirely to the State and livestock benefits that accrue to the individual. Unsurprisingly, much of the marginal land surrounding the MPNP is defended passionately by the rural people found there for, the albeit, small livestock related
benefits they can obtain for themselves, rather than the largely non-existent wildlife related benefits that remain only a distant promise.

This state of affairs is limiting rural livelihoods and damaging both the wildlife and livestock sectors. A radical change to this situation is proposed by effective land use planning and zoning, that reopens dominantly marginal areas of rangeland to wild ungulates and reserves areas with the most potable groundwater and surrounding grazing land exclusively to livestock” p115.

This reiterates the importance of CBNRM as a potential means of generating local livelihood benefits from wildlife and, hence, as a driver of sustainable livelihoods. Realising this potential should be a priority for the Government of Botswana.
7. The Okavango Delta

Key findings

- The Okavango Delta, is the largest inland wetland in the world. Economic values were estimated by Turpie et al (2006) for the ODMP area covering the 55,374 km$^2$ Okavango Delta Ramsar Site (ODRS). Within the Ramsar site, wildlife populations are concentrated primarily in Moremi Game Reserve, which is managed by the Department of Wildlife and National Parks (DWNP).

- In order to minimize risk, most people in this area rely on a mix of livelihood activities but virtually all livelihoods in the ODRS depend directly on natural resource use. Approximately a quarter to a third of adults are in formal employment (in wildlife-based tourism or for the DWNP). Three-quarters of households in the study area are crop farmers although livestock farming (mainly cattle) produces the largest amount of income from local resource use. Fishing is undertaken by up to a third of households in some areas and many households rely on pensions and other government transfers.

- The annual contribution of the Delta tourism industry to the national economy is estimated to be 401 million Pula per year in 2005 prices (622 million in 2010 prices) which accounts for 85% of all annual direct use values (733 million in 2010 prices). Estimates by Turpie et al. suggest that tourism also accounts for 120 thousand Pula/year or 53% of local income from natural resource use by the community themselves and this is less than 0.5% of the total economic value of tourism in the area. Clearly there is very considerable scope for the community to gain a more from tourism.

- Turpie et al (2006) conservatively estimate indirect use values of 277 million Pula/year (430 million in 2010 prices) to Botswana of which 58% are attributable to carbon storage and 28% to wildlife refuge services. These are currently notional values. It makes sense to consider the scope for local communities to benefit from payment for environmental services as there is a significant potential return per household which has a good chance of influencing local behaviour.

- As with the economic analysis for the Makgadikgadi Pan, there is no evidence on how financial returns (or access to NR) are distributed within the community and how this impacts on poverty. Again, this is an area where further research is needed.

- Our conclusions relating to the Okavango Delta are also similar to those reached for the Makgadikgadi Pan. In both cases, livelihoods are critically dependent on natural resources and, in order to provide sustainable benefits for the country as a whole, local natural resource users need better incentives for natural resource management. Indeed, in both cases, the data presented understates the importance of natural resources for local livelihoods as pensions and other forms of direct government support (income transfers) are largely funded by mining and tourism. At the moment the returns to poor households
from wildlife are far too low to encourage the use of land that is in the national interest. Wildlife-based tourism is an important source of national income but could also generate more income for the poor if CBRNM was more effective.

- Local people are well aware of the importance of resilience and reduced vulnerability and they rely on a diverse range of income sources. However, as these are all based on NR use, increased climatic variation as a result of climate change poses a significant threat.

The Okavango Delta environment and ecosystem

This section of our report is based on the 2008 MEWT Okavango Delta Management Plan (ODMP) and economic valuation of the Okavango Delta by Turpie et al. (2006)\(^20\) which served as input to the ODMP. These are large, very detailed reports and readers looking for further economic and environmental information on the Okavango Delta should consult these sources.

Natural resources\(^21\)

The Okavango Delta, is the largest inland wetland in the world. From its headwaters in Angola, the Okavango River flows into the delta situated at the northernmost edge of the Kalahari sandveld in north western Botswana. The ODMP covers the 55,374 km\(^2\) Okavango Delta Ramsar Site (ODRS), which encompasses the entire Okavango Delta (wetland area) and the surrounding upland areas. This area is shown in Figure 41 below.

---


\(^{21}\) This section is drawn largely from Turpie et al (2006)
This semi-arid region is characterized by cold, dry winters and hot, wet summers with rainfall occurring mainly from November to March. Average rainfall across the ODRS is 480mm per annum but as evaporation is 5 – 6 times higher the wetland depends very largely on seasonal inundation of the Okavango river.

The delta’s ecosystems range from perennial swamps to dryland areas, which include a large arid island (Chief’s Island) in the middle of the delta. The ODMP recognises five land categories: water, normally flooded, seasonally flooded, occasionally flooded and rarely flooded areas. Floodwaters reach the panhandle in about April, and take several months to spread through the delta, reaching Maun in about August to October. As the floodwaters proceed, the inundated area expands from about 5000 km² to between 6000 and 12 000 km², depending on the size of the flood.
In the Okavango Delta about 94% of inflowing solutes are retained within the delta but this has not led to a saline environment as numerous islands in the delta seem to have been formed through evapotransporative concentration in groundwater of infiltrating solutes. The soils are predominantly arenosols in the delta and Kalahari sands in the dryland areas.

In the delta there are large variations in habitat patterns over small distances as small differences in altitude of 1-2m result in large differences in the frequency and duration of flooding. This creates habitat gradients from permanent rivers and lagoons, to permanent swamps with reeds and papyrus, seasonally flooded grasslands, occasionally flooded grasslands, and riverine woodlands and dry woodlands. Each of these habitats has a distinct species composition not only of plants but also of reptiles, birds and mammals.

Relative to other tropical wetlands the Okavango Delta has a low number of fish species, but high numbers of plants and mammals, particularly large mammals. Within the Ramsar site, wildlife populations are concentrated primarily in Moremi Game Reserve, which is managed by the Department of Wildlife and National Parks (DWNP).

**Land use and livelihoods**

Within the Ramsar site approximately 95% of land is under tribal land tenure, the remainder being state land. Usage rights are granted to Botswana citizens usually for residential purposes, ploughing or boreholes. These rights are typically passed on through generations. In addition, citizens and non-citizens can acquire 50-year leases for commercial and industrial developments. Land cannot be sold, but the improvements or developments can.

In 2006 there were 37 Controlled Hunting Areas (CHAs) within the Ramsar Site and about half the study area is under wildlife utilisation (9% in protected areas and 42% Wildlife Management Areas). The remaining 49% is communal land of which most is used for livestock grazing. However, the distribution of cattle is limited by a cordon fence and most of the delta is a cattle-free zone.
Although originally populated by the San, there is now considerable ethnic diversity in the ODRS. The population is concentrated along main roads with half the population in Maun and the remainder largely concentrated around the Panhandle. In 2001 the population was about 111,000 people in 18 300 households living in more than 67 settlements. Children make up 53% and the elderly only 6% of the population and 55% of households are female-headed. Turpie et al conclude that most people are rural and poor, and have diversified production systems to reduce risks in an unstable environment.

Virtually all livelihoods in the ODRS depend directly on natural resource use. Approximately a quarter to a third of adults are in formal employment (in wildlife-based tourism or for the DWNP). Three-quarters of households in the study area are crop farmers. Turpie et al report that dryland and molapo farming are worth about P6.5 million and P2.6 million in net income to households in the study area, respectively although relatively little of this is translated into cash income. Livestock farming (mainly cattle) produces the largest amount of economic value from local resource use with an estimated direct economic value of about P34 million.

Fishing is undertaken by approximately a third of households in the panhandle area and a fifth of those in the central area. This is the largest fishery in Botswana, with an estimated total of 3570 fishers and an estimated total annual catch of about 450 tonnes. Firewood, wild foods and grasses are extensively used by local people across the entire area.

By combining data presented by Turpie et al on annual private values from NR use with population in each of the study areas we can see the variation in livelihood activities. This is shown in Table 25. So, while livestock is the main source of private income for all areas outside the Central delta, the relative economic importance it has in per-capita terms varies significantly across the ODRS.
### Table 25: Annual private per capita natural resource use values (Pula, 2005)

<table>
<thead>
<tr>
<th>Resource</th>
<th>Panhandle</th>
<th>West</th>
<th>South West</th>
<th>South East</th>
<th>Central</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock</td>
<td>373</td>
<td>998</td>
<td>1,023</td>
<td>470</td>
<td>25</td>
<td>573</td>
</tr>
<tr>
<td>Upland crops</td>
<td>71</td>
<td>19</td>
<td>35</td>
<td>32</td>
<td>10</td>
<td>39</td>
</tr>
<tr>
<td>Molapo crops</td>
<td>2</td>
<td>79</td>
<td>14</td>
<td>12</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>Upland resources</td>
<td>127</td>
<td>130</td>
<td>139</td>
<td>126</td>
<td>116</td>
<td>128</td>
</tr>
<tr>
<td>Wetland plants</td>
<td>161</td>
<td>119</td>
<td>52</td>
<td>88</td>
<td>61</td>
<td>107</td>
</tr>
<tr>
<td>Fish</td>
<td>88</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>79</td>
<td>25</td>
</tr>
<tr>
<td>Wetland Birds</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>-1</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Derived from Turpie et al. (2006)

Turpie et al. (2006) also find that households with livestock at cattle posts have larger herds, with an average of 32 cattle, 28 small stock, and 6 donkeys/horses. In comparison, those that keep their livestock in the village have an average of fewer than 5 cattle, 16 small stock, and 3 donkeys/horses. In general, herd sizes rise with income and so it is likely that the poorest households hold livestock at the village rather than at cattle posts.

**Economic valuation**

**Direct use values**

It is very important to understand the private values to the households within the ODRS as their behaviour is likely to be governed by these financial incentives. However, for Botswana as a whole, the relevant economic value is the contribution to the national economy. In general, natural resources such as firewood, wild foods and grasses that are used sustainably and locally have an economic value close to their private value. The national economic value of agriculture is lower than the equivalent private value once subsidies are removed. For tourism, however, the national economic value significantly exceeds the local value due to the multiplier effect of local spending on the national economy.

Turpie et al. (2006) estimate the contribution to national income (GNP) of each of these economic activities (Provisioning and Cultural ecosystem services) and this is reproduced in Table 26. We illustrate this data in Figure 42. The contribution of the Delta tourism industry to
GNP, on average 401 million Pula per year in 2005 prices (622 million in 2010 prices\textsuperscript{22}), accounts for 85% of all direct use value.

Figure 42: Contribution of ODRS economic activities to GNP

\textsuperscript{22} Using the CPI index from on the World Bank Development Indicators website
Table 26: Estimated contribution to national economic value from economic activities within the Ramsar site (Million Pula, 2005)

<table>
<thead>
<tr>
<th>RAMSAR SITE</th>
<th>Direct output</th>
<th>Direct GNP contribution</th>
<th>Natural resource rent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tourism accommodation</td>
<td>875 360</td>
<td>327 990</td>
<td>158 450</td>
</tr>
<tr>
<td>Lodges/Camps (non-consumptive)</td>
<td>445 580</td>
<td>209 460</td>
<td>102 480</td>
</tr>
<tr>
<td>Camps (trophy hunting)</td>
<td>103 190</td>
<td>56 890</td>
<td>29 930</td>
</tr>
<tr>
<td>Mobile &amp; self-drive safaris</td>
<td>93 290</td>
<td>43 230</td>
<td>18 660</td>
</tr>
<tr>
<td>Guest houses, B&amp;Bs, motels</td>
<td>19 600</td>
<td>12 240</td>
<td>4 520</td>
</tr>
<tr>
<td>Hotels</td>
<td>13 640</td>
<td>6 170</td>
<td>2 860</td>
</tr>
<tr>
<td><strong>Tourism-linked activities</strong></td>
<td><strong>440 450</strong></td>
<td><strong>72 980</strong></td>
<td><strong>33 160</strong></td>
</tr>
<tr>
<td>Restaurants/bars (independent)</td>
<td>110 180</td>
<td>15 930</td>
<td>7 710</td>
</tr>
<tr>
<td>Transport (air charter, airline, road)</td>
<td>105 480</td>
<td>17 980</td>
<td>8 440</td>
</tr>
<tr>
<td>Travel agents, guiding services</td>
<td>47 220</td>
<td>9 470</td>
<td>4 250</td>
</tr>
<tr>
<td>Shopping</td>
<td>169 590</td>
<td>24 270</td>
<td>11 660</td>
</tr>
<tr>
<td>Additional CBNRM income</td>
<td>10 980</td>
<td>5 330</td>
<td>1 100</td>
</tr>
<tr>
<td><strong>Subtotal Tourism</strong></td>
<td><strong>1 115 810</strong></td>
<td><strong>400 970</strong></td>
<td><strong>191 610</strong></td>
</tr>
<tr>
<td>Crop production</td>
<td>9 030</td>
<td>2 770</td>
<td>320</td>
</tr>
<tr>
<td>Crops – molapo</td>
<td>2 770</td>
<td>1 370</td>
<td>190</td>
</tr>
<tr>
<td>Crops – dryland</td>
<td>6 270</td>
<td>1 400</td>
<td>130</td>
</tr>
<tr>
<td><strong>Livestock production</strong></td>
<td><strong>83 210</strong></td>
<td><strong>39 760</strong></td>
<td><strong>960</strong></td>
</tr>
<tr>
<td>Livestock - cattle posts</td>
<td>74 560</td>
<td>34 370</td>
<td>0</td>
</tr>
<tr>
<td>Livestock - village</td>
<td>8 650</td>
<td>5 390</td>
<td>950</td>
</tr>
<tr>
<td><strong>Subtotal agriculture</strong></td>
<td><strong>92 240</strong></td>
<td><strong>42 530</strong></td>
<td><strong>1 270</strong></td>
</tr>
<tr>
<td>Natural resource harvesting</td>
<td>25 719</td>
<td>24 434</td>
<td>16 420</td>
</tr>
<tr>
<td>Fishing</td>
<td>3 194</td>
<td>3 158</td>
<td>690</td>
</tr>
<tr>
<td>Firewood</td>
<td>9 264</td>
<td>8 912</td>
<td>7 870</td>
</tr>
<tr>
<td>Poles, withies</td>
<td>1 884</td>
<td>1 727</td>
<td>1 600</td>
</tr>
<tr>
<td>Timber</td>
<td>601</td>
<td>596</td>
<td>340</td>
</tr>
<tr>
<td>Grass</td>
<td>3 337</td>
<td>3 295</td>
<td>2 480</td>
</tr>
<tr>
<td>Reeds</td>
<td>2 463</td>
<td>2 327</td>
<td>1 380</td>
</tr>
<tr>
<td>Papyrus</td>
<td>26</td>
<td>22</td>
<td>10</td>
</tr>
<tr>
<td>Palm leaves</td>
<td>1 882</td>
<td>1 879</td>
<td>1 050</td>
</tr>
<tr>
<td>Veld foods</td>
<td>1 475</td>
<td>1 475</td>
<td>830</td>
</tr>
<tr>
<td>Medicines</td>
<td>296</td>
<td>292</td>
<td>170</td>
</tr>
<tr>
<td>Birds</td>
<td>920</td>
<td>582</td>
<td>0</td>
</tr>
<tr>
<td>Other wildlife</td>
<td>376</td>
<td>168</td>
<td>0</td>
</tr>
<tr>
<td><strong>Natural resource processing</strong></td>
<td><strong>4 836</strong></td>
<td><strong>4 749</strong></td>
<td><strong>680</strong></td>
</tr>
<tr>
<td>Craft products</td>
<td>2 017</td>
<td>1 998</td>
<td>280</td>
</tr>
<tr>
<td>Food products</td>
<td>2 527</td>
<td>2 627</td>
<td>350</td>
</tr>
<tr>
<td>Wood products</td>
<td>292</td>
<td>224</td>
<td>40</td>
</tr>
<tr>
<td><strong>Subtotal natural resource use</strong></td>
<td><strong>30 555</strong></td>
<td><strong>29 183</strong></td>
<td><strong>17 090</strong></td>
</tr>
</tbody>
</table>

**TOTAL Ramsar direct use values**

<table>
<thead>
<tr>
<th>Direct output</th>
<th>GNP contribution</th>
<th>Natural resource rent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 238 600</td>
<td>472 680</td>
<td>209 980</td>
</tr>
</tbody>
</table>

### Allocation of direct use values to local livelihoods

In Section 8.2 of their report Turpie *et al.* discuss the local income (cash and in-kind) from the direct use of local natural resources. This is shown in Table 27.

#### Table 27: Estimated direct contribution of the Okavango Delta Ramsar Site to local livelihoods

<table>
<thead>
<tr>
<th></th>
<th>Profits-in-kind</th>
<th>Profits cash</th>
<th>Salaries &amp; wages</th>
<th>Rentals &amp; royalties</th>
<th>Total</th>
<th>% shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-consumptive tourism services</td>
<td>0</td>
<td>0</td>
<td>72,800</td>
<td>18,990</td>
<td>91,790</td>
<td>41%</td>
</tr>
<tr>
<td>Hunting tourism services</td>
<td>0</td>
<td>0</td>
<td>13,410</td>
<td>5,650</td>
<td>19,060</td>
<td>8%</td>
</tr>
<tr>
<td>Tourism linked activities</td>
<td>0</td>
<td>0</td>
<td>5,080</td>
<td>0</td>
<td>5,080</td>
<td>2%</td>
</tr>
<tr>
<td>Additional CBNRM income</td>
<td>0</td>
<td>3,180</td>
<td>1,320</td>
<td>0</td>
<td>4,500</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Subtotal Tourism</strong></td>
<td><strong>0</strong></td>
<td><strong>3,180</strong></td>
<td><strong>92,610</strong></td>
<td><strong>24,640</strong></td>
<td><strong>120,430</strong></td>
<td><strong>53%</strong></td>
</tr>
<tr>
<td>Crop production</td>
<td>5,330</td>
<td>1,060</td>
<td>1,150</td>
<td>0</td>
<td>7,540</td>
<td>3%</td>
</tr>
<tr>
<td>Livestock production</td>
<td>17,560</td>
<td>43,610</td>
<td>7,820</td>
<td>0</td>
<td>68,990</td>
<td>31%</td>
</tr>
<tr>
<td><strong>Subtotal Agriculture</strong></td>
<td><strong>22,890</strong></td>
<td><strong>44,670</strong></td>
<td><strong>8,970</strong></td>
<td><strong>0</strong></td>
<td><strong>76,530</strong></td>
<td><strong>34%</strong></td>
</tr>
<tr>
<td>Natural Resource Use</td>
<td>21,070</td>
<td>7,340</td>
<td>150</td>
<td>0</td>
<td>28,560</td>
<td>13%</td>
</tr>
<tr>
<td><strong>TOTAL Livelihood contribution</strong></td>
<td><strong>43,960</strong></td>
<td><strong>55,190</strong></td>
<td><strong>101,730</strong></td>
<td><strong>24,640</strong></td>
<td><strong>225,520</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source: Derived from Turpie *et al.* (2006) Table 8-3

Comparing the direct (private) contribution of natural resources to livelihoods with the contribution to the national economy in the sub-section above it appears:

1. Tourism (and particularly non-consumptive tourism) is the main provider of livelihoods in the ODRS as well as being the main contributor to national income
2. CBNRM income only constituted a very small share of tourism income
3. Livestock income dominates agricultural income

What is missing from Table 27 is the contribution of natural resources via pensions and other government transfer payments. However, we know that local people perceive these to be quite important – household survey results discussed by Turpie *et al.*23 suggest these have a similar value to natural resource use (firewood, wild food etc). Hence the total value of tourism to local

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23 Section 5, Figure 5-3
livelihoods and poverty eradication is likely to be even higher than that indicated in Table 27 as tax income from tourism contributes to this government support.

As with the economic analysis for the Makgadikgadi Pan, there is no evidence on how financial returns (or access to NR) are distributed within the community and how this impacts on poverty. Again, this is an area where further research is needed.

Turpie et al. also present the results of a household perception survey on livelihood options and, in general, the calculation of direct use value and income shares for local people is not consistent with local household perceptions of the importance of income sources. Local people see crops, livestock and employment as each being similarly important. This could reflect the concern of poor households to reduce vulnerability from income shocks rather than maximising income i.e. concern over the resilience of ecosystem provisioning services. The TEV approach used by Turpie et al has been criticised for overlooking this component of well-being. Yet, in this case, the inconsistency we observe could reflect weaknesses in the perception data survey as the authors also find that “only about 10% of farmers are able to meet their household food needs” p54.

**Regulating ecosystem services and indirect use values**

The wetland ecosystem services identified by Turpie et al for indirect use valuation are:

1) Groundwater recharge; 2) wildlife refuge 3) carbon sequestration; 4) water purification; 5) flood attenuation; 6) sedimentation retention and 7) scientific and educational value

In the context of the ODRS the value of flood attenuation and sediment retention are minimal and values for these services are not estimated. In the current ecosystems literature, scientific and educational value is typically considered as a cultural service that has a direct use value but for ease of presentation we follow the Turpie et al categorisation. Their findings (annual values in 2005 prices) are as follows:

“Groundwater recharge: The Okavango Delta provides a conduit for the recharge of groundwater aquifers which are utilised around the perimeter of the wetland. Some 5.8 Mm$^3$ of groundwater is extracted from the study area, worth an estimated P16 million.

Carbon sequestration: Vegetation sequesters carbon, which contributes to the amelioration of damage caused by climate change by reducing atmospheric carbon. Based on published values and sequestration rates obtained from the literature for different habitat types in the study area, it is estimated that the carbon sequestration function is worth about P86 million in the delta and P158 million for the entire Ramsar site.

Wildlife refuge: The Okavango Delta (and Chobe) wetlands provide refuge for certain wildlife species that migrate to other parts of the Ramsar site and beyond, generating benefits and use value in those areas. The value of use of these species used beyond the wetland area is estimated to be P77 million. Of this, use beyond the entire Ramsar site is worth about P30 million.

Water purification: the wetland area has the capacity to absorb or dilute wastewater, thus saving on treatment costs. Relatively little wastewater finds its way into the wetland, however, and the service is valued at about P2.2 million.

Scientific and educational value: The wetland and the ODRC are frequently used for research and educational purposes. Based on the expenditure involved, the annual scientific and educational value is estimated to be at least P24 million for the Ramsar site, of which P18 million is attributed to the wetland area.” p.viii

Carbon sequestration is clearly the main regulating ecosystem benefit but wildlife refuge values are also significant.

Linkages with livelihoods, economic growth and poverty eradication

It is perhaps not surprising that the conclusions relating to poverty eradication for the Okavango Delta are similar to those reached for the Makgadikgadi Pan. In both cases, livelihoods are critically dependent on natural resources. Indeed, in both cases, the data presented understates the importance of natural resources for local livelihoods as pensions and other forms of direct government support (income transfers) are largely funded by mining and tourism.
In order for the ODRS to provide sustainable benefits for the country as a whole, local natural resource users need better incentives for natural resource management. At the moment the returns to poor households from wildlife are far too low to encourage the use of land that is in the national interest.

Wildlife-based tourism is an important source of national income but could also generate more income for the poor if CBRNM was more effective. Local people are well aware of the importance of resilience and reduced vulnerability and they rely on a diverse range of income sources. However, as these are all based on NR use, increased climatic variation as a result of climate change poses a significant threat.

The indirect use values for the ODRS in terms of carbon sequestration and as a wildlife refuge are very high but these are currently notional values. It makes sense to consider the scope for local communities to benefit from payment for environmental services as there is a significant potential return per household which has a good chance of influencing local behaviour.
8. Overall linkage Between Natural Resources and Economic Development of Botswana

A clear and consistent finding throughout this report is that natural resources are vital both for economic growth and supporting livelihoods in Botswana. Approximately 75% of paid employment can be linked to natural resources in agriculture, mining, tourism (hotels & restaurants) and water. In addition, virtually all subsistence employment in agriculture, fishing and veld products (which is unrecorded in official employment statistics) depends on natural resources.

The main natural resources in Botswana are minerals, wildlife, land for agricultural and pastoral farming, water, forest resources including harvested natural resources, fish populations in areas with abundant water. The major minerals contributing to economic growth in Botswana are diamonds in Orapa/Letlhakane and Jwaneng mines, copper and nickel in Selibe-Phikwe and Tati mines; salt and soda in Sua Pan, and coal mining found in Morupule. Botswana has an extensive system of national parks and reserves occupying 25 per cent of the total country’s land that supports some of Africa’s most precious species such as the lion, cheetah, leopard, wild dog, brown hyena, elephants, zebra, giraffe, hippopotamus and many others. Most of these animals are found in the Okavango Delta, the Chobe River system and National Park, Makgadikgadi Pans, and the Central Kalahari Game Reserve. Nearly 70 per cent of the land in Botswana is held under communal land system and its uses include arable agriculture and livestock production (Moepeng 2010). Other natural resources include fish populations in the Okavango Delta, the Chobe River, and man-made dams such as Shashe, Motloutse and Gaborone and other harvested natural resources such as phane caterpillar are found in the Mophane hardveld belts of north east Botswana and the Okavango Delta.

Minerals, mainly diamonds, wildlife resources through tourism, and agriculture, especially livestock farming for beef production are the main natural resources reflected among the economic sectors that have a major share to GDP in Botswana. For instance, in the financial year 2010/11, the GDP share of minerals was 31 per cent, tourism was 5 per cent, agriculture and transport were 2 per cent each (Table 28).
Table 28: Percentage Share of GDP by Economic Activity 2001 – 2010

<table>
<thead>
<tr>
<th>Economic Activity/Year</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>2.2</td>
<td>1.9</td>
<td>2.4</td>
<td>1.9</td>
<td>1.8</td>
<td>1.8</td>
<td>2</td>
<td>2.2</td>
<td>2.4</td>
<td>2.3</td>
</tr>
<tr>
<td>Mining</td>
<td>45</td>
<td>42</td>
<td>36.3</td>
<td>37.1</td>
<td>38</td>
<td>42.5</td>
<td>40.2</td>
<td>40.8</td>
<td>26.1</td>
<td>31.3</td>
</tr>
<tr>
<td>Water</td>
<td>0.7</td>
<td>0.9</td>
<td>1</td>
<td>1.2</td>
<td>0.9</td>
<td>0.7</td>
<td>0.7</td>
<td>0.6</td>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>Hotel and Restaurants</td>
<td>2.1</td>
<td>2.3</td>
<td>3.1</td>
<td>2.7</td>
<td>2.7</td>
<td>3.5</td>
<td>3.6</td>
<td>3.7</td>
<td>4.9</td>
<td>5</td>
</tr>
<tr>
<td>Air Transport</td>
<td>0.3</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>0.7</td>
<td>1.2</td>
<td>1</td>
</tr>
<tr>
<td>Road Transport</td>
<td>0.7</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0.9</td>
<td>1.1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Value added</strong></td>
<td><strong>51</strong></td>
<td><strong>48</strong></td>
<td><strong>43.9</strong></td>
<td><strong>44.1</strong></td>
<td><strong>44.9</strong></td>
<td><strong>50.1</strong></td>
<td><strong>48.2</strong></td>
<td><strong>48.9</strong></td>
<td><strong>36.4</strong></td>
<td><strong>41.2</strong></td>
</tr>
</tbody>
</table>

Source: Bank of Botswana (2010)

According to the World Travel and Tourism (2011) fact sheet, travel and tourism in Botswana are expected to contribute 6.6 per cent in 2011 and 8.6 per cent by 2021. In Botswana, the most popular source of livelihood for many poor households is paid employment, followed by transfers from family members in paid employment and government remittances, and enterprise income (Moepeng, 2010; Statistics Botswana, 2011). However, the share of each natural resource sector to paid employment contribution in Botswana is highest for hotel and restaurants at 32 per cent, followed by transport at 26 per cent and mining at 25 per cent (Table 29). Agriculture has the lowest share of paid employees at 12 percent, which is consistent with case study results from Nshakashogwe (Moepeng 2010) and is also supported by the latest Poverty Survey results (Statistics Botswana, 2011).

Table 29: Share of Employment by Natural Resource Economic Activity

<table>
<thead>
<tr>
<th>Economic Activity</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>0.16</td>
<td>0.16</td>
<td>0.14</td>
<td>0.13</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>Mining</td>
<td>0.19</td>
<td>0.20</td>
<td>0.21</td>
<td>0.13</td>
<td>0.21</td>
<td>0.23</td>
<td>0.25</td>
</tr>
<tr>
<td>Water and electricity</td>
<td>0.07</td>
<td>0.07</td>
<td>0.07</td>
<td>0.08</td>
<td>0.05</td>
<td>0.05</td>
<td>0.06</td>
</tr>
<tr>
<td>Hotel and Restaurants</td>
<td>0.32</td>
<td>0.32</td>
<td>0.26</td>
<td>0.32</td>
<td>0.32</td>
<td>0.32</td>
<td>0.32</td>
</tr>
<tr>
<td>Transport</td>
<td>0.26</td>
<td>0.25</td>
<td>0.28</td>
<td>0.29</td>
<td>0.26</td>
<td>0.26</td>
<td>0.26</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.00</strong></td>
<td><strong>1.00</strong></td>
<td><strong>1.00</strong></td>
<td><strong>1.00</strong></td>
<td><strong>1.00</strong></td>
<td><strong>1.00</strong></td>
<td><strong>1.00</strong></td>
</tr>
</tbody>
</table>

It is important to note that GDP vastly understates the importance of natural resources in Botswana for two reasons. Firstly, most of the ecosystem services from land, water and air are simply not captured in monetary terms by GDP – no value is given to the regulating services such as carbon storage example. Evidence from total economic valuation of the Okavango Delta discussed in this report reveals that regulating services have an economic value of at least half the annual GDP contribution of tourism, agriculture and natural resource harvesting in this area. Secondly, environmental externalities (e.g. damage from mining) are not subtracted from GDP.

A theme that emerges from our conceptual framework and is supported with evidence at various points in this report is the need to sustainably improve the share of ecosystem services from natural resources that are received by the poor. In tourism, for example, CBNRM offers the potential to achieve this but the evidence suggests this potential has so far not been realized. It is therefore important to understand why this is the case and what can be done to rectify the situation.

The policy and regulatory environment plays a critical role in determining how well the poor can access ecosystem services and how well the government targets transfers (funded mainly from mining and tourism revenues) to them. This report has identified opportunities for the poor to gain from better regulation of fisheries and natural resource harvesting and from improved governance arrangements for CBNRM. The lack of property rights is a cause of livestock overgrazing and as those with the smallest herd sizes (concentrated in village grazing areas) are most affected this is likely to directly increase poverty.

Although agriculture only contributes a small proportion to paid employment it remains an important livelihood strategy for rural households (now 40% of the total) and impacts directly on the urban poor through the price of food. Increasing the productivity of small-scale arable agriculture offers the potential for reducing poverty as poverty in rural areas is significantly higher than the average. An important question to consider is whether positive results in other countries in the region from interventions in soil and vegetation conservation, land rehabilitation, water conservation and rain water harvesting and use of drought resistant crop varieties are likely to apply in Botswana.
In Tanzania, for example, rainwater harvesting (RWH) in semi-arid areas with high levels of evapotranspiration and irregular rainfall has been demonstrated to significantly increase maize, maize/lablab and sorghum yields and to reduce poverty. This RWH does involve additional labour, both to create structures to capture the rain and to undertake additional weeding. In Botswana, unlike Tanzania, on-farm labour for this kind of work is in very short supply and is relatively expensive. Hence in Botswana, new approaches are likely to be needed to tackle the twin limiting factors of water and labour availability. One option the Government might consider piloting is to allow work permits for foreign farm labourers where farmers commit to introducing RWH.

As cattle ownership rises with income across most of the income range policies that subsidise private production will favour the non-poor. It is also the case that most (58%) of the poorest 17% of households do not own any cattle, but those that do are highly dependent on them for their livelihoods. For poor households that do rely on livestock in areas where overgrazing is a problem, low levels of productivity make it very difficult to use livestock production as a strategy for moving out of poverty. More research is needed if policy makers are to better target this group. However, we do know that livestock livelihoods of the poor are likely to be particularly vulnerable to climate change and so tackling over-grazing will help to improve resilience.

Horticultural production and yields in Botswana have risen more than 500% since 1998, in part, as more literate farmers have moved into this area. Yet imports have risen even faster in response to rising urban incomes and this presents an opportunity for local producers. An issue worth considering is what would enable low-income groups to take advantage of this opportunity. Experience from Malawi suggests that poor women can successfully move into vegetable production but that this required NGO support over a number of years to build the capacity of poorer female producer groups.
Water supply is another area in which the regulatory and policy environment has a direct impact on development. Declining water use in agriculture has been outweighed by increasing use by households (88% of whom now have piped water) and the tourism and mining sectors. A number of conflicts over limited supplies have been documented. As water from privately-owned boreholes has no price per unit consumed, users have no incentive to conserve water if they believe there is sufficient supply to meet their needs. This use can impose a cost on society more generally (an “externality”) and government intervention is likely to be required to solve this problem (through market-based instruments or regulation).

Tackling excess demand for water is also very costly: SIDA (2008) estimates that inter-basin water transfers and water purchase from neighbouring countries as well as internal recycling of water, and water conservation will add an estimated 300 million Pula to annual water supply costs in Botswana. In terms of linkages across natural resources it is also worth highlighting the Government commitment to re-use of wastewater for agriculture. The objective is to put the available land within close proximity of wastewater generation under irrigation.

Botswana’s rural poor are particularly vulnerable to climate change because they depend most heavily on rain-fed agriculture, wild foods and harvesting local natural resources. The urban poor are also likely to be affected by water scarcity and rising food prices. Coordination and harmonization across Government is required to develop preparedness to tackle climate change through adaptation measures, thereby increasing resilience. These could include use of drought resistant varieties in agriculture, disease risk reduction strategies and developing cultural tourism in addition to wildlife tourism.

We find powerful illustrations for a number of the issues set out in this conclusion in the economic valuation studies of the Makgadikgadi Pan and Okavango Delta by other authors. For example, seeing that direct and indirect use values to Botswana from the Makgadikgadi management area alone are more than a thousand million Pula a year underlines the importance of sustainable natural resource use for Botswana. Although more research is needed to understand how these economic values relate to poverty, the authors demonstrate how share of total tourism income that goes directly to support local livelihoods is particularly low.
Consequently, local people prioritise livestock use on marginal land that is far better suited to wildlife-based tourism. Unless CBNRM is developed to benefit the community as a whole, local people will continue to feel they lack a stake in developing tourism in this area.

The carbon sequestration values of the Makgadikgadi and Okavango Delta are very high but these are currently notional values. Further work to understand the scope for local communities to benefit from payment for environmental services would be worthwhile as there is a significant potential return per household which has a good chance of influencing local behaviour.
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