

## Assessment of Food Insecurity and Dietary Diversity in the Okavango Delta and the Potential contribution of Indigenous Foods

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**Abstract:** Food insecurity, dietary diversity and the availability of indigenous food plants were studied using survey data from 296 households in five villages in the Okavango panhandle. The Household Food Insecurity Access Scale and the Dietary Diversity Score (DDS) Questionnaires were administered to adults with responsibility over households' food. Only 2% of households were food secure while 12.5% and 85.5% were mildly and moderately food insecure respectively. DDS was low, with a mean score of 5 from a possible of 12. Compared to 97.3% of households reporting intakes of cereals only 30-38% of households reported intakes of vegetables, meats, and dairy groups in the past 24 hours. At 30%, fish intake was high and reflective of riparian livelihoods. The consumption of fats lipids and sugars was atypically high and possibly suggestive of nutrition transition. Indigenous fruits, tree-nuts, tubers, and leafy-vegetables were available seasonally. The contribution of leafy-vegetables and tubers to households' food was described as substantial

**Keywords:** Food insecurity, Dietary diversity, Okavango River, Indigenous foods, Veldt foods, Rural areas, Veldt Resources

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### 1 Introduction

Household food in-security is a great challenge in Botswana. Rural households, households without live-stock or reliable income (including remittances) are the most affected (Clausen, et. al., 2005). The prevail-ing distributions of malnutrition, where geographical locations populated by non-hegemonic groups have malnutrition rates above the national average, also suggest that food insecurity has a population group dimension (Ministry of Health, 2007). In addition and also consistent with the prevalence of food insecu-rity, local diets lack variety (Aplogan et. al., 1996; Clausen, et. al., 2005). Some studies show that diets are constituted largely of starchy foods and are low in fruits, vegetables, and milk and other dairy products all year round (Aplogan et. al., 1996). Rural households, in particular, fare worse in dietary diversity scores and food variety than urban households.

Edible indigenous plants, if accessible, have potential to enhance food security and dietary diversity (Shackelton and Shackelton, 2004). In some parts of the world, edible indigenous plants have been used successfully to improve household food security and micronutrient intakes. Together with other traditional foods, edible indigenous plant foods are generally well received by people of diverse backgrounds (Dovie et. al., 2007; Paya, 2005) and are perceived by many as being healthy, fresh and desirable (Lambden et. al., 2007). In some studies traditional foods, which also include edible indigenous plant foods, have been associated with healthier diets; diets low in salt, fats, and saturated fats (Receveur, et. al., 1997).

Households located in regions rich in veldt resources, including edible indigenous plants may be cush-ioned from food insecurity. Given the reported abundance of veldt food and non-food resources in the Okavan-go Delta, the delta provides a suitable environment for studying food security, dietary diversity and the use of edible indigenous food plants. The Okavango River owes its origin from the Cubango River in the Central Angolan Highlands. The river enters Botswana at Mohebo in the North-western part of the country. Gener-ally, the Okavango Delta can be divided into four main ecological regions. These regions are: the panhandle, the permanent swamps in the upper regions, the seasonal swamps in the lower regions, and a number of land masses which occur as large islands, often referred to as sandveld tongues (Ellery and Ellery, 1997).

The focus of this paper is on the fishing villages on the Okavango Delta Panhandle, which is renowned for its veldt products. The non-food veldt products are used for housing, basketry, canoes and other arti-

facts for household use or sale (Kgathi et. al., 2006; Mbaiwa, 2004). Veldt foods resources include fish and a wide variety of indigenous berries, vegetables, tubers, and nuts. Fish is used extensively for household consumption and income generating activities in the Okavango panhandle (Mosepele et. al., 2006). Locals are reported to use a combination of fishing methods, ranging from basket fishing by women, to hook and line, and gill nets fishing which are primarily used by men. Unlike with fishing, however, studies assessing food in-security, dietary diversity and the use of edible indigenous plants in the area are limited. In fact, to our knowledge livelihoods in the Okavango Delta area have not been studied with a view to ascertaining the impact of the Delta resources on household food security and dietary diversity in both riparian and non-riparian villages. Yet, such studies are important if the potential of indigenous foods in improving food security and the dietary diversity of locals is to be exploited. Generally, there is a growing international acknowledgement of the importance of natural resources to food security and dietary diversity in rural livelihoods. Natural resources serve households in a number of functions including daily subsistence, income generation and safety nets during times of adversity (Shackleton et. al., 2007a). In southern Africa, natural resources have been shown to contribute between 15% and 28% of the total livelihood accruals (Shackleton et. al., 2007b). Analysis of rural livelihoods therefore cannot be complete without the inclusion of components of veldt products relevant to food security. There is need therefore to appreciate the availability and local community's access to these food resources by examining food insecurity and dietary diversity of inhabitants. To this end, this study was carried out to examine food insecurity and dietary diversity in the five villages in the Okavango Panhandle, namely Samochima, Mohembo East, Mohembo West, Shakawe and Ngarange (Figure 1). The types of edible plant foods available and the perceived contribution of these resources to household's food supply were also investigated.

It was hypothesized that households' access to indigenous foods, reported to be in abundance in the panhandle, will be reflected by the high proportion of food secure households and higher dietary diversity scores. This follows logically from the assumption that the harvesting (contribution) of edible indigenous foods is expected to be proportional to the degree of food insecurity (food need). With these assumptions, the study focused on household measures of food in-security (access) and dietary diversity. In addition, village level information on the types and use of edible indigenous food plants in the area was collected and used in guiding the discussion on the role that edible food crops play in the diets of locals in the Okavango panhandle.

## **2 Data Collection Methods**

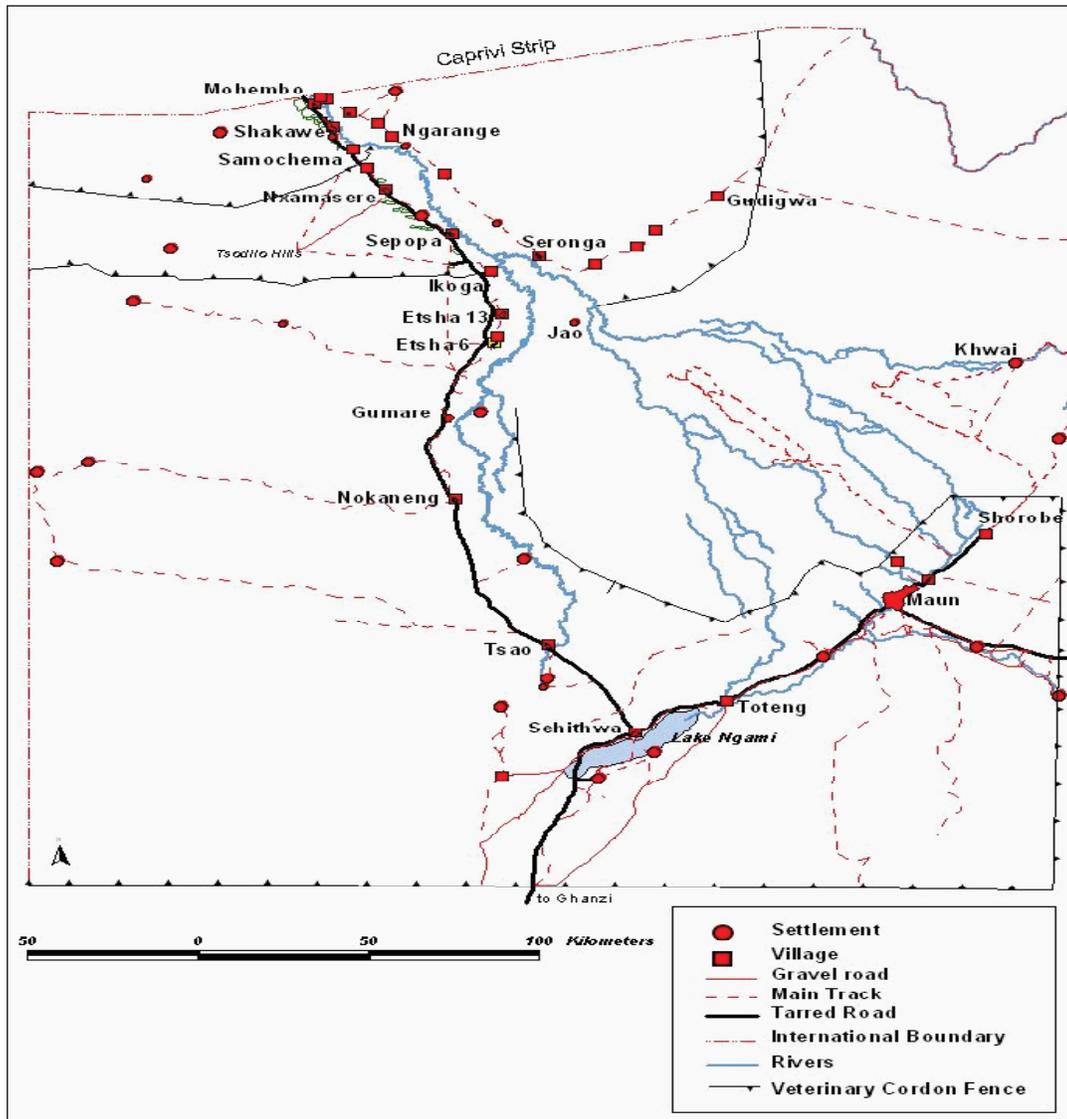
### **2.1 Sampling**

A cross sectional survey methodology was used in this study. Households were sampled using a systematic random sampling procedure from each of the 5 villages. The 2001 population census survey maps were used to identify the boundaries of the five study villages. Thereafter all dwelling units were listed, and a random sample of dwelling units was drawn using a skip pattern of 3 units. Vacant / deserted dwelling units were replaced with other units within the sampling frame. This resulted in a total sampling size of 296 households in the five villages. The sample size per village was therefore proportional to the population of the village.

Trained research assistants administered the survey instruments (Socio-demographics data) and the Food insecurity and Dietary Diversity instruments under the supervision of one Research Associate. All data were collected from the third week of October to the second week of November.

### **2.2 Assessment of Food Security and Dietary Diversity**

Two instruments, the Household Food Insecurity Access Scale (HFIAS) (Coates et. al., 2006) and the Dietary Diversity (DDS) Questionnaires (Swindale and Bilinsky, 2006) were applied to an adult with responsibility over household food to assess household access to food and dietary diversity respectively. The Household Food Insecurity Access Scale assesses households food insecurity through a set of questions that examine household experience of conditions in the three domains of food insecurity; anxiety about



**Figure 1** Locations of study villages along the Okavango River

Source: HOORC GIS LAB

the sufficiency of households food, intake of food of insufficient quality and reduced food intake. The instrument also assesses the severity of households experience and the prevalence of food insecurity. The Dietary Diversity Questionnaires assesses the diet diversity (which is equated to diet quality) by examining the number of food groups represented in the 24-hour dietary recall of household members. The more food groups represented (the more diverse the diet) the higher the likelihood that the diet meets the recommended macronutrient and micronutrient intake and is therefore of high quality. Both of the HFIAS and the DDS instruments have been validated in different cultural settings (Webb et. al., 2003, Coates, 2004).

### 2.3 The Availability and Use of Veldt Food Products

Data on the availability of veldt foods were collected at village level. Informants with in-depth knowledge on available veldt foods, their use and contribution to locals' diets and people responsible for their

harvesting were identified with the assistance of the village chief, extension workers, and other community leaders. The number of informants per village varied depending on the number of referrals but the minimum number of informants per village was three. Data were collected through structured in depth interviews.

### 3 Results

Data from all 296 households were available for analysis, as displayed in Table 1. Since sampling was proportional to the village size, villages with higher populations had a correspondingly larger sample sizes. The mean household size was six and females headed 62.1% of households.

#### 3.1 Household Food Insecurity

The assessment of households' access to food revealed that most households experienced food insecurity conditions that fell in the three domains of food insecurity, as displayed in the Table 2. Five of the nine undesirable food insecurity conditions were very common with over 90% of households reporting having experienced them in the past 30 days. Not only did households report ever being anxious about their food supply (98.7%) in the past month, but quite significant proportion of households also reported having slept hungry because there was no food (75.7%) or having gone for the whole night and day without food (40.9%). Although some households reported experiencing these conditions 1-2 times in the past month, the proportion of households who reported experiencing them more often (10 or more times per month) were in the double digits, ranging from 14.5% for those who spent the whole night and day without food to 64.6% for those who were worried about their food supply, suggesting that food insecurity was a major problem in this population.

Further, the household food insecurity access scale score (HFIAS) was calculated for this population as described by Coates et. al., (2006) and households were assigned into four categories (food secure, mildly food insecure, moderately food in-secure or severely food in-secure) based on their score. The results revealed that only 2% of households were classified as food secure, while the prevalence of mild and moderate food in-security were estimated at 12.5% and 85.5% respectively. Fortunately, no households were found to be severely food in-secure.

#### 3.2 Dietary Diversity

Dietary Diversity Score was computed from twelve food groups shown in Table 3. The mean DDS observed for households in this study was 5.2 out of a possible score of 12 and the mode was 5. A higher DDS score is desirable as it reflects that a large number of different types of foods are consumed. Such a diverse diet is associated with a diet of high quality. Households with more diversified diets are also less likely to have diets inadequate in macronutrient and micronutrient. In regions where dietary diversity has been studied extensively the minimum dietary diversity scores associated with good nutritional status are established. There are no previously established cut off points that are associated with improved nutrition indicators in Botswana. Thus, the Dietary Diversity Scores in this study were divided into terciles and the

**Table 1 Sample Characteristics**

Village	Sample size	Household headed by females (%)
Samochima	40	50
Mohembo East	39	46.2
Mohembo west	68	65.6
Shakawe	108	68.9
Ngarange	41	66.0
All 5 villages	296	62.1

**Table 2 Domains and frequency of food in-security conditions**

<b>Domains of Food Insecurity</b>	<b>Food Insecurity Conditions</b>	<b>% Households</b>	<b>Frequency of Occurrence</b>	<b>% Households</b>
<i>Anxiety and uncertainty of food supply</i>	Worry that food is not enough	98.7	Rare	6.1
			Sometimes	27.6
			Often	64.6
<i>Insufficient quality</i>	Not able to eat kinds of food you like	96	Rare	5.7
			Sometimes	31.6
			Often	58.6
	Eat limited variety of Foods	93.9	Rare	11.1
			Sometimes	46.1
			Often	36.7
Eat food not wanted	45.1	Rare	11.1	
		Sometimes	12.8	
		Often	21.5	
<i>Insufficient food intake</i>	Eat smaller meals	93.3	Rare	11.8
			Sometimes	41.1
			Often	40.4
	Eat fewer meals	93.3	Rare	12.1
			Sometimes	43.8
			Often	37.4
	Had no food of any kind	75.8	Rare	27.6
			Sometimes	20.9
			Often	26.9
	Slept hungry	75.7	Rare	25.3
Sometimes			26.9	
Often			22.9	
Went whole day and night without food	40.9	Rare	15.5	
		Sometimes	10.1	
		Often	14.5	

**Table 3 Household Reporting intakes of Foods from the 12 Food Groups in the past 24 hrs**

<b>Food Groups in the Dietary Diversity Questionnaire</b>	<b>% Households</b>
Cereals	97.3
Miscellaneous (spices, condiments, tea, coffee, alcoholic beverages)	87.2
Oils/fats	72.7
Sugar/honey	63.6
Milk and milk products	37.7
Vegetables	37.0
Fish and sea food	31.3
Meat, poultry, offal	30.0
Fruits	17.8
Pulses, legumes/ nuts	16.1
Roots and tubers	8.4
Eggs	1.7

proportion of household at different terciles were computed to establish the proportion of household with DDS below the lower tercile which may, as a result, be associated with a higher risk of poor nutrition. This analysis revealed that 34% of households had dietary diversity scores below the lower tercile (i.e. a DDS score of 4) while 23.2 % had scores at or above the upper tercile (DDS score of 6). The upper tercile was therefore assumed to be reflective of a more diversified diet in this population group.

The examination of food reported by households showed huge variability in the proportion of households with intakes of foods from the twelve food groups (Table 3). Consistent with the low DDS in this population group the intake of foods from some groups was reported by very few households. In addition, three of the most frequently consumed foods were foods that add less nutritive (especially micronutrients) value to the diet. These were miscellaneous items like spices and condiments (87.2%), oils/fats (72.2%) and sugar (63.6%). Excluding sugars, fats and oils and spices left the cereals group as the only food group from which foods were consumed by a large (97.2%) percentage of households. Vegetables, milk and dairy products, meats and fish which were reported to have been consumed by 30-38% of the households, followed this group. The green leafy vegetables were the most frequently consumed of all vegetables, with 37.7% of households consuming them compared to root vegetables. Very few households reported intake of fruits, pulses, root/tubers, and eggs. The large difference (97% versus 30-38%) between the proportion of households who reported intakes of foods from the cereal groups and other food groups suggest that at the time of the study all that some households had to eat were foods from cereals only. Such diets would surely fail to supply adequate micronutrients and protein. However, given the large proportion of households who reported using fats and oils, the calorie content may have been within recommended levels, although this can only be ascertained by subsequent studies. The high proportion of households reporting oils and fats and simple sugars was rather surprising for rural areas but could be indicative of nutrition transition.

### 3.3 Availability and Utilization of Veldt Foods

Several types of fruits, tree nuts, and green leafy vegetables respectively were said to be commonly consumed by villagers when in season (Table 4). Although veldt products were harvested primarily for consumption, street vendors sold some. Informants described the perceived value of veldt foods based on their contribution to meals. Green leafy vegetables and tubers were said to have a substantial contribution to local meals whereas fruits were said to contribute little. Leafy vegetables and tubers were reported to be used mainly in the preparation of relishes and stews typically served with starchy staples. Thus, they were perceived as being very valuable. Green leafy vegetables were reported to be harvested during the rainy season / ploughing season (December to April) which also overlaps with a high floods season (March to June) in the panhandle. These vegetables were harvested from the ploughing fields and uncultivated land patches around the homesteads. The locals preserved leafy vegetables for use off-season by sun drying cooked or uncooked leaves depending on their variety.

Tubers/roots were commonly available especially tswii, koma and makhungara, (all belonging to the *Nymphaeas family*) and tsaro. Informants reported that tubers were used in relishes, but some parts of Tsaro were eaten as fruits while others were used as vegetables. Although in the permanent swamps tubers were available year round, informants reported that access to them was limited during high floods as households averted the danger of drowning or possible attack by crocodiles. Thus most tubers were generally harvested when flood levels were low. Thus the collection of tubers and fishing were intensive during the low-flood season (August to December): This is also an intense fishing season. To ascertain the availability of tubers during high flood levels, women reported harvesting tubers during low floods seasons and burying them in shallower wet pits along the river. Perhaps as a reflection of their perceived importance in meals, women primarily harvested leafy vegetables and tubers.

Of all the edible plant foods reported to be available in the delta, fruits were said to be the most abundant. Yet their contribution to households' diet was described as being little. It is unclear whether this perception suggests that households did not appreciate the nutritive value of fruits or that foods not used as

**Table 4 Veldt Foods Commonly used in the Okavango Panhandle**

Types of Edible Indigenous Food plants	Role in the Diet	Harvested by	Perceived contribution to household food	General Methods of preservation	Availability	Examples Local ( <i>scientific</i> ) <sup>1</sup> name
leafy vegetables	relish	women	Contributes a lot	Sun dried, cooked and sun dried	Seasonal	Thepe (Amaranthums), Rotlhwe / leketa ( <i>Cleome, gynandra/ monophylla</i> ), Motete, (?) motheka / moanja (?), mogamana ( <i>dailium engleanum</i> ), Motheka (moanja)
Tree nuts	Relish/ snack	Children, women	Contributes little	None	seasonal	Morula ( <i>Schlerocarya caffra</i> ), Mogwagwa ( <i>Stychnos pungens</i> )
Tubers	Relish and used in meat / fish stews	women	Contributes a lot	Burying in wet pits, by the river	Available year round but access limited during high floods	Tswi ( <i>Nymphaea lotus</i> ), Makhungara, Nxlhoma ( <i>Nymphaeas sp</i> ) Nghau ( <i>sp Hyphae</i> ), <i>Phoenix reclinata-tsaro</i>
Fruits	Snacks	Women and children	Contributes a little	Sun dried with the exception of <i>Ximeia Var Americana</i> , <i>Schlerocarya caffra</i> , <i>strychnos cocculoides</i> ,	Seasonal	Moretlwa ( <i>Grewa flava</i> ), Motsentsela / motsintsila ( <i>Berchemia Discolor</i> ), Moretologa / moretonoga ( <i>Ximeia Var Americana</i> ), Mogorogowane <i>Stychnos cocculoides/ maumi</i> ( <i>strychnos cocculoides</i> ), Mokolowane ( <i>Hyphae petersiana</i> ) Mokhutsomu ( <i>Diospyros mespiliformis</i> ), Morula ( <i>Schlerocarya caffra</i> ), Mogwagwa ( <i>Stychnos pungens</i> ), Mongongo ( <i>Ricinodendron ruianenii</i> ), Moxhinxha / ( <i>Grewia schinzi</i> ), Makokoshi/ makokothi(?) Motsaodi/ tsaudi / moshibi ( <i>Garnicia Livingstonei</i> ) <sup>2</sup>

<sup>1</sup> This sign (?) is used against local names of plants whose scientific names could not be established.<sup>2</sup> Multiple uses, the flesh is used in stews and staple dishes. The pips are roasted and used as a nut.

part of main meals were regarded as less important than those used in meals. Compared to leafy vegetables, fruits were harvested primarily during the winter season (June and July) by both women and children. Some fruits were sun dried to improve their shelf life and sold by vendors. Informants also reported that some fruits were processed minimally to make other foods. The fruits *moxhinxha* and *moxhowa* for example were ground and mixed with milk to produce milkshake. Ground *Moxhinxha* was also used as porridge while *Nxhoma* was consumed fresh, dried, or cooked together with meat to produce relish. Fruits which were more likely to be sold by street vendors were *mogorogorwane*, *mokhutsomu* and *moretlwa*.

## 4 Discussion

Despite the vast resources that the Okavango Delta is renowned for, food insecurity in villages in the panhandle remains a tremendous challenge. Not only are most (64.5%) households frequently worried about their food supply, many have repeatedly resorted to eating foods of insufficient variety (36.7%), quality, or have had to eat food that they would not eat if they had a choice (21.1%). As is indicative of the seriousness of the situation, a sizeable proportion of households have slept hungry (22%) or spent the whole day and night without food (14.5%) several times a month. Anxiety about the adequacy of food supply, and experiences of consumption of food of insufficient quality and quantity are common strands in food insecure households across cultures (Coates et. al., 2006), and that these experiences are observed in the Okavango panhandle at such high proportions only serves to confirm the gravity of the problem. The disparity between households who worry about their food supply and those experiencing insufficient (quality and quantity) food may be indicative of a combination of transient and chronic food insecurity. Frequently households employ food insecurity-triggered behaviors such as bartering, selling of assets for food and reducing food intake to avoid or delay having to go without food (Nnyepi et. al., 2007; Oldewage-Theron, et. al., 2006). Thus it is logical that there would be more households who worry about their food supply than those who eventually go without food.

Consistent with the high prevalence of moderately food insecure households, the quality of diets in the Okavango is low. With more households reporting high intakes of cereals, condiments, fats and oils and simple sugars, compared to fruits and vegetables, eggs, milk and dairy products, meats and fish, the nutritive values of diets are likely to be poor in proteins and micronutrients. Given the high intakes of cereals and fats and oils, it is possible that the diets may be adequate in energy. Diets high in starchy foods and low in proteins, and micronutrients are not unique to the Okavango area. Rather this is a problem that affects other regions in the country and some subsets of the population as well (Aplogan et. al., 1996; Clausen et. al., 2005). The intake of foods high in energy but low in other nutrients; such as fats and oils and simple sugars (as observed in this study), is a known concern in food insecure households (Basiotis and Lino, 2003), which if not addressed can lead to high prevalence of overweight and obesity and associated comorbidities amongst the food insecure (Nicholas et. al., 2003).

Perhaps the one factor that pleasantly sets apart the Okavango Delta from other regions in the country and is also reflective of households' access to some riverine resources is the higher consumption of fish in households. The value of fish in food insecure riparian households cannot be understated, as some studies show that riparian households not only fish more to cope with food shortages but also consider fish as their main coping strategy (Nnyepi et. al., 2007).

A rather troubling situation that requires further scrutiny is the prevalence of food insecurity and diets of low quality in households along a river system renowned for diverse indigenous foods and non-food resources (Kgathi et. al., 2006; Mbaiwa, 2004). With numerous edible indigenous plants that are well accepted by the community (Paya, 2005) and of good nutritional value (Madisa and Tshamekang, 1995; Taylor, 1981; Roodt, 1994), it is unclear whether the prevailing food insecurity in the Okavango panhandle suggests that the extent of poverty in the Delta is so grave that it renders the available indigenous food resources inadequate or there is lack of concerted efforts to develop and weave indigenous foods into mainstream foods supply mechanisms or both. Though not detailed, as data were collected only at village level, households use of wild foods underscores their recognition of the contribution of wild foods to their food supply. This was particularly evident

in their characterization of some wild foods as contributing more to their diets than others. This is further supported by households' efforts in preserving indigenous foods for use off-season as reported in this study. Even though the impact of storage methods, such as the burying of tubers in shallower wet pits for easier access during high floods, on their nutritive value still requires further study, these methods show that households work hard to store foods for use off-season. Observations of this nature suggest that households would use simpler and possibly more effective methods of food preservation if they were developed. And as such, the optimization of households' methods of food preservation is a development opportunity that must be exploited if readily available indigenous foods are to feature more prominently in local diets. The development of such methods can also be coupled with the improvement of local trade on indigenous food plants because observations show that surplus home preserved foods are currently sold on the local markets. To support these development opportunities there is need for studies that ascertain the direct use values of veldt food products, the local markets for veldt foods, and the training needs of veldt food traders.

## 5 Conclusion

Despite the availability of veldt food resources, most households in the Okavango are food insecure and rely on poor quality diets for their survival. More research is needed to identify ways in which rural households can be assisted to exploit indigenous food resources to prevent food insecurity and improve the quality of their diets. Given that households are already showing interest in preserving indigenous foods for use off seasons, one important development opportunity that is likely to bear fruit is the optimization of household methods of food preservation and skills transfer to locals. Also, appropriate interventions that would involve increased utilization of edible indigenous plant foods may be useful towards alleviating the burden of food insecurity in this locality.

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