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THE POTENTIAL OF ZERO-GRAZING BY SMALLHOLDERS IN DESTOCKED MVUMI, SEMI-ARID TANZANIA

By

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Summary

The semi arid (550 mm) Mvumi division in central Ugogo was destocked in 1986 by HADO. This was the final stage of a long term intensification of the farming system. The eviction of all livestock is of course a severe loss for the agropastoral society and the question wether zero-grazing can at least compensate for the loss of milk and manure is of major importance.

In 1990 the MRTC (Mvumi Rural Training Centre) started to introduce zero-grazing. Now about 130 households practice zero-grazing, about half with crossbred cows and the other half with local ones. In 1993 78 households were interviewed: 52 had improved animals and 26 local ones.

The improved heifers produced between 1.450 and 1.900 liters in the first 305 days of their first lactation. The intercalving period is 17 months, but might increase in the future. Small investments are needed in housing and animal health. Labor demands are high but as most labor is needed in slack periods the returns per hour are high compared to other activities.

In the wet season natural grasses and legumes from valley bottoms and fallow fields are the major source of fodder. In the dry season crop residues are the most important. Planting fodder is economically not viable, so future strategies need to be oriented towards a proper harvesting and storage of crop residues and the use of dual purpose crops like sunflower, pigeon pea and lab-lab.

Zero-grazing proved to be ecologically sustainable and with a good utilization of the available fodder the number of households practicing zero-grazing could be equal to the number of households which had cows before the destocking.

1. Introduction

Ugogo is the dry heart of semi-arid central Tanzania. It covers both Dodoma urban and Dodoma rural district. Mvumi division is part of Ugogo. Its problems are characteristic for semi-arid sub saharan Africa: low (550 mm) and unreliable rainfall, poor soils, overpopulation (75 inh/km^2), outmigration of men (nearly 40%) and overgrazing. Fallow periods are reduced to nearly nil. Crop residues and the natural vegetation are burnt every year.

The inhabitants of Mvumi, the Wagogo, can be described as 'cultivating pastoralists' (Rigby, 1968): economically they have to rely on crop production but on the level of ideology and culture cows are more important. Traditionally livestock densities were between 1.5 - 2 LU/cap. and over 90% of the households owned cattle (Christiansson, 1981; Rigby, 1968; AHT, 1984). In the wet season the animals grazed in the hills, after the harvest they eat crop residues and at the end of the dry season they went to enclosed areas (in the valleys) where they had been forbidden before. There were communial areas ('luwindo') and privately owned areas ('mlaga'). Per capita nearly always between 0.4 - 0.5 ha is cultivated (Holtland 1993b). Seeing the low yields (500-600 kg/ha) this is the minimum required for survival.

Changes in the farming system, 1945-1985

To feed the growing population (2.5% p.a.) the area under crops gradually increased as this yields more per unit area than livestock. Consequently in 1986 the number of animals in Mvumi had dropped to 0.6 LU/capita, and only 15% of the households owned animals. Still there were too many animals, leading to severe overgrazing and large stretches of land were barren. The resulting erosion lead to floods in the valley bottoms and to sudden changes in the bedding of sandrivers. This caused many problems in the valley bottoms but in some cases it resulted in very productive fields of sand overlaying clay-deposits. Specially sweet potatoes and cowpeas grew very well here.

The traditional land use system in which certain areas (called 'Luwindo') were protected by villages for grazing at the end of the dry season collapsed soon after independence as the traditional leaders ('Watemi') lost their power. The system of individual protected areas ('Mlaga') collapsed after the villagisation process as these areas were usually close to either the homestead or the fields of the livestock keepers. As they now lived and cultivated in concen-

trated areas around villages there was no place for these protected areas anymore and protecting an area far away is not efficient.

Due to the declining ratio of livestock to the area cultivated and due to lack of transport possibilities only a limited number of farmers use FYM. Usually the amount is too little to make a real contribution towards sustaining soil fertility, specially as its quality is very low (as it is exposed to the strong sun and wind for years).

The cropping system traditionally consisted of pearl millet and sorghum supplemented with bambara nuts, lab-lab and cowpea. In the '50 's and '60's the diversity of crops increased and specially groundnuts and some other legumes (pigeon peas, green grams, cowpea) became important. Later the production dropped again as land shortage forced farmers to concentrate on cereals and because the market for the smaller legumes slowly decreased and finally disappeared when the Arab traders were forced to leave the villages in 1973.

The cropping system became more and more intensive by reducing the fallow periods to nearly nil. Rotation of crops was and is hardly done. First because the principle is unknown and secondly most of the area (80%) is under cereals (millet/sorghum/maize) so the possibilities for proper rotations are small. Two special intensive and commercial systems have developed in the western part of the division which has more fertile valley bottoms. Tomatoes are grown for Dodoma town and grapes for an even wider market. No doubt that the management of the fields has improved over the last decades. These days nearly all fields are timely planted and well weeded.

The destocking, 1986

In September 1986 all remaining ruminants were forcefully removed from Mvumi by HADO (Dodoma Soil Conservation Project) as they caused too severe erosion. About 26,000 cows, 24,000 goats/sheep and 850 donkeys were taken elsewhere. About one third of the cows died or was stolen, one third was sold and one third is still kept outside the division.

Although the Wagogo had already reduced the number of livestock, they valued livestock very much and the income from it was still considerable. Destocking meant a loss of capital, income, milk, meat, manure, saving possibilities and social status. People complain that malnutrition and child death has (initial-

ly) increased after destocking, scarce data from the Community Health Program of the Mvumi hospital seem to confirm this. In some cases it also increased the incidence of malaria. The major advantages have been:

- no more soil erosion, even existing gullies disappeared;
- less trampling of soils, so less wind erosion, a higher organic matter content of the soil and a better water infiltration. This all leads to higher yields per acre;
- an increase of the area under cultivation;
- more trees, vegetables and honey;
- more cassava and other permanent crops are cultivated;
- the area under grapes, sugarcane and vegetables has increased;
- pigs have been spontaneously introduced (from Mpwapwa district);
- less dust bowls and eye diseases;
- better roads and less road maintenance needed.

The water regime changed completely: due to the recovering vegetation most rainwater infiltrates in the hills, so sand rivers carry (and store) less water. In the dry season less water is found in the riverbeds and a small swamp which was fed by them virtually dried up. On the other hand more water is available from springs and in valley bottoms. This meant that people who grew sweet potatoes or cowpeas in riverbeds had to stop with this and that others could start growing sugarcane in valley bottoms which were used for watering livestock before the destocking.

The introduction of zero-grazing

Since 1990 the MRTC (Mvumi Rural Training Centre, a church based NGO) is introducing zero-grazing in the area. Now about 130 farmers practice it. Slightly more than half of them having improved cows, the remaining are local cows which are upgraded by Friesian bulls.

In March 1993 78 farmers practicing zero grazing were interviewed. Two-third (52) had improved animals (some only a calf), one third (26) had local cows. For the analysis they are divided in 5 groups:

1. MRTC farmers with improved cows, 1991 (n=14)
2. MRTC farmers with improved cows, 1992 (n=23)
3. MRTC farmers with improved cows, 1993 (n=11)
4. Private people owning an improved cow (n=4)
5. Farmers having a local cow (n=26)

2. The households practicing zero-grazing

The target group of the MRTC are the 'average' farmers, but as in the first year the benefits of zero-grazing were still unclear and the risks seemed to be high, better-of farmers were selected. After seeing that the risks were rather low from the second year onwards the selection of beneficiaries was more rigid oriented towards average or poor households. Women (specially those heading households) were encouraged to apply. Of the 40 heifers half are given to women, of whom 50% are head of their household. They perform as well as male heads of households. Table 1 gives some basic data on the households practicing zero-grazing.

Table 1: Some data on the households practicing zero-grazing

group:	1	2	3	4	5
no. of persons	8.6	7.3	7.2	8.0	7.7
no. of adults	4.9	4.3	3.9	5.0	4.1
adults with off farm income: beer/salt	0	0.3	0.2	0	0.4
crafts/trade	0.8	0.3	0.4	0.7	0.2
employment	0.4	0.2	0.1	1.7	0.2
wealth indicator (*)	32	11	8	94	17
cash exp. on stable	14.300	5.800	2.800	37.800	4.800

(*) This is based on the assets of the household. One acre is 1 point, a cow is 1, a bike is 3, GI-sheets on a house 25, etc.

The table shows that households buying improved cows are clearly the richest, have more members with a salary and invest much more cash in their stables (GI-sheets and sometimes cement). The beneficiaries of the MRTC program of 1991 were still relatively rich (half of them used GI-sheets), but the 1992 and the 1993 group are poor households. Nearly their only asset is land. Their major off-farm income is from local beer brewing, salt making, crafts like pottery and a little local trade. Few members are employed. They use little cash for their stables. Households with local cows have an intermediate position. They are better off than MRTC beneficiaries but they are too poor to buy an improved cow. Their stables are usually less durable and they use little cash for the construction of it.

3 The management of the cows

Housing

During the participatory training of the second group of farmers a simple model stable was designed based on the experiences of the first group of farmers (with their stables of all kind of designs) and the demonstration stable of the MRTC. It consists of a sleeping place (2 or 3 cubicles), an open space (8 m^2) and a shaded feeding place (6 m^2). It requires only local materials. Ever since all farmers follow more or less this design. They only use local materials for their stable. If all materials and the necessary labor are bought it would costs 25-30.000 Tsh. Table 1 shows that many farmers use far less cash for their stable. Often they use their own labor (cutting poles, grass etc.) and/or they make use of existing structures.

Health

Nearly all animals make an healthy impression. Health problems are few as there are hardly any ticks. All 52 improved animals together were sprayed 47 times. Of the 26 farmers having local cows only 3 had sprayed them. Out of the 78 farmers only in one case ticks were found. Some mastitis occurs (as a result of poor milking techniques). In one case (on the MRTC-demonstration farm) it lead to the irreversible loss of a quarter. In the 3 seasons 3 cows have died. Two when they gave birth (one calf survived) and 1 had an abscess in its hart. One calf died after eating plastic.

Water

Per cow 1.5 to 2 debes (=bucket of 20 l.) of water is needed per day. For a local cow 20 liters is enough. In the dry season also watermelons are fed to meet the cows water requirements. Sometimes these are bought from others and some farmers started to grow more watermelons to meet their own demand.

Fodder

In the wet season (Jan-April) the most important species are local grasses and legumes. Most prominent is Dactyloctenium aegyptium which grows abundantly on fallow plots. Others are Digitaria scalarum, 'Mbugumbugu' (local name) and local legumes (a.o. Crotelaria sp., Clitoria tennatea). All are mostly found

in valley bottoms and fallow fields. Also important is Elephant grass from sand rivers (planted by HADO or farmers).

From May onwards people start to harvest their food crops and groundnut haulms become the most important fodder. Of secondary importance are maize stover, D. scalarum and Elephant grass. Of tertiary importance are crop residues of lab-lab and sorghum, grasses from HADO multiplication plots (Chloris gayana and Cenchrus ciliaris) as well as watermelons and pods of Acacia tortilis and A. albida. The same species stay prominent until the next rains. When the rains start D. scalarum is the first to sprout again.

In general farmers try to increase the quality of the feed by offering large amounts of biomass from which the animals select the most digestible parts. The best farmers also try to offer the animals some green foliage every day. For this they use mostly Leuceana, sweet potato vines and Elephant grass from sand rivers. Since January 1993 the Leuceana psyllid is found in Mvumi,so the use of Leuceana will be reduced in the future.

So generally in the wet season only natural grasses and legumes from fallow fields and valley bottoms are used and in the dry season mostly crop residues supplemented with small quantities of other feeds. So the pre-condition of HADO/MRTC to grow one acre of fodder was inappropriate. Reasons for this are:

- not enough seeds of improved species are available;
- due to the high population pressure no land is available for fodder production;
- establishing a fodder plot in the harsh conditions of Mvumi is very difficult, and even if well established the production is very low;
- establishing a fodder plot requires a lot of labor in the peak period of crop production, when opportunity costs of labor are high.

It must be concluded that growing fodder is not economically viable as the product has to compete with easy available natural grasses and crop residues. Therefore the pre-condition of a fodder plot must be dropped. This will not result in erosion problems because the vast majority of the natural grasses are of very low quality and grow on far away hills where they prevent erosion. To cut these grasses will not be economically viable and even if they would be cut the basal stems and roots would sprout again.

All farmers use their home made maizebran and brewers waste. Only 29% buys extra from others. When available 1 - 2 kg is given per day. Although the price of maizebran is quite high (it is also used for pigs and sometimes for beer making) using some more is economically viable. Specially when it is used before calving and in the beginning of the lactation. It appears that many farmers do not have cash to invest in the feeding of their cows. Possibly also the unsure market for milk discourages some of them. Supplements like minerals are hardly used. Also no signs of mineral deficiencies were noted. As the pH of the soils in the area is high no problems are expected in the future.

Marketing

The farmers groups organised by the MRTC decided during their meetings to put the price to 100 Tsh./liter. Generally people only sell about 2 l./day, or about 600 l./lactation. Some sell up to 4-6 l./day. Now and then some farmers have a marketing problem. However the farmers groups discussed the problem and decided that it is not yet big enough to try to find a market in Dodoma (40 km). In Dodoma the price is higher (130 Tsh./l.) and a manufacturer of condensed milk is willing to buy any amount every day for 100 Tsh/l.. In principle marketing in Dodoma is possible as there is daily transport and electricity for cooling, both in Makulu and Mission.

Handling manure

Cows are ideal animals to convert useless roughage in valuable milk and manure. This manure should be returned to the soil to sustain the fertility of it. In practice this ideal is still far away in Mvumi, specially for the most limiting nutrient nitrogen. First of all there are losses. As the floor of the stable is just compacted soil and due to the high temperature, wind speed and radiation all N in the urine gets lost and part of the N in the manure.

Secondly when cleaning the stable the manure is just piled outside together with the discarded fodder. Due to the dry climate composting goes slowly. Most farmers apply the manure on their homestead fields and the results are very visible. Others use it for intensive gardening like growing bananas. For some farmers manure is a major reason for keeping a cow.

Fertility of the cows

The age at first calving of the improved cows varied between 30 and 45 months, with an average of 36 months. In 29 cases a reliable estimate of a calving interval could be made. The average was 17 months, but a large variation was observed. In 8 cases it was over 20 months. Together with some heifers who delayed for their first calving one third of the cows has fertility problems. This is partly caused by a lack of a well functioning monitoring system (both on farm and project level) and partly because the MRTC has (unconsciously) been too optimistic on the local knowledge about the fertility of cows. It is now clear that although Wagogo are agro-pastoralist, they do not have any idea on when, how long and how often a cow is on heat.

Breeding policy

Until now the MRTC has been working with different crossbreeds: Ayrshire/TSZ, Friesian/TSZ and Mwpapwa/TSZ from a DAFCO farm in Morogoro and Boran/Friesians from Kenya. The last one performed better then the others (see ch.3). Partly because they were better taken care of before they came to Mvumi and partly because they are bigger. Although they are more expensive it seems advisable to continue with Boran/Friesian crosses.

The often hot debated question on how much exotic blood should be used is not yet answered, but at the moment nothing indicates that 75% exotic blood would not be possible. On one side it is doubtful whether this high percentage as such would bring higher yields as long as the feeding of the animals is not improved. On the other side, animals with more exotic blood respond better to any improvement so they might be a stimulus for better management. As no differences were found between Ayrshire and Friesian crosses for practical reasons (availability) is was decided to use Friesian bulls.

The cows produce milk, meat and manure. Here the milk production is analysed. The data shown in figure 1 are from the records which MRTC farmers are requested to keep.

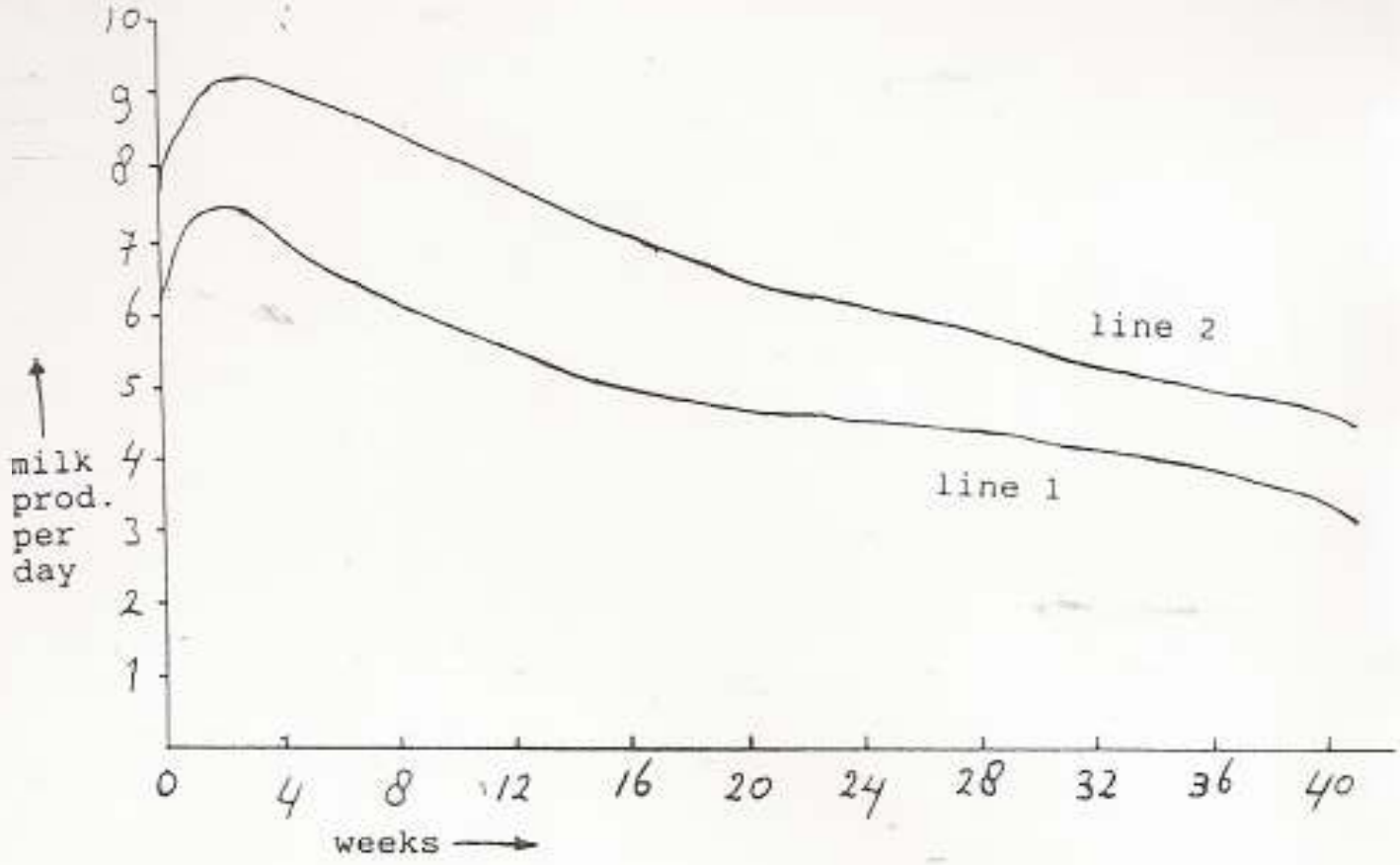

Figure 1: The lactation curve of improved cows under zero-grazing in Mvumi

The animals are divided in 2 groups: the mixture of heifers from the DAFCO farm and the Friesian/Boran crosses from Kenya. The first group consists of 20 heifers. Two of them died, 3 produced very little (local and Mpwapwa blood) and one had unclear records. The data of remaining 14 are shown in line 1. Their total production in a normal lactation of 305 days is 1.452 liter. As around 250 liter is given to the calf, 1.200 liter can be consumed or sold. Many times the intercalving period is 18 months. In the last months the production is around 2 liters per day. This makes the total production in 1.5 year about 1.800, or 1.550 liter for sale or consumption.

Some of these animals went into their second lactation recently. Compared with their first lactation in the first 7 weeks they produced 15% more. This leads to a total production of about 2.080 l. of which 1.800 can be sold/consumed.

The second group of animals are the Friesian/Boran crosses from Kenya. Their production can be seen in line 2 (based on 6 animals only, as some gave birth before they came to the farmers, their data were not used). They gave 1.923 l. in the first 305 days of the lactation. This is 32% more than the first group. Their production tends to drop to 3 liters per day when the lactation is prolonged. This gives a yield of 2.470 liter in 1.5 years, of which 2.200 can be sold/consumed. Four of them started their second lactation and all had a peak production of over 10 l./day.

The shape of the curve is reasonably in both cases. The peak yield is reached quite early but the persistency is good. It takes 40 weeks before the production has dropped below half the peak yield (= average of the first 6 weeks).

Although the number of cows involved is too low to come to definite conclusions the variability in the data is rather low so the trends identified here are not likely to be changed when more data become available. At the moment too few data are available to identify a marked seasonal influence.

Not enough data are available for local cows, but most produce between 1.5 and 3 liter per day. Per lactation of 1.5 year they might reach 600 liter.

5 Economics

Capital investments

The price of the improved cows brought in by the MRTC was 50.000 in 1991 and about 200.000 in 1992 and 1993 (from Kenya, via HPI). The average price of the cows bought by private persons was 90.000. The average estimated value of the local cows brought in was usually between 20.000 and 25.000 Tsh.

As mentioned in par. 2.1 a completely new stable would cost between 25 and 30.000 Tsh., but most farmers only spend 5.000 or less cash on it and do the work involved themselves.

Running costs

For the maintenance of the stable about 1.000 Tsh. is needed per year. Of the 52 farmers interviewed 51 spent less than 1.000 Tsh./year on health services.

The last one (who bought an improved cow) spent one time 10.000 Tsh. on one of his animals. Many people without an employee spend some money (2.500- 4.000 Tsh./year) on buying fodder every now and then.

Paid labor

All people who bought an improved cow have a boy/young man working for them. They pay 2.500 Tsh. per month plus food and basic needs. They are responsible for all the work on the cows. Frequently employees run away after some time, because of the low salary and/or the bad labor conditions.

Of the 48 MRTC farmers interviewed 9 had an employee. Mostly they pay 1.000 to 2.500 for bringing only water or fodder. Some pay 4.000 for someone who does all the work. Usually they also get food and basic needs. Also with MRTC farmers problems between farmers and employees do exist. Nobody having local cows has an employee.

Own labor

Collecting water

Estimating the time needed to fetch this water was difficult for many respondents. In the wet season it is mostly around one hour per day, but at the end of the dry season the estimates differ very much (from 1 hour to 20 hours!). The overall impression is that 3 to 4 hrs/day are needed. If during 6 months 1 hr/day is needed, for 3 months 2 hrs/day and for the last 3 months 3.5 hrs/-day, then per year 690 hours are needed.

Collecting fodder

The time needed to collect fodder was estimated as follows:

- first farmers were asked which month is the most difficult for collecting fodder and how many time/day they collect fodder and how long it takes;
- then they were asked to make a graph of the time needed in other months, compared to this most difficult month;
- lastly they were asked which month is the easiest, how many times/day they collect fodder and how much time it takes.

The answers are difficult to interpret as many farmers are not used to the western time measurement. For one group (the 1992-MRTC farmers in M. Mission)

all figures were used consequently as this seemed to be the most reasonable group. The result is shown in table 2.

Table 2: Time needed for fodder collection (minutes per day)

Month:	1	2	3	4	5	6	7	8	9	10	11	12
time:	158	120	83	83	83	100	127	149	166	183	236	247

December is the most difficult month: 247 minutes or 4 hours/day are spent on fodder collection. The period March to May is the easy: 83 minutes per day (1.5 hours) are needed. In total 868 hours are needed, most of them in the dry season when the opportunity costs for labor are low. Only at the beginning of the wet season there is an overlap of high labor demands for crops and cows.

The high labor requirements can partly be attributed to the Ujamaa policy of the Tanzanian government which forced farmers to live (very) far from their fields. Many of the best zero-grazing farmers live near the edge of the village. Another explanation of the many hours needed for the collection of fodder is the lack of proper means of transport (f.e carts or bikes).

Cleaning and milking

No specific questions were asked about the time needed to milk the cows, to clean the stable, to market the milk or to bring the cow to the bull for service etc. It is estimated that this takes 1.5 hour/day or 540 hrs./year.

Economic viability

Based on the data mentioned before the economic viability of zero-grazing in Mvumi via the system of 'passing on the gift' is calculated: a farmer is given a heifer of 6 months free of charge and returns a similar one to the MRTC. After 2.5 years it calfs. The intercalving period is 1.5 years.

On the costs side a stable is built with 5.000 cash and 200 hrs. of labor. It is depreciated in 4 lactations, so 1.250/lactation. Maintenance costs per lactation includes: 1.000 for the stable; 1.000 for health; 3.000 for serving; 6.000 for maizebran/fodder and 3.150 hours of labor.

On the income side, manure has a low cash value (see 2.9), but this might increase in the future. A rough estimate is that per year a cow produces manure

with a value of 5.000 Tsh. The rest value (for meat) of a mature cow (400 kg) can be put at 60.000 Tsh. Here only the cash income from milk and the sale of calves are considered. Milk yields 155.000 Tsh. in the first lactation and 180.000 Tsh. in the following. Income from the sale of calves is 20.000 Tsh. in the first 2 lactations (= half the price of a bull calf of 1.5 years, the heifer is given back to the MRTC). From the third lactation onwards this is 65.000 Tsh. (=average of 40.000 Tsh. and 90.000 Tsh., being the price of resp. a bull and a heifer of 1.5 years old). Table 3 gives the returns per hour for an average MRTC farmer during 10 years.

Table 3: Some key data on the economics of zero-grazing via the system of 'passing on the gift'. All values are cumulative over the years.

period (years)	0.5-1.5	1.5-3.0	3.0-4.5	4.5-6.0	6.0-7.5	7.5-9.0	9.0-10.5
running costs[1]	5	17	29	41	54	66	78
net income[1]	-5	-17	146	334	566	799	1.032
labor hours[2]	1.2	4.4	7.5	10.6	13.8	17.0	20.1
income/hour	-	-	19	31	41	47	51
seasonal[3]	-	-	10	24	36	43	48

1. in 1.000 Tsh.; rounded figures, but the actual calculations are done with unrounded data;

2. in 1.000 hours;

3. If peak hours are valued at 70 Tsh./hr. Peak hours are the hours in the beginning of the rainy season (Dec.-Jan.): for fodder 202 hrs. are needed, for water collection 60 hrs. and for cleaning/milking etc. 45 hrs. Per year this is 307 hours and per lactation 460 hours or 15% of the total labor requirement.

Table 3 shows that the small investment in term of cash enables the farmer to get a good income for his labor. As soon as the cow starts to produce all work done in the previous 2.5 years is rewarded with 19 Tsh./hour. In the next lactation this is already 31 which is higher than the official minimum wage. From the third lactation onwards the returns become very high.

However in semi-arid areas labor availability is very seasonal and income/hour in peak hours and slack hours should be distinguished. If the peak periods are put to 70 Tsh./hr (double the average income/hour in crop production; Holtland 1993) then the income in slack periods is 10 Tsh. after the first lactation and 24 after the second. This is already high as one recognizes that the opportunities to use the labor in another way are nearly nil. Another important

advantage is that the household is flexible in deciding when the hours will actually be worked, f.e. they can decide to work hard for one week, store some fodder and do some other work next week.

And how do these data work out for somebody who buys a late pregnant cow for 200.000 Tsh? In 7.5 years (5 lactations) he receives 1.032.000 Tsh. and his running costs have been 61.000 Tsh. and 15.950 hours (2.300 peak hours, 13.650 slack hours). If he first wants a real interest on his invested money of 10% per year and if he values the peak hours as 70 Tsh. hour he earns 30 Tsh./hour in the slack period. Or if he values his slack hours as only 20 Tsh. per hour the real interest on his money would be 14% per year.

Keeping a local cow, with a yield of 600 liter/lactation and a maintenance costs of 10.000 Tsh. and 2.500 hours, gives a return of 20 Tsh./hour. If 400 hrs. in the peak period are valued as 70 Tsh./hour the returns for the remaining 2.100 hours are 10 Tsh./hr. Although in many cases a small income is better than nothing the major attractiveness is the hope for a future income.

Simple models like these above are always dangerous. In this case no correction is made for the chance that a cow dies and only averages are used which is not always correct (f.e. if on average 2 kg maizebran per cow is used it differs a lot when this is equally divided by all animals or not). A fundamental difference between this economic model and the financial reality of farmers is that not all available milk is sold; mostly because the farmer does not want to sell more but sometimes because there is no market (see 2.8).

On the other hand the basic data come from the actual practice and are well verified by the MRTC staff in their day to day activities. Most important however is that the outcome of the calculations fits well with the practical experiences with the MRTC farmers. As soon as a cow starts producing they feel that they earn a lot of money. They also know that there is a small risk and they know that they need to be patient, and they are.... Many people request for a heifer, many use their local cows (which requires even more patience) and more and more richer farmers are asking whether they can buy a heifer.

Division of labor and income in the households

In all cases building the stable is done by the male members of the household. Female heads of households get some assistance from others. In 79% of the households the first responsible for the collection of water is female.

In general several members of the household are involved in collecting fodder. Most of the work is done by women, also in male headed households. Men do a smaller share and also children (10-15 years) are actively involved.

Traditionally the Wagogo women have a major say in the use of the milk. In how far this is still the case with zero-grazing is hard to say, as farmers often lie when this issue is raised. Edwards (1992) found that women feel that they have more control over the (benefits of) a cow on zero-grazing than over the traditional herd. So it seems that the male head of the family gives his wife enough benefits to keep her motivated enough to take care of it. When this is not the case the condition of the cow worsens, milk production drops etc. This happened twice with serious results (the cow was taken by the MRTC). Problems often arise in polygamous families.

6 The future

Carrying capacity for zero-grazing

If we assume that the cows are fed natural grasses for 5 months, in the remaining 7 months crop residues would be the major source of fodder. The stover of groundnut, maize and sorghum are best suited for this (with a TDN of 60, 57 and 50 and a CP of 10, 6 and 5 resp.; Chamberlain 1989:61). A lactating cow of 400 kg needs about 15 kg/day of this stover (with some supplementation of maizebran/brewers waste and green foliage) to produce up to 8 liter/day. So in 7 months 3.200 kg is needed per cow.

As on average a farmer has 1 acre of groundnuts, 1 of sorghum and 1 of maize (Holtland, 1993), the total available fodder is 1.125 kg per household (the grainyield is 250 kg/acre and the useful residue is 1-2 times as much). So when all crop residues in the area are systematically collected one third of the families can have a zero-grazing cow. As some farmers will keep more than one animal (the max. allowed is 3) 15% of the households can keep cows, or the same number of households which had cows before the destocking.

Potential income

These households would have in total about 3.500 animals of which 2.000 can produce 1.500 l./lactation of 1.5 year (the remaining are calves and bulls). This makes 2 million liter per year, or the same as the estimated milk production of before destocking (Holtland,1993). It represents a value of 200 million Tsh./year. This gives an increase in the income per capita of 15-20% and a doubling of the income of the households involved (Holtland 1993). In total about 2.000 people will be employed, taking care of the animals.

7 Areas of possible improvement

Monitoring

To reduce the long intercalving period is necessary to develop a monitoring system via which all cows are closely supervised (by the farmer, the VEW and the project staff). Breeding calendars at farm level and pregnancy diagnosis are of utmost importance. The aim should be to reach an average of 15 months.

Marketing

Although farmers say that marketing in Dodoma is not yet necessary, for the future it is. As all necessary facilities are there it is also possible. It might be that a secured market makes it more attractive to improve the management of the cows.

Manure and transport

The use of the manure can also be improved. At least the manure should be put in the shade and deep litter stables should be tried. Carts could encourage the use of the manure and at the same time reduce the high labor requirements for the collection of water and fodder. This could also be reduced if the farmers were allowed to go back to their former areas of before the ujamaa policies. At the moment this is slowly taking place in Mvumi.

Fodder storage

Seeing the high number of hours needed in fodder collection during the end of the dry season and at the beginning of the rainy season it seems advisable to replace the pre-condition of a fodder plot with one for a store. This should be filled with high quality crop residues during harvest time.

Feeding strategies

As the climate, the disease pressure and the genetic potential of the cows are not limiting factors in Mvumi, improving the feeding of the cows is the major challenge for the future. The present strategy of farmers is to invest as little cash as possible and to make optimum use of abundantly available (=cheap) local resources (labor and biomass). Within this basic principle some improvements are possible:

1. early harvesting of crop residues;
2. proper storage of crop residues;
3. using dual purpose crops like pigeon pea and lab-lab;
4. use more green feed, f.e. of leguminous shrubs;
5. cultivation and pressing of sunflower;
6. use more maizebran.

For most of these items research is needed in the form of trials on the optimal timing of stripping, optimum sowing and harvesting of legumes planted with foodcrops, the best leguminous shrubs for fodder production etc.. Specially interesting are the possibilities of sunflowercake. Shayo (1992) shows that even with a price of 45 Tsh. per kg and a milkprice of 80 Tsh./l. this can be used profitably. In Mvumi handpresses could be introduced which make the cake available at a much lower price (about 15 Tsh./kg) while the price of milk is 100 Tsh./l.. This makes the use of sunflowerpresscakes more attractive than grounded Acacia seeds as advocated by Shayo (1992), the more as it also provides the farmers with cheap cooking oil.

Only when one of the abundantly available resources (labor or biomass) is becoming scarce and it's price consequently is rising farmers will be inclinded to make a more optimal use of the biomass by using external inputs (if marketing is secured). In that case the strategy as described by Preston (1990) should be followed.

8 Conclusions

Ecologically the cows make an optimal use of the available biomass in the area which would otherwise be burnt. The biomass on the hills which is critical in terms of erosion prevention is not used. The scarcity of land, the scarcity of labor during planting time and easy available biomass makes it enomically not profitable to grow fodder crops.

Economically the cows make it possible for the farmers to use their surplus labor in the dry season at a very attractive income per hour, despite the labor competition between the cow and crops in the beginning of the dry season.

In the future it is possible that as many households as before the destocking will have cows: 15%. This time they will practise zero-grazing. The total amount of milk produced will be the same as before. Marketing possibilities will be of crucial importance in the long run, but should not be problematic in the case of Mvumi.

In the near future the system can still be improved by using local resources. In the long run carefully selected external inputs are needed to make an even better use of the available biomass.

So zero-grazing in destocked semi-arid Mvumi is ecologically sound and economically attractive and it seems that it can indeed compensate to a large extend for the loss of milk and to a lesser extend for the loss of manure after the destocking.

Literature

Chamberlain, A., 1989. Milk production in the tropics. Intermediate Tropical Agriculture Series. Longman.

Edwards, B., 1992. Analysis of peasant farming households and system in conjunction with MRTC Dairy project. Wye College, London.

Holtland, G., 1993. The farming system of Mvumi, Dodoma region. A case study on intensifying agriculture in semi-arid Africa. MRTC-Comm.bull.no.1 (draft)

Preston, T.R., 1989. The development of milk production systems in the tropics. TCA.

Shayo, C.M., 1992. Evaluation of water melons as a source of water and water melon seeds and acaia pods as a protein supplement for dairy cows in central Tanzania. Dissertation. Swedish University of Agricultural Sciences. Department of Animal Nutrition and Management, Report 211.

Wolf, de J.T., C.M. Shayo and G. Madeje, 1993. Evaluation of the livestock activities of Mvumi Rural Training Centre, Dodoma region.