

POLYTECHNIC OF NAMIBIA



**JOINT ACTION RESEARCH AT KWANDU CONSERVANCY
BETWEEN
COMMUNITY MEMBERS AND STUDENTS
OF THE AGRICULTURE DIPLOMA PROGRAM**

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**Technical Report: NRM/2006/1
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CONTENTS

	<u>Page No.</u>
INTRODUCTION	1
Timeline of doings and findings	2
General PRA exercises	8
WATER	11
WILDLIFE	18
GRAZING	22
LIVESTOCK	29
TREES AND BUSHES	39
WILD FOODS AND MEDICINES	44
CROPS	49
GARDENING	52
ENERGY.	63
VALUE ADDING	61
Workshop on effective microorganisms (EM)	75
CONCLUSION	82

Report on Polytechnic visits to Kwandu Conservancy

7-11 August & 2-6 October 2006

INTRODUCTION

The Agriculture diploma program at the Polytechnic of Namibia wishes to provide practical experience for its students to learn from a rural community. Every year two excursions are therefore undertaken for students to interact with a community. In 2006 the Kwandu Conservancy was chosen for the visits by 21 students of the Agroecology course. An additional seven students of the Agribusiness Management course also joined the first excursion. The Kwandu Conservancy of about 200km² has about 2500 members and is located alongside the Kwando River in Caprivi Region. This conservancy was chosen because its members had shown interest in conservation tillage as promoted by the Cooperative League of the USA (CLUSA). Agriculture is often perceived as being in conflict with conservation, but Polytechnic students learn about ways of farming that are more compatible with conservation and improve ecological support services.

Learning during the first visit took place largely through methods of Participatory Rapid Appraisal (PRA). The students were divided into ten groups and each group focussed on a particular aspect of natural resource use, while every student was given the responsibility for a PRA exercise. In addition, each student had to choose a specific topic for an extension interaction, based upon what had been learned. Most students started their interactions during the first visit, so that the results could be seen in the second visit. All the posters produced in the PRA exercises remained with the community, so the diagrams that appear in this report are copies that were drawn by students.

After the first visit, students had eight weeks in which to prepare for the follow-up to their interactions, to be undertaken during the second visit. Each student had to arrange for the hands-on interaction to be done by community members, such as by demonstration or role-play, including the results that were achieved. The interaction was then filmed and shown to the wider community on the final night.

Great assistance was received from a core group of conservancy members, led by Manager Cordelia Muyoba; CLUSA facilitator Elma Ntelamo, CLUSA coordinator Ron Phillips and many others who are too many to name individually.

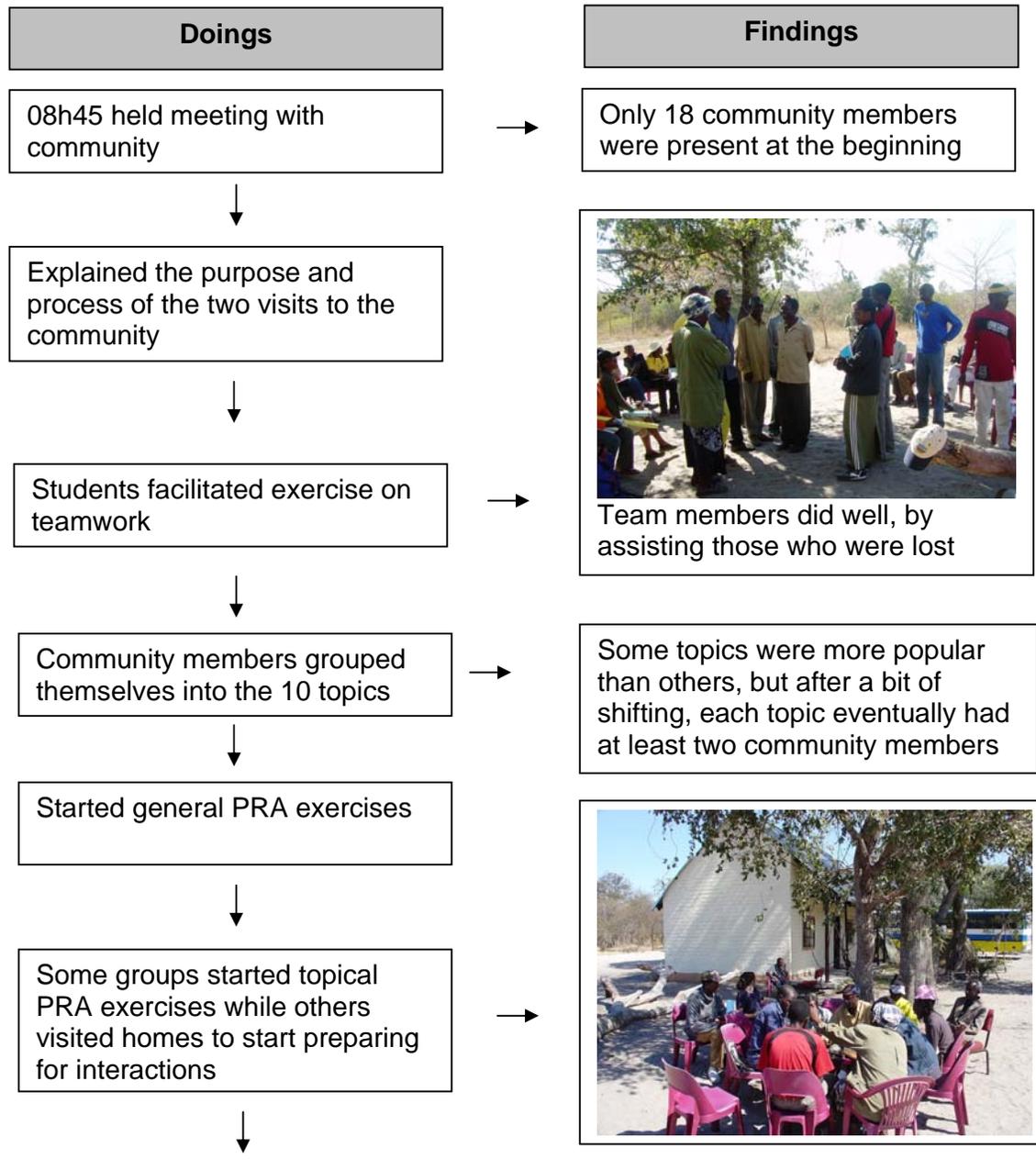


Monday 7 August 2006

Doings		Findings
Toured developments at the Mashare Agricultural Development Institute	→	Local breeds of chickens and pigs are being promoted
↓		
Collected some wild rice plants at Nyangana	→	The grasses were all grazed, so uncertain whether it's really rice
↓		
Reached Kwandu Conservancy at about 16h00	→	The community had expected us earlier, but would be ready for the meeting at 8h30 next day
↓		
Set up camp around Conservancy office	→	



Tuesday 8 August 2006



Wednesday 9 August 2006

Doings

Each of ten groups went to continue their PRA exercises or start on their interactions

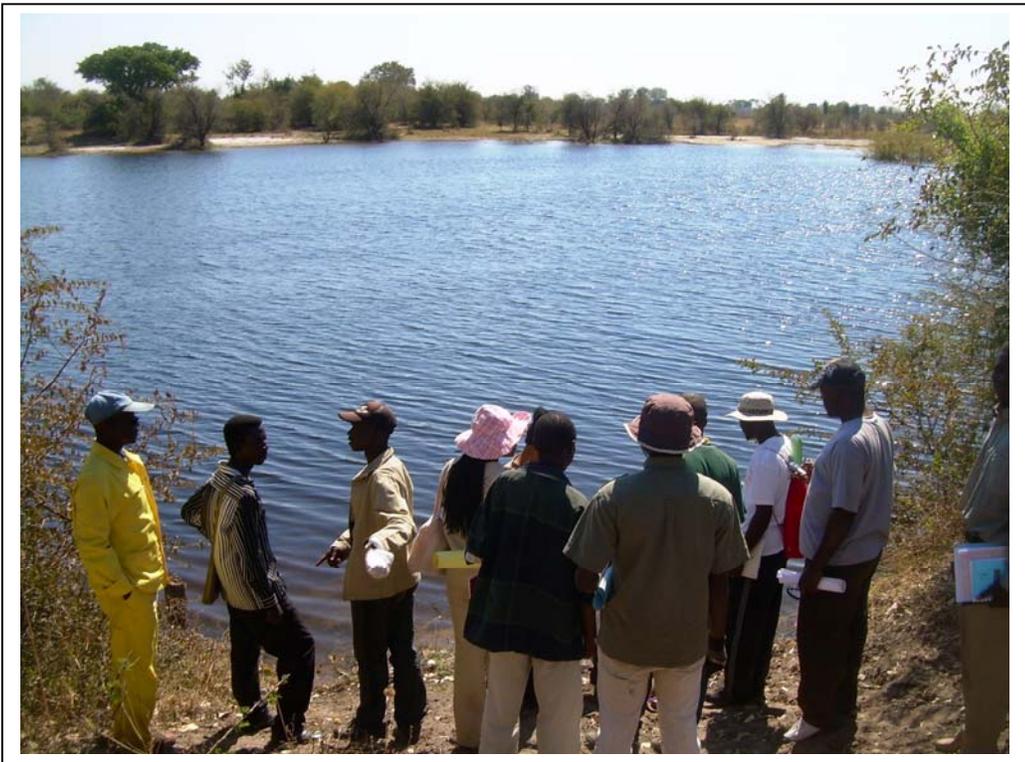
Findings



Some interesting roleplays were filmed



Visited river



Thursday 10 August 2006

Doings

Groups continued to facilitate their interactions with community members, mostly at homes



Visited Bum Hill community camp site



Community members who participated in PRA exercises gave a report back



Showed film of activities of the past few days



Findings



Friday 11 August 2006

Doings

Findings

Left some Polytechnic equipment for community to try out, and data sheets for results to be recorded



Thanked the community, arranged to meet again in October, and departed



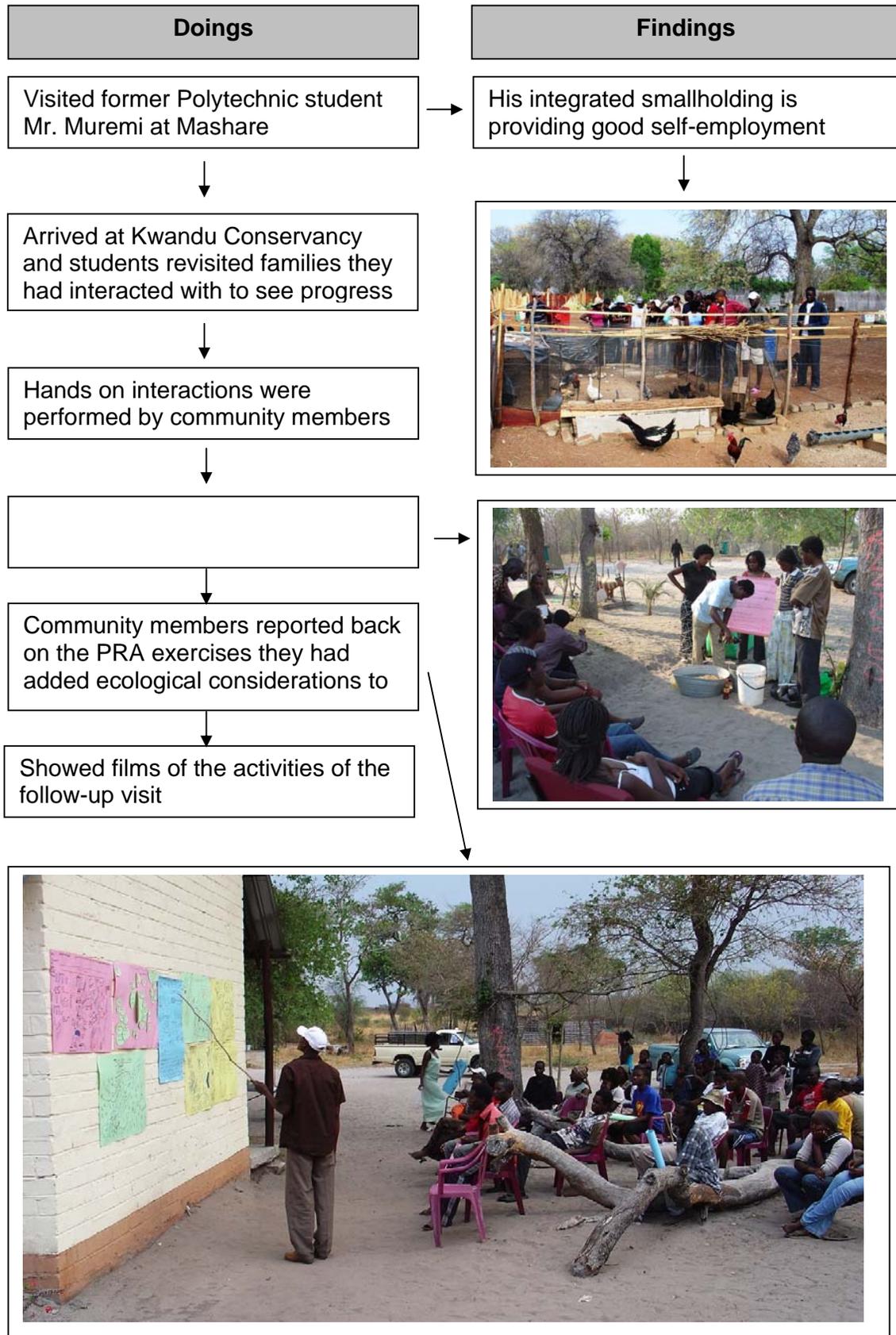
Visited National Youth Training Centre at Berg Aukas



Saw proper way to apply mulch, thickly and widely

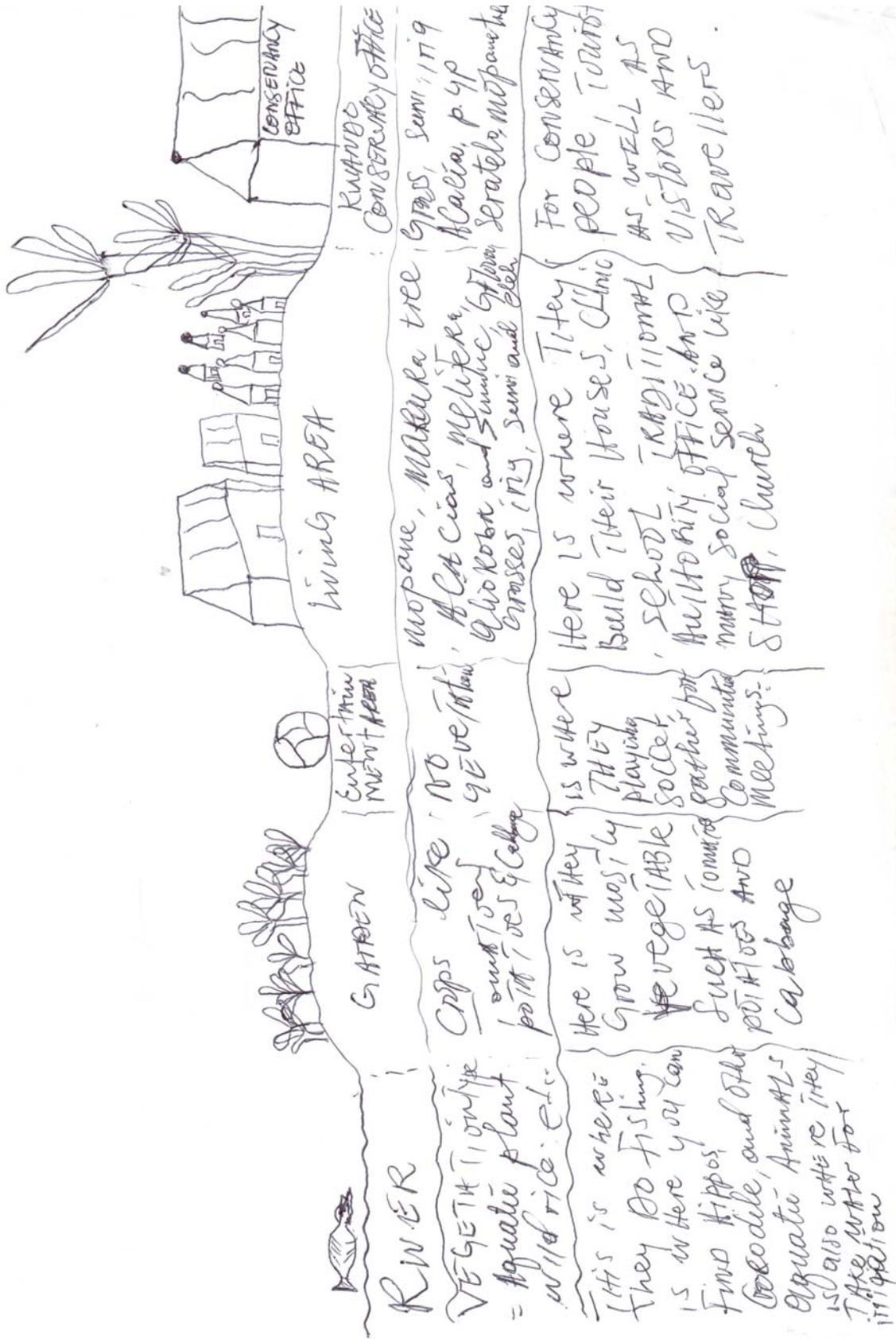


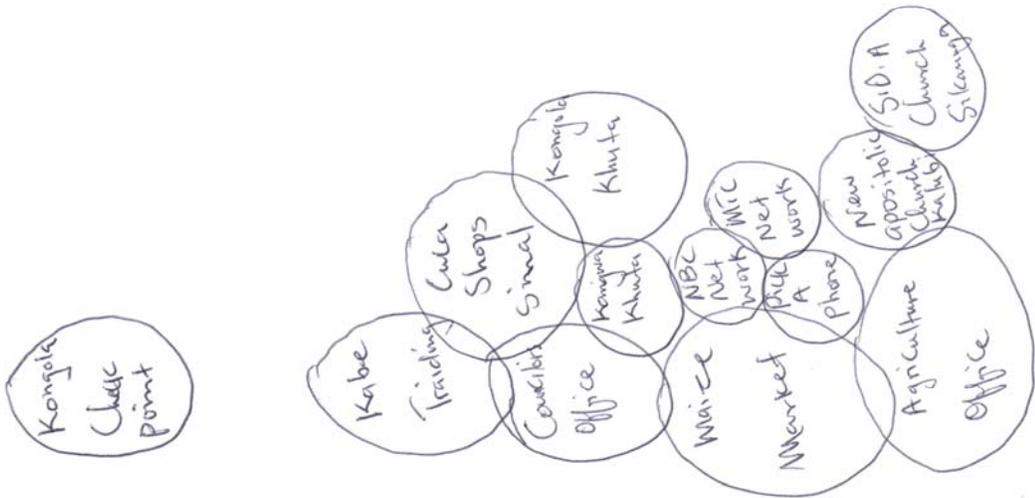
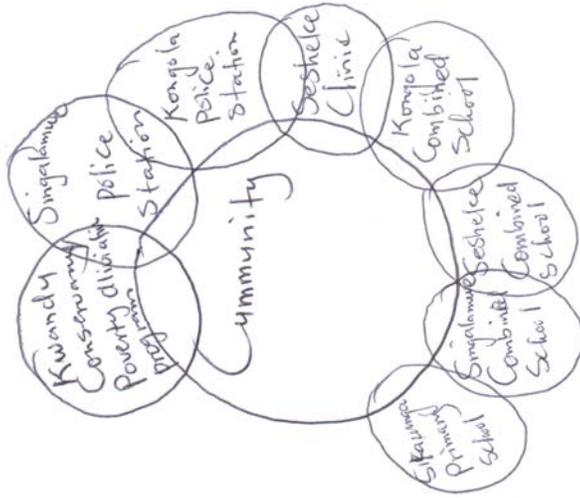
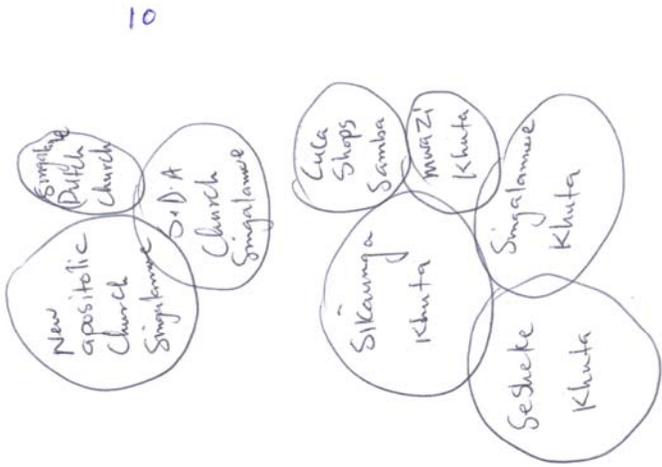
Follow-up visit. 2-6 October 2006



LANDSCAPE I KANSELI MAP OF KWANDO CONSERVANCY

4





WATER

Unlike most of Namibia, Kwandu Conservancy is blessed with a perennial river that brings new water every year and recharges the ground water in the vicinity. However, the security of the water supply and quality is not guaranteed. Most of it fell as rain in countries to the north. As development takes place there, more water will be used in those countries and the smaller quantities that reach Namibia will likely become less clean. The levels of the river water fluctuate from year to year, but already there have been some recent years when only very little water flowed in from the north. Perhaps climate change is also partly responsible, but whatever the cause, this precious resource needs to be greatly valued and conserved.

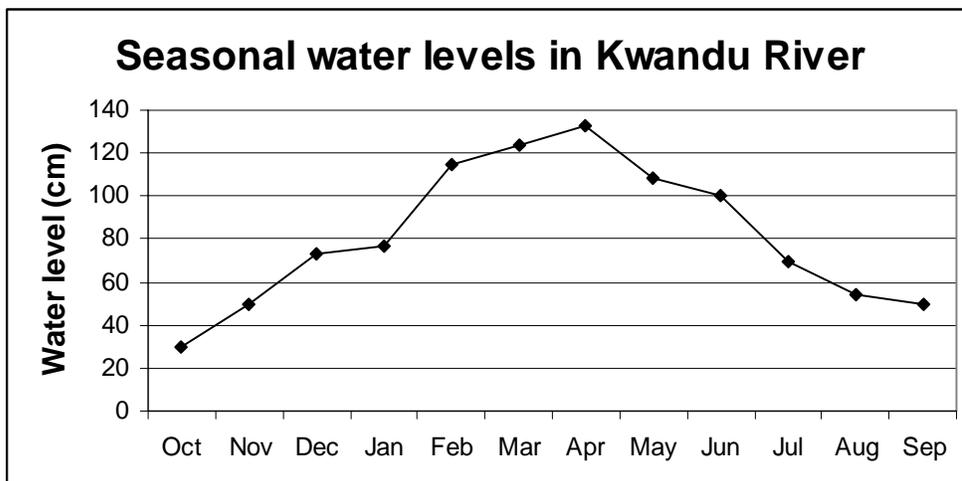
There are five hand pumps available for the community, spaced no more than 2km apart. The ground water is only about 4 or 5m deep at those pumps, making pumping easy, but also likely to result in contamination of the ground water from both human faeces and livestock dung on the ground. Every adult has to pay N\$5 to the water committee, for the upkeep of the hand pumps and the fences around them.



It is convenient to have the river nearby

Students waste water at the hand pump

Records of monthly water levels in the Kwandu River were available in the Conservancy office, but it is not clear in which year they were measured. They appear in the chart below.

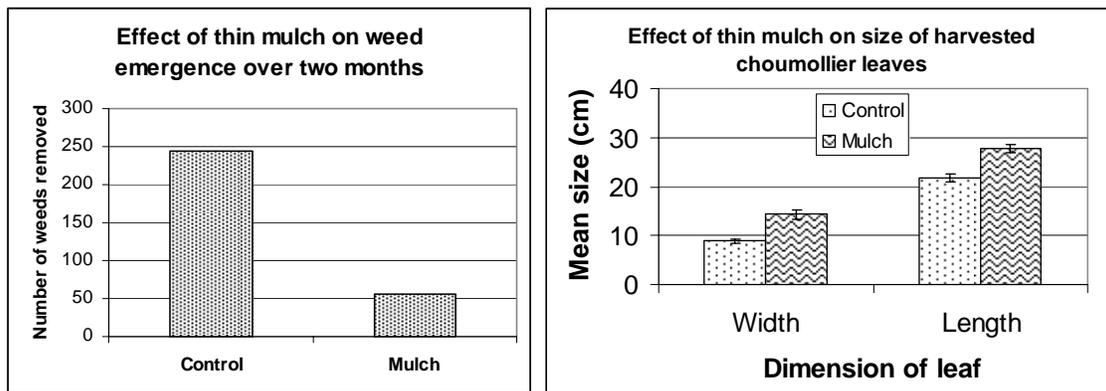


INTERACTIONS RELATED TO WATER

Mulch on gardens, by farmer Ms. Mukuni and student Theresia Muzaza

Grass was cut, and leaves were raked up, from the nearby rangeland. This organic matter was applied as a mulch layer of about 4cm in 12 basins of about 20cm radius around individual choumollier plants, with the neighbouring rows left as the control. The farmer was asked to count the number of weeds removed from each basin and measure the size of leaf subsequently harvested from each plant.

Two months later there was almost no more sign of the thin layer of mulch that had been applied. It had either been blown away by the wind, consumed by soil organisms or scratched away by chickens. Nevertheless the mulch had been effective, as shown by the reduction in weeds and increase in leaf size of the choumollier crop, as is apparent in the charts below. The differences in leaf size are highly significant, as can be seen by the 95% confidence limits shown in the chart.



During the follow-up visit a much thicker layer of about 12 cm was applied, over a larger area, and maize cob waste was used as a weight to reduce wind removal of the lighter organic matter underneath.



Some improvements were obtained from the initial thin and narrow mulch



Better results are expected from the thicker and wider mulch applied later

Low pressure drip irrigation, by farmer Hoster Mukuni and student Abia Nakanduungile

During the first visit plans were made to set up a small stretch of drip irrigation in a garden to demonstrate how it can save on both labour and water, and prevent the soil erosion that occurs with the commonly applied watering method by bucket. Back in Windhoek the necessary pipe, water container with tap, drippers and some connecting pieces were purchased.

During the follow-up visit the drip irrigation was set up, with the 20 litre water container hung from a tree and supplying water to four stretches of pipe about 6m each. Three of the pipes were laid alongside onion plants and one alongside choumollier plants. The water container has an opening of about 15cm diameter into which water is poured by bucket. The drip irrigation system worked well. Its total cost came to N\$224, including 50m of pipe.



Water is poured into the container hanging in a tree



The tap of the container is then opened



The water moves by gravity along the drip pipes



Water drips out of the pipe at each onion plant

Appropriate plot design to conserve irrigation water, by farmers Lushetile Smith and Lovemore Kumpoma; and student Simasiku Mutonga

An existing vegetable garden with rape plants growing close together in long narrow plots was used as an example of how water can be saved. This was compared with another garden where wide plots and low density of choumollier plants resulted in a lot of the water that was applied over the whole plot either evaporating or percolating beyond the reach of roots. The farmers were asked to keep records of the amounts of water applied to each garden, with measured plot sizes and densities of plants.

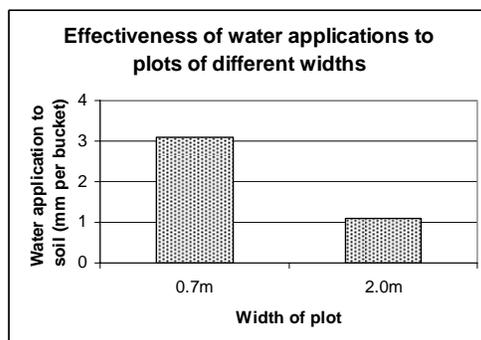


Wastage of water by growing plants at low density on wide plots



Saving of water by growing plants at high density on narrow plots

On the follow-up visit it was found that only the farmer with the wide plots had kept records. However, he had also converted some of his plots to narrow ones, so the results are even better for comparison than with the neighbour. The dimensions of his wide plot were 7 x 2m and for his narrow plot 7 x 0.7m. He applied four buckets of water per day to the wide plot and three buckets per day to the narrow plot. His bucket holds 15 litres of water, so he applied 60 litres per day to the wide plot and 45 litres per day to the narrow plot. These work out at about 4mm of water per day on the wide plot and about 9mm per day on the narrow plot. The effectiveness of the water applications is compared in the chart below, showing the mm of water applied to the soil per bucket, of water. After 25 days the farmer stopped the recordings, as insect pests were attacking his crops, so he harvested what he could save. He did not record the amount harvested per plot, so relative water use efficiencies cannot be calculated. It is clear that the narrower plots are more efficient at water use, moreso when considering the evaporation loss that will be the same



ROLEPLAY ON WATER

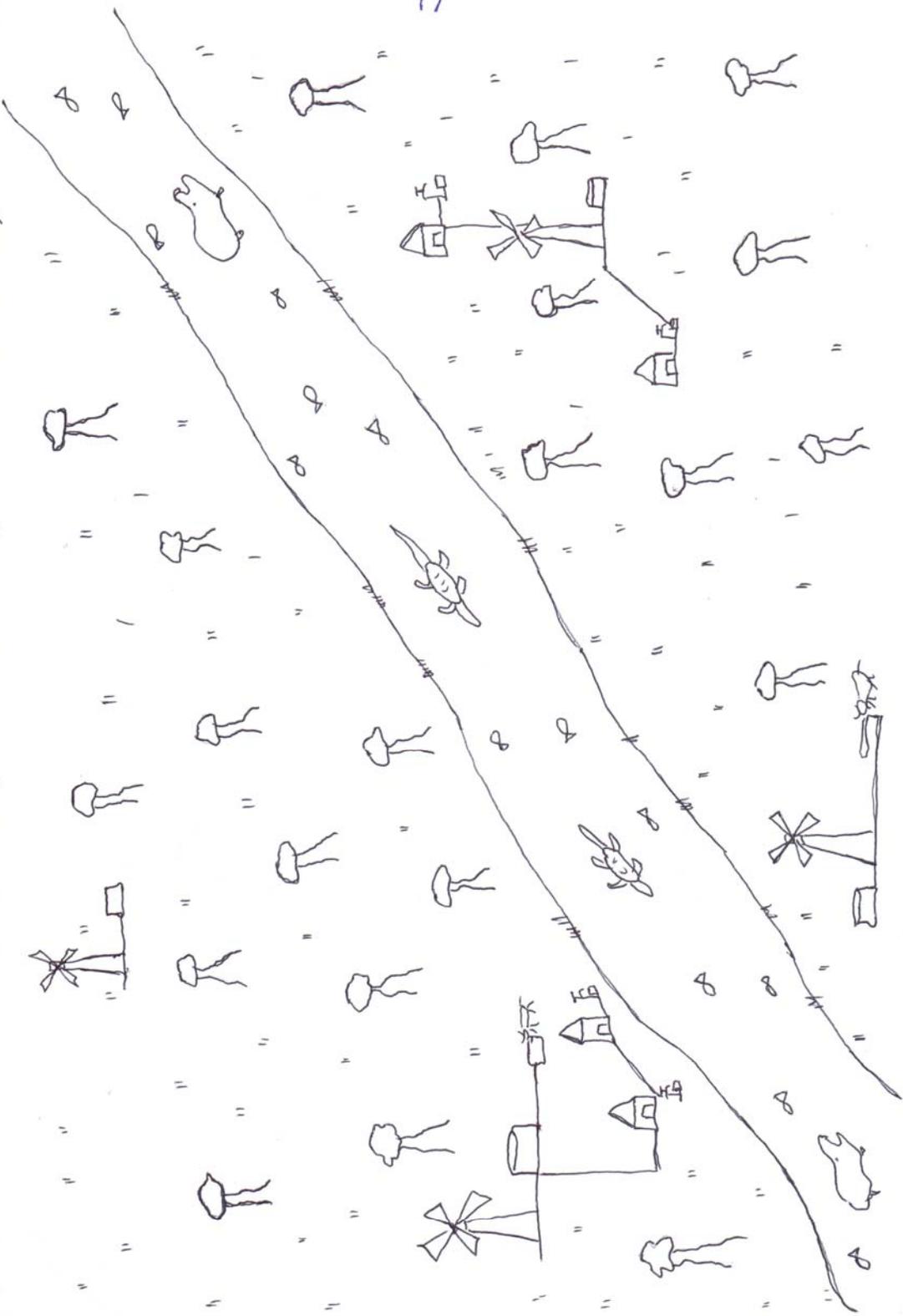
- At the hand pump a man is wasting water by trying to drink directly from the pump while children pump for him.
- Other community members complain about this wastage of water, and the man goes away.
- Next day the community members again see the man wasting water in the same way.
- One of the community members goes to report it to the traditional court.
- The headman orders his assistants to arrest the man and bring him to the kutla.
- The headman orders the man to pay a fine of one cow.
- After paying the fine the man carries a bucket with him whenever he wants to drink water, so that he no longer wastes the water.



The water waster is made to feel ashamed by all the community members who scold him for trying to drink water directly from the pump. He will not waste water again!

The PRA exercises from the topic of water appear on the following two pages.

TREND DIAGRAM - WATER (THE NEXT 50 YEARS)



WILDLIFE

Since Kwandu Conservancy is quite small, covering about 20000ha, it has gone into partnership with three adjoining conservancies, further downstream along the river. Together these four conservancies have formed a joint venture with a hunting company that brings its clients to hunt on the conservancies. The hunting fees are split between all four conservancies, regardless of which conservancies the animals were actually hunted on. Examples of fees that the conservancies get from the hunting company are N\$95000 per elephant, N\$12000 per lion, N\$3000 per bushbuck and N\$2000 per kudu. If cattle are killed by predators then the Conservancy could pay compensation of N\$800 to the owner for each beast killed.

To address the problem of elephants raiding crop fields, chillies are grown and mixed with elephant dung to be burnt and give off a smoke that elephants are particularly sensitive to.

Habitat for wildlife is threatened by the rapidly expanding human population and the hunger for new crop fields

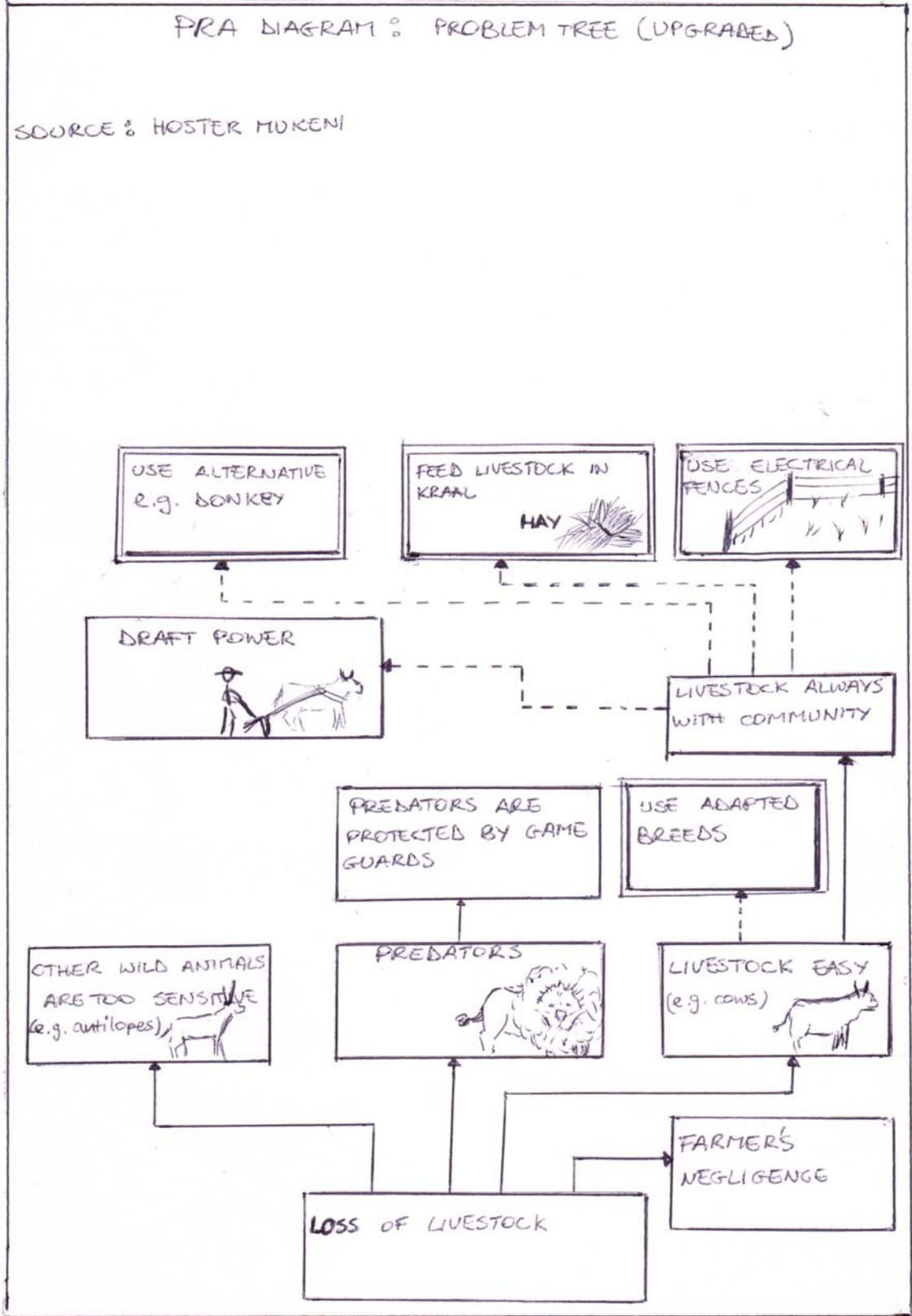


Hippo skulls kept at the Conservancy office

There was no facilitated interaction on the topic of wildlife. The PRA exercises from the topic appear on the following three pages.

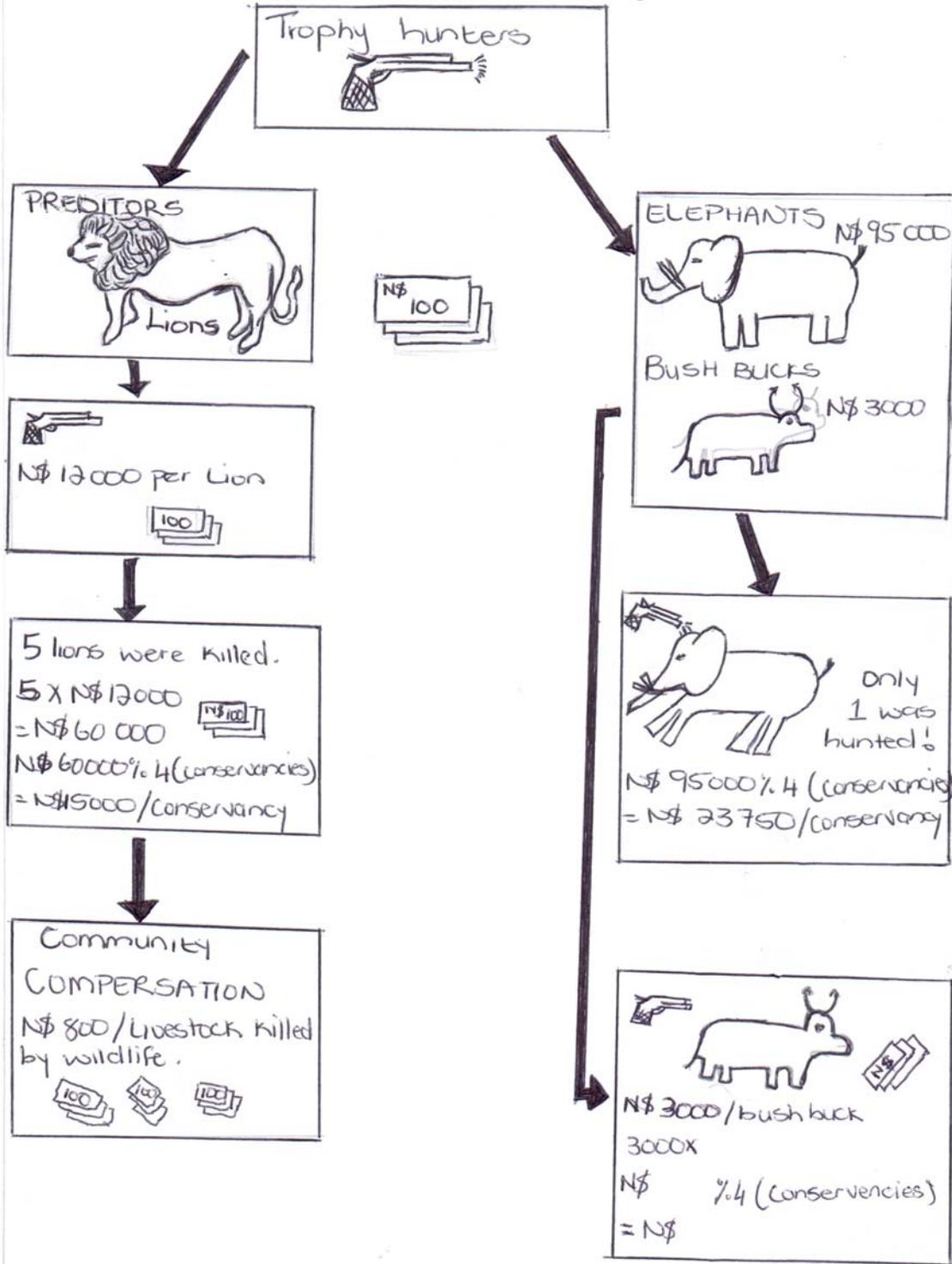
PRA DIAGRAM : PROBLEM TREE (UPGRADED)

SOURCE : HOSFER MUKENI



20

CASH FLOW DIAGRAM: KWANIND CONSERVANCY: WILDLIFE
2006 (JAN - AUG)

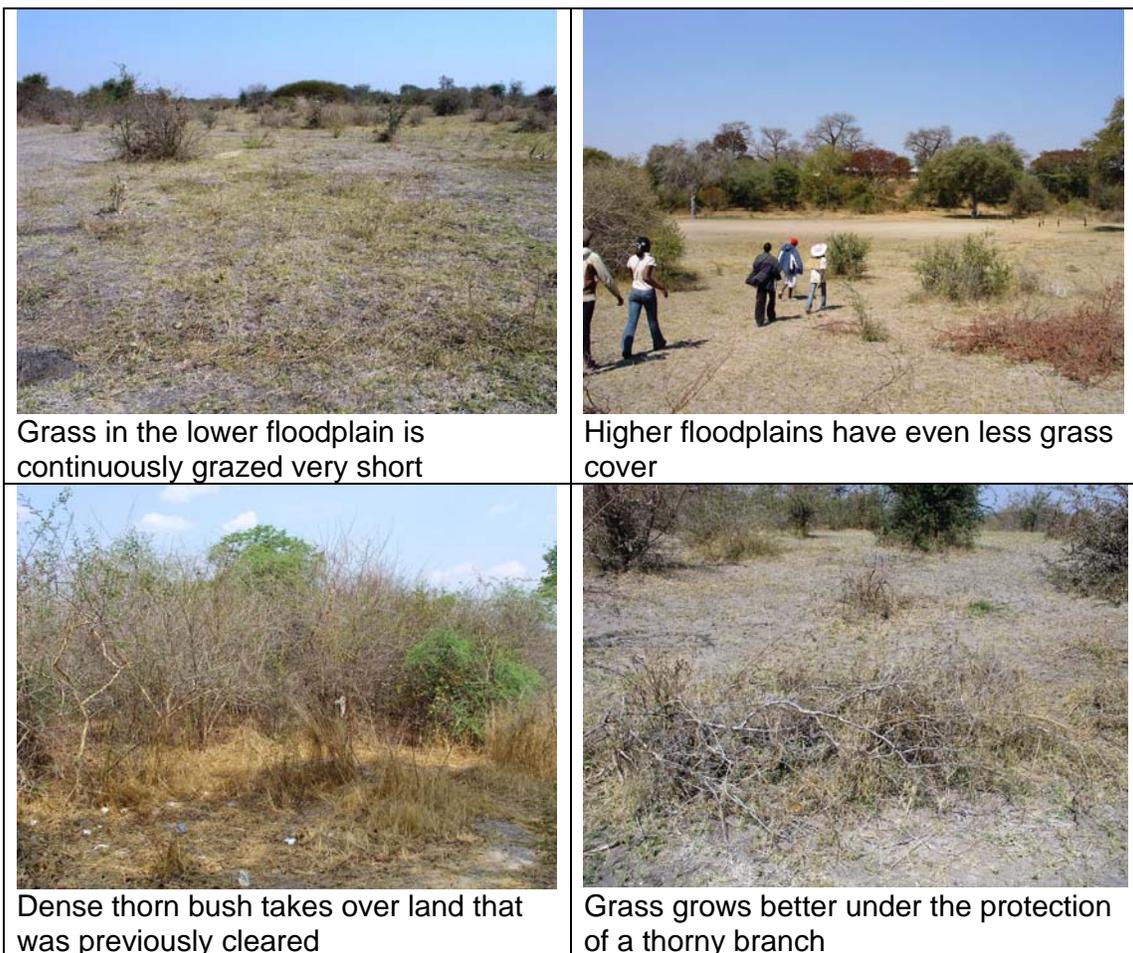


LAND use zone Map with Linkages (Upgraded) Kwando Conservancy



GRAZING

During the dry season the cattle spend most time grazing near the river where some species of perennial grass with rhizomes, such as *Cynodon dactylon*, still survive. The continuous grazing keeps the grass in the floodplains very short. On higher ground it is mainly annual grasses that grow in the vicinity of settlements. Where trees have been cleared previously, dense thorn bush takes over and that makes it very difficult, or in some places impossible, for cattle to graze there. The problem of excessive thorn bush could help to solve two other problems. By cutting some of the thorn bushes and placing them strategically in parts of the floodplain, it would not only allow cattle to access the grass growing amongst the thorn bushes, but would also give temporary rest to grass underneath the cut branches.



Grazing and fire also have an influence on the availability of thatching grass. The Conservancy has appointed some resource monitors who determine, from the growth stage of the grass, when it is ready to be harvested after ripe seed has been shed to ensure sustainability of the thatching grass. This usually happens over July to August and after it is announced that the thatching grass is ready to be harvested, then people start harvesting it.



If cattle



... or fire, does not get to it first,



..... thatching grass is harvested after its ripe seeds have been shed ...



..... and then used for building new homes.



Some tussocks of wild rice are dug up from where they are still abundant, along the Okavango River



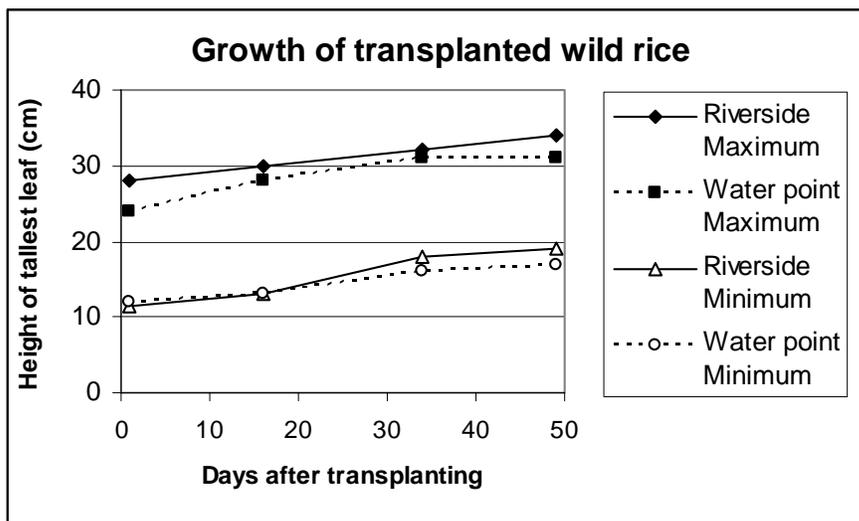
.... and transplanted at Kwandu Conservancy. The cardboard reduces competition from *Cynodon dactylon*

INTERACTIONS RELATED TO GRAZING

Reintroduction of wild rice, by community game guard Kebby Likando and student Otilie Amunyela

About 20 tussocks of what was thought to be wild rice (*Oryza longistaminata*) were dug up from a site where they are still abundant along the Kavango River. There was uncertainty in identification of the species, as the tussocks had been grazed and none had flower heads on them. They were then transplanted at two sites in the Kwandu Conservancy, one inside the fence of a hand pump where excess water spills onto the ground, and one by the river. The transplanted grasses were protected with cut branches of thorn trees. The farmers were asked to maintain the fencing and record the progress with the establishment of the grasses. This would allow the grasses to be later transplanted to other sites within the conservancy and encouraged to spread out, through the application of grazing management. The grass can fix nitrogen, just like legumes, and is much sought after by grazing animals, hence its demise from many of its former habitats.

En route for the follow-up visit, another site along the Kavango River was visited. None of the wild rice was found growing there, but the predominant grass was heavily grazed where the flood water had receded, so about 20 tussocks were dug up from the water's edge. Later this grass species was identified as *Vossia cuspidata*. Some were transplanted inside the fence of the hand pump near the Conservancy office and the remainder were transplanted within a fenced garden of a farmer in a floodplain in the northern part of the Conservancy. The farmers will be able to evaluate the effectiveness of these two grass species for fodder production under protection from grazing, and consider ways to prevent them from being overgrazed in the grazing areas. Weeding may also be necessary in the initial stages after transplanting, as was done at the water point site. The growth rate of the transplanted wild rice is plotted in the chart below, showing the height of the tallest leaf measured by the farmer in both the tallest and shortest tussock at each of the transplant sites at intervals of roughly two weeks.





Determination of grazing capacity, by student Ester Namushinga (who failed to name the community members involved in this interaction)

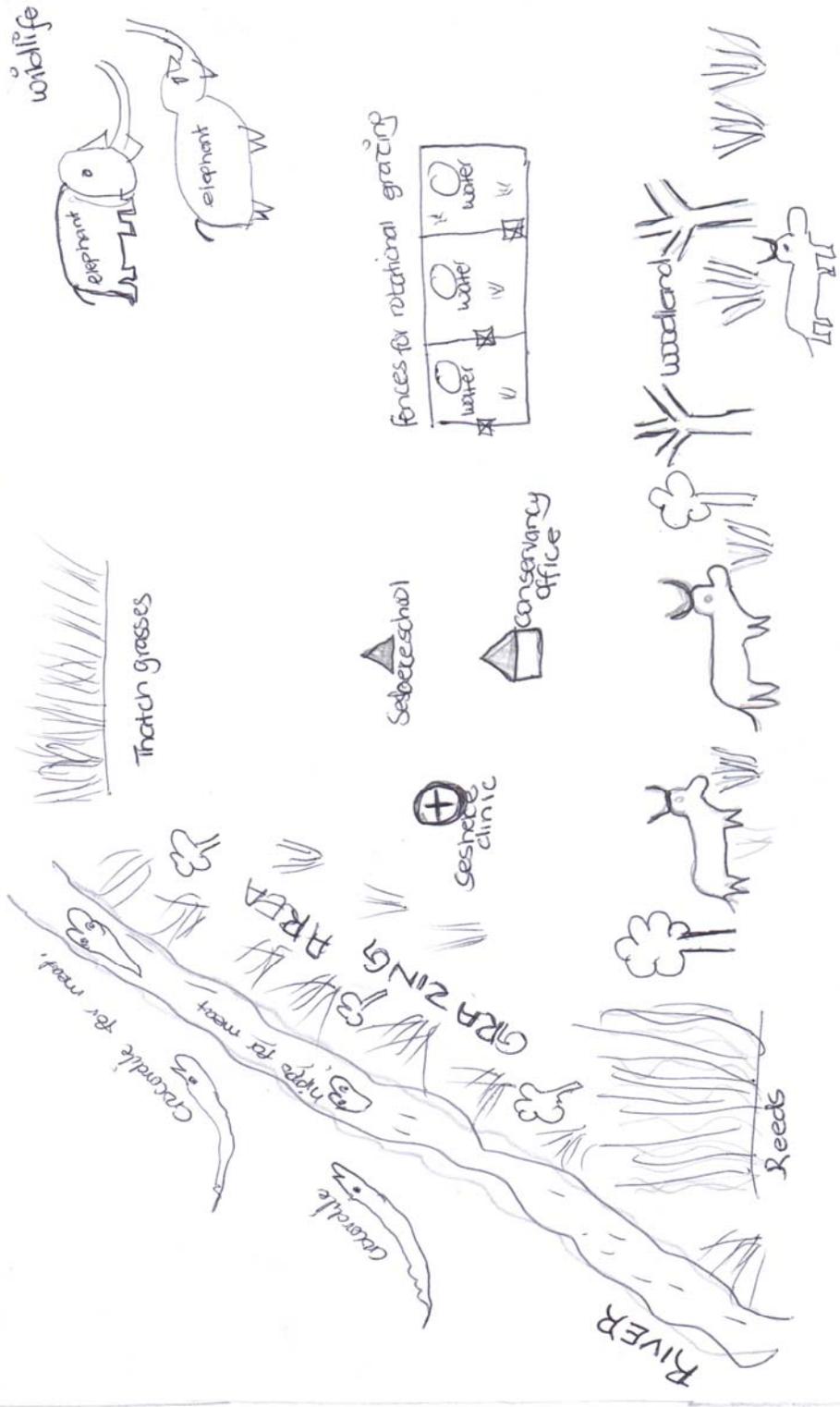
A group of farmers was shown how to determine the grazing capacity by two different methods. They identified an area that they considered to have grass that represents the average available in the conservancy. There they first formed a square, with one person at each corner, which they considered to have enough grass to feed one cow for one day, while leaving enough to remain uneaten for protecting the soil and feeding soil organisms. They then found that the sides of the square measured 18m so they squared it to calculate the area needed for one cow for one day. A booklet on local level monitoring was left with the farmers, after showing them how they can compare their grazing with that shown in photos of different grazing capacities.

On the follow-up visit some further information was obtained from community members. Out of the 20000ha of conservancy, about half is available for livestock grazing. It was estimated that there are about 1000 cattle in the conservancy, so the current stocking rate is about 10ha/LSU. If the square that was estimated during the first visit, dominated by annual grasses, is representative of the amount of grass available over the 10000ha available to livestock, then the grazing capacity would only be 12ha/LSU. However, the cattle do a lot of their grazing in the floodplains, where the perennial grasses regrow quite fast and are able to support more animals than the higher ground dominated by annual grasses.

The PRA exercises from the topic of grazing appear on the following three pages.



THE GRAZING TRENDS DIAGRAM OF KWANSHI CONSERVANCY

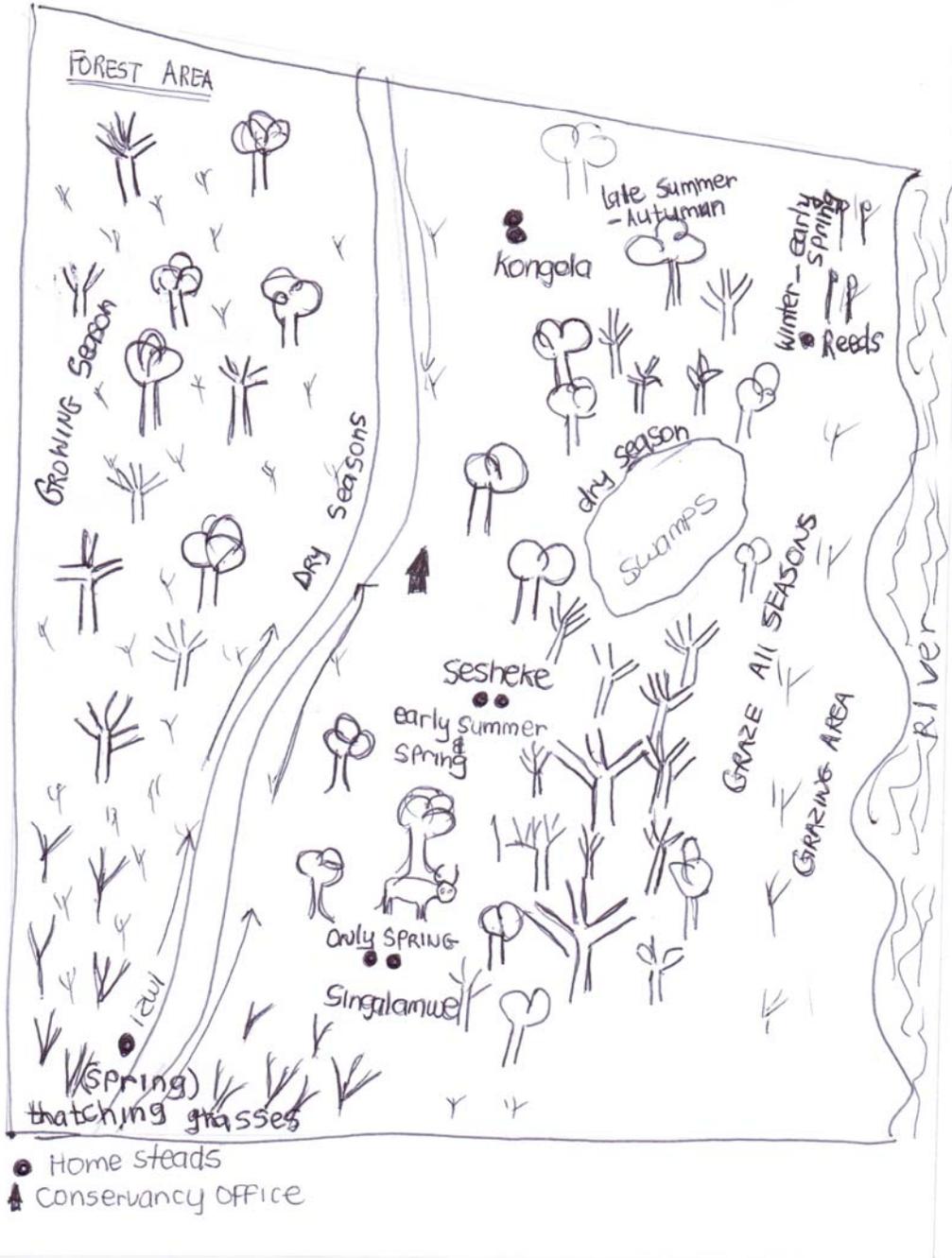


Done By: Miss Ester Ngunjiri

SEASONAL GRAZING MAP

NAME: OTTILIE AMUNYELA

COMPILED BY: MR Likando Kebby



LIVESTOCK

Cattle are the most important livestock in the Conservancy, but goats are gaining in popularity because they are easier to keep and do not go far from the kraal. Chickens are also kept by many households, while some keep ducks. Sheep used to be kept in the past, but they did not perform well. Some farmers find the size of their herds diminishing, as they are tempted to keep selling some in order to get money that is increasingly needed for a variety of purposes. Conflict with wild animals also occurs, and similarly livestock cause damage to gardens and crop fields. Diseases sometimes take their toll on livestock, as was experienced by poultry during the period between the two visits. All livestock range freely in search of food during the daytime, and most are kept under protection at night. Very little supplementary feeding takes place, even though many of the animals and birds could benefit from it.



Cattle provide transport as well as many other benefits



Some cattle could benefit from supplementary feeding



A trap helps to control tsetse flies



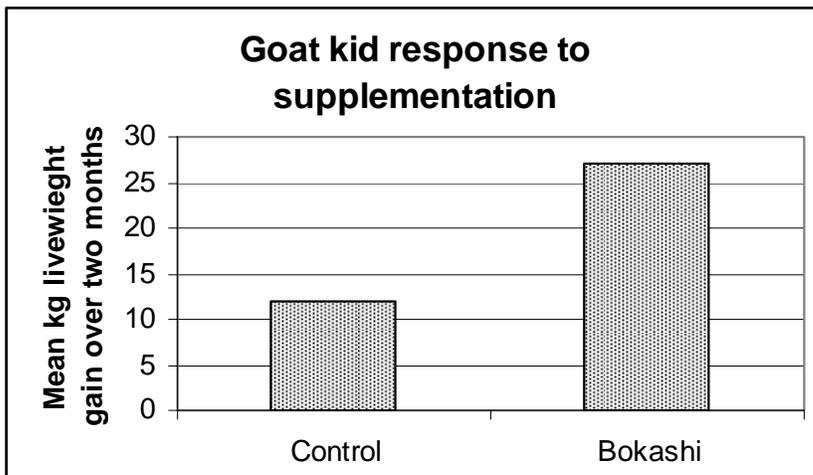
Domesticated guinea fowls are also kept by some farmers

INTERACTIONS RELATED TO LIVESTOCK

Adding EM-bokashi to the diet of goats, by student Rosina Heita (who failed to name the community members involved in this interaction)

Two goat kids were marked with string tied around a leg and together with the remaining three unmarked kids were weighed. The farmer was given about 3 litres of ready made EM-bokashi and asked to feed a handful daily to each of the marked kids and to leave the unmarked group as the control. About 6 litres of EM-bokashi were made with the farmer for use when the 3 litres got used up.

Before the follow-up visit one of the marked kids disappeared after it had grown very fast. It is suspected that it got stolen. During the follow-up visit the four surviving kids were re-weighed. The one that received bokashi had gained 27kg over the two months, in comparison for an average weight gain of 12kg for the three untreated kids.



A goat kid is weighed at the start of the experiment

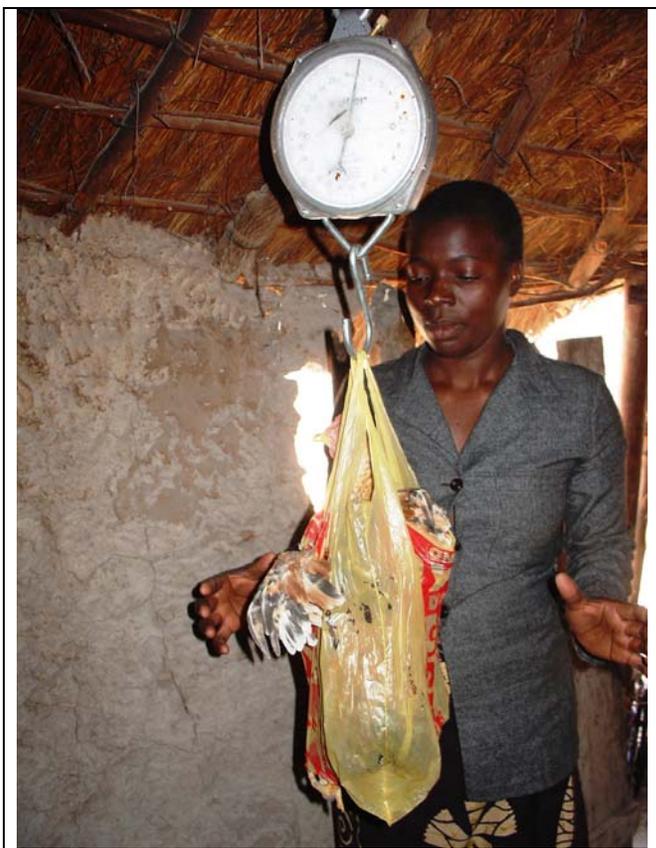


Two months later the goat that received some EM bokashi (left) was much bigger

Producing EM-bokashi from bran, to feed chickens, by community members Vasco and Ms. Samakwa; and student Beata Negumbo

A solution made from 200ml of molasses dissolved in 3 litres of water that then had 200 ml of multiplied EM mixed in it was used to thoroughly moisten 25 litres of wheat bran, before being pressed into a large plastic bag and tied with string to become airtight. The bag was kept indoors to ferment, with instructions to the farmer to use it when another bag of about 20 litres of ready made EM-bokashi was used up. Ten chickens out of a flock of 25 were weighed. The farmer was asked to feed three handfuls of ready made EM-bokashi daily to her flock and record the numbers of eggs laid daily by her flock and by her neighbour's flock that did not get EM-bokashi. A spring balance was left with the farmer for weighing ten of her chickens and ten of her neighbour that did not receive any bokashi.

At the start of the trial the average mass of the treated chickens was 1.23kg, which was comparable with the 1.24kg average for her neighbour's chickens. Three weeks later the chickens that received bokashi averaged 1.70kg, but those of the neighbour had died. The disease, which was apparently brooder pneumonia caused by an *Aspergillus* fungus, affected all the chickens in the neighbourhood and even those that received the bokashi succumbed to it seven weeks after the start of the treatment. Before the disease outbreak the treated chickens seemed to perform well. They hatched 10 chicks and laid 18 more eggs. They did not scratch themselves as they used to do, suggesting that they were no longer suffering from lice.

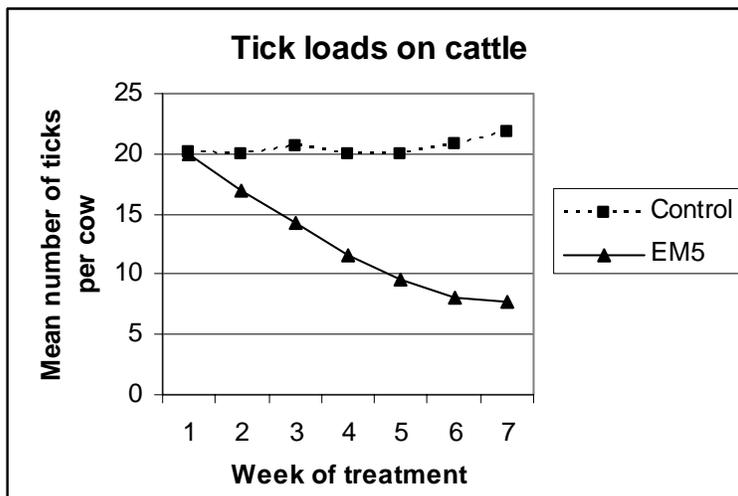


A chicken is weighed at start of experiment

Controlling ticks on cattle, by community member Hoster Mukuni and student Daniel Haikali

Out of a herd of about 40 cattle, five were marked on the rump with black paint and five were marked on the thigh as control. EM5 diluted with an equal amount of water was sprayed weekly with about 100ml each under the tail and on parts of the body where ticks were found. The farmer was asked to spray the experimental cattle weekly and count the ticks on each experimental cow and on each of five control cows. Oxpecker birds were seen on some of the cattle, feeding on some of their ticks.

Over the two months the tick load on the treated cows decreased steadily to about one third that of the control group. At about 6 or 7 weeks after starting the treatment it looked like the tick load on treated cows was starting to level off, while on untreated cattle they started to increase, probably as a result of rising temperatures. There was a high demand for the EM5 made at the EM workshop. The recipe for making EM5, and the telephone number of the EM supplier, were left with the community, so that they could in future make their own.



The experimental cattle are sprayed under their tails with EM5



Cattle in some kraals have no ticks, perhaps thanks to oxpecker birds that the Conservancy is still blessed with

Fodder production, by student Festus lipumbu (who failed to name the community members involved in this interaction)

A few potted plants of Elephant grass, Siratro and Pigeon pea were planted within a fenced area. In addition, seeds of the latter two species were sown in some pots. The farmer was asked to water the plants and protect them from livestock.

After two months it was found that all fodder plants previously planted in the fenced area had died, because they had not been watered. The new seedlings, together with some more seedlings and elephant grass from the Polytechnic, were planted in another garden, alongside the fence. A total of 30 fodder plants were transplanted into the garden. The Siratro was planted next to the other two species so that, being a vine, it could climb up them.



First attempt at growing fodder failed



Second attempt - hopefully successful



Siratro seedling next to pigeon pea, to climb up it



Pigeon pea is already grown at some homes in the Conservancy

Producing silage and haylage in an airtight sacks, by community member Mike Kachitomwa and student Johnplay Shetukana

For silage, green leaves were harvested, mainly from trees. For haylage, dried tree leaves were gathered from the ground and some dried grass was harvested and chopped into pieces of about 15 cm. These materials were then sprayed with a solution made from 500ml of molasses dissolved in 15 litres of water that then had 500 ml of multiplied EM mixed in. The moistened plant material was then pressed into heavy duty plastic sacks and made airtight by tying with string. The contents of each bag occupied about 15litres, and three bags of silage and three of haylage were produced. Back at the Polytechnic another student, Martin Siyamana, produced two bags of about 25 litres of haylage each made in the same way, but using dry grass from around Windhoek.

After two months the bags were opened and all had a sweet acidic smell. They were offered to cattle in the kraal and some cattle finished off the haylage from Windhoek, but the Kwandu silage and haylage remained mostly uneaten, probably due to the presence of unpalatable tree leaves. If mixed with a bit of manure they would soon turn into excellent compost.



Haylage made from dry leaves



Silage made from green leaves



Both haylage and silage smelt good ...



... but cattle only liked grass haylage

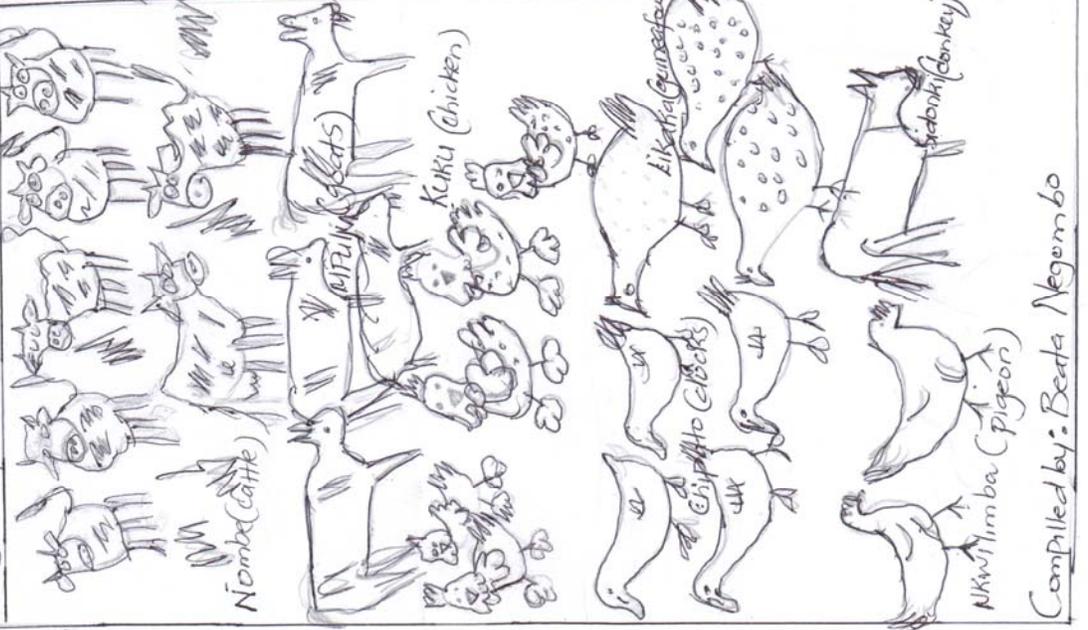
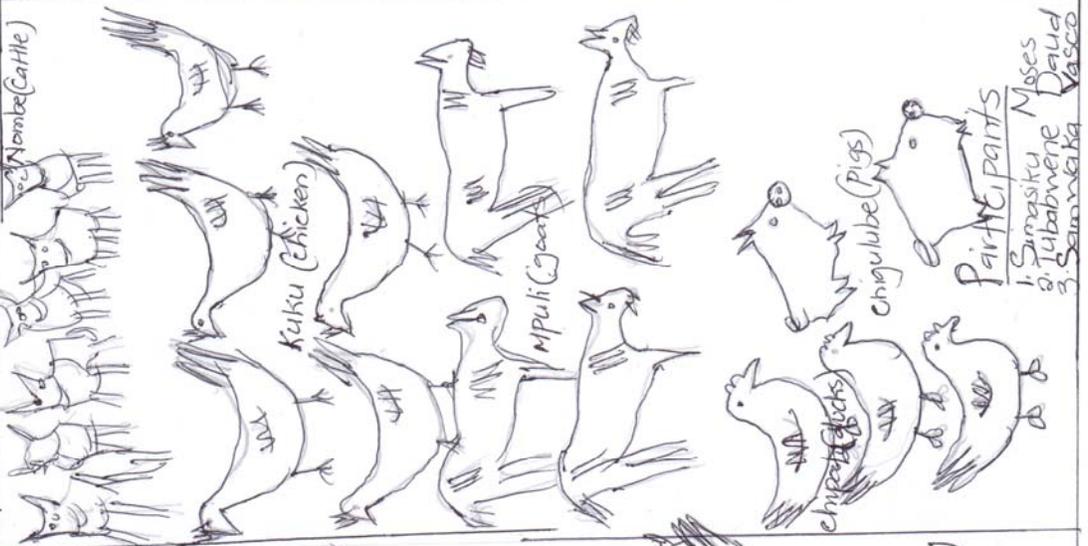
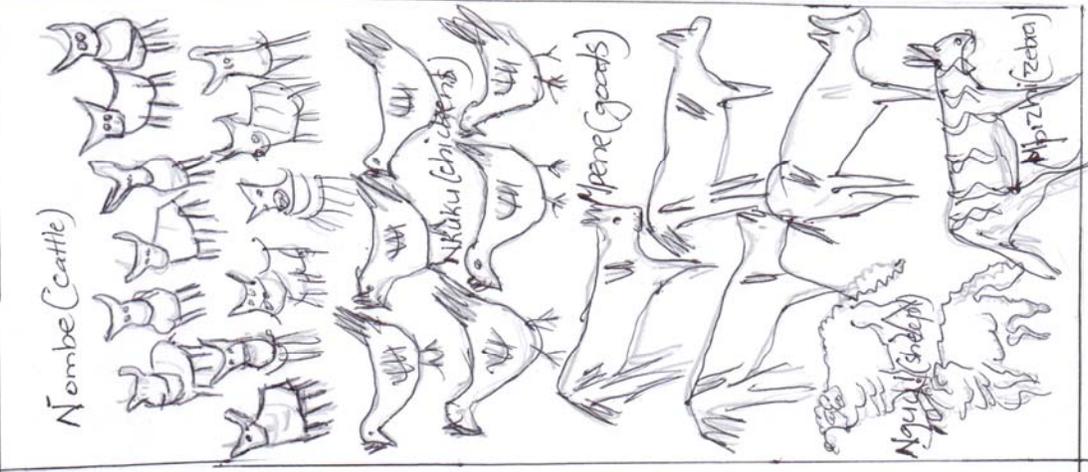
The PRA exercises from the topic of livestock appear on the following four pages.

Kwando Conservancy Livestock Trend Diagram

50 YEARS TO COME

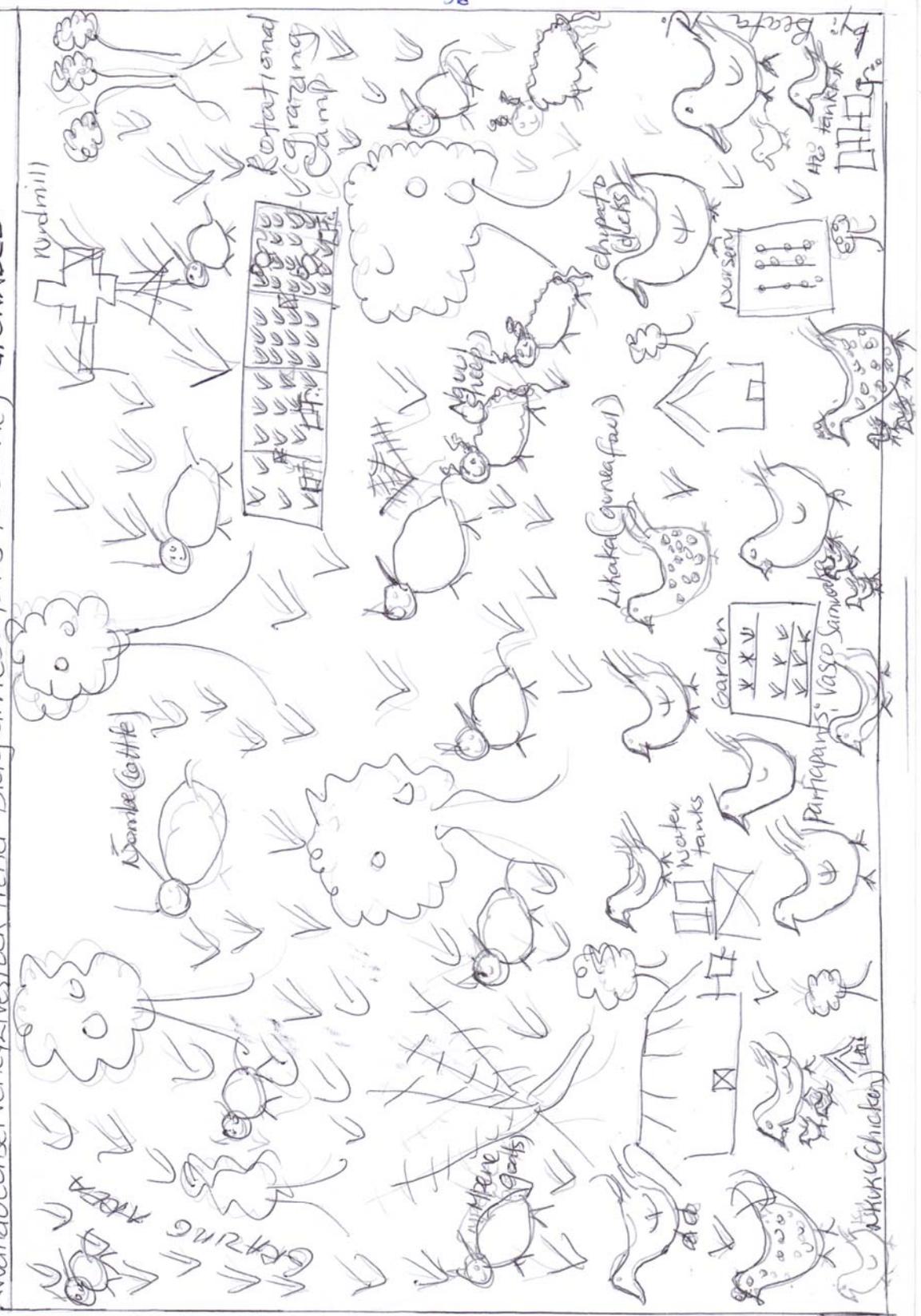
PRESENT

50 YEARS AGO



35

Kwando Conservancy Livestock Trend Diagram (50 years to come) UPGRADED



nsikunku Bokashi
(Report on Bokashi feeding to chickens)

After (shitwazihi)



chicken free from lice (Kuzi Zhuba ngina)

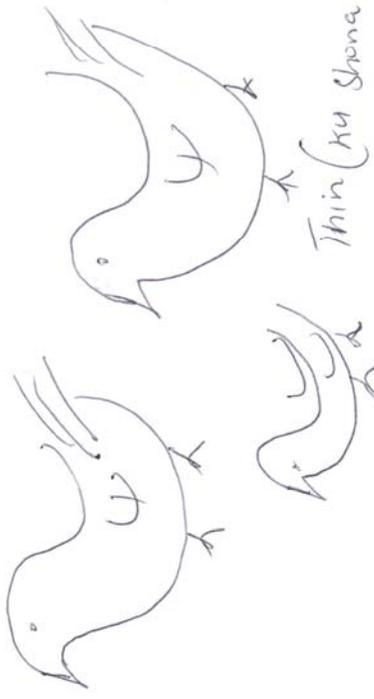
Increased no of eggs

(Palo ya mangi ari eke zehi)



Ku hu ba
(Report on

Before (Nety shini ku zina)



Thin (ku shona motili)

chicken lice (ngina)

Completed by:

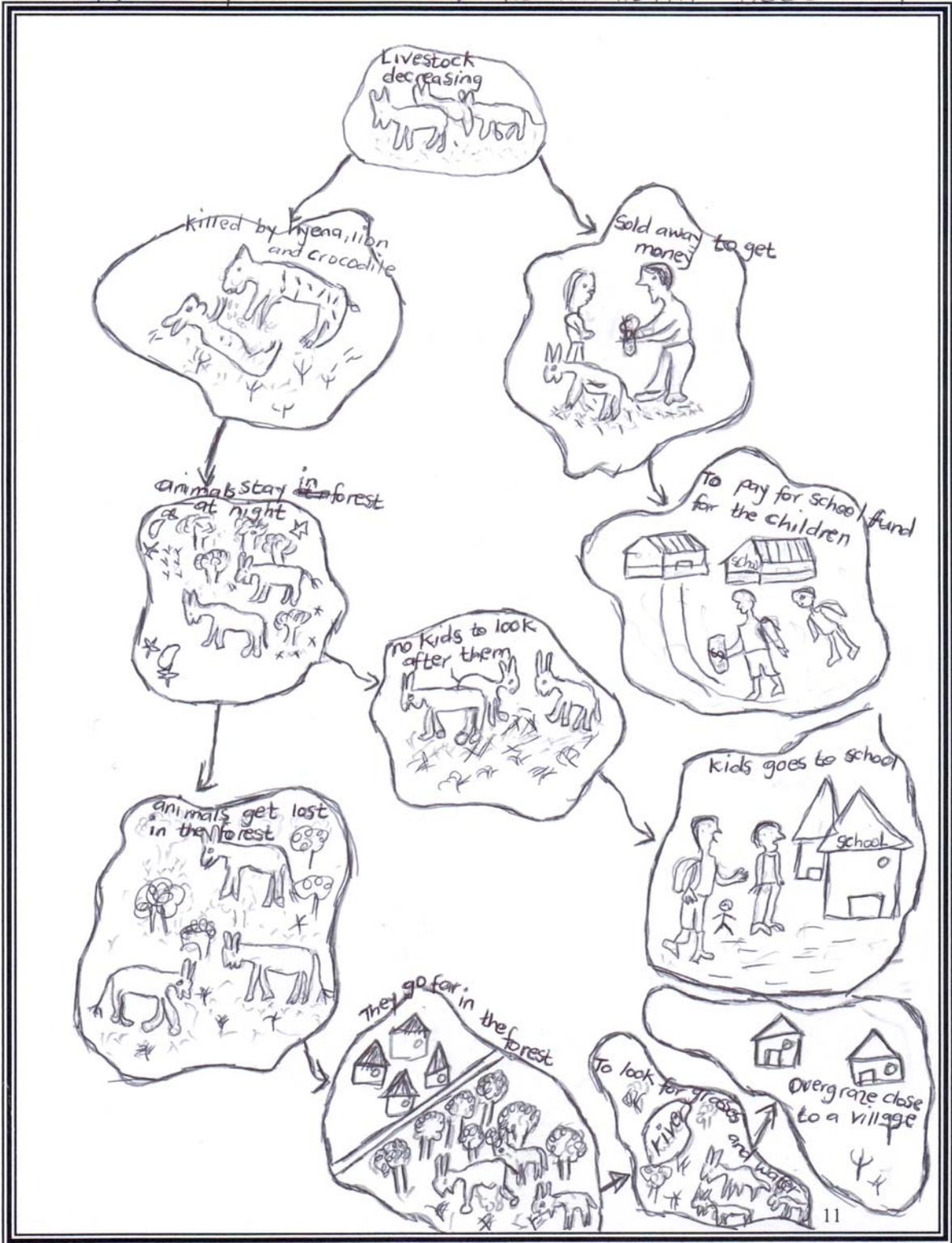
Beata Ngunjiri
Participants:
Vasco Samuata
Juel Kabusu

of eggs (pala ya mangi)



weak chicken

Upgraded problem tree 38 ROSINA HEITA 200302094



TREES AND BUSHES

Valuable trees still grow in the Conservancy, although many have been cleared to make way for crop fields. Timber from many of the trees is of high quality, but their growth rates are slow so they need to be managed with care if benefits from their harvesting are to be sustained. Young trees of most valuable species need to be protected from fire if they are to survive into adulthood. The fruits of the baobab tree are highly valued, both locally and overseas. The baobab fruits from the Conservancy are not likely to be contaminated with pesticides, and could probably fetch a very high price in the lucrative European market. Most Baobab fruits in neighbouring countries get rejected by the European market because they are contaminated by pesticides used to protect cotton, which is usually grown in areas where baobab trees occur in most of those countries. A good tree cover provides non-consumptive benefits too, that might be even more valuable than the consumed products. Some of these benefits are ecological support services, such as encouraging rain, and providing protection from wind and the heat of the sun. Another non-consumptive benefit is the beauty provided by the trees, which also attracts tourists who pay to visit the Conservancy.



Baobab trees attract tourists



Many trees are damaged by fire



Some trees are put to good use by supporting granadilla vines



The poisonous Ricinus bush is common in the Conservancy

Some farmers prefer to plant exotic trees, such as blue gum (mupalanga) that is considered by others to be harmful to the environment by wasting water and causing the soil underneath the trees to be toxic for other plants. Other prefer indigenous.

INTERACTION RELATED TO TREES

Promotion of the Moringa tree, by community members Hoster Mukuni, Alex Kukomokua and student Wendelinus Kalimbo

Seeds of *Moringa oleifera* were brought along to the Conservancy, but a number of trees were already found growing there, after a farmer had been given seed during a visit to Zimbabwe. However the farmers were unaware of its diverse uses, including human food rich in anti-oxidants and its water purifying properties, so relevant information was provided. The Moringa tree growing at the Conservancy office was too tall, so it was pruned to increase production and facilitate harvest of leaves and pods, while manure and bokashi were applied in a basin around its trunk, followed by a layer of hay as mulch.

After two months the pruned Moringa tree at the office was re-growing nicely. Some leaves were harvested and a demonstration was given on how to dry the leaves and then use them to make a nutritious drink. A few Moringa seedlings were given to some community members who showed interest, including one lady who hopes to lower her high blood pressure by consuming some of the tree products. Some recipes from Zimbabwe were left with the community so that they could make a variety of food dishes from the Moringa leaves, pods, seeds and flowers.



Moringa leaves are very nutritious



A Moringa seedling is transplanted



Dried Moringa leaves, if crushed and added to water, produce a health drink



EM Bokashi will help the Moringa seedling to grow well

ROLEPLAY ON TREES



1. A lady, whose immune system has been weakened by HIV, coughs a lot



2. Her parents go to buy antibiotics at the pharmacy, but they do not help



3. They then take her to a traditional healer, whose herbs also do not help



4. She becomes so sick that they call the ambulance to take her to the hospital



5. Nurses check her temperature and inject her with antibiotics, but her condition only improves for a short while before getting worse again



6. After having spent all their money, her parents try to supplement her food with Moringa leaves. This boosts her immune system so she gets some relief.

The PRA exercises from the topic of trees and bushes appear on the following two pages.

WILD FOODS AND MEDICINES

Although some of the older generation still make use of the wild foods and medicines that used to be so important for the community, a lot of the younger generation disregarded them in favour of modern foods and medicines. This might be later regretted, as some of the wild foods and medicines are not only cheaper than the modern alternatives, but also healthier in many cases.



Results from growing seedlings of three species of wild foods and medicines



Fruits of *Cucumis metuliferus* that grows wild and has marketing potential



Student Martin Siyamana practices what he preaches about benefits of local medicines, by picking *Syringa* leaves ...



... and pounding them in a plastic bag to extract the sap, which he then dilutes with water and drinks to stop diarrhoea

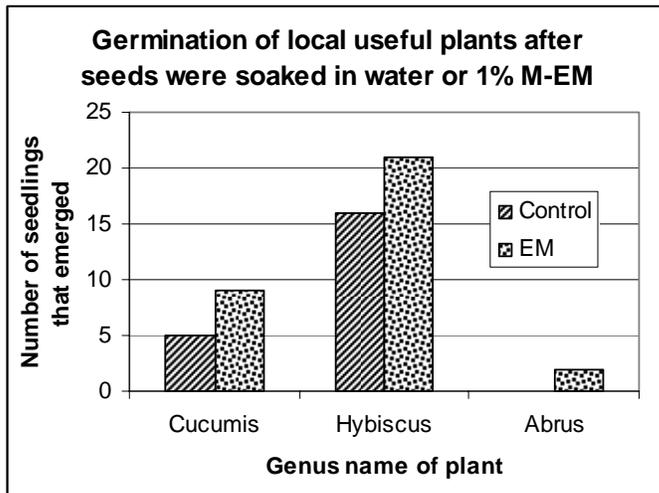
There are already efforts at promoting local fruit. Seedlings of some indigenous fruit trees are being grown in the nursery near the Conservancy office, including *Garcinia livingstonii*, *Diospyros mespiliformis* and *Brechemia discolor*.

INTERACTION RELATED TO WILD FOODS AND MEDICINES

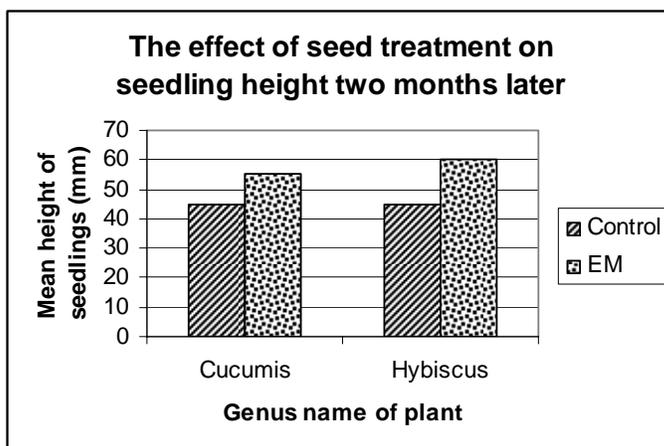
Propagation of local medicinal and food plants, by Alina Mutumbulwa (who failed to name the community members involved in this interaction)

Seeds were collected from three locally occurring species, *Abrus precatorius*, *Cucumis metuliferus* and *Hybiscus sabdariffa* that are used by the community as foods and/or medicines. Half of the seeds were soaked for a day in multiplied EM diluted 100 times and the other half soaked in water. The seeds were sown in small bags both at Kwandu Conservancy and at the Polytechnic in Windhoek. The farmer was asked to record the number of seeds that germinated from each treatment and the heights of the seedlings, while the student recorded the same in Windhoek.

The seedlings raised in Windhoek were brought along to Kwandu Conservancy for the follow-up visit. Both in Windhoek and at Kwandu there were more seeds that germinated from the EM treatment, but the difference was not significant at the 5% level, so the results were combined to plot in the chart below.



There was also a slight but not significant effect of the EM seed treatment on height of seedlings as shown below:



ROLEPLAY ON WILD FOODS AND MEDICINES



1. A Polytechnic lecturer prepares her students to facilitate a community workshop on how to grow and manage local foods for the novelty export market.



2. After the workshop one family continues to waste money on tombo, while making fun of the other family that plants lots of Cucumis for sale



3. The children of the tombo family get sent away from school because their parents could not afford their uniforms



4. A European company buys Cucumis fruits from the other family on a regular basis at a very good price



5. The family that sold the Cucumis buys a house and a car with their proceeds

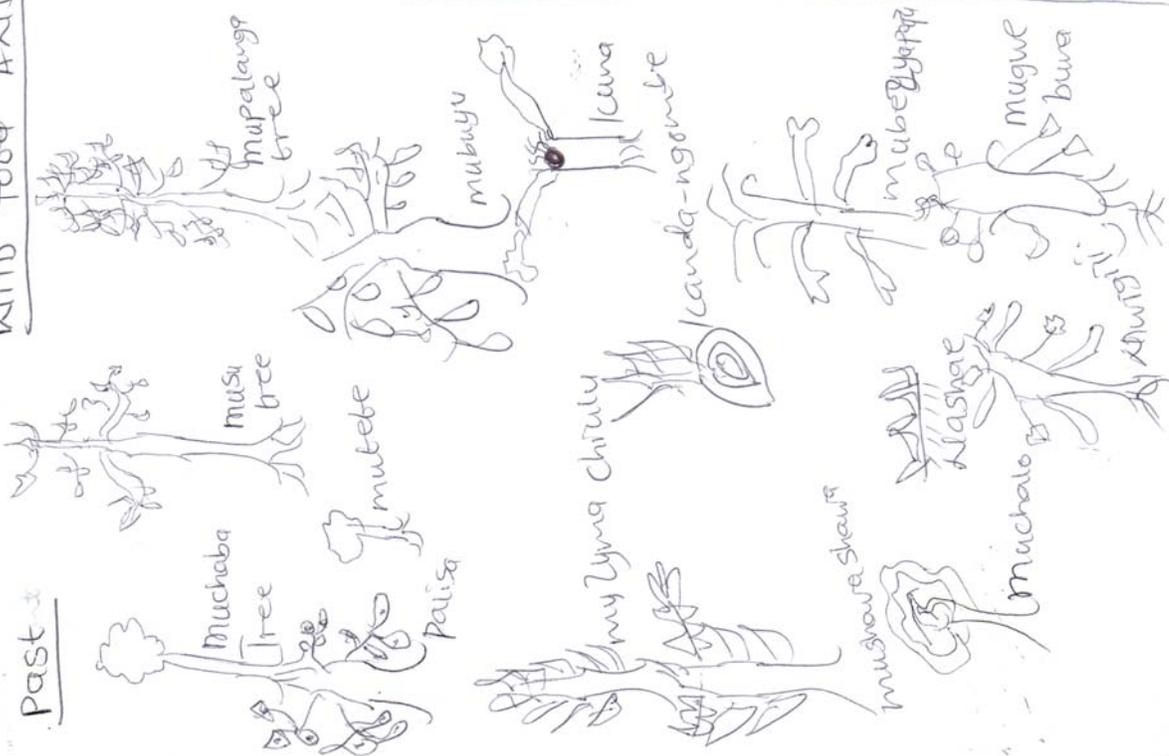


6. The full roleplay cast takes a standing ovation after their great performance

The PRA exercises from the topic of wild foods and medicines appear on the following two pages.

WILD FOOD AND MEDICINE TREND DIAGRAM

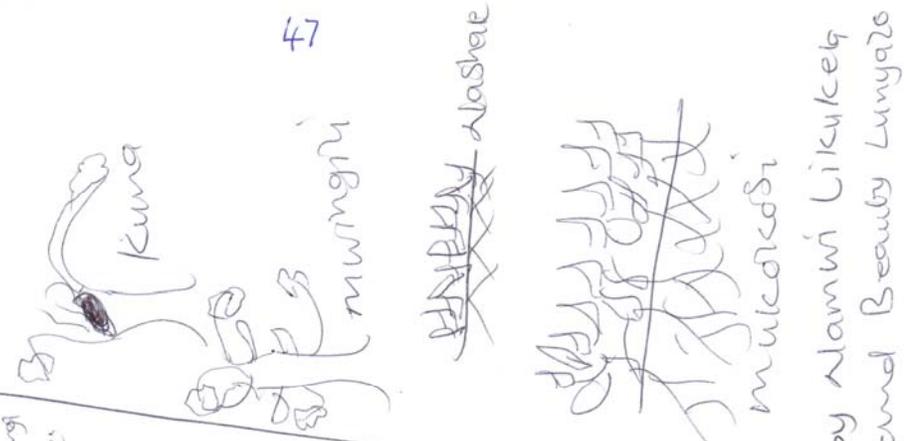
Past



Present



future



by Namwi Likykele
and Beauty LungaZo

CROPS

Crop production provides most community members with their staple food. Maize and sorghum are the major crops, while millet, beans and groundnuts are minor crops. Previously a newly cleared field was used for about 10 years, before the fertility declined to the point where it was abandoned and a new field was cleared. Now, with increasing human pressure, more intensive means of crop production are needed. Hence conservation farming is being promoted.



New fields are still being cleared for fields, removing the protective cover of trees



Chillies are grown, not only for export but also for mixing with elephant dung to burn when elephants threaten crops



Planting basins restore a little bit of protection, but not as much as the former tree cover and its leaf mulch



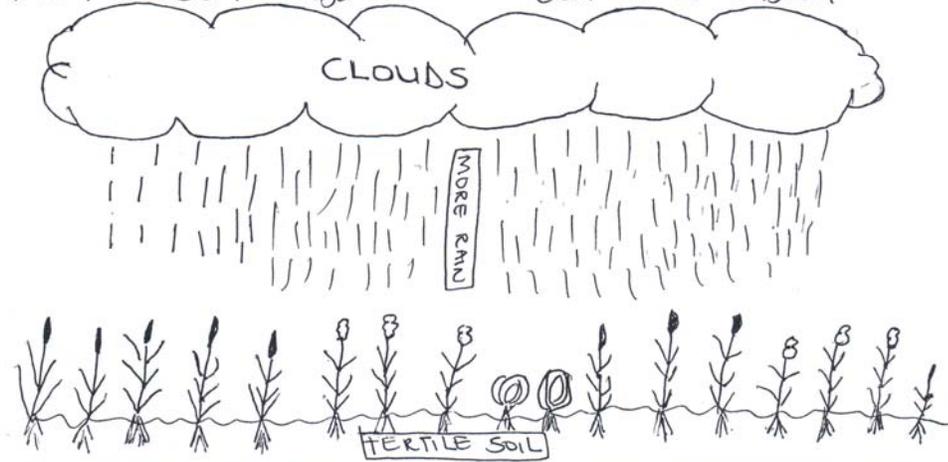
Sunhemp gets intercropped with the grain crops, to fix nitrogen and provide mulch

DEMONSTRATION ON CONSERVATION FARMING



There was no facilitated interaction on the topic of crops. The PRA exercise from the topic appears on the following page.

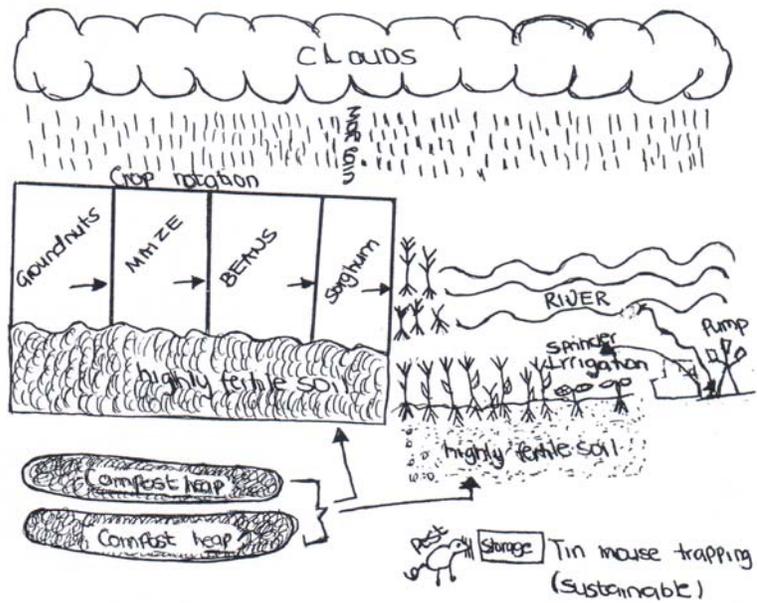
Past years : 50 years ago (Mama) Crop Trend diagram



Present time



Upgraded Crop Trend diagram Future (Soyis)



GARDENING

Vegetable gardens provide nutritious food, and in some cases, an extra source of income. Green leafy vegetables, such as choumollier and rape, seem to be the most popular vegetables that are grown, with some gardens also having tomatoes, onions and carrots. Fruit trees, especially pawpaws, are also grown in some of the gardens. As with crop fields, most gardens are exposed to the sun and wind. They could benefit from protection from some scattered trees, windbreaks and mulch.



Flowers, such as nasturtiums and marigolds, are planted amongst rape to repel insect pests and eelworms



Some gardens are conveniently located nearby the river, to ease irrigation



Water gets piped from the hand pump to one of the gardens



.... where it is collected in a tub for later transfer by bucket to the choumollier

Insect pests are a problem and the most common solution appears to be the application of pesticides, such as Blue Death. Many community members seem more concerned about the high cost of the pesticide, than about its toxicity, which can be harmful to the farmer who applies it, the family member or customer who eats the crop, and other forms of life, such as birds that feed on poisoned insects and therefore become less effective at controlling the pests by natural means in the future.

INTERACTIONS RELATED TO GARDENING

Composting manure in an airtight sack, by community member Alex Kukomokua and student Niita Konias

EM compost was made by mixing 10 litres of old, loose kraal manure with equal parts of multiplied EM and molasses diluted 30 times, in a large plastic bag due to be opened during the follow-up visit. Three plots of 1x1m each were treated differently. One had 10 litres of ready made EM-bokashi mixed into its soil. A second was treated with the same amount of manure and the third was left as an untreated control. The farmer was asked to grow the same species of plant in each plot, at the same time and density, two weeks after soil preparation, to give the bokashi time to raise its pH.

After two months the EM manure had a good smell and appearance. It was displayed at the EM workshop, some was placed as mulch on pawpaw seedlings and the remainder was taken by the farmer who had made it, for use on his garden. The trial plots had been sown with cabbage seeds, but it was the wrong time of the year for cabbage so not surprisingly the seedlings had mostly been eaten by insects and birds. The plots were therefore re-sown with cow peas.



Kraal manure for use in these trials



The plots are re-sown with cowpeas



Pawpaw seedlings that were given EM-manure are watered at the EM workshop



EM-bokashi and manure around a granadilla vine is covered with mulch

Amending soil with EM-bokashi, by student Monika Kandjimi (who failed to name the community members involved in this interaction)

Two different ways of applying EM-bokashi were tried. One was by surface application, as a 3mm mulch layer, on two plots of 7 x 0.45m where rape plants were already growing, with neighbouring untreated plots serving as controls. The second was by digging the same application rate of EM-bokashi into soil of two plots of 1x1m. Two neighbouring plots were left as controls and the farmer was asked to grow the same species of plant, at the same time and density, two weeks later into all four plots.

During the follow-up visit, the rape plots were found neglected, because the farmer's wife became ill and he took her to the hospital where she got admitted so he remained with her there. By the time they returned home they found the plots had not been watered and the leaves had all been harvested. At the small square plots the farmer had sown chillies and the seedlings were only about 6cm tall. There were no seedlings in one of the control plots and germination had been patchy in the other three plots. Some seedlings were therefore transplanted to even out the spacing. A refractometer was used to measure the brix of sap squeezed through a garlic press from some leaves harvested in each plot. The results were suspicious, with unrealistically low brix readings of 2 and 3% from the control plot, so had to be discarded.



EM-bokashi is applied to the soil as mulch amongst rape plants



The rape garden was all harvested by the time of the follow-up visit



Small plots to test soil amendment



Chilli sap is measured by refractometer

Vermiculture based on EM, by Induna Puetsa and student Stephan Diergaardt

Two old buckets of about 15 litres capacity each were filled with a mixture of organic matter, including tree leaves, cow dung and hay. The mixture was moistened with multiplied EM at 1000 x dilution. A litre of humus with surface feeding earthworms, *Eisenia fetida*, was added to one, while local burrowing worms dug up from the river side were added to the other. The farmer was asked to moisten the bedding and add some vegetable or fruit peels weekly. He was also asked to note the relative reproductive rates by recording numbers of immature worms found in each bucket.

After two months the *Eisenia fetida* had multiplied and converted most of the mixture into rich castings. However, there was no sign of worms or their activity in the other bucket, and it is likely that these were burrowing worms that had escaped into the soil through the holes at the bottom of the bucket. About two litres of the vermicompost from the first bucket were placed into an old grain sack and dipped repeatedly into a bucket of water to make vermi-tea, which was then poured onto a bed of tomato plants, while an equal quantity of water was poured onto the neighbouring bed to act as the control. The vermicompost with worms remaining in the bucket was removed and split into two, while a new mixture of organic matter was mixed with the old organic matter from the other bucket, moistened with multiplied EM at 100 x dilution (stronger than before) and also split into two. Each bucket was then refilled with a portion of organic matter and worms. One bucket was kept with the farmer who had raised the worms, and the other was given to a visiting farmer who had witnessed the interaction and shown great interest in it.



Local worms are collected near the river



Fruit peels feed the worms in the buckets



Vermi-tea is produced in a bucket ...



... and poured onto a tomato bed

Controlling grasshoppers on rape, by community member Lushetile Smith and student Benedictus Kanutus

In a garden with about 12 plots of 7x0.45m supporting productive plants of rape, a farmer was given 20 litres of Lantana fermented plant extract (FPE) and 5 litres of EM3-in-1 to try spraying weekly at 1:500 dilutions to test their effectiveness in protecting the plants from locusts that frequently attack the garden. Of the three plots to be sprayed with Lantana FPE and EM3-in-1, one also had 3mm of EM-bokashi applied as a mulch. The farmer was asked to record infestation rates on the three treated plots and on three neighbouring control plots.

A week after starting the treatment the farmer recorded two grasshoppers on the control plots and one on the EM treated plots. Two weeks later there were about 50 grasshoppers on the control plots and none on the treated plots. Thereafter the farmer's wife became ill and he took her to the hospital where she got admitted so he remained with her there. By the time they returned home they found the plots had not been watered and the leaves had all been harvested. This condition was also found during the follow-up visit. The farmer had given some of the FPE and EM3-in-1 to his friend on the other side of the river. Apparently the friend also had success with using the treatments on his garden, but he did not keep any records.



Lantana FPE is sprayed onto rape plants to discourage grasshoppers

ROLEPLAY ON GRASSHOPPER CONTROL



1. Grasshoppers come to feed on rape seedlings and have a good feast



2. The farmer then sprays Lantana fermented plant extract onto the seedlings



3. When the grasshoppers return they are disgusted at the taste of the sprayed seedlings and leave, disappointed



4. The farmer is satisfied that the fermented plant extract has saved his rape crop from further attack

Windbreak for garden, by community member Mike Kachitomwa and student Benedictus Kakwena

Fifteen pads of spineless cactus were harvested at Mashare Agricultural Research and Development Institute and planted along a stretch of about 10m of the community garden next to the chilli nursery near the Conservancy office. The soil was moistened before planting and the community members were told to just wait for the rain as no further watering would be needed. It would then hopefully grow into a windbreak while providing fruits and fodder.

After two months new growth was evident on four of the pads. The pads had not been complete, but had been cut to make them short enough to fit into a box, and it appeared that fungal disease had entered through the cut surfaces. Some new complete pads were placed to fill some of the wider gaps between the previously placed pads. Some recipes for utilizing the fruits were left with the community, as well as information on the Cochineal insect that can be grown on the pads to produce a dye that fetches high prices in Europe where environmentally friendly alternatives to artificial food dyes are in demand.



The first pads are incomplete, allowing fungus to attack the cut surfaces



Open spaces are filled during the follow-up visit, this time with complete pads

ROLEPLAY ON WINDBREAK



1. A windbreak of prickly pear is planted on the side of a garden facing the prevailing wind



2. Later the windbreak produces prickly pear fruits, that the farmer harvests, makes jam from and sells



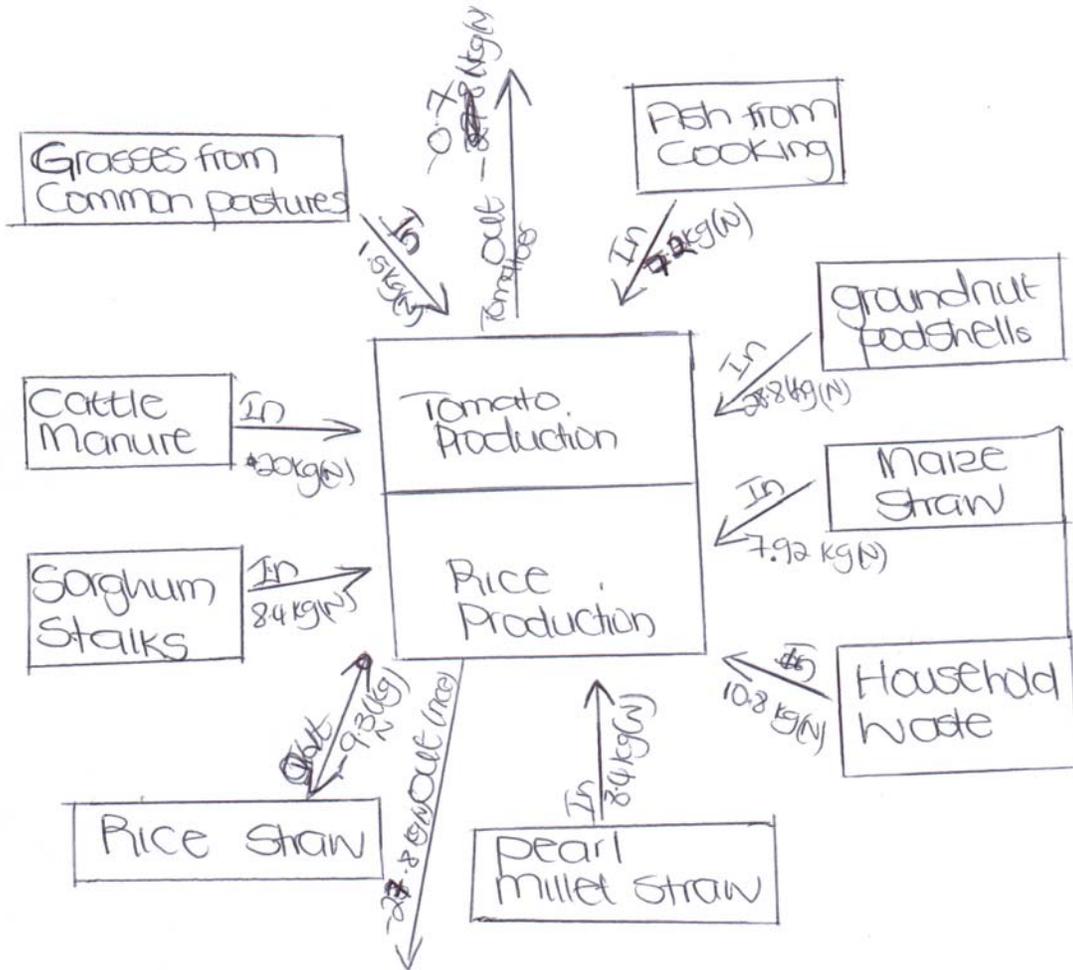
2. Some of the pads are harvested from the prickly pear windbreak and are fed to cattle, as fodder



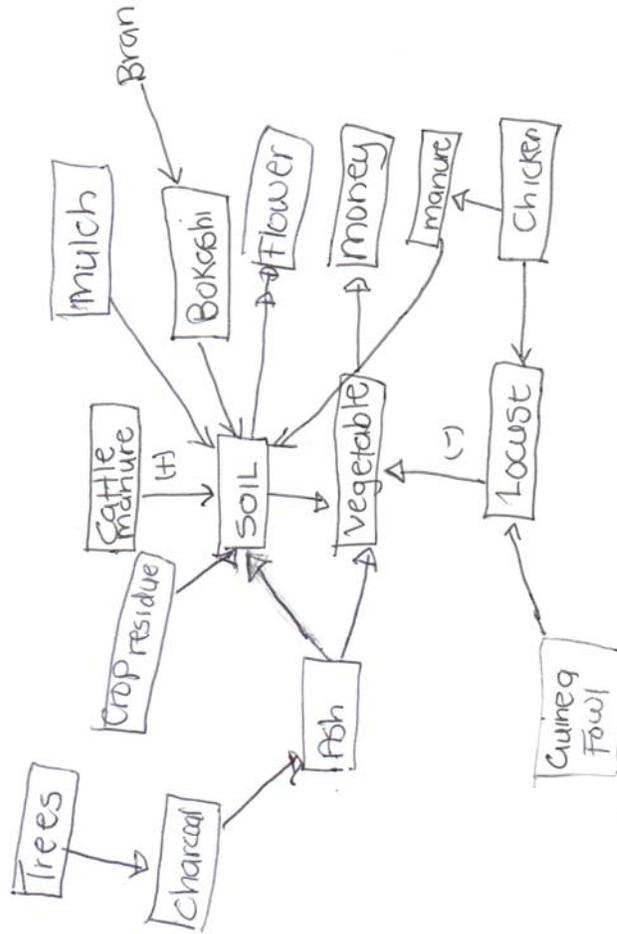
4. Cochineal insects come to feed on some of the pads and are later harvested to extract the red dye, which is then exported to Europe for food colouring

The PRA exercises from the topic of gardening appear on the following three pages.

CROP NUTRIENTS Budget: PRA



UPGRADED PRA DIAGRAM ON GARDEN IMPACT LINKAGE AT KWANDU KANDJIMI



ENERGY

Energy is an important resource, not only because non-renewable fossil fuels are becoming depleted at a very fast rate and need to be replaced with alternatives, but also because the burning of any fuel releases more carbon dioxide into the atmosphere and contributes to climate change. Firewood still appears plentiful in the Conservancy, because trees are being cleared at a fast rate for new fields. As most species of tree grow only very slowly, it will take a very long time before new trees provide sufficient firewood. Sunshine is freely available in the Conservancy on most days, and is already being used to produce electricity at a few places.



A shop uses a photovoltaic panel to run its fridge



Photovoltaic panels provide the Conservancy office with electricity



Bicycles are friendly to the environment and to one's health



Oxen provide energy to transport water from the hand pump

The hand pumps at the water points are also very friendly for the environment, in comparison with diesel engines that are used to pump water at other places. When using a hand pump, the air does not get polluted by diesel fumes, people who pump keep their bodies fit and healthy, and it is likely that less water will get wasted.

The bushes of *Jatropha curcas*, already growing at the Conservancy, are a potential source of energy, from high quality oil that can be pressed from their beans. If the bushes are planted as windbreaks, they will provide additional benefits for soil conservation. In some countries *Jatropha* produces 3 tons per hectare of beans when two-years old. Its growth rate under Namibian conditions is not yet known.

INTERACTIONS RELATED TO ENERGY

Cooking with a home made solar oven, by Conservancy Manager Cordelia Muyoba and student Hiskia Mbura

A solar oven was used for baking potatoes and cooking macaroni. The oven was left for the community to try out between the two visits. Plans were made for building a solar oven during the follow-up visit to show how food can be cooked on most days when there is sunshine.

On the follow-up visit the data sheet showed that the solar oven had been used four times since the first visit, for baking potatoes or cooking vegetables and rice. A new solar oven was made with the community, using cardboard, aluminium foil, glass wool insulation, glue, water-resistant paint and a sheet of perspex. When it was completed, it was used to cook meat and rice, and was then left with the community member who contributed the most to its construction.



The Polytechnic sunstove was left for the community to try after the first visit



During the follow-up visit a solar oven was made with the community

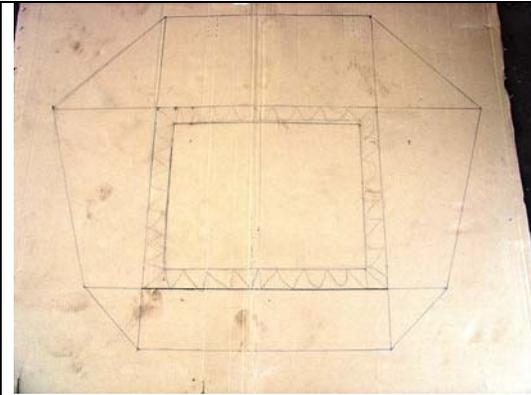


Learners from the Kongola Senior Secondary School show interest



.... and get to sample some of the meat it had cooked

Some of the steps in making the solar oven are shown on the following page.



The plan is drawn on the cardboard



Cuts are made until the bends



Wood glue is used to stick the sides



The joints are pressed into shape



Insulation is placed in the lower part



Upper part is covered with reflective foil ..



... and tucked into the lower part



A Perspex cover is hinged to the back

Biodiesel production, by community member Hoster Mukuni and student Jen Mbayo

Seeds of the biodiesel plant (*Jatropha curcas*) were brought along to the Conservancy, but a lot of plants were already found growing there mostly as hedges. However the farmers were unaware of its biodiesel potential.

On the follow-up visit some relevant information on the biodiesel potential of *Jatropha* was provided, such as possible yields, ways of extracting the oil, how it could be used to fuel certain engines and possible prices that could be obtained. In addition, some *Jatropha* seedlings were given to some community members who showed interest, and the additional benefits of *Jatropha* were discussed. These include its relative ease of growing, usefulness as a windbreak and improving soil conditions in comparison with annual crops from which more gets harvested.



Jatropha bush and beans



The poster explains biodiesel processing



Jatropha fruits, both fresh and dry

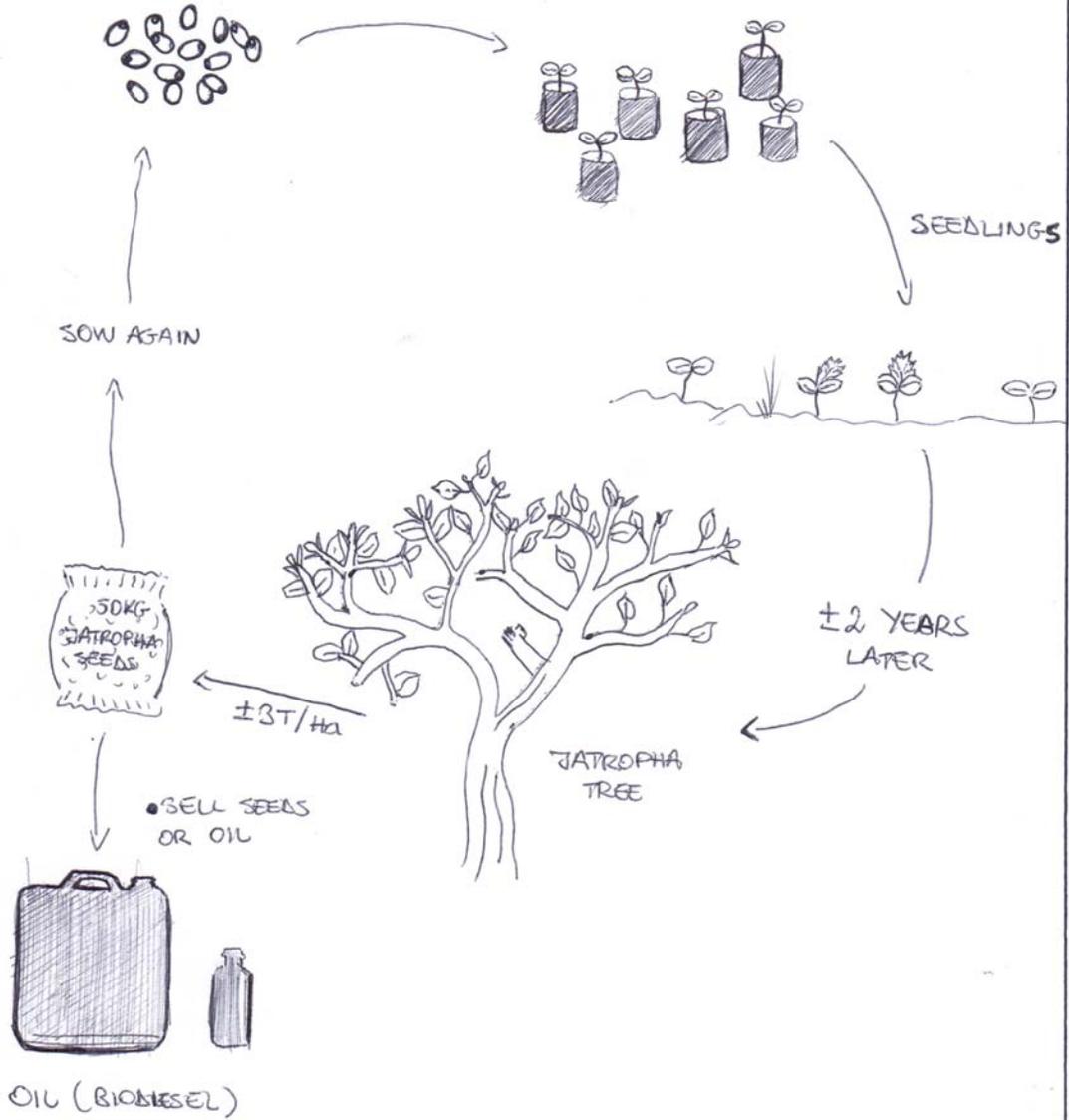


Seedlings of Jatropha in the nursery

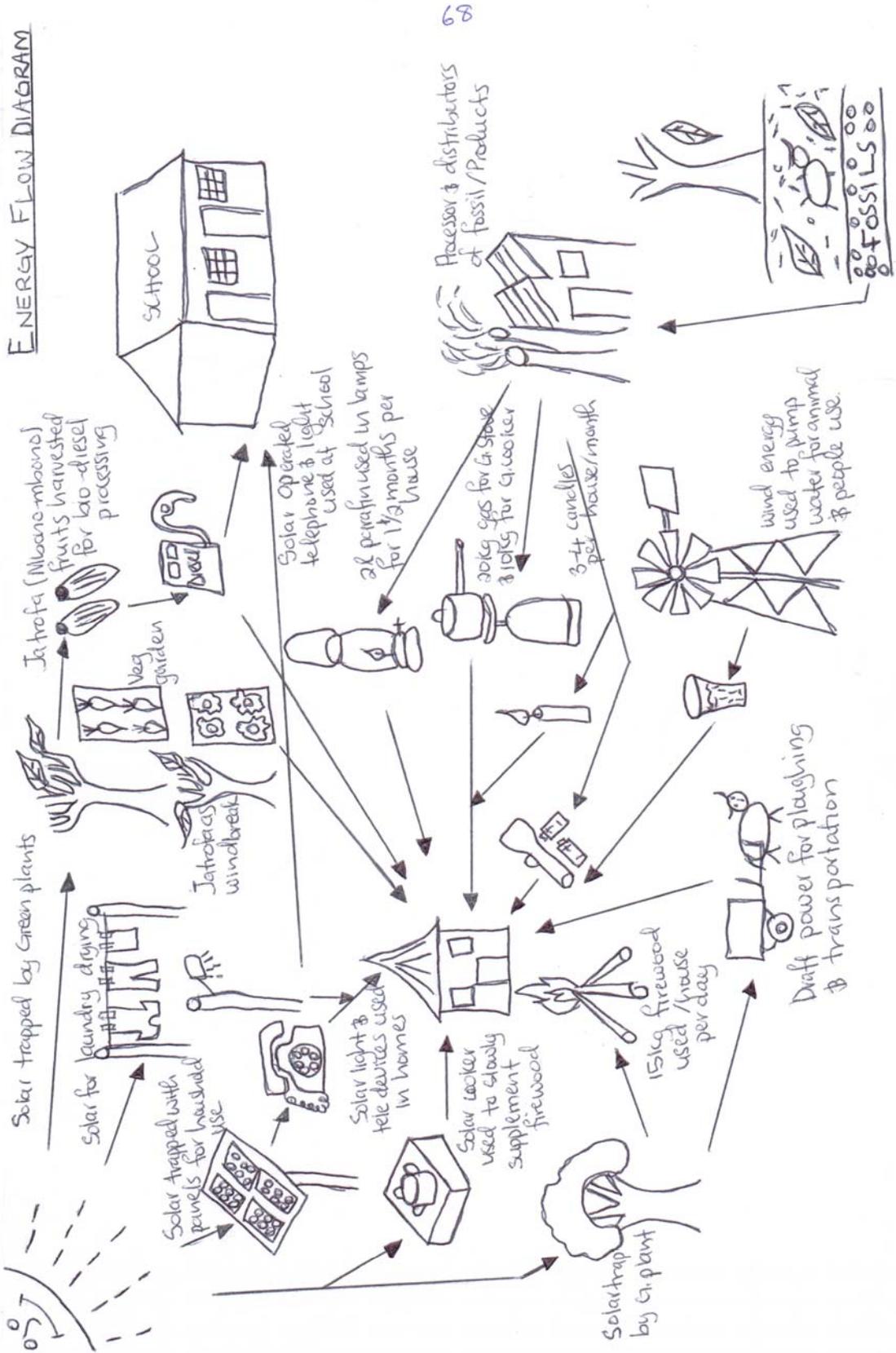
The PRA exercises from the topic of energy appear on the following four pages.

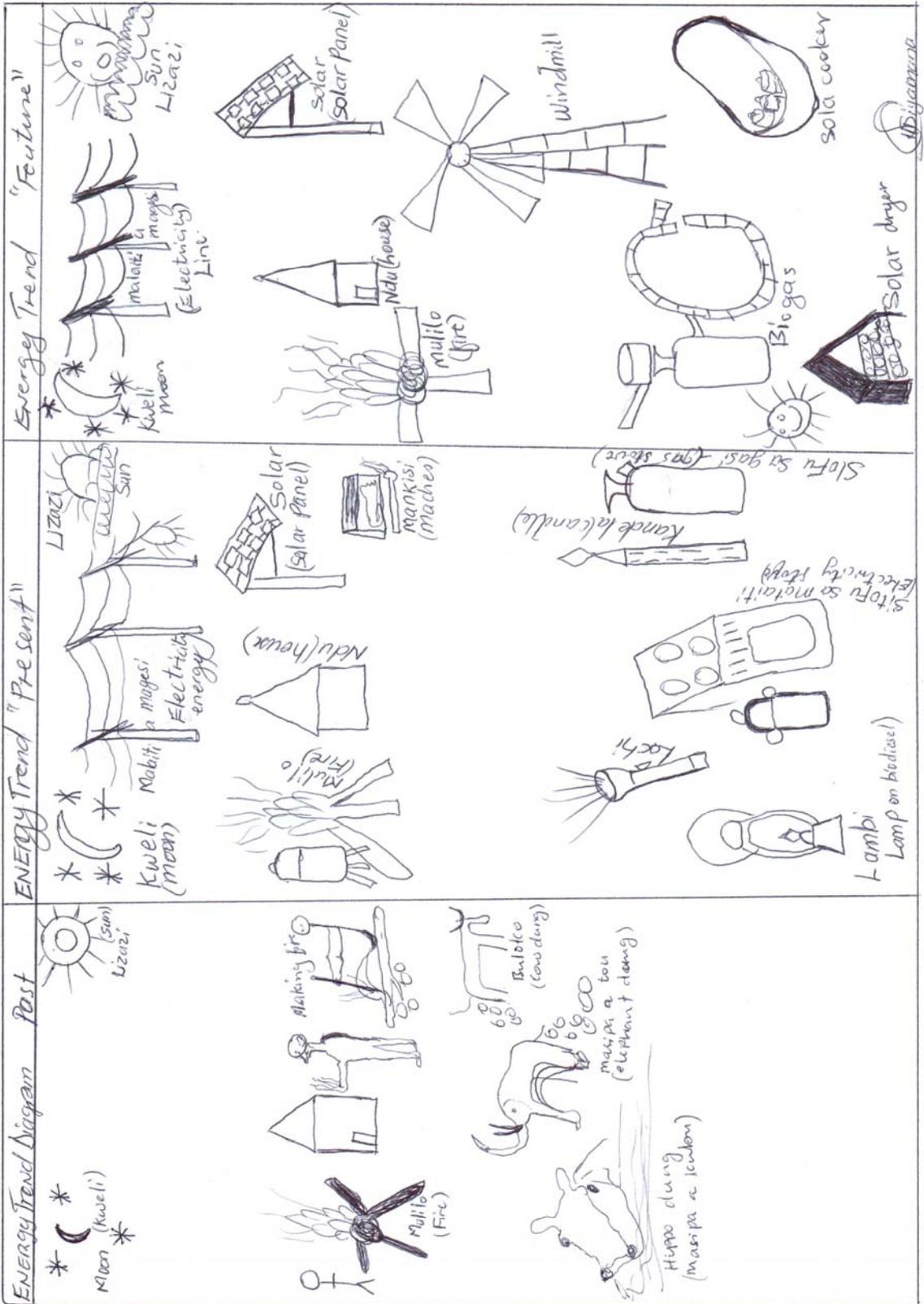
JATROPHA CURCAS

PRODUCTION CYCLE BY MR. JEN MRAYO



ENERGY FLOW DIAGRAM





VALUE ADDING

Value can be added to natural resources or agricultural produce by processing them into products that fetch higher prices, or by preventing damage to or loss of the harvested resources. Vegetables can be processed into products, such as chutneys, soup packets and pickles. These processed products not only have a longer shelf life, but can also be transported easier and cheaper, and sold for a better price than the fresh vegetables.



Ingredients for chutney are mixed in the pot



After cooking the chutney becomes more appealing



Onions can be pickled in Effective Microorganisms (EM)



Mixed chopped vegetables make good soup packets if dried and spiced

A lot of damage gets caused to harvested produce, either lowering the price that can be obtained per unit of produce, or resulting in less produce that can be sold, because some gets consumed by pests or has to be thrown away after being spoilt. Rats cause such problems at grain storage sites. A common solution is the application of rat poison, but this is expensive and also causes harm to humans. Poisons will not be needed if rats can be trapped instead. Predators can also be used to catch rats, but domestic cats cause harm to a lot of other useful organisms such as birds and lizards. Indigenous predators, such as mongooses, are very effective at catching rats if they are kept as pets, but permits are required to keep them.

INTERACTIONS RELATED TO VALUE ADDING

Drying garden produce with solar energy, by student Martin Siyamana (who failed to name the community members involved in this interaction)

A solar drier was built from local sticks, plastic sheeting and shade netting. Vegetables were sliced and dried to demonstrate how the fresh produce can be preserved. A data sheet was left for recording products that were dried and level of success.

During the follow-up visit there was only one recording found on the data sheet, for sliced onions that were successfully dried within two hours. A bigger and sturdier solar drier was then constructed with some community members. It was designed to better resist wind and dust, and to allow more products to be dried at the same time by having two shelves. Dogs would also not be able to get to drying meat inside it. Products that were successfully dried during the visit were meat and maize meal. Some already dried chillies were also placed in the drier to see whether it would cause them to burn, but they remained in good condition. The community were particularly excited about trying the drier on their forthcoming chilli harvest, as previously they experienced rotting of many chillies.



Onions are sliced and dried during the first visit, using a simple solar drier



A larger and stronger solar drier is constructed during the follow-up visit



Meat is dried on the top shelf and maize meal on the bottom

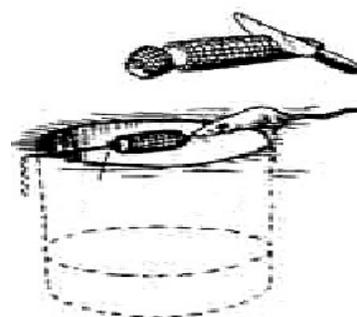
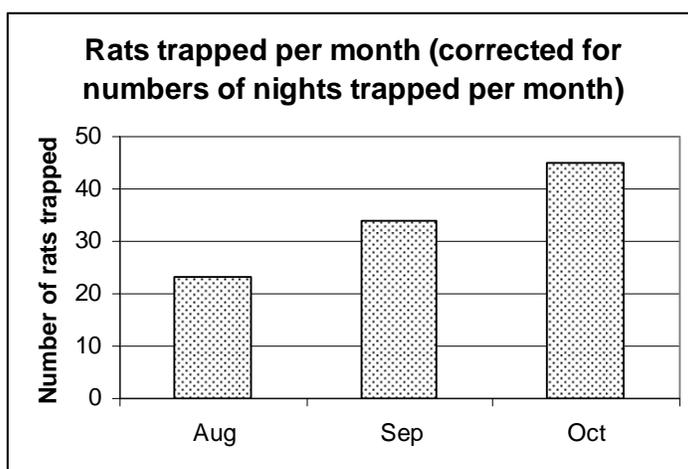


Drying of chillies (top shelf) will hopefully lead to less spoilage by rotting

Trapping of rats, by community member Hoster Mukuni and student Maria Newaya

Nine rat traps from the Polytechnic of Namibia that use peanut butter as bait were set up in and around the grain storage room at a home in the Conservancy. Only one house-mouse was caught, belonging to the species *Mus musculus*. The traps were lent to the farmer who kept records of the number of rats trapped per night.

Some of the traps did not work, but the few that did caught quite a lot of rats. The figures shown in the chart below have been corrected for the number of nights that trapping took place, extrapolating it over 30 days. The only full month of trapping was September. The apparent rise in rats trapped may be the result of greater rat activity as temperatures rise from the winter low.



The traps had to be returned to the Polytechnic at the end of the follow-up visit, so during the visit another method of trapping rats was tried. Old coffee tins were dug into the soil, had some water poured into them and peanut butter was smeared on their inside surface about 6cm from the top. A piece of wire was pierced through an old corn cob and was balanced on the top of the tin (see drawing above, sourced from http://journeytoforever.org/at_rattrap3.html). The idea was that a rat would try to get at the peanut butter, lose balance and fall into the water where it would drown. However this method did not catch any rat during the only night it was tried.



The Polytechnic trap caught a rat



The pit trap caught none on first night

ROLEPLAY ON VALUE ADDING

- A farmer complains of damage by rats to her stored grain.
- She buys rat poison, in the form of pink pellets, and spreads them around the grain storage area.
- Her children play nearby and discover the pellets.
- They think that the pellets are sweets, and excitedly eat some.
- They soon discover that the pellets do not taste nice and actually make them sick.
- They vomit and cry for their mother.
- Several parents come rushing out and try to calm the children.
- One of them advises that traps are a much safer way of controlling rats.
- They try out the rat traps, catch many rats, and kill them safely by drowning



Traps are a much safer way of controlling rats than poison, which resembles sweets

There were no PRA exercises from the topic of value adding.

Workshop on effective microorganisms (EM)

During the follow-up visit, a workshop was held at the Conservancy office, where the use of effective microorganisms (EM) was demonstrated and explained.



The workshop on effective microorganisms (EM)

EM is a liquid containing different types of naturally-occurring micro-organisms that create the right conditions to support each other and outcompete harmful pathogens, while producing useful substances such as vitamins, enzymes, hormones, antioxidants and amino acids.

The benefits can be large, while the risks are minimal, because EM supports natural processes rather than working against them. They help to restore natural balances in systems that have been upset through mismanagement, and will usually be maintained if provided with the right conditions. EM is normally applied by spraying or pouring.

Participants at the workshop expressed shock when they heard that one litre of stock EM costs about N\$150. However, since most applications of EM are greatly diluted with water, the costs are actually fairly low and in many cases the benefits exceed the costs. Farmers can multiply their own EM by fermenting stock EM with molasses and water in a tightly closed container that keeps out air, for one or two weeks. The stock EM can be obtained from a certified EM distributor. The Namibian distributor is Jan Labuschagne, Tel: 062 571722 or Cell: 0812 988411.

The multiplied EM then usually gets diluted further immediately before application. The approximate dilutions for some different uses are:

- Undiluted – for controlling rust or dosing animals against intestinal worms
- 10 x dilution – for controlling bad smells, applying to wounds or unblocking drains
- 100 x dilution – for making compost or silage
- 1000 x dilution – for water to drink or for spraying onto plants or pouring onto soil
- 10000 x dilution – for aquaculture or cleaning water in ponds or tanks

Stock EM remains viable for at least six months after culturing in South Africa, if kept within the right temperature range. The viability of multiplied EM is lower and depends not only on storage conditions but also on the dilution rate used in its multiplication. For example, 1 part stock EM to 1 part molasses to 20 parts water will produce multiplied EM with a viability of at least 30 days, while 1 part stock EM to 1 part molasses to 100 parts water will produce multiplied EM with a viability of only about 6 days.

For pest control the EM can be fermented with plants that have repellent property against the target pests. It is then called fermented plant extract, or FPE for short. A more general insect repellent can be made from fermenting garlic, chillies, ginger and black pepper with EM. It is then called EM 3-in-1. Alternatively a potent insect repellent can be made by fermenting equal parts of EM, grape vinegar, molasses and gin or vodka. It is then called EM5.

For composting and animal feeding, EM can be fermented with a cheap source of organic matter, such as husks of sorghum or millet. It is then called bokashi, which is a Japanese word meaning fermented organic matter.

For production of fertilizer, EM can be fermented with manure (called EM manure) or a cheap source of protein, such as fishmeal (called fermented fish extract or FFE for short) or blood from slaughtered animals.

When treating dirty water or conditioning the soil, the effectiveness of EM can be improved if provided with a material with tiny holes for the microbes to live in, such as charcoal.

At the EM workshop the following practical tasks were performed:

- Multiplication of stock EM.
- Production of EM bokashi from millet husks and maize germ.
- Production of EM manure.
- Production of fermented plant extract (FPE) from a mixture of local weeds.
- Production of EM5.

In addition, examples of each of these products made during the first visit, were passed around for community members to examine, and some of their application to plants and the soil was demonstrated. Applications to animals were only explained, but the results from trials were presented by the farmers who conducted them.

Since EM proved to be popular at Kwandu Conservancy for a wide diversity of uses, some guidelines on its use are presented on the following pages:

Multiplying stock EM

Stock EM is expensive, at about N\$150 per litre. However it can be multiplied to make it cheaper to use. The materials and equipment needed for this are:

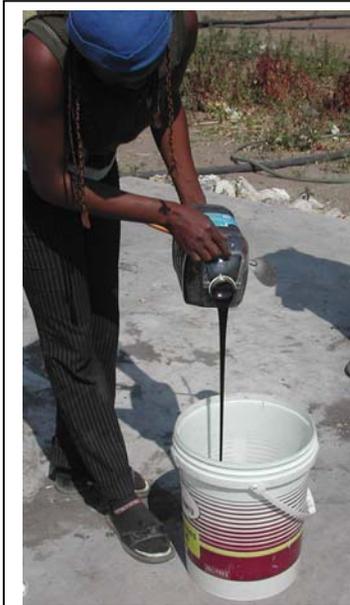
- Stock EM, obtainable in Namibia from Jan Labuschagne, Tel: 062 571722 or Cell: 0812 988411
- Molasses that is free of preservatives, because the microorganisms will be killed by preservatives. It can be obtained at shops such as Agra, or sometimes even at Pick 'n Pay and pharmacies.
- Water that is free of chlorine, because chlorine will kill the microorganisms. Water from rivers or boreholes, such as at Kwandu, is excellent to use. If using municipal water then it can be left in an open bucket in the sun for a day, to remove the chlorine.
- A plastic container with an air tight lid.

The more the stock EM is multiplied, the shorter will be the life before the multiplied EM loses its effectiveness. It can be multiplied up to 100 times, by mixing 1 part stock EM with 5 parts molasses and 94 parts water, but then it must be used up within a week or two. The guidelines below are for multiplying the stock EM by 20 times, which will allow some of the multiplied EM be stored for a few months before use, without losing too much of its effectiveness.

- Warm 18 litres of water, such as by placing it in the sun for a few hours.
- Dissolve 1 litre of molasses in about 5 litres of the warm water.
- Pour this into the plastic container, if the mixing was done in another container.
- Pour in the remaining water.
- Feel that the temperature is right. It should not be hot, but warm.
- Pour in 1 litre of stock EM and stir or shake to mix it.
- There should only be a small air space remaining in the container, to ensure that the EM brews in anaerobic conditions. If the air space is too big, add some more warm water.
- Tightly close the lid.
- Place the container in a shady place that does not get too hot or too cold. If it is winter then the container can be insulated, both on the bottom and around the top.
- Check for the first few days. If the container is seen to swell, open the lid a little to allow excess gas to escape, and re-tighten.
- Leave it to brew for about two weeks.
- When ready it should have a good acidic smell. In case it smells rotten then throw it away on a compost heap.
- Pour it into plastic bottles with tight lids for storage indoors, until needed.
- When transporting the multiplied EM, be sure to keep it at the right temperature. If the weather is hot then use a cooler box. If the EM is left in the sun or in a hot vehicle, the microorganisms will die.

If making fermented plant extract (FPE) then the chopped plants can be added to the brew mixture either before or after adding the stock EM. Alternatively, a less effective but cheaper version of FPE can be produced in the same way as described above, but using multiplied EM instead of stock EM.

The photos below show some steps of multiplying EM in a 20 litre bucket:



Pour about one litre of molasses in about 5 litres of warm water.



Stir thoroughly until all the molasses has dissolved.



Pour in more warm water until the level is about 5cm from the top.



Pour in one litre of stock EM.

Making EM bokashi

The materials and equipment needed for making bokashi are:

- Multiplied EM.
- Molasses.
- Water, free of chlorine.
- Bran or husks from grains such as maize or millet. The amount of husks will be roughly 4 x the volume of the water, if the husks are completely dry. Otherwise less will be needed if the husks contain some moisture.
- An open container, such as a basin, to mix the above ingredients.
- Large strong plastic bags, or buckets with tight fitting lids, to ferment in.
- String, if using bags, to tie them shut.
- A sprayer or watering can or bottle, to apply liquid to the bran or husks.

The guidelines for making the bokashi are:

- Dissolve 1 part molasses in 30 parts warm water (e.g. 200ml molasses in 6 litres of water if wanting to make about 20 litres of bokashi)
- Add one part of multiplied EM to the dissolved molasses. (e.g. 200ml of multiplied EM to the 6 litres of dissolved molasses if wanting to make about 20 litres of bokashi)
- Pour the above liquid into a bottle, watering can or sprayer.
- Pour the husks into a basin in which mixing can take place (e.g. 25 litres of husks if wanting to make about 20 litres of bokashi). It does not have to be all mixed at once. If the basin is too small then it can be done a bit at a time.
- Spray or pour a small amount of this liquid onto the husks while mixing them well.
- Continue applying the liquid while mixing with the husks, until all the husks are moist, but only a little excess liquid can be pressed out upon squeezing some in the hand.
- Transfer the moist husks into the fermenting container.
- Squeeze out as much air as possible, such as by sitting on the bag.
- Tie the bag shut to keep out air (or press down the lid if using a bucket).
- Store in a shady place, not too hot and not too cold.
- After about 6 weeks the bokashi should be ready, as evidenced by its good acidic smell.
- If it smells bad and has unpleasant mould growing on it, then throw it away onto a compost heap. If the mold smells sweet and is white in colour then it is OK.
- If small amounts will be needed daily over long periods, the bokashi can first be spread out and dried in the shade, after which it is transferred into containers for storage.
- Or if only large amounts will be used infrequently, then it can be stored in the same bag, which should then be retied tightly after every opening.

Some rates at which bokashi can be applied are:

- 1to3 litres moist bokashi per square metre of ground, for mixing with soil. However, this will make the soil too acidic for most plants. Therefore the soil with the bokashi mixed in should be left for at least two weeks, before sowing or transplanting into it.
- 3% of the food eaten by animals.

The photos below show some steps of making bokashi in garden refuse bags:



Measure out the right quantity of multiplied EM and molasses, such as 200ml of each when making 20 litres of bokashi



Dissolve the 1 part of molasses in 30 parts of water and then pour in the 1 part of multiplied EM. If making 20 litres of bokashi then ± 6 litres of water is needed



Add the husks to the basin where mixing will take place. About 25 litres will be needed to produce 20 litres of bokashi, because it gets compressed.



Pour some of the mixture of 1 part molasses, 1 part EM and 30 parts water onto the husks, while mixing.



Thoroughly moisten the husks until only a few drops fall out when squeezed in the hand.



Tighten the bag with string, to keep out air, and keep for 4 to 6 weeks before use.

Making EM5 insect repellent

The materials and equipment needed for making EM5 are:

- Multiplied EM, which can be multiplied as explained on page 78.
- Molasses that is free of preservatives, because the microorganisms will be killed by preservatives. It can be obtained at shops such as Agra, or sometimes even at Pick 'n Pay and pharmacies.
- Natural grape vinegar, which is available at bigger shops such as Pick 'n Pay.
- Strong alcohol, with at least 40% alcohol content, such as dry Gin or Vodka.
- Water that is free of chlorine, because chlorine will kill the microorganisms. Water from rivers or boreholes, such as at Kwandu, is excellent to use. If using municipal water then it can be left in an open bucket in the sun for a day, to remove the chlorine.
- A plastic container with an air tight lid.

The guidelines below are for producing five litres of EM5:

- Warm 3 litres of water, such as by placing it in the sun for an hour or so.
- Dissolve 500ml of molasses in the 3 litres of warm water.
- Add 500 ml of grape vinegar to the dissolved molasses.
- Pour this into the 5 litre plastic container, if the mixing was done in another container.
- Feel that the temperature is right. It should not be hot, but warm.
- Pour in 500 ml of multiplied EM and stir or shake to mix it.
- There should only be a small air space remaining in the container, to ensure that the EM brews in anaerobic conditions. If the air space is too big, add some more warm water.
- Tightly close the lid.
- Place the container in a shady place that does not get too hot or too cold. If it is winter then the container can be insulated, both on the bottom and around the top.
- Check for the first few days. If the container is seen to swell, open the lid a little to allow excess gas to escape, and re-tighten.
- Leave it to brew for about two months (the microbes multiply more slowly if they are drunk).

Some rates at which EM5 can be applied are:

- Spray on plants weekly at 1:500 to 1:1000, to protect from attack by insects.
- Spray on animals weekly. Since EM5 is quite expensive, first try at 1:10. If this does not reduce ticks significantly then try 1:4 or even 1:1. If the livestock is also eating EM bokashi, then the EM will get into their dung and will eventually get onto their skin when they lie down in the kraal. If this happens then less EM5 can be applied, or maybe even none at all if ticks do not become a serious problem again.

CONCLUSION

The visits to the Kwandu Conservancy were interesting and enjoyable. The number of community members that students interacted with was quite small, and some of them took care of their trials better than others. However all of those who participated reported back on the activities with enthusiasm and confidence, so other community members who came to observe the report backs and view the films could learn from them. The students therefore learnt a lot about the complexities of community development in a conservancy.

Some students expressed the opinion that too many meetings were being held at the Conservancy office, leaving insufficient time for community members to implement their decisions. They got to learn that joint management of resources requires consensus that will not please everybody. The chances of success are greater if options are thoroughly discussed and all members are aware of other people's opinions. Many members of the community are very keen to try out new ideas, so it is likely that appropriate options will eventually be found through experimentation. Ways can be found to use natural resources more sustainably, to ensure long term success of the Conservancy.

Suggestions for the community include:

- That preventative measures be taken to protect the quality of borehole water, if it is not already contaminated with pathogens. Methods of dry sanitation could be applied, instead of pit latrines that take faeces even closer to the ground water.
- That some of the excessive thorn bushes be cut and placed over heavily grazed grass in the floodplains.
- That fewer trees be cleared when making new fields, so that the crops can benefit from the services and farmers can benefit from the products of the trees.
- That windbreaks be planted across large open fields.
- That environmentally friendly alternatives to poisons be used for pest and parasite control.
- That value be added to natural resources in the Conservancy.



Thanks to all who contributed in any way to the wonderful learning experience!

