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Forest Dependency and Its Implication for Protected Areas Management: A case Study From Kasane Forest Reserve, Botswana

Lepetu, J. [1*], Alavalapati, J. [2] and Nair, P. K. [2]

[1]Botswana College of Agriculture, Private Bag 0027, Gaborone, Botswana
[2] University of Florida, School of Forest Resources and Conservation, FL 32603, Gainesville, USA

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ABSTRACT: Conservation of biodiversity in protected areas will be more challenging if local communities are heavily dependent on them for various products and subsistence needs. This study estimated forest dependency and identified factors influencing dependency for households living around Kasane Forest Reserve (KFR). Data collected from 237 households were analyzed using logistic regression model. Logistic regression suggests that forest dependency is positively and significantly associated with family size. However asset rich households were less dependent on forest resources. Thus, policy makers need to consider the needs and economic options with the above components as an alternative strategy for forest protection so as to create a win-win relationship between conservation and local rural development options. Apart from the biological threats of the forest such as fire and elephant damage, large areas of the forest (about 3060 hectares) have already been de-gazette for residential purposes of the Kasane town and the expansion of the Kasane airport in 2002.A sustainable management plan should use the forest to pay its own management costs and allow surrounding communities to benefit; hence, they can see the forest reserve as worthy of the protection.

Key words: Biodiversity conservation, Forest dependency, Local communities Kasane Forest Reserve, Botswana

INTRODUCTION

The importance of biological diversity as natural resource capital for economic development, human welfare, and ecosystem sustainability is well recognized (Karimzadegan *et al.,* 2007) and the decline in biological diversity that has been happening during the past several decades has raised serious concerns. For example, in Africa, by the early 1920s, law-makers started realizing that natural resources would not last for ever, and that something needed to be done to conserve the dwindling wildlife and forests, and to combat land degradation (Schroeder, 1999). In many developing countries, a strategy that has been adopted for addressing the problem of biodiversity loss is establishment of protected areas (Wells & Brandon, 1992; *Aminzadeh and Ghorashi, 2007*).

However, legislative measures on natural resources have generally failed to take into account the intricate traditional relationships between people and nature, and replaced them with western institutions and practices, such as courts of law, fines and fences (Fabricius, 2004). This approach viewed forest-dependant people and their activities as "threats" to the forest ecosystem, depriving local people of a resource that they have been accessing for a long time (Shepherd, 1991). Consequently, the preservation paradigm of conservation approach of prohibiting local access to protected areas has escalated conflicts between local communities and

*Corresponding author E-mail: jlepetu@yahoo.com

management authorities in developing countries (Wells *et al.,* 1992). In southern Africa, this particular "official" approach to natural resource management has generated a range of social conflicts that now endanger the very future of natural resources. In particular , for many local communities in developing countries these areas are the main sources of food, energy, nutritional, medicinal and other subsistence needs (Bahuguna, 2000).

Therefore in designing community-based management programs or any conservation and development approaches, an understanding of relationships among resource use patterns is critical. Particularly of interest, are cases in which resource users are composed of diverse stakeholders with various interests? Forest dependency also varies across households (Adhikari *et al.,* 2004; Gunatilake, 1998; Lise, 2000; Masozera & Alavalapati, 2005). In some instances, dependency is reduced as a result of alternative sources of income and livelihood (Gunatilike, 1998; Shackeleton *et al.,* 1998). This suggests that locals' dependency must not be overlooked in protected areas management. In particular the identification of the factors affecting forest dependency is an initial step towards formulating policies that are conducive for an equitable sustainable resource management (Gunatalike, 1998; Hedge and Enters 2000). This study estimates households' dependency on the Kasane Forest Reserve (KFR) in Botswana, identifies key factors influencing the dependency and draws policy implications for management.Before addressing these issues, an overview of the historical and current management and policies relating to forests and the KFR is provided.

At independence in 1966, Botswana did not have a well-defined national forest policy. Only a number of policy statements were inherited from the colonial days. The Forest Act (1968) of Botswana is based on the earlier Pre-independence Forest Act and is still the only legal framework for forest management in the country. This Forest Act is based on scientific forest management that is drawn from existing forestry practices in Europe and the USA. The practices encourage maximization of forest revenues from timber exploitation; but the current issues of biodiversity conservation, equity and customary rights do not feature prominently in the legislation. It is apparent that up to the early twentieth century, indigenous rights and access to forests were restricted by state agencies who claimed to act in the interests of their nations. Many forest-dependent communities were branded as agents of forest-destruction. In the face of these contests (and rapid degradation of forest cover), there has been growing support in Botswana toward placing some 'power' back in the hands of the rural poor. Since the late 1970s, a number of social forestry programs have been developed and the emphasis of state forest policies has shifted from commercial forestry to that of meeting needs of the forest dependent communities. The most recent of these programs (Nowergian Forestry Society(NFS), 1993) has embraced a philosophy of Multiple Use Zoning of forest reserves.

Unlike other countries in the southern African region, Forestry in Botswana has been a sub-sector under the Ministry of Agriculture up until 2003 when it transfeered to become a Department when Ministry of Environment, Tourism and Wildlife was established . The initial functions of the forestry sub-sector, which was transferred from the Ministry of Agriculture in 2003, were mainly to establish plantations and tree nurseries. However, these functions have since expanded to include some technical responsibilities with a view to consolidating the wider objectives of protection, conservation and management of forest resources in Botswana in accordance with the proposed draft national forest policy.

Gazetted Forest Reserves (Table 1). were established specifically for the conservation and better regulation of the use of forest resources. Since the early 1930s, the government has been granting concession to companies to exploit timber in the forest reserves and has, in turn, been paid royalties only from the timber exploitation. The raw timber used to be exported to neighboring countries particularly South Africa and Zimbabwe. This arrangement was not economically sustainable as the country was losing revenue because the timber was sold in its raw form. Furthermore, there were also concerns that concessionaires were not observing their

contractual obligations especially concerning the tree sizes that they were supposed to harvest. The government also had inadequate skilled work force to monitor and supervise the activities of the concessionaires. Subsequently, harvesting operations were suspended in 1993 pending the completion of forest inventories and acquisition of skilled manpower to implement new management plans and supervise any future concessions. However, it is likely that protected forest areas and land under plantations/woodlots will increase because of adoption of new integrated approach towards sustainable management of natural resources.

Table 1. Areas of woodlands on state land forest reserves

Year of	Name of forest	Area (km^2)
1968	Kasane Forest	162.2
1980	Kasane Extension For. Reserve	475
1980	Kazuma Forest Reserve	237.5
1980	Maikaelelo Forest Reserve	625
1980	Sibuyu Forest Reserve	1175
1980	Chobe Forest Reserve	1880
Total		4555

The Chobe District is one of the smallest districts in Botswana and has an international setting. It is located in the extreme northern part of country where Botswana shares boundaries with, Namibia, Zambia and Zimbabwe. The district has a total land area of 22 559 km^2 of which 17 831 km^2 is the total land area of the Chobe National Park and the six forest reserves (Chobe District Development Committee (CDDC), 1997). The District lies within the lines of longitude 24°E and 26°E, and the lines of latitude 17°S and 19°S.The forest vegetation and associated fauna is part of the Zambezian biogeographical region. In Botswana, Chobe is the only district where the rainfall is just adequate to support more or less closed canopy forest vegetation (NFS, 1992). The *B. plurijuga* forests represent the southernmost extension of the natural range of this species, which is geographically restricted from southern Angola eastwards through southern Zambia to western central parts of Zimbabwe. This vegetation type has a wide distribution throughout sub-Saharan Africa and contains a large number of deciduous tree species, all of which are more or less adapted to periodic fires, low and erratic rainfall.

The study area, the Kasane Forest Reserve (total land area 1 360 km^2) is one of the six gazetted forest reserves in Botswana (Forest Act, Chapter 38:04, 1968) all of which are located within the Chobe District. The forest reserves were originally established to protect valuable timber-sized trees from logging operations under Concession agreements (Anton, 1997; NFS, 1992). However, due to the dwindling supply of commercially exploitable timber trees, the logging operations were suspended in 1988 (NFS, 1992). The KFR is located at the extreme northern corner of the country, adjacent to the Zimbabwe international border and very close to Chobe River, which is also an international boundary between Botswana and Namibia. The reserve is bounded to the north by the Kasane town and Kazungula village, Zimbabwe to the east and Chobe National park to the west (Forest Protection and Development Project, 1996). The total annual rainfall for the district is 500–600 mm, which is the highest in the country.

Although all forest reserves are equally important from an ecological point of view, the KFR will always be most affected by any development plans. This is because of its proximity to the town of Kasane, and the villages of Lesoma and Kazungula. In addition, the forest reserve has a well developed road network and therefore experiences a lot of human pressure in the form of tourism, private investors, expansion of villages and government installations. The number of threats to the future existence of the KFR is increasing. Apart from the biological threats of the forest such as fire and elephant damage (Department of Forestry and Crop Production, DCP& F, 1996; Nduwayezu *et al.,* 2004), large areas of the forest (about 3060 hectares) have already been de-gazetted for residential purposes of the Kasane town and the expansion of the Kasane airport in 2002.

Land encroachment poses an even greater threat to wildlife conservation because the KFR

acts as a buffer zone for the Chobe National Park, which is already under immense pressure from the large elephant population. Discussions with the Departments of Forestry and Tourism in Kasane (B. Losika, Pers. Comm, July 2004.) revealed that a lot of pressure is exerted on the Regional Forestry Office in Kasane by different hotels and enterprises who want to conduct mobile tourist safaris and similar activities in the forest reserve. The over-crowding by tourists in the Chobe National Park seems to be the main reason for justifying their interest in opening up the forest reserves for conducting tourism operations.

MATERIALS & METHODS

For the purposes of this study, three (3) communities of Kasane, Kazungula and Lesoma that surround the KFR are considered. According to the 2001 census records of Botswana, the population of this area is approximately 10 247, more than half of the total (18 258) for the Chobe District population. This area has one of the highest population growth rates of 4.03% in the country compared to the national average of 2.38% (Central Statistics Office (CSO, 2001). According to the Central Statistics Office (2001) Kasane Township in 1991-2001 recorded the highest population growth rate (6.46) percent in the country.

The village of Kazungula was established by the Wenela Agency in 1935 to recruit workers for the mines in South Africa. The Wenela Agency also started a forest logging industry for the Chobe forests. The establishment of the clinic and school around 1945 and 1949 brought about rapid expansion of the settlement and crop cultivation. The KFR was established in 1968 on the northern edge of the settlement (Anton, 1997). In 1969, Wenela closed its office in Kazungula and many people who originated from Zambia returned to their home country. The start of the liberation war in neighboring Rhodesia (now Zimbabwe) with its frequent cross-border incursions, forced some people to move to nearby Kasane.

The Lesoma village is completely surrounded by protected areas, which include the Matetsi Safari Area on the Zimbabwean side and the Kasane forest reserve in Botswana. The first recorded settlement was in the 1860s around a semi-perennial spring on the valley floor around which cultivation has continued to the present-day. The bulk of the village is located within the KFR following the movement of people away from the international border due to cross-border incursions in the mid and late 1970s at the height of the liberation war in neighboring Rhodesia. In 2000, the Forestry department negotiated a land swap with villagers and the District Authorities. This re-aligned the KFR boundary further away from the Lesoma village. The population of Lesoma has grown from 234 in 1991 to 454 in 2001(CSO, 2001).

On the other hand, Kasane is not a traditional village, but was established around Government Offices of the District Commissioner, District Police Officer and the Forest Officer in the 1950s (Anton, 1997). Kasane (and to a lesser extent Kazungula) is made up of people of varied ethnic and social groups. Many inhabitants have migrated on a permanent or temporary basis from the other villages in the District into Kasane. In addition to a number of government officers, a number of expatriates are staying in the district, mostly involved in the tourism sector and arable farming. There is improved infrastructure and good housing, although there is shortage of land as the area is surrounded by the Chobe National Park, the Chobe River and the forest reserves. The implication of this migration is that unemployment in Kasane continues to rise (CDDP5, 1997).

Kasane, Kazungula and Lesoma, the three villages surrounding KFR where the study was conducted, have a total of 2657 households (CSO, 2001). From this, a sample size of 237 households was selected which was approximately about 10% of population size. Within the selected villages, a list of the households was acquired from the District Council Offices from which a simple random sample was applied to select households. Sampling was done by writing down names of residents' households on pieces of paper and these were put in a box from which names of the household owners were drawn at random based on the location of the wards. The choices of respondents based on the location of the wards were done in order to ensure equal chances of selecting different land uses around the PA (arable farmers, livestock farmers, tourist operators) and

location-specific factors (e.g., distance to the Protected Areas). Where the household owners were unavailable, it was not possible to go back to visit the household in the evening for fear of wild animals; therefore in such cases, where the head of the chosen household was not available at home, the adjacent or a nearby household was selected.

The survey instrument contained both close and open ended questions. The questions asked were related to resource use, perceptions, the demographic characteristics and socio economic data. The data on household characteristics included (gender, age, household size, residency and education [ability to read and write, non-formal, primary, secondary and tertiary level] and occupational data).Household's dependence on KFR was calculated as the ratio of annual income earned from forests to the total annual income earned from wealth and other sources (agriculture, off-farm employment, and the KFR). The procedures that were followed to derive income from each source are explained below.For this analysis, the forest dependents are defined as the households having a positive income from forest related activities (see explanation below for calculating percentage of forest income below). Forest dependency is classified based on the relative forest income rather than the absolute forest income. Relative income is used because it is difficult to say what level of absolute income determines the forest dependency. Relative dependency is classified as the percentage of full income contributed by forest products while absolute dependency is classified as quantities of forest products collected (Pattanayak *et al.,* 2003). The model used to estimate forest dependency is as follows:

$$\ln(P_i / 1 - P_i) = \beta_0 + \beta_1 X_1 + \ldots + \beta_k X_{ki}. \quad (1)$$

Where:

i denotes the i-th observation in the sample

p is the probability of dependency on forest resources

β_0 is the intercept term

$\beta_1 \ldots \beta_k$ are the coefficients associated with each explanatory variable $X_1 \ldots X_k$.

The impact of age, gender, education, household size (HHsize), total wealth assets (Weassets), and number of years living in the area (Resident) on forest dependency is estimated.Household income was computed for each household based on the information provided by them. The computation of household income was carried out as follows:

Household Annual Income = ∑(Forest Income + Agriculture Income +Return to Wealth + Wage Income)

Forest Income = ∑(Fuel wood annual income + wild fruits income+ poles income + Thatching grass income)

Agriculture Income = ∑(maize income + sorghum income + millet income + Beans income)

Wealth (Assets) = ∑ (Livestock Assets + Household Assets)

Livestock Assets = ∑ (Cattle income + Goats income + Sheep income + Donkeys income + Pigs income + Chicken income)

Household Asset = ∑ (Radio price + TV price + Bicycle price + Tractor price + Donkey cart price + Car price + Cell phone price + Fridge price + Bed price)

Forest income: Information about collection and sale of forest products was obtained from households. In addition, a list of all non-timer forest products (NTFP) was prepared with key informants and the Forestry Staff and Document reviews as a checklist to remind respondents about product they might forget. Products such as thatching grass, fuelwood can be traded commercially to generate cash while subsistence products such as medicinal plants, wild fruits and fuel wood are used for household consumption. Income from commercial products was calculated by multiplying the quantities with market prices. Income on subsistence products was computed based on surrogate prices.

Agriculture Income: Agriculture includes cultivation of crops for purposes of both household consumption and selling. Information on crop yields was gathered from individual households through the questionnaire survey. Prices of crops were obtained from the local market or through the Botswana Agricultural Marketing Board (BAMB) which sets prices for the sale of crops in the country.

Wage Income: Information on salaried jobs and business was collected from individual members. This also includes other sources of income such as

remittances, and pensions for age old people. This information was provided by the respondent.

Other household assets: The annual rate of return on capital (livestock, tractor, and car) was computed as a product of the price and the interest rate. The interest rate used for this study was 10% which was determined after discussion with relevant departments in Botswana. In certain cases such as prices for cattle, goats and other livestock, the surrogate market price was used depending on the age of the animal. Other assets such as small items such as radios, bicycle, and television, the respondent was asked how much he will be willing to sell that item at the current market.Since there was no basis for assigning the forest dependency index from Botswana Government sources, the dependency index in this particular study was divided at the median (Sah and Heinen, 2001). Although there are a few cases in the 40% range and beyond, the majority of cases are clustered at the lower end of the scale, with most of them falling below 8%. These high values for only a few cases have a significant effect on the mean but little or no effect on the median, making the median a better indication of central tendency in this example (Mertler and Vannata, 2005).It is assumed that households whose forest income represents greater or equal to a value greater than 8% of the total income are dependent on the forest, while households whose forest income represents less than 8% of the total income are less dependent. Thus, the variable is assigned a value of zero (0) if the household forest dependency is < 0.08 and a value of 1 if the household dependency index is e" 0.08. The binary nature of the dependent variables suggests that a logit model is appropriate (Gujarati 1995). The categorical explanatory variables, education are recoded as 0 representing "those with above primary education level as educated (1) and those below primary education level as (0). Gender was also recoded as 1 and 0 respectively, male (1) and female (0). Before presenting the results of estimation, a brief description of each explanatory variable and expected theoretical relationship to forest dependency is provided below.

Age

People of all ages can be forest dependent, however young people may be more dependent on forest products than elderly people may. The reason for this is that the young people may have multiple uses of the forests and more so forest products collection is labor intensive. On the other hand, the elderly people may not take a risk of going into the forest to undertake forest activities particularly that the elderly people may not have the strength to carry out forest related activities (Kohlin and Parks, 2001).It is therefore hypothesized that forest dependency is inversely related.

to age

In general, education opens up better employment opportunities for people, thus diverting them from agricultural and other subsistence activities (Hedges and Enters, 2000). The higher social status of the educated, government or private sector employees may also restrict their involvement in forest dependent activities since they can afford the modern type of lifestyle e.g. using gas stoves or electricity for cooking. Therefore, it is hypothesized that forest dependency is inversely related to the education level of members of the family.

Gender

Both the males and females can be dependent on the forest. However, women and men collect and use different forest products, for different uses (Campbell, 1991). The collection of firewood and medicinal plants are joint activities, while the collection of thatching grass and wild fruits are exclusive chores for women.Cutting building poles is exclusively a man's activity. Because collection of forest products is prohibited and in some cases there is a danger of wild animals in these areas, men are more likely to take the risk of going into the forest when compared with women.It is therefore hypothesized that male-headed households are more likely to be more dependent on forest resources than female-headed households are.

Families with more labor tend to extract more forest resources (Gunatilake, 1998; Hedges and Enters 2000; Masozera and Alavalapati, 2005) because they are able to mobilize part of their families to undertake forest dependent activities while maintaining a labor supply for other village–based activities. Furthermore, larger families have

higher subsistence needs, and that may be another reason to depend more on forest resources. Therefore, it is assumed that larger households are directly related to forest dependency.

Wealth assets are calculated in this study as the sum of physical and livestock assets. In rural Africa, livestock acquisition remains a key form of wealth accumulation (Dercon, 1998 quoted by Fisher, 2004). In the Chobe District, scarcity of land and the Tsetse fly disease limit cattle rearing. Livestock is relatively liquid asset that can be sold in response to price fluctuations, or for consumption or to provide financial capital to start a business or to pay for the acquisition of household assets. It is hypothesized that people who have more livestock and other household assets are inversely related to forest dependency, because livestock rearing is one of the stable sources of income for the households (Fisher, 2004). Therefore, it is expected that asset-rich households are less likely to exert pressure on forest resources.

Duration of residence

Long-term residents are likely to be more knowledgeable about the ecological structure, composition and seasonal patterns of the forests and hence collect more forest products (Pattanayak *et al.,* 2003; *Kartoolinejad et al.,* 2007). It is therefore expected that length of residency is directly related to forest dependency.

RESULTS & DICUSSION

As in most other parts of the country and in this region in particular, firewood is still one of the most important source of household energy (Table 2). However, only 138 (58.2%) of the households reported ever going into the forest reserve. Most households are virtually asset-poor and the distributions of key assets are unequal. The use of building poles and thatching grass has declined significantly in the study area as compared to a decade ago (Anton, 1997). This is shown by a shift towards corrugated iron roofing by households in the study area (personal observation).

Although there is widespread selling of handicrafts to tourists by both men and women at the market place (personal observation), all of these products were bought from traders from the neighboring countries of Zimbabwe and Zambia and others from the neighboring remote areas of the Chobe Enclave. Residents attribute this to the scarcity of local material for making handicrafts in the Kasane Forest Reserve (KFR). Residents also felt that the availability of fruits was declining due to an increased population in recent years of elephants and baboons which either damage the trees or pick the fruits before they are ripe for human consumption. Thatching grass is becoming more difficult to find due to the lack of annual early burning to promote fresh vigorous growth in the next growth season. According to villagers in the survey, this was due to disagreement between the Forestry Department and the local people on certain management decisions such as the timing of early burning.

Table 2. Frequency distribution of forest resources collected in KFR

Category	Frequency	Percent
Forest Resources		
Fuelwood	128	54.0
Building Poles	2	0.8
Wild Fruits	15	6.3
Thatching Grass	2	0.8
Handicrafts	4	1.7

Results of the model explaining forest dependency are presented in Table 3. The likelihood ratio test shows that the regression model is significant with Chi-Square statistics of 37.58. This result indicates that the explanatory variables in the model are significantly related to forest dependency. The results show that the model predictions are correct 72.60% of the time indicating that the explanatory variables can be used to specify the dependent variable, in discrete terms (1,0), with a moderate degree of accuracy. Coefficients of Household size (HHsize**)** and Wealth assets (Weassets**)** are statistically significant at 5% significance level. Other explanatory variables, Gender, Age, education and Residency, the coefficients are generally small and insignificant too.

The positive association between household size and forest income indicated that larger households tended to derive more income from forests. The variable Household size (HHsize)

Table 3. Logistic results of forest dependence

Variables	B	S.E.	Wald	Exp(B)
Gender	.064	.330	.037	.938
Age	.016	.014	1.360	1.016
Education	-.268	.478	.315	.765
Resident	.016	.013	1.542	1.016
Household size	.144*	.051	7.946	1.155
Wealth assets	-.00044*	.000	7.613	1.000
Constant	-1.851	.965	3.679	.157
Correct Prediction	72.6%			
LR Test	37.58			

shows a positive relationship with forest dependency. This suggests that large families tend to depend more on forest resources. The effect on the probability of forest products utilization (collection) of increased family size is further pronounced when the household lacks other income generation options such as formal employment. This result concurs with the findings on fuel wood collection reported by Köhlin and Parks, (2001). Kgathi *et al.,* (2004) also found a positive significant relationship between household size and fuelwood consumption in Mmankgodi, Botswana. Though regression model revealed that fuelwood consumption increased as household size increased, each subsequent increase in household size was associated with a lower increase in fuelwood consumption in proportional terms because large households tend to use fuelwood more efficiently than small households (Kgathi *et al.,* 2004).

The variable Weassets shows a negative relationship with forest dependency which is consistent with the prior expectation. This implies that households with larger wealth assets are less dependent on forest resources. Asset-endowment of the household was included in this analysis in terms of value of household assets and value of livestock held. The only plausible explanation for this result could be that people who have large herds of livestock are unlikely to have time for harvesting forest products as they have to spend most of their time herding their animals. This finding is corroborated by other studies in Africa (Barrettt *et al.,* 2001) and elsewhere (Sills *et al.,* 2003; Takasaki *et al.,* 2000). However, the use of basic and advanced technology e.g. donkey cart and trucks by well off community members may lead to overexploitation of the forest resources, hence denying those who do not have the new technology access to the forest resources. This could even be more detrimental where regulations and rules governing the resource use in a forest reserve are not enforced.

CONCLUSION

The understanding of the dependency of households on the KFR is critical in the development of management strategies. Reducing the human pressure on biologically rich hot spots and conserving valuable genetic resources has been and still is a fundamental policy concern in many countries. In the face of rapidly growing human populations in and around the bio-diverse regions of the tropical forests, sustainable use of forest products, both timber and non-timber forests products is not easy. This research analysis reveals that forest resources in the protected forest area are an important component of the households' activities. About 54% of the sampled households reported collecting fuel wood from this area for home consumption and/or income generation.

The result from the logistic regression reveals that rich in assets households (mainly livestock owners) are less forest dependent. This suggests that the financial attractiveness of the collection of forest product is more pronounced on less diversified farmers than on more diversified farmers, perhaps as the means of portfolio diversification. This implies that asset-rich households are less likely to exert pressure on the KFR. Furthermore, the study reveals that

educated and employed households, although not statistically significantly different, are less dependent on forest resources. If the government provides employment opportunities through alternative livelihood options such as tourism, the dependence on the KFR might be reduced. The present study also indicates that forest dependency is positively and significantly associated with family size. This study is supported by the findings on energy uses in Botswana by Kabaija (2003) who reported that small-sized households (1 to 3) persons predominantly used gas for cooking while larger-sized households used wood, which is the "cheaper" energy source. This difference may be attributed to the fact that more energy is used in cooking than lighting. Hence larger-sized households cook more food leading to more energy for cooking, and hence are forced to use the cheaper energy source.

Controlling household/family size through the provision of favorable policy incentives could help reduce the residents' dependency and extraction pressure on the trees being conserved in the protected areas. Particular attention here needs to be given to households with large numbers of adult family members who are unemployed and need alternative means for income generation. This means that the welfare of elderly people and resource conservation may be promoted through diversifying income sources such as increasing monthly pension, which is currently very low, about US$18 per month.

However, one positive aspect in relation to the use of energy sources in Botswana is that the use of fuel wood as an energy source has been on a consistent decline since the 1981 population census.The general pattern therefore appears to be one of an increase in the uptake of conventional energy sources and a decrease in the uptake of traditional energy sources, particularly fuel wood (Kabaija, 2003).These are welcome developments particularly in view of the fears of unsustainable use of wood resources for energy uses. Botswana can rely on the following alternatives/opportunities in order to reduce pressure on the already dwindling forest resources:

Firstly, Botswana has an abundance of one source of energy whose use is environmentally friendly, and that is solar energy. Therefore, the potential for solar energy can be exploited, particularly in rural communities that are not catered for by the national electricity power grid. In addition, the National Development Plan 9 (NDP 9) Energy sector policies and strategies that could have a positive impact on the improvement of this sector include:

- Continuation of the collective rural electrification scheme (which allows for only 5% down payment in rural areas and a repayment period of 15 years). This payment method makes it easier for poor households to connect electricity to their households.
- Improvement in safety aspects and distribution of illumination paraffin and gas- especially in rural areas where there are no service stations.
- Support of the introduction and use of other fuels (e.g. cow dung, coal) and other appliances such as coal stoves.
- Ensurance of the sustainable use of fuel wood by promoting fuel efficient stoves.

Efforts to conserve the KFR through restricted access, might lead to the impoverishment of the already poor households which are reliant on collecting forests products, especially fuel wood. However, forest protection could in fact benefit the poor if it leads to a rise in prices of harvesting permits for those that collect firewood for commercial purposes. More importantly, policies that focus on securing forest access by the poor and maintaining them in the KFR may actually perpetuate poverty and overexploitation of the resource, if other development options are overlooked (Anglesen and Wunder, 2003). A more effective pro-poor and pro-forest conservation strategy may be one that assists the poor in moving out of the KFR and into more gainful employment. Towards this end, public investment creating employment opportunities and promoting self-employment (e.g. educational spending, food-for work interventions and micro-lending programs),are highly recommended, Forest-based approaches, such as market development for under-exploited products like wood crafts and palm crafts from *Hyphaene pertasiana* for making baskets, may be more effective. A very high potential exists in this area, which is the hub of the tourism sector in Botswana. Such programs can increase local incentives to sustainably

manage forest resources. Nevertheless, careful implementation is necessary, because the rise in non-timer forest products (NTFP) may encourage over-harvesting of resources and decrease incentive for local residents to participate in forest management (Jumbe and Angelesen, 2004). This needs special attention in areas such as Kasane and Kazungula that are highly populated urban centers with a strong market economy from the tourism industry coupled with the scarcity of some of these NTFPs in the Forest Reserve.

Programs that encourage tree planting outside natural forests may foster other approaches in reducing dependency on forest resources and attaining forest conservation. One possibility is community-company partnerships: these have proven useful for conserving natural forests and improving rural welfare in many areas (Scherr *et al.,* 2002).Companies provide necessary materials, low interest loans, and technical assistance for establishing small woodlots on farm or customary land. In return, companies have the sole rights of buying the mature trees. Botswana government through the Department of Forestry and Range Resources has initiated such projects in other parts of the country. However, the feasibility of such programs in the land-scarce and problem-animal Chobe District requires further investigation. Perhaps the most feasible intervention is the promotion of tree planting around homes, which has been quite successful elsewhere in Botswana due to the tree protection afforded by the family members.

Lastly, the government should consider and act upon the creation of alternative employment and income sources. The use of the forest reserves in Chobe including the KFR is more appropriate because Safari companies have already expressed interest in using the forest reserve to conduct game drives and other tourist activities (Ross, 2001). The communities could benefit by sharing a percentage of lease revenues, or take a more proactive role in tourism ventures and forest management. The demand for daytime tourism activities from the numerous tourists staying in Kasane Township gives the KFR potential as a tourist center. Activities may include day game-drives, walking safaris, naturalistic or scientific groups, bush dinners, bird watching and community based utilization of NTFPs such as crafts in tourist markets. The activities also seem to be particularly appropriate for the KFR due to its lower wildlife concentration when compared to the Chobe National Park. This would permit safer walking, bird watching and other botanical activities (Ross, 2001). The lower wildlife densities of the KFR which could be a disadvantage could also be an advantage by diversifying the activities available for tourists in the Chobe district. The diversification of activities also allows for the potential generation of jobs, an increase of local skills and maintenance of traditional cultures.

In summary, to enhance greater cooperation from local people and achieve sustainable conservation and utilization of the forest reserve, greater stakeholder participation is recommended in the design of any management plan. A sustainable management plan should use the forest to pay its own management costs and allow surrounding communities to benefit; hence, they can see the forest reserve as worthy of the protection. Caution should be taken to avoid marginalizing other members who use the reserve for their basic needs. This will require critical consideration and integration of conservation of the resource with peasant household development in the area. Lastly institutions must be identified to facilitate the implementation of the management plan and ensure equitable distribution of the benefits to local communities.

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