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ORIGINAL RESEARCH

BOJAAS

Documentation of indigenous knowledge and best-bet practices on the use of animals and plants for sustainable natural resources management in Botswana

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KB, data analysis, manuscript preparation; TR, manuscript preparation; SS, prepared study protocol; MD, prepared study protocol

ABSTRACT

A study was carried out to document indigenous knowledge (IK) and practice on use of animals and plants, and best-bet practices (BBPs) during Phase I (2003-2004) of the Desert Margins Programme (DMP), whose overall objective is to arrest land degradation in the desert margins of Africa through demonstration and capacity building activities. The documentation work was executed in Bobirwa Sub-district and Kgalagadi District using a structured questionnaire, the sample size of which depended on the identification ability of initial informants for more respondents. The study showed the importance of IK on the effective functioning of the traditional leadership to monitor-and-ensure adherence. Traditional leadership played an important role in protecting some animals and trees as well as continuously ensuring that there were active advisors to assist in monitoring the environment. The study further showed that past (indigenous and best-bet) practices were labour intensive and capable of exploiting limited amounts of natural resources which could only satisfy the needs at household level. The predominant existing practices in both districts are the harvesting practices. These practices such as selective cutting of trees, grass cutting using hands or sickle, and harvesting medicinal roots/tubers and replacing soil thereafter, have contributed to sound management of natural resources. Farming practices have, however, undergone some phenomenal transformation including the use of tractors for cultivating large areas across the slopes thus predisposing them to land degradation.

Keywords Botswana, indigenous knowledge (IK), best-bet practices (BBPs), resource management

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INTRODUCTION

A study by Kayombo *et al.* (2005) observed that the deterioration of soil quality, in terms of nutrient depletion and poor physical properties for cultivated as compared to virgin soils was a result of continuous cultivation. Evidence of environmental degradation of land and plant resources resulting from soil trampling and loosening by livestock, soil erosion and decline in tree and grass species was also noted (Kayombo *et al.,* 2005). Darkoh (2000) reviewed work from Botswana and concluded that due to the development of the livestock sector and over-use of the grazing resources, a complex relationship between people and the environment has emerged, giving rise to land degradation. This finding by Darkoh (2000) reinforced the concern and need to stem the trend and to reverse it. The Desert Margins Programme (DMP) was formulated to alleviate this problem. The overall objective of the DMP is to arrest land degradation in Africa's desert margins through demonstration and capacity building activities. In order to achieve this objective, the activities are carried out through seven components; 1. Ecological monitoring and assessment 2. Biodiversity conservation and sustainable use 3. Capacity building 4. Sustainable alternative livelihoods 5. Policy and legal framework 6. Up scaling natural resource management options 7. Stakeholder participation. The DMP had three phases: (a) Phase I (2003-2004) dealt with component 1, (b) Phase II (2005-2008) concentrated on components 2-5, (c) Phase III (being pipelined) will focus on components 6-7. DMP Phase I dealt with soil physic-chemical characterization of benchmark sites, inventory of endangered species, and documentation of natural resources management policies, documentation of IK and Best-bet-practices (BBPs), and assessment of training needs. The output of component 1 has improved the understanding of the ecosystems status and dynamics with

regard to loss of biodiversity. The contribution of the documentation of IK and BBPs to this output is to produce user friendly information packages based on existing scientific and accumulated IK and BBPs.

Indigenous knowledge is local knowledge of a culture or society. It is the basis for local level decision making in agriculture, health care, food preparation, education, natural resource management and a host of other activities in communities (World Bank, 1998). The term indigenous knowledge denotes a type of knowledge that has evolved within the community and has been passed on from one generation to another (Rao and Ramana, 2007). Best-bet practice is defined as a practice common and beneficial to everybody in the community, groups of people and/or practiced by a particular community and/or groups of people over a period of time (Phuthego and Chanda, 2004). The practice can either be indigenous or not. Sustainable natural resources management is the global developmental paradigm consisting of policies, plans, programmes and activities of conserving, managing and utilizing resources to, at least, satisfy basic needs without degrading the resources base (Gyasi and Uitto, 1997). It is generally recognized that IK and BBPs play an important role in the sustainable management of natural resources and also has an impact on global issues such as climate change. This recognition is related to the growing realization that scientific knowledge has contributed very little to the development of communities and societies; in fact it has commonly hastened the depletion of their social and natural resources (Murdoch and Clark, 1994; Norgaard, 1992; Ulluwishewa, 1993). The potential disappearance of indigenous practices could have a negative effect on those who have developed them and who make a living out of them (Tripathi and Bhattarya, 2004). A greater awareness of the important role that IK and BBP can play in the development process is likely to help preserve valuable skills, technologies, artifacts and problem solving strategies among local communities.

It is therefore, important to assess the actual contribution of IK and BBPs to the improvement in understanding the ecosystems status and dynamics in the DMP study areas. The objective of this paper was therefore, to document IK and BBPs for sustainable natural resource management in Botswana's DMP study areas of Bobirwa Sub-district and Kgalagadi District.

MATERIALS AND METHODS

The study was conducted during DMP Phase I (2003-2004) in Bobirwa Sub-district (eastern Botswana) with a mean annual rainfall of 350 mm, and Kgalagadi District (western Botswana) with a mean annual of 250 mm. Bobirwa Sub-district is situated in the hardveld with mostly loams to sandy clay loam soils whereas Kgalagadi District is in the sandveld with predominantly sandy soils (FAO,
1990). The villages were selected by the Purposeful method based on the following criteria:

(a) Inclusion of villages hosting other DMP related studies;
(b) Diversity of livelihood activities (e.g. village population, livestock census);
(c) Close proximity of villages (due to budgetary constraints).

The villages thus covered in the study included:

(i) Motlhabaneng, Mathathane and Semolale in Bobirwa Sub-district;
(ii) Hukuntsi, Tshane, Lokgwabe and Lehututu in Kgalagadi District – North;
(iii) Tsabong, Maleshe, Maubelo and Makati in Kgalagadi District – South.

The location of the villages is shown in Figure 1.The main instrument used to collect data was a structured questionnaire. Before preparation of the questionnaire, there were familiarization visits during which brief meetings were held with community leaders in the Kgotla (i.e. assembly point to deliberate substantive issues and resolve disputes) in each village. The purpose of these meetings was to inform the community about the study. These introductory meetings allowed the village leadership to recommend potential informants for the questionnaire. The questionnaire was then prepared and administered to interviewees, the sample size of which depended on the identification ability of initial informants for more study participants.

Three sub-instruments were used to gather information:

– Individual interviews (based on sample size of 2% of the village population)
– Focus group discussion (comprising of 38 and 50 study participants from Kgalagadi District and Bobirwa Sub-district, respectively)
– Key informants' discussion (comprising of all old village persons perceived to hold vast IK).

The gender composition of the study participants was 70% male and 30% female in Kgalagadi District, and 40% male and 60% female in Bobirwa Sub-district. Ninety-two percent of study participants in Kgalagadi District were 65-95 years old whereas 86% of them in Bobirwa Sub-district were 55-95 years old.

To capture IK, the study participants consented to identify the various practices they used in the past to sustainably exploit natural resources. To identify BBPs, correspondents were asked to identify the practices contributing to past, present and future destruction or conservation of natural resources. The BBP were then established from the past IK and existing knowledge based on;

– Number of study participants to the practice
– General perception of the practice
– Socio-cultural and political acceptability
– Sustainability of the practice.

Focus group discussions with key informants (vis. old experienced farmers, herbalists and traditional leaders) were arranged to verify the data from the administered questionnaire and gather further information on the subject.

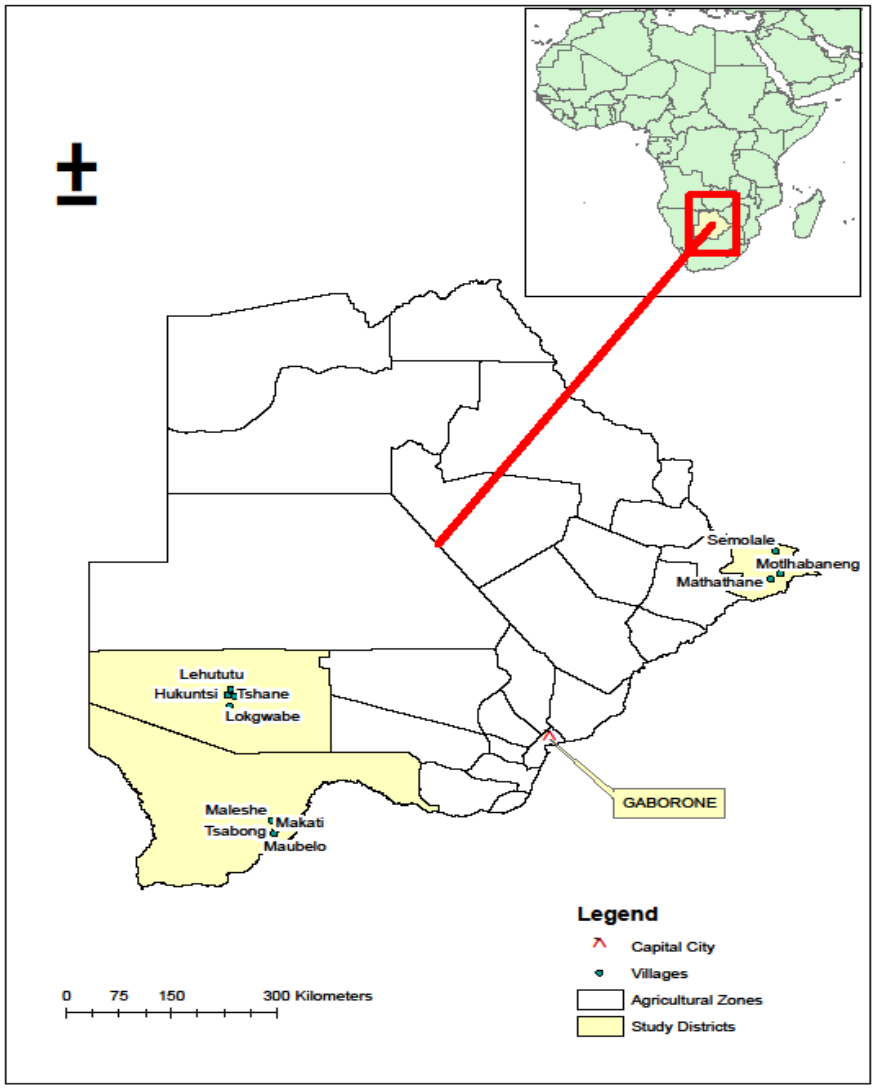

Figure 1. Location of DMP sites in Botswana.

During individual interviews and focus group discussions, the study participants and key informants confirmed the practices by visiting certain sites with the study team to ascertain (ground-truth) artifacts.At every stage of data collection, verbal consent was obtained from each study participant.

Descriptive statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS, 2012).

RESULTS

Past IK on natural resources conservation

Harvesting practices as indicated by study participants in Bobirwa Sub-district and Kgalagadi District are shown in Table 1. Sparing fruit trees and neighbourhood natural resource monitoring featured conspicuously in both districts. Certain harvesting practices were, however, restricted to each district. Manual collection of firewood, sparing some trees from cutting in winter, and carving were peculiar practices in Bobirwa Sub-district whereas grass cutting by sickle and dusting seeds off thereafter, temporal relocation for gathering fruits, and leaving shade trees in the fields were special practices in Kgalagadi District.

The role of traditional laws and taboos on human activities and surrounding environment in Bobirwa and Kgalagadi districts is shown in Table 2.

Table 1. Harvesting practices

Practice	Bobirwa		Kgalagadi	
	Frequency	%	Frequency	%
Fruit trees not cut/used as firewood	16	24	23	26
Neighbourhood natural resources monitoring	11	17	11	12
Only dead plants and trees cut during field clearing were used for fencing and other purposes	7	11	3	3
Only dead wood was manually collected for firewood	20	30	-	-
Some trees were spared from cutting during rainy season	8	12	-	-
Carving was restricted to dead trees in winter	4	6	-	-
Grasses were cut by sickle and seeds dusted off	-	-	25	28
Shade trees were left in the fields	-	-	11	12
Temporal relocation for gathering fruits	-	-	17	19
Total	**66**	**100**	**90**	**100**

Table 2. Traditional laws and taboos on human activities and environment

Practice	Bobirwa		Kgalagadi	
	Frequency	%	Frequency	%
Chiefs protected some animals from being hunted	19	30	19	20
Widows, miscarriage victims and girls on puberty were confined and restricted for given periods	19	30	34	35
Chiefs monitored surroundings and announced start of seasons (for ploughing, hunting, gathering and harvesting)	13	20	9	9
Praying for rain	9	14	4	4
Soil replaced after harvesting medicinal roots and tubers (not exposed to the sun)	3	5	-	-
Household belongings of the dead not kept in rainy season	1	1	-	-
Hunting calving animals was prohibited	-	-	22	23
Starting wild veld fires was prohibited	-	-	9	9
Total	**64**	**100**	**97**	**100**

The role of traditional laws and taboos on human activities and surrounding environment in Bobirwa and Kgalagadi districts is shown in Table 2. The Chiefs played a key role in protecting some animals including totems, monitoring surroundings and announcing commencement of seasons for a variety of human activities. Certain taboos such as confinement and restriction of widows, miscarriage victims and girls on puberty were highly regarded and strictly followed in both districts due to the maintenance of the resource stock enforced by the restrictions. Other practices affecting the environment in Bobirwa and Kgalagadi districts are shown in Table 3. In Bobirwa Sub-district, the most important practices (under this category) were the monitoring of the environment by chiefs and advisors followed by harvesting of fully-grown leaves and barks of certain trees, and the collection of only mature mopane worms *(Imbrasia belina* West*)* from the upper canopy of trees. In Kgalagadi District, however, other practices focused on a variety of traditional methods of conserving water such as the use of ostrich eggshells and special animal skins to collect/keep/transport water, and the collection of liquid from the rumen after killing wild ungulates.

Existing knowledge on sustainable utilization and conservation of natural resources

The existing knowledge on sustainable utilization and conservation of natural resources in Bobirwa and Kgalagadi is shown in Table 4 under various categories of practices. Harvesting practices, such as cutting trees with axe, selective cutting of trees for particular purposes and collection of plant parts to be used for medicine, are common in both districts.

Past BBPs in Bobirwa Sub-district and Kgalagadi District

Both past- and existing-BBPs were established from the past IK and existing knowledge based on four criteria stated under “Materials and Methods” of this paper.
The past BBPs are shown in Table 5. One conspicuous feature in this category of practices is that Kgalagadi District had more distinct water conservation practices than Bobirwa Sub-district. It is also interesting to note the meticulous handling in harvesting veld products such as Mokolwane leaves and mopane worms in Bobirwa Sub-district.

Existing BBPs in Bobirwa Sub-district and Kgalagadi District

The existing BBPs are shown in Table 6. Harvesting practices still persist in both districts whereas arable and other practices are restricted to Bobirwa Sub-district.

Table 3. Other practices affecting the environment

Practice	Bobirwa		Kgalagadi	
	Frequency	%	Frequency	%
Monitoring of environment by chiefs and advisors	15	56	-	-
Harvesting of fully-grown leaves of Mokolwane (*Hyphaene pertersiana)*and bark of Monyee (*Berchemia discolor*)	6	22	-	-
Harvesting of fully-grown mopane worms (Imbrasia *belina*) leaving caterpillars in the highest part of the trees and pupae for regeneration	5	18	-	-
Protection of endangered species and some animals from hunting for aesthetic purposes	1	4	-	-
Use of ostrich eggshells for storage of water, milk, medicines, etc.	-	-	9	45
Manual collection and transportation of water in animal skins	-	-	5	25
Use of liquid from the rumen as drinking water and medicine	-	-	4	20
Fetching of water just before sunset to limit misuse of water	-	-	2	10
Total	**27**	**100**	**20**	**100**

Table 4. Existing knowledge and practice on utilization and conservation of natural resources in Bobirwa and Kgalagadi

Existing Practice	Bobirwa		Kgalagadi	
	Frequency	%	Frequency	%
Harvesting practices				
Gathering ripe fruits only	26	10	-	-
Cutting trees with axe and allow for regeneration	20	7	30	26
Selective cutting of trees for particular purposes	41	15	32	27
Cutting of both dead and live trees (e.g. for firewood)	-	-	30	26
Harvesting of medicinal roots/tubers and replacing soil thereafter	21	8	25	21
Cutting grass with hands/sickle and releasing seeds	37	14	-	-
Farming practices				
Use of cattle/donkey draught power for ploughing	37	14	-	-
Use of hand hoes for cultivation by people without draught power	13	5	-	-
Use of tractors (on hire) for cultivation	13	5	-	-
Gardening	38	14	-	-
Other practices				
Filling of gullies	26	10	-	-
Total	**272**	**100**	**117**	**100**

The most varied and widespread BBPs in both eco-regions concern harvesting practices.

DISCUSSION

The harvesting practices highlighted the differences in social structures of the two eco-regions. In Kgalagadi, the special practices are common for a dominantly hunting and gathering culture whereas the peculiar practices in Bobirwa reflect a more settled life. The dusting off seeds when collecting thatching grass ensured regeneration and avoidance of spread of any invasive species where they existed. It is interesting to note the similarity of this practice to that of the Chenchu people of Andhra Pradesh, India as indicated by Rao and Ramana (2007). The use of already dead plants (for firewood and fences) limited the cutting down of trees whereas manual collection of firewood ensured that limited amounts of wood were gathered. The harvesting of any veld product was guided by customary and common law hence the featuring of neighbourhood natural resource monitoring in both districts. Traditional laws and taboos serve as cultural mechanism to control wanton harvesting of veld products and excessive hunting of wildlife. Other practices in Bobirwa focused on harvesting veld products while those in Kgalagadi concentrated on water conservation. The reason for the differences in water conservation practices between the two districts is that in Kgalagadi water is a scarce resource. Water conservation is, therefore, one of the priorities in Kgalagadi District.

The existing knowledge on sustainable utilization and conservation of natural resources in Bobirwa and Kgalagadi still exhibits a wide range of practices. The glaring absence of farming practices in Kgalagadi District is a reflection of the low annual rainfall (250 mm) and poor soil fertility (sandveld) characteristics in the district. This is in contrast to the relatively higher rainfall (350 mm) and

Table 5. Past BBPs in Bobirwa Sub-district and Kgalagadi District

Category	Practices	
	Bobirwa Sub-district	**Kgalagadi District**
Harvesting practices	Fruit trees not cut for firewood	Grasses cut by hand/sickle and seeds dusted off
	Cutting dead trees	Temporal relocation to gather fruits
	Neighbourhood monitoring of natural resources	Neighbourhood resource monitoring
	Some trees not cut in rainy season	Gathering fruits without cutting trees
	Carving performed only in winter on male dead trees	In field clearing, trees were spared for shade and those cut used for fencing
	Firewood collected from dead trees and transported manually	Protection of trees within the village space
Traditional laws and taboos	Chiefs protected some animals from being hunted	Chiefs protected Kgori and eland
	Restrictions on movement of widows , miscarriage victims and girls on 1st menstruation into livestock and other environments	Restrictions on movement of widows , miscarriage victims and girls on 1st menstruation into livestock and other environments
	Prohibition of killing water snakes	Prohibition of starting uncontrolled veld fires
	Chiefs announced start of ploughing, hunting, gathering and harvesting seasons	Prohibition of hunting calving animals, and hunting was done in winter
	Totems were respected and not killed by respective tribes	Prohibition of cutting trees in rainy season
	Soil replaced after harvesting some roots/tubers for medicinal purposes	Praying for rain
	Chiefs and advisors monitored surroundings	Chiefs and advisors monitored surroundings
Farming practices	Selection of seeds was based on drought resistant varieties, and if treated with ash	
	Shift cultivation	
Water conservation		Water was manually collected and transported in specially designed animal skins
		Ostrich egg shells were used for storage of water, milk and medicines
		Water was fetched before sunset to limit its misuse
		Rumen liquid was used as drinking water and medicine
Other practices	Encouraged harvesting of fully-grown leaves of Mokolwane(*Hyphaene pertersiana*) and the bark of Monyee (*Berchemia discolor*)	
	Harvesting of fully-grown mopane worms leaving pupae and those in the highest branches of trees for regeneration	
	Colonial prohibition of hunting some animals for aesthetic purposes and protection of endangered species	

better soil quality (hardveld) characteristics of Bobirwa Sub-district (Kayombo *et al.,* 2010).

It is evident from the past BBPs in both eco-regions that traditional laws and taboos governed the utilization of natural resources. Differences in traditional laws and taboos between the people of Bobirwa and Kgalagadi were exhibited. People in Bobirwa exhibited settled tendencies through sustainable harvesting of medicinal plant roots whereas those of Kgalagadi demonstrated their pastoral leanings through prohibitions of hunting calving animals and starting of wild veld fires. The traditional authorities are custodians of the taboos and laws which protected the environment.

Natural resource utilization, management and conservation are products of the people's beliefs, taboo systems, traditional practices and knowledge accumulated over decades. Similar observations have been noted elsewhere in Kenya (Mwangi, 2002), India (Rao and Ramana, 2007) and Philippines (Suminguit, 2005).

The harvesting practices are the most predominant BBPs in both districts despite ecological differences.

Table 6. Existing BBPs in Bobirwa Sub-district and Kgalagadi District

Category	Practices	
	Bobirwa Sub-district	**Kgalagadi District**
Harvesting practices	Selective cutting of trees according to need	Selective cutting of trees according to need
	Cutting trees with axe and allow for regeneration	Cutting trees with axe and allow for regeneration
	Gathering ripe fruits only and so enabling maturity of seeds	Cutting dead and live trees
	Cutting grass with hands/sickle and releasing seeds	Collecting only dead trees for firewood
	Selection of medicinal parts of roots according to exposure to the sun	Harvesting of medicinal roots/tubers and replacing soil thereafter
		Protection of trees within the village space and those in the field for shade
Farming practices	Land cultivation using hand hoes	
	Use of cattle/donkey as draught power for ploughing	
	Ploughing across slope	
Other practices	Filling of gullies	
	Harvesting of Monyee bark and Mokolwane central leaf	
	Ancestral control over specific areas	

These practices have contributed to the sound management of natural resources. Farming practices such as the use of hand hoes and animal draught power enabled relatively small areas of land to be cultivated. The introduction of non-indigenous tractor power has markedly increased areas of land cultivation thus predisposing large scale of land to degradation. There are, however, some non-indigenous farming practices such as ploughing across the slope and filling of gullies, which conserve the environment by restoring the land value. All these occurred with a small human population. The rise in human population, in recent decades, has imposed its associated demands on the environment. As a result, some natural resources such as veld products are threatened by deforestation, expansion of cultivated areas and overharvesting (Kayombo *et al*., 2005; Neudeck *et al*., 2012). Sustainable utilization and awareness are needed to respond to these threats. The values of veld products need to be recognized so that they can receive the conservation status they deserve.

CONCLUSIONS

Documentation of IK and BBPs for sustainable natural resources management in DMP areas of Botswana was carried out using a structured questionnaire, the sample size of which depended on the identification ability of initial informants for more respondents. The study showed the importance of reliance of IK on the effective functioning of the traditional leadership to monitor-and-ensure adherence. Traditional leadership plays an important role in protecting some animals and trees and continuously ensuring that there are active advisors to assist in monitoring the environment. The study further showed that past (indigenous and best-bet) practices are labour intensive and capable of exploiting limited amounts of natural resources which could only satisfy the needs of communities at household level, and hence the assertion that the practices were environmentally-friendly. The predominant existing practices in both eco-regions are the harvesting practices. These practices have contributed to the sound management of natural resources. Farming practices have, however, undergone some phenomenal transformation. Tractors are used for ploughing, resulting in large areas being cultivated hence encroaching on previously conserved areas. Ploughing across the slope has, nevertheless the potential to restore the land value.

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Conflict of interest BK is member of Advisory Board of Botswana Journal of Agriculture & Applied Sciences

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