CROP PRODUCTION IN KAVANGO: FINDINGS OF CASE STUDY MONITORING 1995 - 1997

by Elizabeth Mutwamwezi and Harriet Matsaert

KFSRE Working Document Number 29
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ACKNOWLEDGEMENTS
We would like to thank the seven case study households who, month after month, have patiently answered our questions and have enabled this report to be produced. Thanks also to the other KFSR/E team members who have often assisted in carrying out interviews and providing transport to the villages.

EXECUTIVE SUMMARY
This is one of a series of reports based on case study monitoring with seven Kavango households from 1995 - 1997. KFSR/E working document 26 gives a broad overview of household livelihood systems and discusses implications for research, advice and support systems for rural people. This working document is one of a number of companion reports which look in more detail at key enterprises. This report focuses on the role of crop production in Kavango livelihood systems and documents crop management practices carried out by the households monitored.

Some key issues for research and extension emerge from the case study monitoring:-

- Many households have lost their stock of legume and cucurbit seed. This has serious implications for the adaptability and food security of their crop production activities. There is a pressing need to assist farmers to gain access to lost seed varieties.
- Poor soil fertility is a key concern to most households. There is a particular need to develop options that are accessible to resource poor households with no access to manure or fertiliser.
- Weed control (particularly of perennial weeds) is a key issue for farmers. There is a need to develop options for weed control, which are compatible with current intercropping practices.
- Legumes and cucurbits are particularly vulnerable to pest infestation. Options for control are needed.
- Though women are key decision-makers and managers in crop production, they are often not reached by research, extension and other support services. More effort needs to be made to target women.
- There is an increasing trend by farmers to remove trees from cropped fields. This is supported by current government and Agribank policy. The implications of this practice for sustainable cropping systems need to be urgently reviewed.
GLOSSARY
ADC - Agricultural Development Centre
Agribank - Agricultural Bank of Namibia. This has recently begun to give out loans in Kavango region
Canameco - Canada Namibia Cooperation (administered by Oxfam Canada)
KFSRE - Kavango Farming Systems Research and Extension
NDC - Namibian Development Corporation
Nzambi - communal work party for crop production activities
Rufisorusita - loan of animals (usually between family members).

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1. INTRODUCTION

The KFSR/E team has used 'case study monitoring' to build on the information collected in previous community surveys. This detailed monitoring of a number of households complements the findings of the surveys in two ways. Firstly it allows us to observe household activities and livelihood strategies over time, and secondly by focusing in detail on different household types it helps us to understand the specific opportunities and constraints that these face.

Our case study monitoring has followed the activities of seven households in two villages (riverside and inland) over a poor and a good rainfall year. Each case was selected for its representation of a different household type (from villagers' own categorisation of farm types). This was based mainly on livestock ownership and/or size of area under cultivation (see Table 1).

We began monitoring four households (L1, L3 and R1, R2) in November 1995. In November 1996 we took on an additional three households (L2, L4 and R3) which represented different household types.1

Monitoring was carried out on a monthly basis. At these interviews we discussed on and off farm activities, income and expenditure, food security and labour issues. Farming systems diagrams and ranking tools and farm maps were also used to assist discussion and to summarise activities at the end of the agricultural year.

On the basis of the two season's of monitoring, summary reports have been produced on: general analysis of farming systems, crop production, livestock production, fish and forestry. We hope these studies will help improve the understanding of the opportunities and constraints faced by different household types in Kavango.

This report focuses on crop production. It looks at the importance of crop production to the systems of the various households monitored and at the interactions between crop production and other household enterprises. The report also describes the crop management practices observed.

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1The initial selection was based on the very simple division of farm types into plough and non-plough owners and river and inland. At the end of the first season we discussed household types with groups of farmers and ended up with three more types: those with no fields (gardens only) who are dependent on casual labour, San households and inland pioneer households. In order to monitor these, three more cases were taken on.
Table 1. Summary of Households Monitored²

<table>
<thead>
<tr>
<th>LEVEL OF RESOURCES</th>
<th>RIVERSIDE</th>
<th>INLAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOWER</td>
<td>Robert (R3)</td>
<td>Ivan and Namivura (L4)</td>
</tr>
<tr>
<td></td>
<td>One person household</td>
<td>San (bushman) household</td>
</tr>
<tr>
<td></td>
<td>Robert migrated away from the area for many years and came back to find his wife remarried. No livestock.</td>
<td>This couple owns no livestock and cultivates a small garden only (0.3 hectares). Very limited access to draught animal power (through patron). Dependent on forest products, casual employment and gambling for income and food.</td>
</tr>
<tr>
<td></td>
<td>Cultivates small 'garden' only (0.1 hectares). No access to draught animal power. Depends on casual employment for income and food.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Becky and Hamutena (R2)</td>
<td>Infrud and Hangura (L3)</td>
</tr>
<tr>
<td></td>
<td>Two adults in the household and eight school age children. No cattle but own some chickens. No formal employment. Dependent on casual employment.</td>
<td>Two adults and two young children. Have no cattle but own some chickens. Cultivate 2 fields (1.5 hectares) with borrowed draught animal power. Access to cattle through short-term usata loan.</td>
</tr>
<tr>
<td></td>
<td>Some access to draught animal power through relatives and hiring. They cultivate a small field (0.5 hectares).³</td>
<td>Hangura has formal employment (literacy teacher) and works as casual labourer.</td>
</tr>
<tr>
<td>HIGHER</td>
<td>Rachel and Ben (R1)</td>
<td>Ian and Nance (L1)</td>
</tr>
<tr>
<td></td>
<td>The husband and wife live with two grown up daughters and five young children. Have permanent access to cattle through usata loan system and own one cow. Also own chickens. Cultivate 1.3 hectares. Husband has low paid formal employment as village headman. Wife sells beer and other crop produce to raise income. Access to tractor ploughing services.</td>
<td>The couple are pensioners. Have cattle, goats and chicken (including children's animals). Cultivate 2 fields (2.7 hectares). The couple looks after a large number of grandchildren (11) and receives income from their two children who are working elsewhere.⁴</td>
</tr>
</tbody>
</table>

² Names have been changed to maintain confidentiality.
³ During the study period, Hamutena managed to get formal employment (road building). Since then the household has purchased oxen and a cow, and is investing more into crop production.
⁴ In the first season of monitoring two of Ian's sons were also resident in the village and labour was pooled for some activities. One son has since moved to settle near his wife's parents.
Figure 1: The Role of Crop Production in the Farming System: Some Systemic Linkages

- **Crop Production**
  - Used to hire labour
  - Produce profits after harvesting
  - Harvest and store

- **Forest**
  - Trees used to generate cash
  - Building materials
  - Forest cleared to plan
  - Trees used for crops

- **Livestock**
  - Storeroom after harvest
  - Cash received from crops
  - Livestock provide

- **Household**
  - Buildings material for construction
  - Provides food, cash
  - Crop production

- **River**
  - Fishing
  - Indigenous vegetables and

- **Oil Palm Employment**
  - Invest in crop
  - Provides cash for

- **Oil Palm Income**
  - Cash income

- **Home-based Industries**
  - Mills and sorghum used
  - Value added to crops

- **Other crops**
  - Hulls and husks cropped with
  - Hay used to feed livestock
<table>
<thead>
<tr>
<th>Location</th>
<th>Area (sq km)</th>
<th>Population</th>
<th>Arable Land (ha)</th>
<th>Crops Planted (ha)</th>
<th>Crop Yields (t)</th>
<th>Livestock</th>
<th>Income (Tk)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Village A</td>
<td>5</td>
<td>2,000</td>
<td>50</td>
<td>Wheat</td>
<td>20</td>
<td>100</td>
<td>500</td>
<td>May</td>
</tr>
<tr>
<td>Village B</td>
<td>3.5</td>
<td>1,500</td>
<td>40</td>
<td>Rice</td>
<td>15</td>
<td>80</td>
<td>300</td>
<td>June</td>
</tr>
<tr>
<td>Village C</td>
<td>4</td>
<td>2,200</td>
<td>55</td>
<td>Maize</td>
<td>25</td>
<td>120</td>
<td>400</td>
<td>July</td>
</tr>
</tbody>
</table>

*Note: The data is presented in summary form, detailing the arable land, crops planted, crop yields, livestock, income, and notes for three different villages.*

**Figure 2 - Summary of Crop Production:**

- 96/96 100% of households surveyed reported crop production.
- The most common crops produced were rice, wheat, and maize.
- Livestock ownership varied, with poultry being the most common.
- Income from crop production varied significantly between households.
2. ROLE OF CROP PRODUCTION IN HOUSEHOLD LIVELIHOOD SYSTEMS

Crop production is a central element of Kavango livelihood systems (See figures 1 and 2). All households monitored cultivated land, though the scale of cultivation varied considerably. In the riverine village, households types were distinguished by villagers according to their level of crop production. Of the seven households monitored four cultivated for subsistence and sale while three households cultivated for subsistence only. Crop production was not the main source of income for any of the households monitored.

The most important staple food crop produced for all households was millet. Cucurbits were found to play an important role in food security with leaves being harvested and eaten during the ‘hungry period’ between November and March. Cowpeas and green maize were harvested earlier than millet and for this reason were important for both food security and to meet cash needs. (See section 4 - Crop Management Practices for detailed description of crops grown).

Though sale of crops was used to meet day to day cash or exchange needs, none of the households monitored were able to meet all their cash needs through crop production. For the livestock owning household at the riverside, however, cash raised from crop production in a good year is equal to, or even more than the cash generated from off farm employment.

2.1 Interactions with Livestock Production

Ownership of livestock is a crucial factor in crop production. Draught animal power (DAP) is used by the majority of farmers for land preparation. Of our seven case study households, two owned livestock and ploughs throughout the monitoring period. Two households had access to livestock through the ‘usuwa’ loan system (see livestock report). Two households purchased oxen during the case study period. Two households (including the San bushman household) had no (or very minimal) access to draught animal power and these cultivated less than 1 hectare. Those using the usuwa system ploughed late, or had ploughing interrupted due the needs of the real owners of the animals. This resulted in them cultivating a smaller area and receiving a lower yield than hoped for. We can conclude from our case study monitoring that ownership or secure and timely access to draught animal power is a prerequisite for crop production on the scale necessary to meet household consumption needs.

Draught animal power is also used for transportation of crops to the homestead. The MAWRD is currently promoting the further use of DAP for weeding. None of the households monitored were using their DAP for this purpose.

A second important interaction between livestock and crop production is in the use of manure for soil fertility maintenance. Of those households monitored, four used manure on the ‘sipata’ (garden) areas. The farmers monitored appeared to be well aware of the value of manure to improve soil fertility. Those who did not use manure did so because they were farming on newly cleared or recently followd land, because their fields were far from their kraals or because they had no access to manure.

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5 The San bushman household monitored (L4) was quite unusual in that they did cultivate a small area of land. Many San households do not cultivate land but depend on forest products and employment as casual labourers.
While livestock make a vital input to crop production, crop production in turn makes an important input to livestock production as stovers are used as a source of dry season fodder. Once harvesting is finished, animals can graze freely on all crop fields. One livestock owner also made use of the residue from beer production to feed livestock in poor condition.

The main negative interaction between livestock and crop production is the problem of livestock damage to cropped areas during the growing season, as cropped areas are generally untended. The need to herd their animals during the cropping season presents a considerable expense to livestock owners. Though there is a fine payable for livestock damage, control of animals in the heavily populated areas by the riverside and close to the centre of the inland villages cannot be guaranteed. In these areas farmers fence their fields with thorny branches to prevent livestock entry. However, cases of livestock damage are still common. The San bushman household monitored lost much of their maize crop due to damage by horses.

2.2 Interactions with Forestry

The Kavango forest is being progressively cleared as new fields are opened up for crop production. Clearance requires considerable labour, and uncleared land is now further and further from the settlements monitored. Perhaps it was for this reason that it was only undertaken by the livestock owning households monitored. Those without livestock were cultivating previously cleared land close to their villages.

All households monitored made use of trees for fencing. Fruit trees and 'large trees' tended to be left on cultivated fields (see forestry report for list of trees found on fields). There was some debate about the value of leaving trees in cropped areas. Some farmers, particularly older people, considered trees as an important part of the cropping system and believed that some trees had a beneficial effect on crop growth. Others saw all trees as a hindrance to crop production as trees encouraged birds and made ploughing difficult. Rachel, the cattle owning farmer in the riverside community, told us that she planned to clear all trees in her new inland field.

The negative attitude towards trees in fields is reinforced by the example of clearing all trees from cropped land practised by commercial farmers in the South (where some of the household members had worked) and by the local Namibian Development Corporation farms. In addition Agribank have made tree clearance a requirement for farmers to obtain loans for crop production.

Trees were also used to manufacture equipment used in crop production (tool handles, sledges)

2.3 Interactions with Home Based Industries

The households monitored generally preferred to sell their excess millet and sorghum in the form of beer rather than grain. By producing beer considerable value is added to the price of the grain. Crop produce provided the raw materials for beer production by three of the households monitored. Beer production was carried out by female household members, with cash generated being used to meet day to day household needs and to hire labour for crop production. In the inland community beer was brewed by the livestock owning household before calling a 'nzambi' (work party).
2.4 Interactions with Off Farm employment

Off-farm employment was found to play a vital role in generating capital for crop production. Those households with livestock and one of those who acquired livestock during the case study monitoring period did so through investing cash earned off farm⁶.

In the inland community, the local school teacher provided cash loans to many farmers to enable them to purchase seeds at the beginning of the cropping season.

The three households who had no access to formal off farm employment were not able to make the necessary investments into crop production to allow them to produce enough for their subsistence needs. These households were dependent on low paid casual employment with neighbouring households for their hand to mouth existence. In the second season of monitoring one of these households, Rebecca and Hamutenya (R2) managed to get access to formal off farm employment. The transformation in the family’s crop production was dramatic. Through investment in labour hire and purchase of draught animal power, the family was able to significantly increase their levels of crop production. In contrast to 1995/96 when no income and insignificant consumption needs were met from crop production, in 1996/97 23% of income (from beer brewing) and 22% of consumption was met from crop production. The household planned to further expand the area under cultivation in 1997/98.

2.5 Interactions with Horticulture

Wild vegetables and indigenous fruit trees grew together with crops in all the farms monitored. The perceived costs and benefits of combining trees, crops and wild vegetables in fields are discussed above (2.2 Interactions with Forestry) and in section 4 (Crop Management - Weeds).

3. INTERNAL & EXTERNAL FACTORS INFLUENCING HOUSEHOLD CROP PRODUCTION.

Internal Factors

a) Off farm income

As mentioned above, this appeared to be absolutely crucial for capital investment into crop production. The case study monitoring was carried out after a series of very poor rainfall years. This may have accentuated the importance of ‘alternative income sources’ in the farming system.

b) Access to Draught animal power.

As noted above, secure and timely access to draught animal power appeared to be a pre-requisite to producing sufficient crops to meet food and other needs.

c) Access to land

⁶An interesting exception was the livestock owning household on the riverside, which purchased oxen using an Agribank loan. These loans could provide an important source of capital for those without access to off farm employment.

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Access to new land was limited to those households with labour or capital to invest in clearance and transport to allow them to exploit inland areas. Those without access to new land face increasing soil fertility problems.

**d) Soil fertility management**
Areas where manure was used were significantly more productive than other fields.

**e) Household Labour Availability**
Labour available in the direct household did not appear to be as important as the ability to pay for hired labour or to command labour through work parties. Rachel, the largest crop producer in the river community cultivated over thirteen hectares with a household labour force of four people. She was able to do this through hiring in casual labour. Similarly the two largest producers in the inland communities (L1 and L2) had very small household labour forces (2 people in each case) but were able to make use of hired labour and nzambhi (work parties) to meet labour needs.

One labour crisis noted in the monitoring was caused by absence of male labour from a livestock owning household during the ploughing period. The female household members were not able use the draught animals to continue ploughing activities due to lack of experience and training in how to manage these animals. This could also present a constraint to weeding with DAP as more men were observed to leave the villages in search of employment once plough and planting had finished.

**External Factors**

a) **Access to inputs and information**
The households in the river community monitored, had better access to seeds, services and advice from the extension services. The influential livestock owning household was also able to gain access to tractors for ploughing and transport.

b) **Access to capital**
The ability to access capital through an Agribank loan has allowed one of the case study households to purchase oxen to develop her crop production.

**Access to Labour**
As discussed above, household labour availability was less important than the ability to access labour outside the household. In the inland village where nzambhi is still practised, all but the San household was able to access extra labour. As one old lady told us “we cannot stop ploughing until everyone’s fields have been finished”. In contrast, at the riverside, access to labour depended on ability to pay. Here we noted a much greater difference in the size of area cultivated between the richest and poorest households (for example compare R1 and R3 in figure 2).

**4. CROP MANAGEMENT PRACTICES**

**4.1 Land Use**
All households monitored showed a preference for sandy loam (ndombe hecke) soil above the less fertile sandy (muheke) soil and for new land over old (See figure 2 for a summary of
land use by each household monitored. However, new fields were cleared only by the livestock owning households monitored. Those without livestock and ploughs did not have the labour to clear new land, or indeed to plough and weed this land once it had been cleared. The household which acquired livestock during the 1996/97 season now plan to clear new land.

4.2 Management and Decision Making
The eldest male in the household is usually the acknowledged ‘head of household’ and decision-maker. However as many men of working age leave the village to obtain off-farm employment, much of the day to day management and decision making with regard to crop production is carried out by female household members. Even where male household members were present we found that they were particularly concerned with cereal crops, leaving management of legumes, cucurbits and other crops to female household members. Young men play an important role in land clearance and in managing draught animals at ploughing time. The absence of young men to assist in ploughing was a serious constraint to Rachel’s household crop production in the 1996/97 season.

Despite the key role played by women in crop production, most of the participants of extension groups, Ministry of Agriculture open days and field trips are men. Often these men are not full time farmers but are between jobs or have other employment. It is crucial that more efforts are made by the MAWRD to reach female household members when providing information and advice or when seeking comments on crop production issues.

4.3 Crops Grown and Varieties
The households monitored grew the following crops:

<table>
<thead>
<tr>
<th>CEREALS - all households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millet - local varieties: kakunya, mpende, upoko, dairieni, simu, samahuki, steyn and short duration Okashana.</td>
</tr>
<tr>
<td>Maize - local varieties mavara gandimba</td>
</tr>
<tr>
<td>Sorghum - local varieties kovara, nyova (sweet sorghum) and varieties sold by extension (name unknown).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LEGUMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cowpea</td>
</tr>
<tr>
<td>Groundnuts - only KFSR/E new varieties</td>
</tr>
<tr>
<td>Bambara nuts - only KFSR/E new varieties</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CUCURBITS - all households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumpkins</td>
</tr>
<tr>
<td>Melon</td>
</tr>
<tr>
<td>Watermelon</td>
</tr>
<tr>
<td>Squash</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mutete (Hibiscus vititulus) - all households</td>
</tr>
<tr>
<td>Sweet potatoes - 1 household only (riverside)</td>
</tr>
<tr>
<td>Castor - 1 household only (riverside)</td>
</tr>
</tbody>
</table>

7 See also the report from Kavango seed fair 1997 for an inventory of crop varieties cultivated in the region.
Millet was by far the most important food crop. Though cucurbits and cowpeas were found to play an important role in food security. Farmers sold cowpeas, maize and sweet sorghum during the cropping season to meet immediate cash needs and to pay for labour on the fields. Only the largest producing household sold millet in the two years of monitoring.

Yields recorded were very low (from 60kg/ha to 625kg/ha for millet) and were probably under reported.

Seed sources used by our case study households were own seed, gifts from family, gift from patron (San household) and purchase from Canamco, the local ADC and Rundu Market. Seed shortage of Cowpeas, Cucurbits, Bamburanuts and Groundnuts were noted.

New short duration varieties of millet such as Okashana I were appreciated for their ability to provide some yield under difficult conditions or when late planted. However there was considerable criticism of the varieties by female household members. They felt that the new varieties were inferior to their own local millet when it came to storage, cooking and beer brewing. Those who planted these new varieties did so for sale rather than household use.

Households were extremely keen to get access to new varieties of legume and cucurbit. Though the quantity and diversity of legumes in the region as a whole is enormous (see report from Kavango seed fair), many villages and individual households have lost their seed stock due to successive years of poor rainfall.

Table 2. Cropping Calendar

<table>
<thead>
<tr>
<th>Season</th>
<th>Kwenye</th>
<th>Kurombo</th>
<th>Epemba</th>
<th>Kufu</th>
<th>Mangenyena</th>
</tr>
</thead>
<tbody>
<tr>
<td>Months</td>
<td>Oct - Nov</td>
<td>Dec - Feb</td>
<td>March - April</td>
<td>May - August</td>
<td>September</td>
</tr>
<tr>
<td>Activities</td>
<td>Clearing/Planting</td>
<td>Ploughing</td>
<td>Ploughing</td>
<td>Weeding (Feb/April)</td>
<td>Millet and sorghum harvest (April - June)</td>
</tr>
<tr>
<td></td>
<td>Ploughing/Planting</td>
<td>Harvesting cowpeas, sweet sorghum, maize and millet (March - May)</td>
<td>Harvesting cowpeas, sweet sorghum, maize and millet (March - May)</td>
<td>Harvesting cowpeas, sweet sorghum, maize and millet (March - May)</td>
<td>Harvesting and building storage structures.</td>
</tr>
<tr>
<td>Notes from 1996/97 season.</td>
<td>Non-plough owners had to wait a long time to start ploughing planting.</td>
<td>Riverside plough owning household had shortage of male labour for ploughing.</td>
<td>Insect pest damaging melons.</td>
<td>Aphids on cowpeas recorded from Feb</td>
<td>Ground mice damage groundnuts and bambara</td>
</tr>
<tr>
<td></td>
<td>Some lacking of millet.</td>
<td>Some army worms observed (not serious).</td>
<td>Peak labour demand.</td>
<td>Peak labour demand.</td>
<td>Thresher hired by large producing cow household.</td>
</tr>
</tbody>
</table>

4.4 Planting Practices

We observed that farmers preferred to cultivate the legumes and some of the cucurbits in the garden (sipata) intercropped with maize or sweet sorghum, while millet and sorghum were grown in the more distant fields far from the homestead. Home fields tended to be

*Hungry period*
more fertile than the distant fields because of livestock and refuse around the house. One farmer in the riverside community told us that thieves would steal legumes or maize if these were planted in an isolated field.
**Planting methods observed:**

- Maize-behind plough (high fertility areas)
- Sorghum and millet- across furrow, five to seven plants/hill. Some dry planting.
- Cucurbits-Broadcast before ploughing intercropped at selected sites
- Sweet sorghum- broadcast.
- Cowpeas- intercropped with cereals
- Sorghum and Millet mixed before planting (Okashana and traditional millet)

Only one household practised crop rotation, however, intercropping was carried out by all the farmers. There was considerable variation between households in plant spacing for millet (probably dependent on soil fertility).

Thinning and transplanting was carried out during weeding time.

### 4.5 Weeding.

The most troublesome weeds noted by farmers were the vigorous and intrusive perennial weeds known locally as *Esusu* and *Ngwena* (*Cynodon dactylon*). Infestation by these could result in the need to abandon whole areas of land. In contrast, many annual ‘weeds’ were welcomed as they provided a nutritious and palatable food source in the hungry period before the main crops could be harvested. These wild vegetables were ‘weeded out’ and consumed before the main crops were harvested. The fact that such plants are valued has important implications for the development of management practices such as weeding with draught animal power.

**Table 3. Problem Weeds**

<table>
<thead>
<tr>
<th>Problem weeds Inland</th>
<th>Problem weeds riverside</th>
<th>Control methods observed</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Esusu</em></td>
<td><em>Esusu</em></td>
<td>Weed early while plants are young</td>
</tr>
<tr>
<td><em>Muncastra</em></td>
<td><em>Muncastra</em></td>
<td>Dig out roots</td>
</tr>
<tr>
<td><em>Mupuwi</em></td>
<td><em>Mupuwi</em></td>
<td>Dig out bulbs</td>
</tr>
<tr>
<td><em>Nasingandu</em></td>
<td><em>no</em></td>
<td>Dig up roots. NB this weed is good fodder for cattle.</td>
</tr>
<tr>
<td><em>Ngwena</em></td>
<td><em>Ngwena</em></td>
<td>Dig out roots.</td>
</tr>
<tr>
<td><em>Nandundu</em></td>
<td><em>Nandundu</em></td>
<td>Weeding with hoe</td>
</tr>
<tr>
<td><em>Nangotu</em></td>
<td><em>Nangotu</em></td>
<td>Weeding with hoe</td>
</tr>
<tr>
<td><em>Nchui</em></td>
<td><em>Nchui</em></td>
<td>Controlled by ploughing or digging up bulb.</td>
</tr>
<tr>
<td><em>Nchoneka</em></td>
<td><em>Nchoneka</em></td>
<td>Weeding with hoe.</td>
</tr>
</tbody>
</table>

Weeding was carried out with hand tools. None of the farmers monitored made use of draught animal power after initial land preparation.
4.6 Pest Control

During the monitoring period no major pests affected the cereal crops. However cowpeas were heavily infested by aphids. Cucurbits also suffered from infestation by the stink bug.

Table 4. Main Pests Observed

<table>
<thead>
<tr>
<th>Pests</th>
<th>Crops affected</th>
<th>Damage</th>
<th>Control methods used.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singurukutu</td>
<td>Cucurbits</td>
<td>Drying out of the leaves, which turn brown</td>
<td>No, control known</td>
</tr>
<tr>
<td>(Stinkbug)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aphids</td>
<td>Cowpeas</td>
<td>Sucking of juice from the plant, leads to wilting</td>
<td>Using ash to spread on the plant and fruits</td>
</tr>
<tr>
<td>Armyworms</td>
<td>Millet and Sorghum</td>
<td>damage the grains of the crops</td>
<td>No local control known. MAWRD spray with insecticides.</td>
</tr>
<tr>
<td>Livestock</td>
<td>All</td>
<td></td>
<td>Fencing, herding.</td>
</tr>
</tbody>
</table>

4.7 Soil Fertility Management

Soil fertility was of great concern to most of the households monitored. Low fertility was particularly an issue for those households who were cultivating on old land. These households were all actively taking measures to improve fertility (see figure 2). These included:

- Application of manure on home fields
- Experimental use of fertilisers
- Ploughing in crop residues
- Crop rotation
- Fallowing
- Cultivating old cattle kraal sites.

There was also some awareness of the role that certain trees (for example musu) can play in improving soil fertility⁹.

Maintaining soil fertility is particularly difficult for resource poor households who do not have access to manure and who do not have the financial resources to purchase fertilisers. Developing practices based on intercropping, rotations and agroforestry is particularly important for these households.

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⁹ This tree has extremely palatable seed pods. During the dry season livestock gather under the tree to collect the pods. Thanks to their manure, the fertility of the surrounding area is high.
5. CONCLUSIONS:
The case study monitoring confirmed the central role of crop production for all Kavango households (with the exception of San bushmen). Crop production was carried out both for subsistence and for income generation. Crop production was not the main income source for any household. However, it played an important role in meeting household consumption needs and in providing income for women household members who did not have access to off farm employment.

We observed important system interactions between off farm employment and crop production with off-farm wages being used to purchase livestock, to hire labour and to obtain other inputs for crop production.

Case study monitoring confirmed the important system linkages between crop production, the home based brewing industry, forest management and livestock production. An awareness of the impact of these linkages is essential when developing new management practices or recommendations for crop production in Kavango.

The case study monitoring explored some internal and external factors which play an important role in household crop production. Access to off farm income and livestock were found to be critical. Household labour availability was found to be less important than the ability to access labour outside the household. In the inland villages this was possible through the nzimbi system. In the riverine village, access to labour depended on the ability to pay and was thus closely linked to a household’s access to off farm employment. Access to seeds was another important factor identified.

Some key issues which should be addressed by crop research and farmer advisory and support services are:-

**Shortage of Seed/Loss of Varieties**
Though the 1997 Kavango Seed Fair demonstrated that the region has a wealth of indigenous seed varieties, we found that at the individual village and household level many varieties have been lost. Some households now have no legume and few cucurbit seeds. There is a pressing need to make lost varieties available again to households, in order to allow them to maintain a healthy diversity and balance of crop types.

**Soil fertility management**
This is a key concern to most households and particularly to the resource poor who are increasingly forced to cultivate old land. As these farmers often do not have access to manure or resources to purchase fertiliser, it is important that research focuses on alternative options for soil fertility maintenance such as rotation, agroforestry and intercropping.

**Weed Control**
Control of intrusive perennial weeds and management of annual weeds in the field is an area of concern to crop farmers.

**Pest Control**
The major pest problems were noted on cucurbit and legume crops.
Targeting women farmers

The study observed that while women are often the key managers and decision makers in crop production, they are often not reached by research and advisory services. This is for a variety of reasons including the fact that some activities such as ploughing are considered to be male activities and that women often have less time to attend meetings and are less vocal than men when they do attend. It is important that women’s key role in crop production is acknowledged and that particular efforts are made to target them.

Agroforestry

The role of trees in Kavango cropping systems is one that is currently being debated by farmers. At present the government (through Agribank policy of requiring destumping of all fields and the NDC example) is giving a clear message that trees should not be kept in cropped fields. However, local experience and experience from other areas suggests that in the long run, trees may have an important role in maintaining soil fertility on the poor soils of Kavango. Further debate and investigations are needed on the agroforestry question.
Figure 1: The Role of Crop Production in the Farming System: Some Systemic Linkages
<table>
<thead>
<tr>
<th>State</th>
<th>Area</th>
<th>Dominant Species</th>
<th>Crop</th>
<th>yr.</th>
<th>Fert.</th>
<th>Soil Type</th>
<th>MF</th>
<th>Yield (kg/ha)</th>
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Figure 2: Summary of Crop Production carried out by Case Study Households

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<th>Households (kha)</th>
<th>Number of Households</th>
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<table>
<thead>
<tr>
<th>Number of Families</th>
<th>Number of Households</th>
<th>Case Study Households</th>
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<table>
<thead>
<tr>
<th>Household</th>
<th>Area (kha)</th>
<th>Crop</th>
<th>Yield (kg/ha)</th>
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