

## **CHAPTER 6**

### **IMPACTS OF TREADLE PUMP INTRODUCTION ON DAMBO FARMING SYSTEMS AND SOCIO-ECONOMIC ASPECTS**

#### **6.1 Introduction**

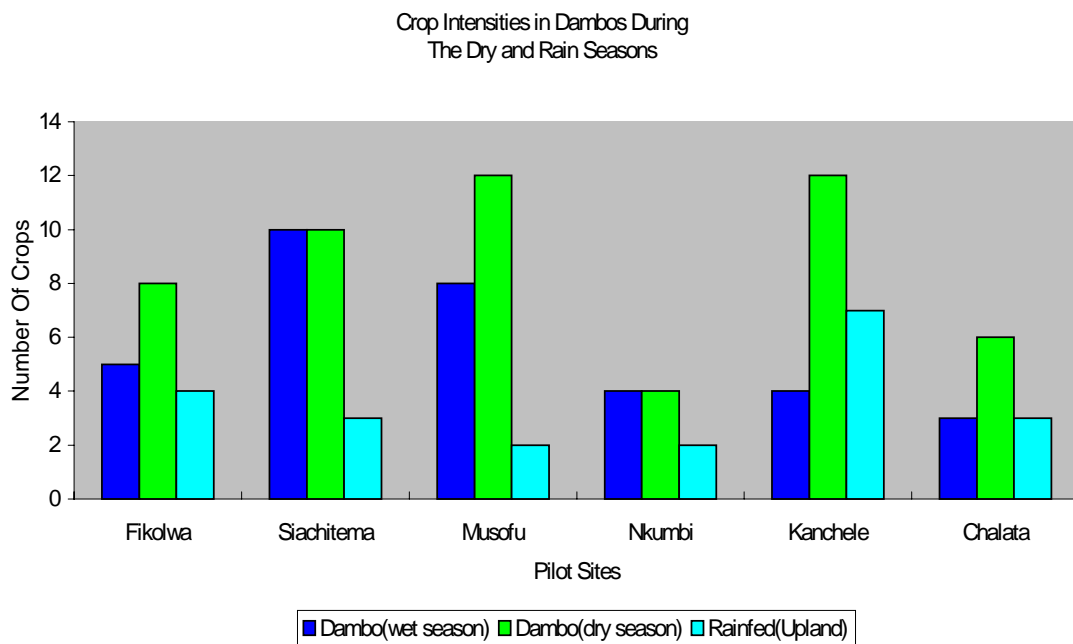
A Participatory Rural Appraisal (PRA) carried out after one year of piloting the treadle pump technology, reveals some positive impacting information regarding the intervention in the selected sites. This chapter discusses the impact of the treadle pump in Dambos and its relevance to household food security. Information is documented as revealed by about sixty small holder farmers belonging to Water Users Association groups that were initiated by this study. The study sites include Chalata, Fikolwa, Musofu, Siachitema, Noole, Mugabi and Nkumbi Dambos in Zambia. A post harvest data capturing of the 1997/98 irrigation season was done. Eight key farmers comprehensively provided income data from Dambo gardens and are thus highlighted in this chapter.

#### **6.2 Crops Grown in the Pilot Sites**

It was found that before the introduction of treadle pump technology, farmers grew vegetables with a primary aim of providing for the livelihood of their households and only sold something if there was surplus or when some urgent need for cash arose. In this way, only a limited range of vegetables was grown. All farmers in the pilot sites mostly planted vegetables like rape, cabbage and tomatoes. With the advent of the treadle pump, a diversification of vegetable varieties is noticeable. For instance, Figure 24 reveals that a wide range of crops are grown particularly in the cool dry season when diseases and pests are not common. Farmers attribute this diversity of crops to the use of treadle pumps since they are able to plant large areas of their gardens given the time gained on irrigating. Farmers at Fikolwa, Musofu, Kanchele and Chalata grow a range of 8, 13, 12 and 6 different types of vegetables respectively during the dry season and 5, 8, 4 and 3 vegetable types during the wet

season. The very big difference at Kanchele Dambo is particularly noticeable. The reduction in the range of vegetable types grown during the rain season, is due to the prevalence of pests and diseases for some crops like tomatoes and cabbage and frequent flooding in the Dambo.

At Siachitema and Nkumbi Dambos as many types of vegetables as in the dry season are grown in the rain season. The two Dambos are extremes in terms of number of types of vegetables grown, with a high number (10) being grown at Siachitema and a very small number (4) at Nkumbi. It was found that the farmers at these two sites had recognized that the time when it is most difficult to grow vegetables (the rain season) coincides with high market prices for vegetables because of a scarcity of vegetables at this time.



**Figure 24:** Crop diversities in Dambo sites during the dry and wet seasons/rainfed cropping.

The scarcity is caused by high prevalence of diseases and/or flooding, which results in low yields unless counter measures are taken. In order to coincide with high market prices, these farmers force production by investing in pesticides and other agro-chemicals for the control of pests and diseases and also to grow these crops on high ridges or flat beds to create a normal rootzone which is free from flooding hazard. Khuvutlu & Laker (1993) at Middle-Letaba irrigation scheme for small-scale farmers in South Africa also found similar patterns. They observed two reasons for off-season production of crops:

1. The farmers grew Okra in winter although it yielded less in winter than in summer. Because of food scarcity in winter, Okra prices in winter are so much higher that the profit per hectare is higher than in summer.
2. The farmers adopted a system of spreading work throughout the year so that they have work for their labourers the whole time.

### ***6.2.1 Crop Diversification due to Treadle Pump use***

Due to use of the treadle pump and ensuing increase in sizes of gardens (see Section 5.13), farmers have diversified their cropping (Table 19). Exposure to many types of crops and the availability of a market for produce has enhanced growing of different crops. Information from this table shows evidence of a higher range of crops grown by farmers in the study area after the introduction of the treadle pump technology as opposed to the period before this intervention. Farmers indicated that very limited land can be cultivated to vegetables if watering is done by hand using watering cans. This is one factor that caused low diversification of crops before the introduction of treadle pumps.

Before the introduction of treadle pumps the interviewed farmers grew crops that were limited to maize, cabbage, rape and tomatoes (Table 19). Production was also limited to household consumption and very little was sold at local markets. (See also Kwaw-

Mensah, 1996). With the advent of the treadle pumps, crop diversification is evident with the inclusion of Irish potatoes, watermelons and sugarcane to the previous cropping patterns. Larger volumes of crops produced also became characteristic as farmers could now expand their gardens. This opened up avenues for outside markets in addition to the local ones.

### **6.3 Synergy between Rainfed Cropping and Dambo Vegetable Growing**

At all sites farmers grew some upland crops during the rain season. This was most pronounced at Kanchele where cotton as a cash crop, maize as a staple, sorghum as a drought tolerant crop and groundnuts were still held in high esteem. At this Dambo upland rainfed cropping becomes more prominent during the rain season than Dambo cropping. The main reason for this is that at Kanchele most of the Dambo zones get too flooded, making it difficult to grow any crop during the rain season. There are two reasons for this: Firstly, water tables at Kanchele Dambo are usually high throughout the year on account of an earth dam upstream from the Dambo gardens. This has implications on the Dambo areas getting recharged from this severely leaking dam. A cut-off drain below the dam, to divert the water leaking from it, could solve the problem. It follows therefore that the first rains immediately begin to inundate the seepage/central zones of the Dambo because of additional supply of water. Secondly, the soils in the Dambo area at Kanchele are poorly drained because of their heavy clay texture.

On the other hand upland fields have well-drained soils which can support a wide range of crops, including rainfed vegetable crops. This explains why there is concentration on upland rainfed cropping during the rain season. Farmers are innovative by having a mix of easily storable and drought resistant crops like groundnuts and sorghum respectively.

This strategy will ensure that any possibility of drought occurrence can be escaped by the drought tolerant crops and surplus storable crops produced during good seasons can be stored for use after bad seasons without perishing. A cash crop like cotton will counter any shortfall of the staple maize since such cash can be used to buy the staple maize during times of scarcity. Another peculiar phenomenon which coincides with a reduction in lowland vegetable cropping is a conspicuous lack of a market at this time of the year because the Mapatizya amethyst mine is normally closed at this time of the year. The miners at Mapatizya are the biggest consumers of vegetables from Kanchele. Thus the availability of a market has an influence on the cropping pattern at this location. Compounding this is the absence of a local market because everyone is able to grow his/her own vegetables in upland fields for household consumption.

At Musofu, Fikolwa and Nkumbi tobacco, cotton and maize were the main upland rainfed crops. Land preparation and planting of these crops at the onset of the rains in November affected Dambo activities significantly whereas weeding did so only very little. During land preparation and planting of upland crops, the whole morning and part of the afternoon is spent in upland fields. Only two hours per day are dedicated to Dambo gardens. However, all farmers interviewed submit to the fact that there is more income generation from Dambo gardens than from upland fields. Thus there is a clear shift of farmers to specialize in vegetable growing in Dambo gardens all year round and earn income that can purchase the staple maize or household food requirements. This is supported by the unreliability of the rainfall pattern in these areas. Droughts often cause crop failures in rainfed upland cropping, particularly with the staple maize.

Taking into account the crop diversity due to dry and wet season Dambo cultivation and wet season upland cultivation of maize, tobacco, cotton and groundnuts in the pilot areas, it was found that the diversity is greatest at Siachitema, followed by Musofu, Fikolwa and others (Figure 25). Farmers at Musofu, Fikolwa and Nkumbi are motivated to grow many

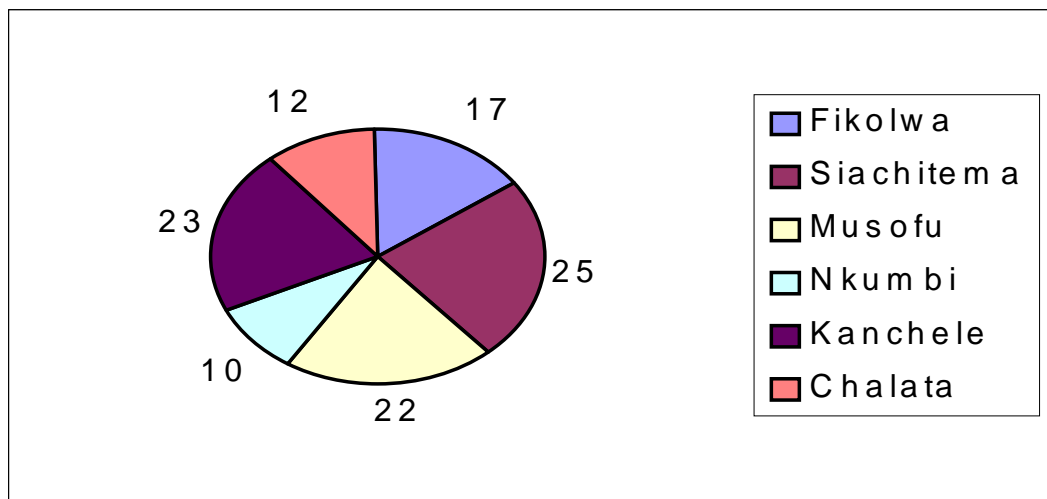
crop types throughout the year because of access to big markets. Their buyers come from as far as the Copperbelt and others from within the district, particularly the secondary school and the hospital. Women buyers from the Copperbelt have organized a regular transporter called DODOMA to take them to these gardens twice a week to buy produce which they resell at Masala market in Ndola on the Copperbelt. In this way, the market is predictable. Nkumbi and Msofu are easily accessible as they are very close to a tarmac road. Fikolwa, however, because of soil acidity requires acid tolerant vegetables. This is the reason why only 5% utilization of the Dambo is exhibited in this Dambo (see Section 6.9).

Siachitema farmers with the highest consistent year-round diversity, market their produce at Choma, a nearby town, which is very near the railroad line, which opens up avenues for buyers from Livingstone, a tourist town.

**Table 19: Crop Diversification Since Adopting Small-scale Irrigation using treadle pumps.**

Farmer	Dambo	Year started	Crops grown	Method of Irrigation	Treadle pump Involvement	Crops grown	Method of irrigation
Charles Chiswala	Fikolwa	1981	Rape,maize	watering can	1997	rape, cabbage, tomato, sugarcane, water melon	Treadle pump
Morgan Bwale	Chalata	1987	Rape,tomato	watering can	1996	tomato, cabbage, maize, rape	Treadle pump
Cholobola Ngosa	Musofu	1977	rape,tomato, maize	seepage capillary rise, watering can	1996	rape, tomato, cabbage, peas, impwa, carrot, onion, cauliflower, green pepper, eggplant, water melon, irish potato	Treadle pump
Neli Banda	Nkumbi	1990	Cabbage,rape, cauliflower	watering can	1996/7	rape, cabbage, cauliflower,tomato	Treadle pump
Robert Simawawa	Siachitema	1987	Maize,tomato	watering can	1996	rape, tomato, cabbage, impwa, carrot, onion, cauliflower, green pepper, eggplant, paprika, watermelons, irish potato, cassava, gourd, maize	Treadle pump

At Chalata farmers do well, despite having a small range of crops. Tomatoes are grown all year round as main crop due to good control of pests and diseases. A farmer at Chalata has in fact a higher net income than most farmers interviewed in the pilot sites due to correct timing of the market situation and use of a treadle pump for irrigation. This farmer grows tomatoes throughout the year by staggering the planting of nurseries. In this way, some of his crop coincides with very high prices on the market. The crop is sold at Mkushi secondary school and Kapirimposhi, a nearby town connected by a very good tarmac road. Some buyers drive to these gardens to buy tomatoes as it is available all year round.



**Figure 25: Combined Crop diversities In Dambos (including upland rainfed cropping).**

#### **6.4 Dambos as Safety Nets for Household Income and Food Security**

Despite the problems encountered with marketing of vegetable crops at different times and locations, farmers are however able to sell Dambo vegetable crops at any time



throughout the year unlike upland rainfed crops like maize, cotton and tobacco which are generally sold to out-grower companies once a year. The latter arrangement is often associated with long delays in transport and payments. This study established that out of the sixty farmers interviewed, 25% had not yet received cash from the sale of their upland produce, particularly cotton and tobacco, some six months after harvesting and marketing the crop on credit. This happens as a result of the buying companies being undependable. As indicated earlier, farmers in the Senanga district of Western Zambia also indicated this as a big constraint (Kwaw-Mensah, 1996).

Meanwhile their well-established Dambo vegetable gardens continued to provide in their daily household requirements. The farmers described a Dambo garden as a **"goose that lays the golden egg"**, a **"grocery"** or **"Leswa wa lusuba i.e the daily God "** who looks after each family member on daily basis.

Dambo garden produce is used for a combination of household consumption and sale. Those who buy the produce pay for it immediately, irrespective of whether they purchase it for their own consumption or for reselling it in order to generate income. Income from sale of the Dambo produce provides for other household needs as well. The fact that small but steady daily income comes from Dambos, they are considered as reliable socio-economic safety nets for household food security and other requirements.

Unlike staple grains, such as maize and sorghum, or cash crops, like tobacco and cotton, vegetables need to be marketed immediately when they are harvested and this offers the flexibility for households to obtain cash income at varying times during both the dry and wet seasons. The range of marketing possibilities was more flexible and greater than that of rainfed crops in terms of the times of the year at which they could be sold. One factor accounts for this i.e. there is not a fixed planting season, vegetables can be grown as needed. A household can decide on a monthly basis whether to grow crops for sale or home consumption or both. The fact they can use treadle pumps to reduce labour requirements enables them to expand gardens and offers them an opportunity to diversify

cropping.

Dambo farming has been described as a very lucrative farming enterprise by all farmers in the pilot sites. This is mainly due to the following comparative advantages over upland farming as identified by farmers themselves (Table 20).

**Table 20: Advantages of Dambo Land Use Compared with Upland Fields.**

<b>Dambo Garden</b>	<b>Upland Field</b>
<ol style="list-style-type: none"> <li>1. Offers crop security with full control of water.</li> <li>2. Yields are usually high and double cropping is possible.</li> <li>3. Crop harvest can be spread over a period of time to provide food.</li> <li>4. Produce are sold immediately after harvest.</li> <li>5. Bridges the hunger period between November and January.</li> <li>6. Income and food provision is steady</li> </ol>	<ol style="list-style-type: none"> <li>1. Crop failure is common as there is no control over rains.</li> <li>2. Low yields and crop loss result due to drought.</li> <li>3. Have to wait long before harvest.</li> <li>4. Very an uncertain market for cash crops and have to wait for payments for too long.</li> <li>5. Food insecure between November and January.</li> <li>6. An unsteady supply of food and income.</li> </ol>

Because of the perishable nature of Dambo produce, the advantages of vegetable production is strongly dependent on marketing opportunities, as was also clear from section 6.3. Marketing opportunities are not only determined by markets, but also the availability of the necessary infra-structure to get produce to markets. According to Kwaw-

Mensah (1996) the Dambo vegetable farmers at Senenga in Western Zambia were able to produce excellent vegetables (see Figure 23) but they had serious marketing problems because of the poor infra-structure, i.e. bad roads and poor transport services. Consequently they could only produce limited quantities for sale at local markets at the school and hospital. This factor also manifests itself when glut occurs, i.e. when surpluses of one crop as a result of farmers following a similar cropping pattern and intensity. Such surplus crop has to be sold outside the village community over long distances to fetch a market outlet. Many times farmers have to travel long distances on bad roads transporting their produce on ox-carts. Sometimes the ox-carts break down and it could take several days to reach the markets where they wait for extra days before all the produce is sold. Such delays culminate in perishable crops like tomatoes getting rotten and damaged.

In the case of Senanga there was a potentially good market available in Lusaka, if only the roads and transport services were not so bad. In section 6.3 it was indicated that Musofu, Nkumbi and Fikolwa Dambos had the advantage of having a good market in the Copperbelt and being close enough to the tarmac road so that transport was not a problem.

At Mugabi Dambo in Chipata, Freshmark Limited sent trucks to Dambo gardens to buy vegetables for Shoprite Checkers supermarket. This created a good market for the Dambo vegetable farmers whose gardens have an access tarmac road to Chipata town. Moreover some farmers sell their vegetables across into Malawi, a neighbouring country that does not produce much vegetables.

## **6.5 Influence of Treadle Pumps on Farmers' Income from Dambo Gardens**

Farmers' own incomes have increased since their involvement in the use of the treadle pump. This is attributed to the fact that their productivity has improved as a result of one or more of the following reasons:

- ◆ Labour savings between 60-75% by changing from irrigation using watering cans to

using the treadle pump.

- ◆ Expansion of the area under irrigation as a consequence of gaining on time of irrigating a unit area of land has been made possible. Most farmers have increased the size of their gardens by an average of 150%.
- ◆ Income level before and after the treadle pump use is shown in Figure 26. The Figure also shows input expenditures associated with these levels of income.

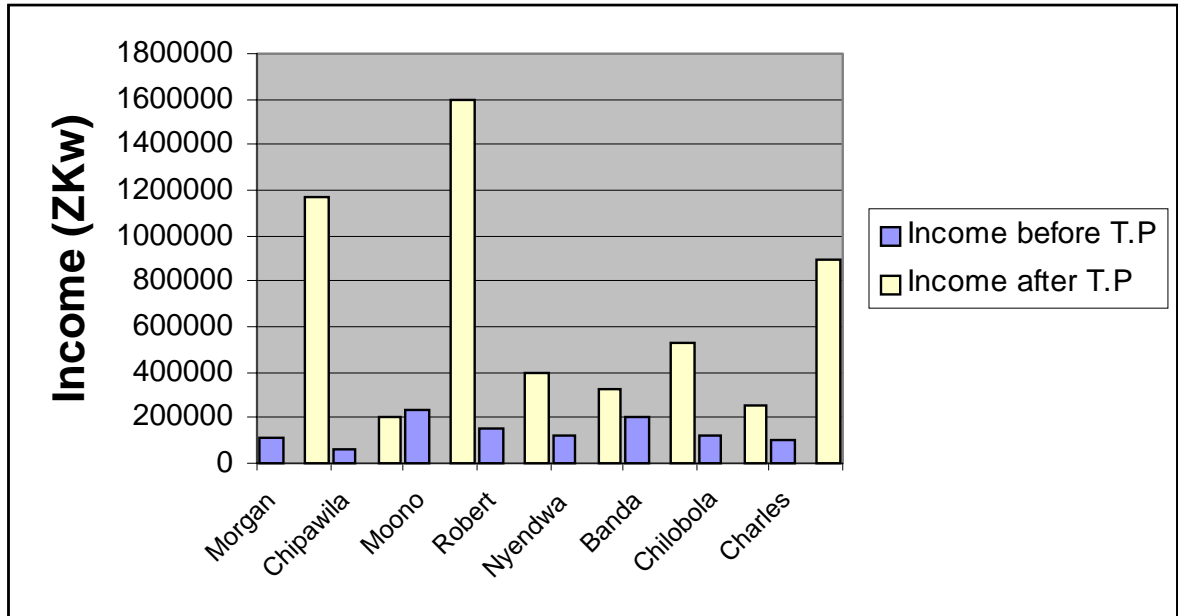
Figure 26 indicates a distinct increase of cash income from Dambo gardens after the farmers began using the treadle pumps in the pilot sites. From farmers' interviews, it transpired that Morgan at Chalata, Moono at Kanchele and Charles at Musofu registered gross incomes of US\$333 (ZK1,165,500), US\$455 (ZK1,592,500), and US\$257 (899,500) respectively in the 1997 irrigation season.

These farmers recall from their past cropping activities without using the treadle pump and coupled with little horticultural and water management knowledge, having attained gross incomes to a maximum of only US\$33 (ZK115,500), US\$66 (ZK231,000) and US\$28 (ZK98,000) respectively. Thus income increases as a result of adopting the treadle pump technology are noticeable. The range of incomes after the treadle pump represents an increase in the order of sixfold to tenfold. It is therefore expected that the lifestyle of farmers will improve with time as is already evident in some respect. This is discussed in

the following section on the use of Dambo garden income. It should be borne in mind that for most of the farmers interviewed, these figures are on the conservative side for reasons that their monthly sales recalled, were on the low side because of not keeping records and that it is customary for farmers not to reveal all the figures in anticipation of external assistance from agents of change.

Comparing farmers' purchases for garden inputs, it occurs that farmers like Morgan and Moono have a good understanding of cultivation practices and pest and disease control as well as fertilizer requirements. These farmers spent more money to manage their gardens than others in the pilot sites (Figure 27). The same farmers obtained higher income from

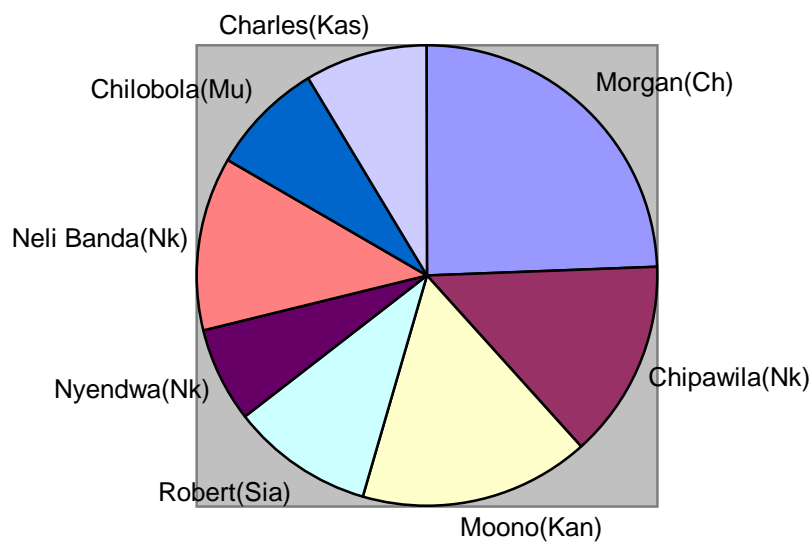
sales of their produce (Figure 26).



**Figure 26: Household Income From Dambo.**

*It must be kept in mind that the advantages of the introduction of treadle pump technology can only be reaped if suitable markets are available and if this is supported by the necessary infrastructure to get the produce to the markets.*

Farmers' Dambo Input Expenditure levels  
Before and After Treadle pump(Combined)



**Figure 27: Farmers' Dambo Input Expenditure.**

## **6.6 Use of Income from Dambo Gardens**

Farmers in the pilot sites outlined several uses of income derived from vegetable gardens, some of which are outlined in Table 21.

**Table 21: Usage of Dambo garden income by farmers in the pilot areas.**

<b>Description of Expenditure</b>	<b>% farmers using income from vegetables for the purpose</b>	<b>% of total expenditure used for the specific purpose</b>
1.Purchase of seed, sprayers and chemicals for control of pests and diseases in vegetables.	93	30
2.Buying fertilizer for upland fields.	100	35
3.Bartering vegetables with staple maize for household consumption.	35	3
4.Buying work-oxen.	10	3
5.Buying mealie meal	5	10
6.Buying of soap, salt and clothing	100	10
7.Payment of school fees	100	7.5
8.Purchase of television, radio cassette, bicycle etc.	2	0.5
9.Bartering vegetables with chickens and goats.	65	1.0

For some of the outlined uses, it was possible to quantify how much had been spent by each farmer on specific Dambo garden inputs such as fertilizer, manure, pesticides etc.

It is clear from Table 21 that **all** the farmers interviewed, met their expenses on fertilizer for upland fields, daily household requirements (salt, soap and clothing) and payments for school fees from income generated from sales of Dambo garden produce. Nearly all the farmers (93%) also used income from Dambo garden produce to buy inputs for Dambo gardening. It is also evident that on average the farmers spent nearly two-thirds (65%) of the money generated by the sale of Dambo produce on the purchase of inputs for Dambo gardens and upland fields. This indicates that the livelihood of these farming families is dependent on crop production.

Bartering of vegetables with chickens and goats is done by 65% of the farmers, but it comprises only 1% of the total expenditure of vegetable garden income.

Bartering of vegetables for staple maize was done by 35% of the farmers, but it amounted to only 3% of the total expenditure of vegetable garden income. This indicates that in the area there are some farmers with surplus maize and inadequate amounts of vegetables, probably upland rainfed crop farmers without access to Dambo land. Conversely there are also some vegetable farmers who are not self-sufficient in regard to maize. Only 5% of the farmers bought maize meal but the expenditure on maize meal was 10% of the total expenditure. This is a very high proportion, considering the small number of farmers involved. It stresses the well-known fact that it is very expensive for small-farmers everywhere who are not self-sufficient in regard to staple maize to buy in maize meal. Overall these figures also indicate that 60% of the vegetable farmers were self-sufficient in regard to staple maize grain.



Only 0.5% of the total expenditure was spent for purchasing of television, radio cassette players and bicycles. Luxury items therefore appear to be far less important than requirements for crop production in the livelihoods of the farmers.

## **6.7 Gender Considerations and Labour Requirements in Dambo Gardens**

In as much as male headed households worked with their families in Dambo gardens, it was recognized that certain chores were gender specific as outlined in Table 22. Although men have mostly acquired the treadle pumps, women and youths often operate them in the fields. Socio-culturally, irrigation, weeding, fertilizing and harvesting of vegetables are activities considered to be mainly for women. During the piloting phase, there were alleged fears and scepticisms that a woman who excessively used the treadle pump would not conceive because the movements during operation of the equipment shook the womb and affected her.

Such scepticisms have no basis. The scepticism was mostly mere speculation from the women's folk and has since disappeared. There were no conflicts regarding specific roles men and women perform in preparing land and growing vegetables in Dambos.

**Table 22: Dambo Garden Gender Specific Activities (DGGSA)**

<b>ACTIVITIES</b>	<b>MEN</b>	<b>WOMEN</b>	<b>BOTH</b>
1. Operating treadle pump	***(+)	*	
2. Weeding	*	***	
3. Cultivating	***		
4. Fertilizer application			***
5. Harvesting	*	***	
6. Selling produce		***	
7. Keeping money		***	
8. Watering (irrigating)	**	***(++)	
9. Decision on cropping pattern	***		*
10. Attending organized farmer meeting			***
11. Purchase of inputs	***	*	
12. Planting or sowing	*	**	
13. Land ownership	***	*	
14. Garden fencing	***		

\*\*\* = frequently done by    \* = sometimes    \*\* = often

(+) = After treadle pump introduction (++)= Before treadle pump

## **6.8 Cultural and Socio-Economic Aspects of the Treadle Pump**

### ***6.8.1 Cultural Aspects***

The information in Table 22 depicts irrigation using a treadle pump to have shifted towards being done by men rather than women. Irrigation is always seen as a women's activity when watering is done by watering cans and buckets. The men often resisted watering the garden the whole day using laborious methods and left the task to women and their children. However due to reduced time of watering, men have since joined their families in irrigating using the treadle pump. Now women concentrate on weeding, fertilizing and harvesting the vegetables. The laborious activities of digging the Dambo land and fencing are left to the men while women do most of the Dambo activities that men think are light.

Men also encourage their wives to use this labour saving device which enables them increase yields and income by (i) applying adequate water to the crop and (ii) irrigating larger gardens with a diversity of crops. With these associated benefits, adoption rates have tended to increase at a rapid average rate of more than 800 pumps per year.

Women in Zambia operate the treadle pump without any traditional or religious restrictions such as those that prevail in Asian countries where a woman should not be seen exposing herself on the treadle pump (Alastair et al, 1991). In the latter countries women use the pump under a shelter or very early in the morning before sunrise or in the evening at sunset.

It is interesting to note that in Zambia, men are at the forefront in encouraging women to use the treadle pumps for irrigation since they have recognized its labour saving potential and antecedent opportunity to increase income. It is not clear if any antagonisms are offset by higher income. In Zimbabwe, the opposite obtains where men discourage their wives to expose their legs and hidden body parts while operating the treadle pump (Zirebwa, 2000).

The pump enables users to irrigate a 0.25 ha piece of land in less than three hours as compared to taking the whole day under traditional methods of watering. This gain in time would imply a feasibility to hire out the pump to other users. However, this has been rejected because farmers fear their colleagues' carelessness may lead to breaking of the pump. Moreover, if left unattended to in the field, the pump would be stolen by others. For these reasons, farmers in Zambia prefer individual pump ownership as opposed to group ownership.

Chancellor and O'Neil (1999) observed that the use of the treadle pump had greatly changed a woman's workload per day. They observed a case in Zambia where a farmer who had increased the cropping pattern by adding paprika in a vegetable garden where they previously grew only rape and tomatoes for their own consumption and for sale actually increased the workload for his wife who was in-charge of watering. Acquisition of a treadle pump by the farmer's wife greatly reduced her workload because her husband has now joined her to irrigate the crops using the treadle pump which is less labour intensive. This task was previously done by his wife alone. Due to the advent of the treadle pumps, male farmers have changed their cultural calendars of resting and attending to traditional ceremonies in the dry season, as they have to grow crops throughout the year.

### **6.8.2 Economic Impacts**

Economic impacts of the treadle pump adoption as a technology for increased crop production could face dangers of depressed adoption due to glut on the market causing losses for the Dambo produce. As indicated earlier, local markets in the production areas would not absorb this increased production. Success would, therefore, be strongly dependent on markets elsewhere. As indicated earlier, this is not only dependent on the availability of a market, but also on the necessary infra-structure to get the produce to the market. The success achieved at Musofu, Fikolwa and Nkumbi Dambos is due not only being close to the Copperbelt market and a tarmac road, but also buyers or hawkers coming from the Copperbelt in an organized manner to buy produce on the farm, as indicated earlier.

In other areas this factor has been mitigated by the farmers themselves organizing regular markets, which attract a great number of consumers to participate in such a market system which has the format of an exhibition. This type of marketing is commonly practiced in Eastern province of Zambia in Chipata where farmers have established a Wednesday and Saturday market. Buyers of Dambo produce go to Dambo gardens with hired vehicles a day before the market day to buy produce for the sale the following day. An example of tomatoes being transported to markets is seen in Figure 28, whereas a typical market day is shown in Figure 29.

Another marketing system is contract farming, in which clients, e.g. Shoprite Checkers supermarkets, Chankwakwa limited, Sunripe Limited, and Rivonia companies enter into contracts with farmers to grow specified crops for them on an agreed forward price. In this way farmers of Chipata have improved their marketing arrangements. They are able to meet the required volumes by growing large areas using treadle pumps for irrigation. Examples of crops grown under contract Dambo irrigation include strawberries, Irish

potatoes, birds eye chillie, onion, tomatoes and green pepper. Figure 30 shows a crop under contract farming.



**Figure 28: Tomatoes ready for transporting to an organized market (Mugabi Dambo).**



**Figure 29: A typical organized market for Dambo produce in Chipata.**





**Figure 30: A crop under contract farming at Indaba Dambo in Chipata.**

The adoption of this technology by farmers has had some positive spillover effects on the nation's economy, including:

- ◆ Farmers are able to grow up to three crops in a year (300% cropping intensity) on the same piece of land, increase irrigated areas in the dry season and increase production per unit land area and per unit water. In this way they are not only able to bridge the dry season hunger-gap and achieve household food security, but also to provide much needed vegetables to mining and urban communities on a sustained basis. This reduces the country's reliance on imports of such produce and saves foreign exchange.
- ◆ Employment is created through the supply chain of pump manufacturers, retailers and users (farmers) who employ artisans at manufacturing points and carpenters to produce the wooden accessories.



- ◆ Employment creation at farm level because families cannot handle the labour required on the larger areas cultivated.
- ◆ Increased income at household level. Farmers have been able to increase their annual net income from a meagre US\$125 without a treadle pump to US\$850 - US\$1,700 on a 0.25 ha piece of land with treadle pump growing three crops in a year.
- ◆ Creation of employment at the output side for buyers (merchants/hawkers) and transport contractors who trade and transport the produce.
- ◆ The treadle pump is economically viable and beneficial, as it does not depend on petrol, diesel, gasoline and electricity to operate it. These sources of energy are expensive and not always readily available.

## **6.9 Access to Land in Dambos**

There were no restrictions to access to Dambos at all the sites studied. Men and women had equal access to Dambos. Table 23 shows that in the areas studied between 22.7% and 100 % of households had access to Dambo land. Much more Dambo land was still available for occupation. For some reasons a large proportion of the people had not acquired any piece of land at some Dambos, i.e. Chalata, Siachitema and especially Fikolwa. Although laziness to till Dambo soil was cited as a reason for low utilization and access to the Dambo at Fikolwa, this study has established that on account of high soil acidity, this Dambo does not support a wide range of crops and is, therefore, less utilized. At Musofu and Nkumbi practically all households and at Kanchele 80% of the households accessed Dambos and yet the utilized proportions of these Dambos were very low. It is noteworthy that the population densities at these Dambos seem to be lower than where small proportions of the farmers accessed Dambos.

Dambo soils are perceived to be very difficult to till unless when moist. With the treadle pump, it is possible to apply adequate water in the dry Dambo zones and make such land

ready for tillage. Further more, upper grassland zones of Dambos are often away from shallow watering points within a Dambo and one has to dig deeper than 3 m to access water within this zone. Lifting water from such depth by the bucket and rope method is tedious and hard work. A treadle pump has made it possible to reticulate water from watering points further away to this water gardens in this zone or to abstract water more easily from deeper wells in this zone.

**Table 23: Information on Dambo utilization in the study areas.**

<b>Location</b>	<b>Number and % households accessing Dambos</b>	<b>Average Garden Size (ha)</b>	<b>Dambo land area cultivated (ha)</b>	<b>% of Dambo cultivated</b>	<b>Presence of Stream</b>
Fikolwa	45 (22.7%)	0.10	4.50	5	Yes
Chalata	87 (50%)	0.50	43.50	21	Yes
Musofu	65 (100%)	0.25	16.25	15	Yes
Nkumbi	36 (98%)	0.10	3.60	16	Yes
Siachitema	65 (50%)	0.50	32.50	29	Yes
Kanchele	55 (80%)	0.50	27.50	21	No
<b>Total =</b>	<b>353</b>	<b>0.32</b>	<b>127.85</b>	-	-

The above analysis shows an estimated number of 353 households accessing Dambos for cultivation in the two districts of Mkushi and Kalomo. It is further estimated that about 128 ha are under vegetable production using either buckets and watering cans or, to some extent, treadle pumps.

Most farmers indicated that they acquired land in Dambos by inheriting it from relatives while village headmen allocated it to a few. Once allocated, they are free to pass the land parcel to the next of kin.

#### **6.10 Influence of the Introduction of Treadle Pumps on the Adoption of Irrigation**

It is difficult to estimate the adoption of irrigation because of the introduction of the treadle pumps, as most farmers in the pilot areas already practiced irrigation, using watering cans and buckets to abstract water from shallow wells, before introduction of the pump. What is evident, however, is that introduction of the pumps led to adoption of better methods of lifting water using treadle pumps, good irrigation practices with nice farm layouts for water reticulation, improved shallow wells and better horticultural practices.

For example, at Musofu farmers who could not easily control the seepage water are now able to manage this through training in irrigation field layouts and in using furrows and small ditch drains for easy operation of the treadle pump. Using the treadle pump, they have also been enabled to utilize the upland parts of the Dambo which they could not irrigate using watering cans because of the distance from the water sources. In these zones, crop productivity is very high due to better soil aeration and good drainage as a result of light textured soils unlike the heavy clays in the central parts of the Dambo and also because of their position in the landscape. Farmers in Chalata also share this experience.

Farmers in Kanchele and Siachitema have been able to expand their gardens as a result of owning the treadle pump. They have, however, been unable to irrigate adequately due to collapsing wells which, by the end of this study, had just been lined with concrete rings. This having been their major constraint, farmers are confident of achieving even better results in subsequent seasons, as the recharge will have improved to levels where the treadle pump can be used without drying these wells.

### **6.11 Use of Treadle Pumps for Activities other than Irrigation**

During the present study it was found that treadle pumps are used not only for irrigation but also for other purposes. These include *inter alia* the following:

- ◆ Women use the treadle pump to draw water for domestic purposes such as; drinking, washing and bathing children. This has reduced the long distances they walk to fetch water from streams and rivers and give them more time for other chores, including farming activities such as weeding.
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- ◆ The pump is gaining importance in construction activities requiring water and in dewatering during well lining.
- ◆ Farmers also use the treadle pump to draw water from either a well or the wet central zones of the Dambo to the uppergrassland zone for provision to livestock.

### **6.12 Conclusions And Recommendations**

1. The capability of the treadle pump to contribute to household food security has been demonstrated in the pilot areas where farmers' incomes have increased by

between sixfold to tenfold when compared to cultivation without a pump.

2. It is evident that operation of the treadle pump is done by men, women and children. It is therefore recommended that training in the use of treadle pumps should be directed at both men and women, who can in turn train their children.
3. It is recommended that the training for use of the pump should be emphasized to both men and women with their children as they all use the pump.
4. Time savings on irrigation as a result of using the pump have resulted in increased areas under irrigation.
5. Given that each pump commands an average of about 0.25 ha per crop cycle, irrigating two crops per year, there is about 1250 ha currently irrigated by small-scale farmers using the treadle pump.
6. Crop diversity in Dambos is a signal of increased use of these environments for crop production.
7. Farmers' livelihoods are fast changing positively through visible improvement in terms of nutrition and increased income at household level.
8. Introduction of treadle pumps created new employment opportunities, both on the input (manufacturing of pumps) and the output (marketing and transport) sides.
9. Before advocating large scale introduction of treadle pumps in an area it must first be ascertained whether the necessary markets and infrastructure exist, or can be put in place, to absorb the surplus produce that will be generated. This is a key component of any land use planning exercise.