

ECONOMIC ANALYSIS OF THE PYRETHRUM INDUSTRY IN
TANZANIA: THE CASE OF NJOMBE DISTRICT

BY

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ABSTRACT

Agricultural product production in Tanzania has been facing deep seated problems beginning the late 1960s and early 1970s. In effect, output production of the export crops had continued to decline throughout the 1970s and 1980s. Various factors have been pointed out in various studies to have contributed to the decline. These range from price to non price factors. This study has attempted to look into the factors which have contributed to the decline in pyrethrum output production in Njombe district with special emphasis on smallholder producers who are the main producers of the crop.

The study is organised into five chapters. The first chapter gives the background to the study. Ecological requirement for the crop and the main farm husbandry practices are presented followed by a discussion on producer and world market price trends.

The chapter observes that, 98 % of the crude extract and 70 % of the dry marc produced at the Mafinga plant is exported. Better prices for these products were received after the 1985/86 crop season both in the export and the domestic market. However, the export market prices increased at a higher rate than the domestic market in local currency terms. Devaluation of the local currency

was more responsible for this than the actual increase in export prices. This was due to a government policy of export promotion.

Chapter two is all about literature review. Generally it is concluded in the chapter that, although price can be the main machinery which account for agricultural output production trends, attention need also to be paid to non price factors which affect the smallholder pyrethrum output production in Njombe district.

Chapter three describes the study area and the methodology used in the study. The chapter shows that, descriptive statistics, gross margin, the chi-square and the multiple regression models have been used in data analysis.

In chapter four, study findings are presented and discussed. Basing on the study objectives, it is identified that, the factors which are related and account for the observed pyrethrum output produced in Njombe district include poor crop husbandry practices, unavailability of some of the essential rural agricultural development infrastructure. The other factor is the unfavourable competition of pyrethrum with other major crops grown in the area.

As the Mafinga pyrethrum extraction plant is the main processor of the output from Njombe district, this study extends its coverage to look into the working of the plant and its ability to absorb and process more produce should production increase in the near future.

For the case of the Mafinga plant, the study identifies that, the plant is performing poorly due to factors like the shortfalls in the plant layout, high processing cost and the high administration costs of the pyrethrum board which own the plant and its produced output. In effect, pyrethrum producers have received a very low share of the board's average sales price of the pyrethrum products because most of such sales proceeds go to finance the board's operational costs.

On this account it is concluded that, the pyrethrum industry in Njombe district is performing poorly both quantitatively and qualitatively. The Mafinga plant is unlikely to absorb reasonably more quantity of pyrethrum for processing should production increase in the near future.

Basing on the study's findings, it is recommended that, the pyrethrum board together with the cooperatives should work on methods, and probably policies, which will ensure that high quality rural infrastructure and

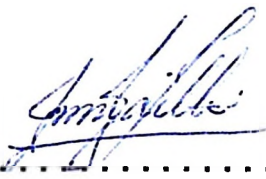
incentives for pyrethrum production is developed. Such incentives should include an upward review of the producer price relative to the price of the competing crops, an improvement in the pyrethrum output per unit area and the quality of the output.

Immediate rehabilitation of the Mafinga plant be done in order to improve its working capacity. The plant should be connected to the national power grid, which is only about 60 km away, to reduce processing costs. The pyrethrum board should streamline its activities and its manpower needs in order to lower administration costs.

Cooperatives, that is NJOLUMACU for the Njombe case, should strive to ensure that they get hold, either partially or totally, of the Mafinga plant in order to make sure that smallholder producers benefit from their pyrethrum production in terms of higher returns. However, this will depend on the financial worthiness of these cooperatives.

DECLARATION

I NGAILO, LEGNARD NICHOLAUS do hereby declare to the senate of Sokoine University of Agriculture that this dissertation is my own work and has never been submitted nor concurrently being submitted for a degree at any other University.

Signed 

Date 22/03/1993

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DEDICATION

This work is dedicated to my mother, GETRUDE and my late father NICHOLAUS, for their tireless efforts in ensuring that I get education. My father tragically passed away on 4 August 1984 only after finishing my national service course and hence he could not see at least a return from his educational investment. May God rest his soul in peace.

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The management of the Mafinga plant, pyrethrum board at the head office Iringa and regional office at Njombe, the cooperative union at Njombe and its affiliated cooperative societies deserve special thanks for their invaluable cooperation and provision of some of the necessary data for this study.

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The authors' wife, Lucy, had to face hard times during the study period because of being away from her. However, she kept on encouraging him to continue with the programme. Enormous thanks go to her and Nicholaus, their son, for their patience and tolerance.

The data analyst and the typist have not been forgotten. In fact both data analysis and typing of the manuscript was done by the author using computer units donated by the sponsor. On these, thanks go to Dr Mlay and Mrs Temu from the department of Rural Economy who taught a course on computer application.

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LIST OF ABBREVIATIONS

| | |
|-----------|--|
| EEC | European Economic Community |
| MDB | Marketing Development Bureau |
| MPEP | Mafinga Pyrethrum Extraction Plant |
| NJOLUMACU | Njombe Ludewa Makete Cooperative Union |
| PPMB | Project Planning and Monitoring Bureau |
| TECO | Tanzania Extraction Company |
| TFA | Tanganyika Farmers Association |
| TPB | Tanganyika Pyrethrum Board |
| URT | United Republic of Tanzania |
| IDA | International Development Agency |

CHAPTER ONE

1.0 BACKGROUND INFORMATION

1.1 Introduction

Pyrethrum is a small, bushy, perennial cash crop plant cultivated for its white flowers. The flowers when harvested, dried and processed produce chemical compounds known as pyrethrin. The pyrethrin is useful in insecticide formulations for controlling both household and crop pests. The commercial value of pyrethrum therefore lies on the insecticidal properties of the pyrethrin.

Pyrethrin from pyrethrum is said to be superior over organic synthetic pyrethrin for insect control. This is because apart from having a rapid "knock down" effect and killing action, a good "flushing out" effect i.e. forcing the insects into the open, strong repellency action and effectiveness against a wide range of insects, they are virtually non toxic to human and other mammals and are non persistent with low levels of insect immunity (Ryan, Pilon and Leduc 1990, MDB 1989, Pyrethrum Bureau 1978, Mrak 1973). Therefore pyrethrin from pyrethrum flowers has no residual effects like DDT.

Pyrethrum first became fully established in the southern highlands of Tanzania in 1938 and first production trials were done at Uwemba in Njombe district. In the 1950s pyrethrum production spread to the northern highlands mainly Arusha and Kilimanjaro regions. In all these places first producers were european settlers (World Bank 1980).

Smallholder production of the crop started to increase after 1961. The new government after independence had taken some deliberate measures to encourage smallholder producers to produce the crop for income generation in order to improve their living standards, as in most areas where the crop was grown there was no any other cash crop for income generation (UNDP/FAO 1976).

Smallholder production encouragement took the form of provision of free planting materials, extension and marketing services. In response to these promotional services by the government, smallholder production of pyrethrum more than doubled between 1963, when only 2300 tons were produced, and 1967 when more than 6000 tons were produced (URT 1976).

Up to 1974/75, Tanzania was among the five major pyrethrum exporting countries in the world, ranking second after Kenya. It supplied between 20 and 24 % of the total

export volume (Pyrethrum Bureau 1978, URT 1976). Kenya supplied two thirds of the total export volume to the world market by then. Today Kenya alone supplies 80 % of the total world market supplies (Ngugi and Ikahu 1990, Okello 1990). This indicates that the relative share of Tanzania in the export volume has decreased.

The highest output in Tanzania was recorded in 1966/67 when about 6700 tonnes of dry flowers were procured (URT 1976). Since then production has been fluctuating far below that level with limited signs of recovery (Appendix A.1). Manang (1988) had the opinion that there must be some socio-economic factors which are responsible for this downward production trend, however none of the factors was mentioned. UNDP/FAO (1976) asserts that, the low yield of pyrethrum flowers over time in some areas of the country was due to lack or insufficient use of fertilizer, poor crop husbandry practices and inappropriate or poor quality planting materials specifically the splits. It was then suggested that, demonstration of proper preparation and planting of splits was one of the potential areas to improve yield.

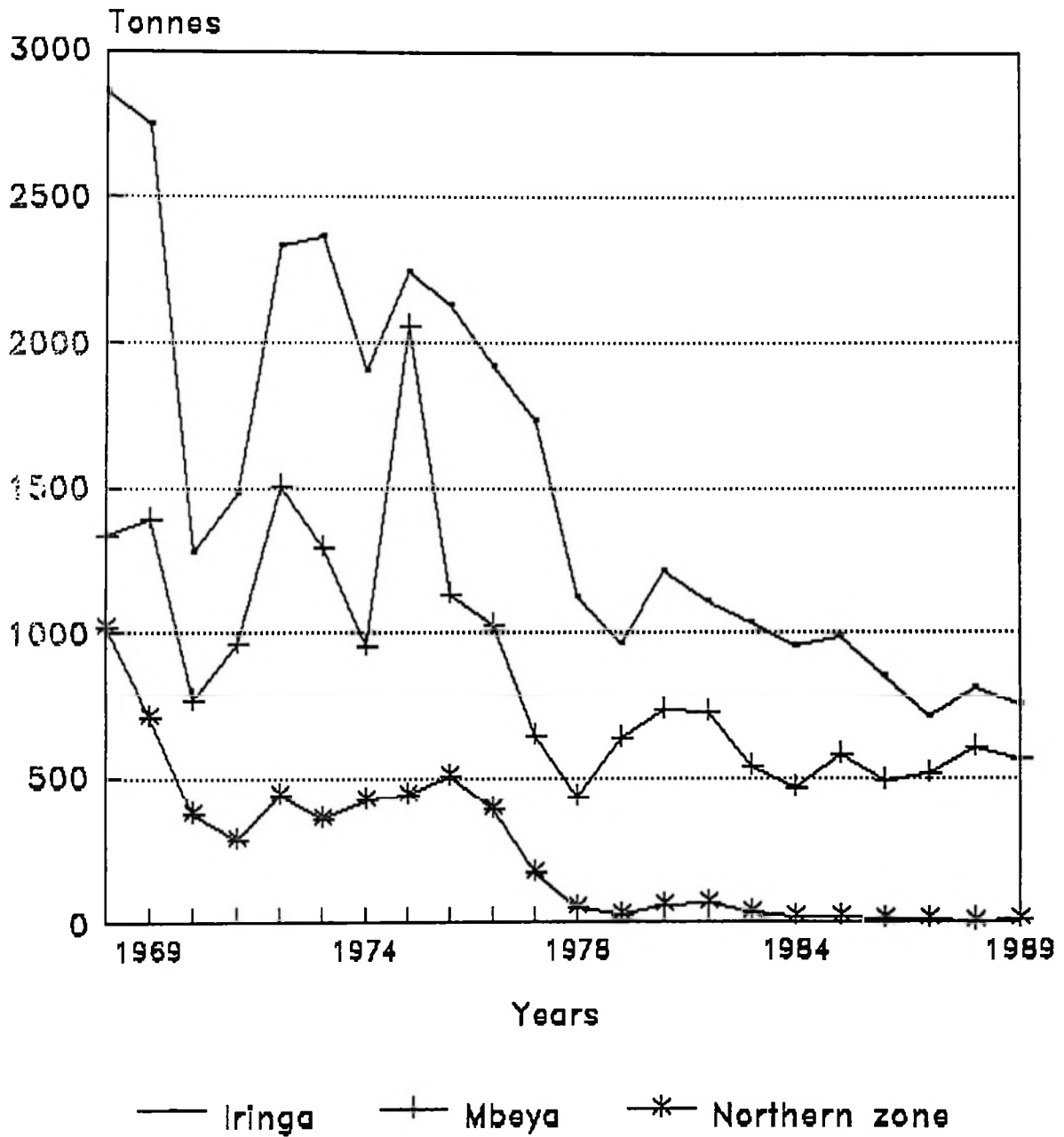


Fig 1.1 Tanzania: Volume of pyrethrum production by regions, 1967/68 – 1988/89

In Tanzania the main pyrethrum producing regions are Iringa and Mbeya (Figure 1.1). The northern production zone, which is composed of Kilimanjaro, Arusha and Tanga regions, has lost its importance over time as pyrethrum production there has declined progressively to a negligible contribution to total output since 1978/79.

The crop is currently being produced exclusively by smallholder producers. Large scale production ceased in the late 1960s and early 1970s as a result of the Tanzania nationalization policy and an increase in agricultural wages which made large scale pyrethrum production to be too costly.

1.2 Ecological Requirements for Pyrethrum Production

Pyrethrum does best in fertile, deep, well structured and drained soils. A well distributed rainfall of not less than seven months per year and temperatures of between 15 and 25 degree centigrade are essential. However, lower temperatures are necessary for bud initiation and prolific flowering on one hand while a sufficiently dry period is necessary to permit weed control.

Optimum altitude range is from 1500 m above sea level to 3000 m above sea level. According to Acland (1971), there is an inverse correlation between temperature and the quality of the flowers. Thus flowers produced in higher altitude areas are expected to have higher pyrethrin content.

1.3 Main Farm Husbandry Practices

The most important farm operations in a pyrethrum field include land preparation, harrowing, ridging, transplanting, fertilizer and insecticide application, weeding, harvesting or flower picking, flower drying and cutting back of the old flower stalks.

In Tanzania, it is recommended that pyrethrum be grown in ridges and in pure stands. Therefore, after land preparation harrowing need to be done to make a fine tilth followed by ridging of the fields. A fine tilth is essential especially when seedlings are to be used as planting materials.

There are two types of planting materials which can be used for propagation or transplanting. These are the split which are usually obtained from rosetts of one or two years old stock plants and the seedlings prepared from well selected seeds.

The recommended fertilizer application is 100 kg of phosphate per ha. Benlate 0.05 or 0.10 % and nemacur 5 % need to be used for treating seedling against root rot and nematodes respectively before transplanting.

Pyrethrum plants are very susceptible to weed competition. It is recommended that weeding should be done after every eight weeks in high rainfall areas for better results.

Pyrethrum flowers have a rapid floral senescence. As a result of this, it is recommended that flower picking should be done after every 14 days for better quality of the produce. The picking process involve picking of individual flowers by hand. Once flowering has commenced, it usually continues for about 7 to 11 months provided there is adequate rain.

Immediately after flower picking, the flowers need to be dried to a moisture content of 10 %. Normally insufficient drying of the flowers is not recommended as this has a negative effect on the quality of the dried flowers.

After drying, the flowers need to be promptly delivered to the processing centres and actually be processed after delivery because a prolonged flower

storage allows a deterioration in the pyrethrin content of the flowers. This calls for both an efficient marketing and processing systems.

The useful or economic life of the pyrethrum plants in the field is three years (UNDP/FAO 1976). Yields are better in the second and third year after which they gradually fall off. Yield of as high as 800 to 1000 kg of dry flowers can be obtained per hectare (Mpina 1986). However URT (1990) shows the Tanzania average is between 125 and 300 kg per ha.

In general, therefore, it can be concluded that pyrethrum production practices have a significant effect on the quality of the output produced apart from its quantity.

1.4 The Pyrethrum Producer Price

It has already been established that the commercial value of pyrethrum lies on the insecticidal properties of the pyrethrin content. Essentially this means flowers with more pyrethrin content are more valuable than ones with a smaller amount of pyrethrin. It is on the basis of this that producer prices are usually set according to the pyrethrin content of dry flowers.

In total, pyrethrum has five grades. However grading is only possible through chemical analysis of the dry flowers. Because of this, pyrethrum growers usually receive the price of the lowest grade pyrethrum when they sell their dry flowers. The flowers are then analyzed for their pyrethrin content at Mafinga plant. Should it be found that the flowers are of a higher grade, the farmers are supposed to receive a second payment equivalent to the difference in flower grades.

The trend of producer prices are shown in figure 1.2. Although there have been a nominal increase in producer price over time, constant prices (at 1985/86 prices) have remained more or less constant.

MDB (1987a) has the opinion that the low level of producer prices have a significant effect on pyrethrum production in the country. However, Lipumba (1977) had argued that, agricultural supply in Tanzania is not a question of price policy only. The cultural and institutional framework in which farmers are working need to be considered as these may even outweigh the producers' price responsiveness. Thus there has been a need of reviewing all these for the case of pyrethrum growers in Njombe district.

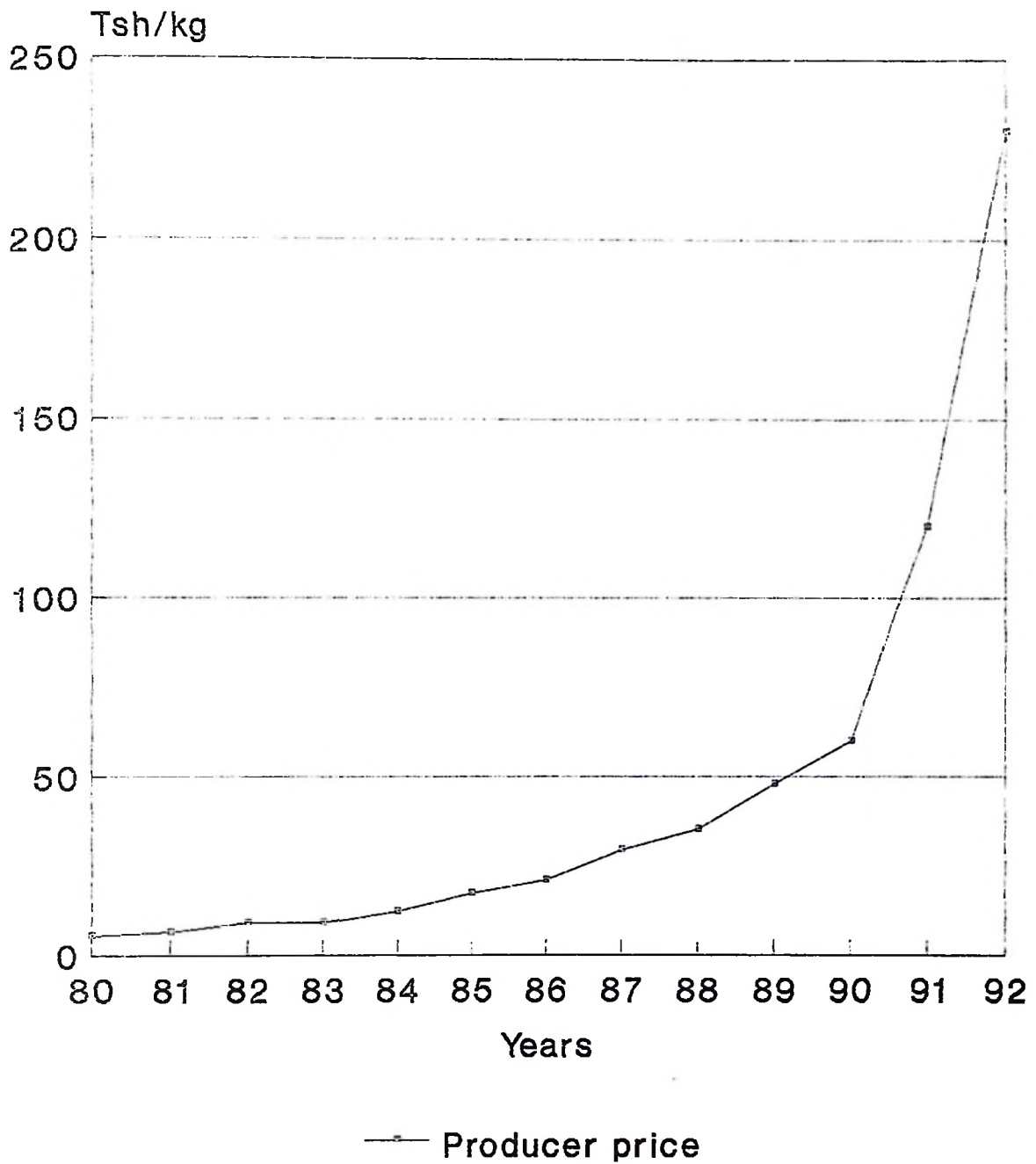


Fig 1.2 Tanzania: Fifth grade pyrethrum producer price, 1979/80 - 1991/92.

1.5 World Market Prices

Tanzania mainly exports pyrethrum in form of a crude extract. Another product exported is dry marc, which is a product left after the flowers have been extracted for the crude extract.

The unit price of the crude extract in Tsh/kg in the export market has increased by 616 % between 1972/73 and 1985/86 and by 1618 % between 1985/86 and 1991/92 (Appendix A.3 and B.1). This shows that prices have increased fast between 1985/86 and 1991/92 as compared to the 1972/73 and 1985/86 increase using local currency units.

The crude extract export price in foreign currency terms (US \$ per kg), the situation is as shown in figure 1.3. Crude extract prices increased by only 83 % between 1972 and 1985 while the same increased by 122 % between 1985 and 1992. According to the MDB (1987b) significant increase in export market prices in foreign currency terms after 1985 is an indication that there has been an improvement in the world market demand for the product.

Constant prices were higher than nominal export prices up to 1979 after which the two moved together up to 1985. After 1985 constant prices has become lower than

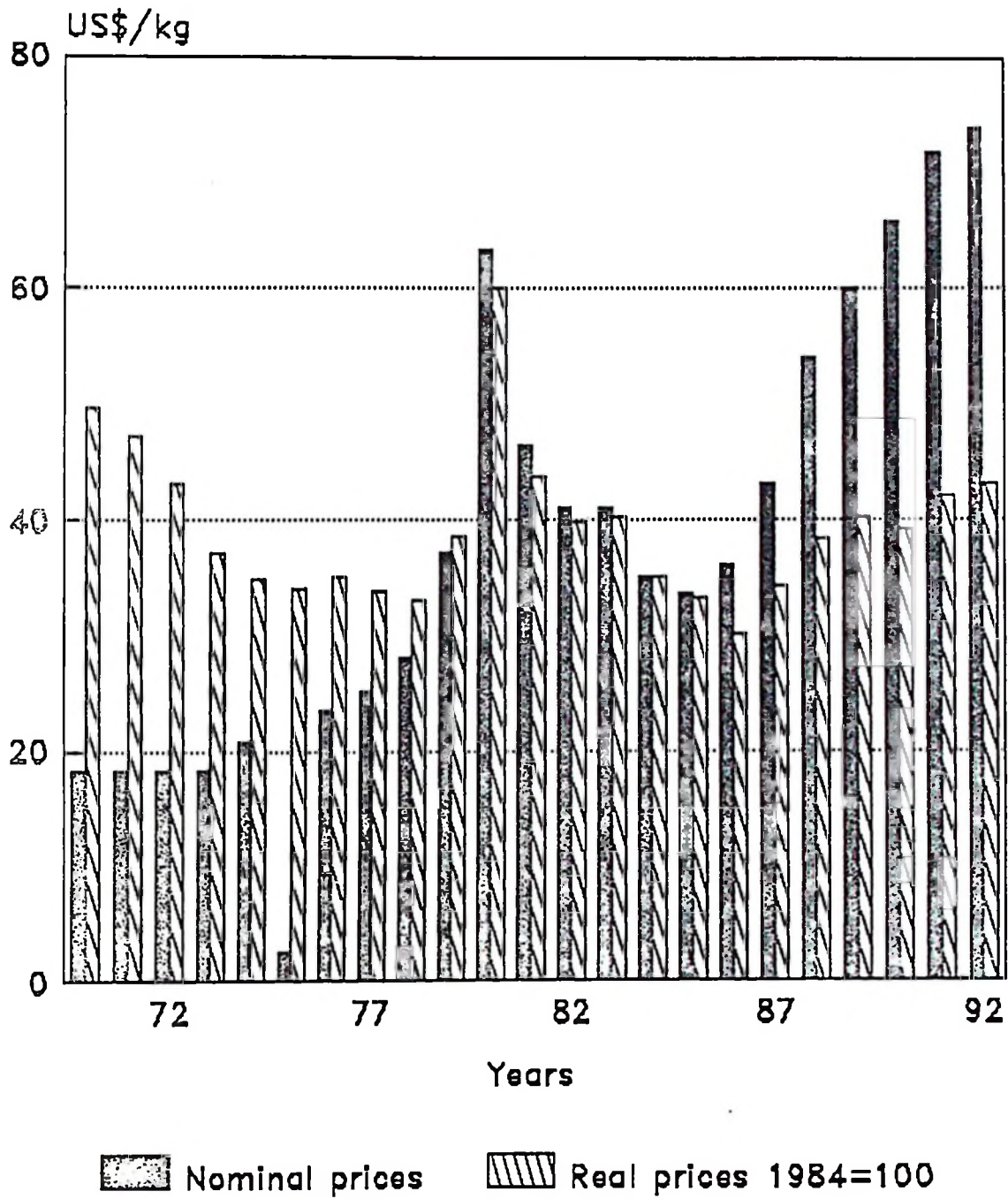


Fig 1.3 Tanzania: Crude extract export prices, 1970 - 1992.

the nominal prices. Thus Tanzania does not receive the real value of its pyrethrum exports.

The fact that there has been a larger increase in the export market prices for the crude extract when valued in domestic currency (Tsh/kg) than when foreign currency is used indicates that, there has been a significant local currency devaluation after 1985/86. This is true basing on the fact that, this was the period when Tanzania started to implement the trade liberalization programme which involved the devaluation of the local currency in order to reduce its appreciation. The aim was to increase earnings from domestically produced commodities and to encourage foreigners to import more products from Tanzania.

In the domestic market, the crude extract price in Tsh/kg has increased by 1730 % between 1972/73 and 1985/86 and by 700 % between 1985/86 and 1991/92. This implies that the price increased faster before 1985/86 as compared to the later period.

The trend of dry marc price in Tsh/ton is as shown in appendix A.5 and B.2. The price increased by 1472 % between 1978/79 and 1990/91 in the export market and by 760 % in the domestic market. Between 1978/79 and 1985/86 the price has almost remained constant in the export

market but it increased by 454 % in the domestic market. This shows that the dry marc was more paying in the domestic market than in the export market at that period. Increase in the domestic market demand and decrease in the export market demand for the product account for this as shown by the amount sold in the two markets. While the domestic market demand increased by 58 % between 1978/79 and 1983/84, the export market demand dropped by 79 % in the same period.

The dry marc prices increased by 1532 % in the export market and by only 55 % in the domestic market between 1985/86 and 1990/91. These changes are similar to those of the crude extract in which more increase is observed after the 1985/86 period and a slower increase of the domestic market price than the export market price in the same period. This really reflects the policy effects of export promotion through currency devaluation.

1.6 Pyrethrum Marketing

Pyrethrum marketing at the producer level is done by the pyrethrum board in Mbeya region and by cooperative unions in all other regions including the Iringa region. In Njombe for example the Njombe - Ludewa - Makete Cooperative Union (NJOLUMACU) is the main buyer of smallholder produced pyrethrum. However all produce so

purchased by the Cooperative Unions is resold to the Tanganyika Pyrethrum Board (TPB) at an into store price which account for marketing costs. The board is the owner of the processing plant at Mafinga.

The pyrethrum board is the sole exporter of the Mafinga plant products, that is the crude extract and dry marc. The trend shows that, most of these products are exported as compared to what is sold in the Tanzania local market (Appendix B.3 and B.4). On average 98 % of the crude extract was exported between 1972/73 and 1990/91 while 70 % of the dry marc produced was exported between 1978/79 and 1990/91.

The main market of the crude extract produced at Mafinga plant is the United States where the MGK company is the major buyer. Dry marc is mainly exported to Japan where the Nichimen is the main buying corporation. Few local buyers exist like the Mansoor Daya Chemicals which buy dry marc, and individuals mainly in Iringa region who buy dry marc and use it as an insecticide to control stalk borers in maize production. The dry marc used for this purpose is locally known as *luhoma* in the region.

Currently the pyrethrum board has started advocating the use of dry marc as an animal feed. Also dry marc is good as an organic fertilizer. The product has got between

0.06 % and 0.08 % pyrethrin which is not bad for both use as an animal feed and fertilizer.

1.7 Pyrethrum Processing

Since 1962 pyrethrum produced in Tanzania was processed by the Tanzania Extraction Company (TECO) which is based in Arusha. In 1981 the Mafinga plant, whose construction started in 1976, was commissioned. The failure of the government to revive TECO prompted the construction of the Mafinga plant. TECO was already beyond repair because of the old age of the machinery, faster decline in flower production in the northern regions with its associated high costs of transporting dry flowers from the high production southern highland regions and an urge to reduce losses in pyrethrin content of flower on long distance transport.

The commissioning of the Mafinga plant automatically took over the functions of the TECO, that is processing the dry pyrethrum flowers into crude extract. TECO was left to prepare pyrethrum marc and marc powder which are mainly used in making mosquito coils. Therefore, TECO mainly makes use of pyrethrum output from the northern highlands though with minor supplements from the southern highlands, while the Mafinga plant makes use of the southern highlands pyrethrum output. Whether the present

location of the Mafinga plant is convenient and economical remains a question for study.

The installed rated capacity of the Mafinga plant is 4500 tonnes of dry flowers per year or a daily throughput of 18 tonnes when the working days are 250 at the same period. Recovery levels were expected to be 40 kg of crude extract per tonne of flowers and 0.95 kg of marc per kg of dry flowers.

With reference to the quality of the raw product, it was anticipated that the dry flowers received will have a pyrethrin content of 1.3 % or above, and a moisture content of between 10 % and 12 %.

1.8 Other countries producing pyrethrum

According to World Bank (1980), sixteen countries grow pyrethrum all over the world. However 97 % of the worlds output comes from five countries which are Kenya, Tanzania, Rwanda, Ecuador and Papua New Guinea, in descending order of importance.

1.9 Justification and Objectives of the Study

1.9.1 Justification

Pyrethrum is the eighth ranking export crop in mainland Tanzania after coffee, cotton, tobacco, sisal, tea, cashewnuts and cardamon. However the crop stands to be the main smallholder cash crop in Njombe district of Iringa region (MDB 1989).

Iringa region is the biggest supplier of pyrethrum in the country and it supplies an average of 57 % of the total volume (Appendix A.1). In Iringa region, Njombe district ranks second in pyrethrum production after Makete district. The former supplied between 6 and 15 % of the total national supply between 1976/77 and 1987/88 (Fig 1.4 and Appendix A.7).

While the crop ranks eighth among Tanzania exports, Okello (1990) reports that, in the neighbouring Kenya, pyrethrum has big potentials as forex earner and is the most promising crop in this regard after coffee, tea and horticultural crops.

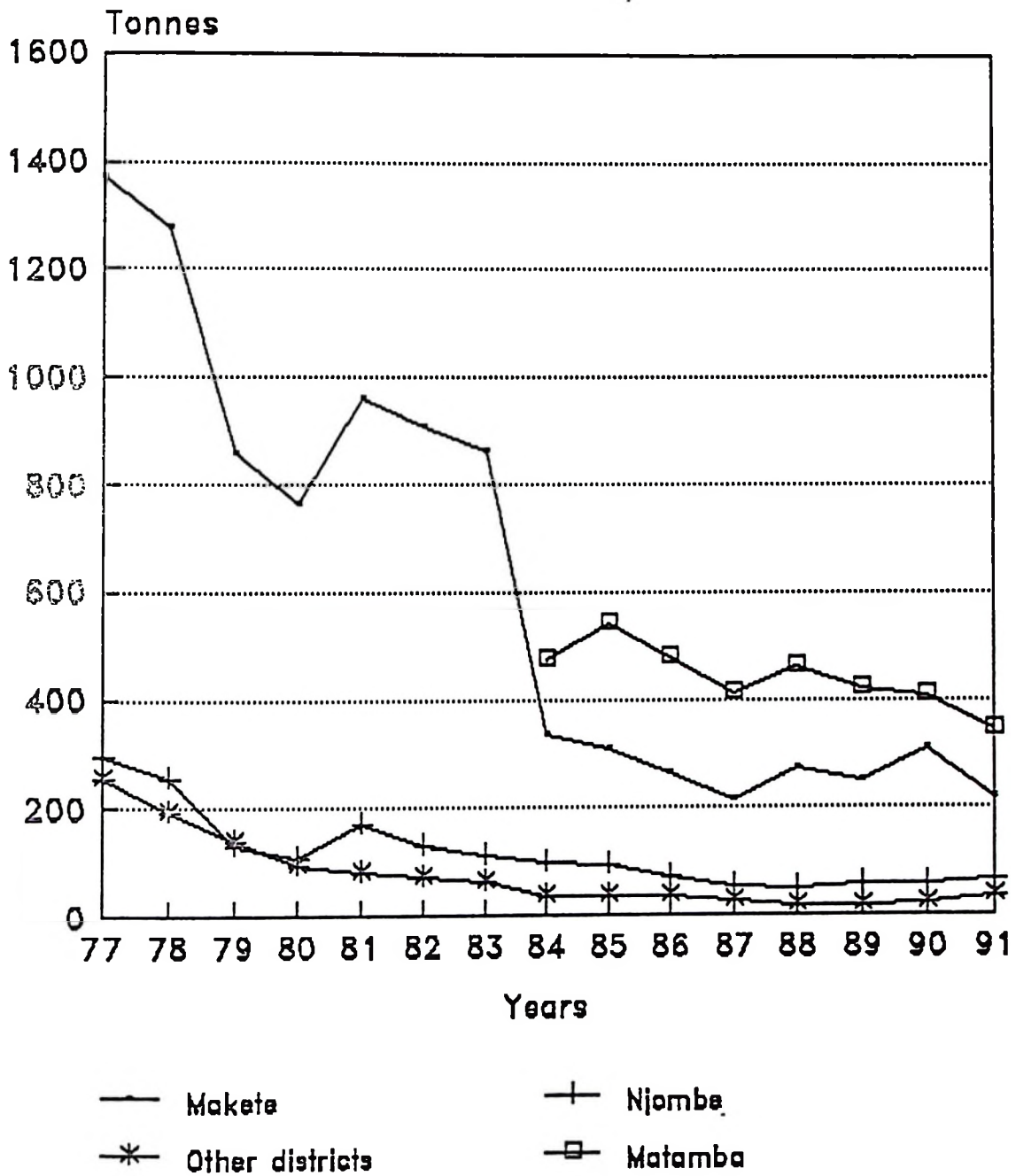


Fig 1.4 Iringa: Pyrethrum production by districts, 1976/77 - 1990/91.

The international market for pyrethrum has improved considerably since 1986 due to the United States banning of the use of synthetic organic pyrethroid in food production and household appliances (MDB 1987a). As a result of this prices received by the pyrethrum board for its crude extract has risen by 105 % from US \$ 36 in 1986 to US \$ 74 per kg in January 1992 (Appendix A.4). In turn these changes have made possible an upward adjustment of producer prices by 990 % between 1985/86 and 1991/92 crop seasons (Appendix A.2).

Unlike other crops such as maize, pyrethrum has the potential of being harvested for about seven to eleven months each year at a frequency of two times a month. This means that the crop can generate income at shorter intervals and hence act as a more regular source of income to smallholder producers in Njombe district.

The economic value of the pyrethrum flowers lies on their pyrethrin content (Mpina 1986, Ngugi and Ikahu 1990). Due to this, farmers are paid according to the pyrethrin content of their flowers. Flowers with higher pyrethrin content fetch higher price than those with lower pyrethrin content as shown in appendix A.2. Essentially this is a move to motivate farmers to produce a high quality produce.

Local currency devaluation has made it possible for both the export and the domestic market prices for the crops' main industrial products, crude extract and dry marc, to increase over time (Appendix B.1 and B.2). This could have acted as an incentive for policy makers to mount some programmes to increase the production of the crop in the country.

Despite all these potentials for more quantity, better quality and more income from pyrethrum produce, the overall production of the crop has continued to show a declining trend overtime (Fig 1.4). For Njombe district, production has declined by 85 % between 1976/78 and 1987/88 from 293 tonnes to only 51 tonnes per year (Appendix A.6).

The MDB (1987a) was highly concerned with this trend and had gone as far as suggesting that, a review of the complete production and processing sector be carried out if farmers' confidence is to be revived in pyrethrum production.

Evidence shows that, acreage under the crop in Iringa region has remained at an average of 5000 hectares over the period from 1983/84 to 1987/88. However yield per ha has decreased considerably from 173 kg per ha to 125 kg per ha in the same period, unlike in Mbeya where yield per

ha has been increasing from 224 kg per ha to 300 kg per ha (URT 1990).

Qualitatively, the pyrethrum received at the Mafinga plant has remained lower than the industrial rated of 1.3 % pyrethrin content (MDB 1989).

On the basis of the above, the questions to be answered are: Why is there no any improvement in the acreage under the crop, yield per unit area and the quality of the pyrethrum produced overtime. Do farmers view pyrethrum as their main source of income in the absence of any other major smallholder export crops in the area ?.

The Mafinga plant, which processes most of the pyrethrum from the southern highlands (Iringa and Mbeya), is operating under capacity since it started its operations in 1981/82 due to both lower quality and quantity of pyrethrum flowers received at the plant.

It has also been reported that the plant is using the major inputs more than what it was originally planned. The inputs include solvent hexane, gas and furnace oil. Despite this high level of use of extraction inputs, the plants recovery levels have always been lower than expected.

Should these conditions persist in the above order, the usefulness of the Mafinga plant to the nation and individuals (as source of employment) is likely to cease. This is because such a situation undermines the financial position of the whole pyrethrum industry in the country. But what exactly contributes to this lower performance of the Mafinga plant ?. What will happen to it if producers were to respond positively to the current higher producer prices ?.

It is in respect of the above posed questions that this study concentrates on the major factors which affect pyrethrum production at a smallholder level in Njombe district and its processing at the Mafinga plant.

1.9.2 Objectives of the Study

The main objective of this study, therefore, is to determine the main factors that affect the pyrethrum industry in Njombe district (Tanzania).

Specifically this study had the following specific objectives for study in relation to pyrethrum production in Njombe district and its processing at Mafinga plant:

1. To describe the socio-economic conditions of the farm households which are related to agricultural production activities.

2. To determine the husbandry practices and economic factors which affect pyrethrum production in the study area.
3. To analyze and compare the gross margins of selected major crop enterprises in the study area and establish their relative profitability.
4. To identify the major problems affecting the performance of the Mafinga Pyrethrum Extraction Plant, and put forward some recommendations which may help to revive the pyrethrum industry in the country.

CHAPTER TWO

LITERATURE REVIEW

Little economic research has been carried out on pyrethrum in Tanzania. This is because of the high concentration of research work and funds on the main export crops, leaving the marginal export crops like pyrethrum and cardamon unattended, although these have as well a role to play in the economy as far as foreign exchange generation is concerned.

Poor financing, under staffing and lack of key facilities have been pointed out by Manang (1988) as being the major causes of inadequate research on pyrethrum. In addition the pyrethrum board is said to have played a passive role, without financing the pyrethrum research in the country unlike in Kenya where the pyrethrum board finances half of the research work. It is on this basis that Manang concludes that, the pyrethrum board itself has contributed significantly to the deterioration of the crop in the country. However, he went further and argued that, there are many other factors including socio - economic ones which have been responsible for the decline in pyrethrum production, though none was mentioned.

UNDP/FAO (1976) argues that, the failure of smallholder to produce more pyrethrum in the country stems from a government policy adopted after 1966/67 of lowering pyrethrum producer price to avoid over production of the crop in the face of anticipated lower world market prices and unavailability of new markets. These were influenced by the 1966/67 higher than expected production and continued use of organic synthetic pyrethroid as a substitute for pyrethrum in the main pyrethrum product markets in Europe and America. During this period i.e. between 1966/67 and 1973/74, producer price for pyrethrum was slashed down from Tsh 5.00 /kg to Tsh 2.75, which is a 45 % decrease. Consequently production of dry flowers dropped by 55 % between 1966/67 and 1970/71 alone.

The PPMB (1986) notes that, the minimum, acreage policy in the 1970s of 3 acres (1.2 ha) for food crops and 1 acre (0.4 ha) for export crops by each household has had a negative impact on pyrethrum production. It is asserted that the policy had created a labour competition among crops during the peak season. Pyrethrum being a perennial crop has been neglected and considered only during the off season food crop production.

Ellis (1982) supports these arguments when he points out that, the minimum acreage laws which followed the 1973/74 draught for food crops had a serious negative effect on export crop production. He further reveals that during this period even producer price policies shifted in favour of food crops which made producers shift significantly from export crop production to food crop production.

On the same lines Ellis (1980) had found that, the fall in cashewnut production in Mtwara and Lindi regions in the 1970s was due to fall in real prices of the crop in favour of food crops which were progressively being procured in large quantities from the same regions when cashewnut procurement continued to decline. He however, could not specifically deal with the effect of non - price factors in the study.

Mwamfupe (1987) categorically supports the idea that pyrethrum has been neglected or marginalized on account of its being lowly priced. However he differently argues that, the 1974/75 villagization programme and growth in population with its resultant land fragmentation, forced producers to operate their farms far away from their residential areas. The result has been the increase in distance from the town-like planned village settlements to the farms. Food crops were however given priority and the

farms were located relatively nearer to the villages and those of export crops far away. Due to this and the fact that pyrethrum production demands more labour than food crops, producers paid little attention to crop husbandry practices and resource allocation.

Macha, Semuguruka and Mwambene (1986) had predicted that the future of pyrethrum industry in Mbeya and Iringa regions was doubtful due to the ever increasing importance of the potato crop, which is grown more in the same regions as a new cash crop. They attribute this to the fast development of industries in the country and the general increase in the working class who are increasingly depending on potato fast foods in restaurants. Demand for the crop and its price increased as a result. Supply has to correspondingly increase, thus more people have joined the potato industry.

MDB (1989, 1987a) tackles the problem of pyrethrum decline from the relative profitability side when they report that, the main factor of pyrethrum production decline is due to its lower relative profitability when compared to main crops like maize and potatoes which are grown on the main pyrethrum producing areas. It is argued that although pyrethrum has relatively lower variable cost outlays, the crop has low returns to labour hence it competes unfavourably with potatoes and maize which,

despite their higher cost outlays require less labour in production. These arguments are based on the fact that labour is increasingly becoming a constraint in household agricultural activities and hence significantly determine the types of investments and production activities to be done. The returns to labour therefore indicate the farmers likely production response, as these show the extent to which both the household labour and variable inputs are paid in the farm production process.

Although most of the above cited studies emphasize more on the price and price policy factors as the main reason behind the decline in crop production trends in Tanzania, theory suggests that there is no single factor which determines the farmers decision in the production and resource allocation process (Jones and Mutuura 1989). Under similar reasons, Ellis (1982) argues that, it is not price policy alone that should be considered in explaining marketed output trends in Tanzania. Hence he denied the use of purely quantitative relationships in explaining the trends. However, he agreed that, the evolution of marketed output in Tanzania broadly followed trends in relative producer prices in the 1970s.

Minde (1991) indicates that producer prices are among the most important and effective tools for influencing agricultural output. However his analysis on the factors

affecting agricultural marketable surplus in Tanzania concluded that, a complex web of economic, social, institutional, structural and environmental factors interweave to determine the amount of marketable surplus.

Lipumba (1977) in his study on price responsiveness of pyrethrum supply in Tanzania argues that, although peasant farmers respond quickly normally and efficiently to price changes, the cultural and institutional framework in which these farmers are working are limiting to the extent that there is no significant response to price changes.

Mwamfupe (1987) studied the factors which affect agricultural decision making in Makete and observed that, the choice of a crop was to a greater extent influenced by the "quest for security" and hence risk aversion took precedence over profit maximization. He further noted that, farmers view production for the market as a source of additional risk due to lower producer prices, poor supply of inputs and the inefficient marketing and transport systems. He then concludes that, these in total had made farmers in Makete district abandon or lower their pyrethrum production in favour of food crop production.

These findings concur with Ellis's (1982) prediction that under various farm production constraints, it was not

surprising if Tanzania peasants were observed to retreat into the subsistence economy where at least their interaction with the state is minimized.

Adesimi (1990) reports that, farmers in his study area could not proportionately devote more of their land to those crops which resulted in the highest gross margin. Further analysis indicated that, crop enterprises which had the highest gross returns and gross margins were the ones which had the highest fixed and variable cost outlays. Land and labour were found to be limiting. Hence farmers opted to plant maize and cassava which required lowest cost outlays, although they had provided the lowest gross margins per hectare. He thus concluded that, other considerations such as food security and availability and costs of inputs played a significant role in production decisions and hence on the general level of output.

The MDB (1987a) argues that, a comparison between annual and perennial crops show that the latter generally provide a better cash return. Nevertheless, annual crops have a number of major advantages which may, to a certain extent, compensate for the lower level of profitability. For example, decision to grow has to be taken annually depending on a number of factors such as prices, agro-ecological conditions, input costs, food self sufficiency

levels and labour availability. Hence farmers become more flexible with respect to investment decisions as it helps them to work out the best possible alternative use of their labour and capital within a relatively shorter time.

In studies which seek to advise farm producers to adjust their resource use, Heady and Delon (1961) had suggested that, input factors should be disaggregated so as to help farmers to know the exact resource adjustment to make. Kimburi (1980) fitted a Cobb-Douglas production function model to determine the main input factors which shaped the physical potato output per farm. It was observed that chemical fertilizer, acreage under the crop and spray chemical variables were the main significant factors and explained 77 % of the total variations in potato yield.

However, the above exercise could not be possible for Olagoke (1990) who failed to disaggregate input factors in his study on account of his small sample which could not offer enough degrees of freedom to include more variables in the model. He thus fitted a model with general input costs as a single variable which, on analysis, happened to be positive and significant in explaining the causes of variation in yield among rice fields. This had suggested that more inputs were needed in order to increase output per farm.

Jones and Mutuura (1989) and Mlay (1988) had the opinion that, when dealing with supply response models in agricultural production studies, it is better to analyze acreage supply response rather than analyze output supply response over time. This is because output production may be affected by factors which are beyond the control of the farmer like weather and diseases, unlike acreage allocation which can be directly associated with a set of factors to which a farmer responds to. However, Mlay (1988) could not use acreage to study maize supply response in Tanzania due to unavailability of data on acreage. Instead output supply response was studied. Thus despite its shortcomings, the output supply response models still remain to be useful in agricultural supply response analysis.

From the cited literature it can be concluded that, although price can be the main machinery which account for the production trends of agricultural products, much needs to be worked on non - price attributes. It is because of this that this study, apart from dealing with price factors like relationships of production and producer price trends and return per man-day, special attention is paid on effects of non price factors on pyrethrum production by the smallholder producer in Njombe district.

CHAPTER THREE

DESCRIPTION OF THE STUDY AREA AND METHODOLOGY

3.1 Description of the Study Area

This study was undertaken in Njombe district of Iringa region. The region is located on the southern highlands of Tanzania. It shares its borders with Dodoma in the north, Singida on the north - west, Mbeya to the West, Ruvuma to the East, Morogoro to the north - east and Lake Nyasa to the south.

Administratively, the region is divided into five districts namely Iringa, Mufindi, Njombe, Makete and Ludewa. The major crops in Njombe district include maize, sunflower, beans, pyrethrum and plantation crops like wattle and tea. Others include wheat, and peas, vegetable crops and fruits, barley and potatoes.

Average rainfall is 1536.6 mm most of which falls in the months of March and April. Temperatures range from 6.2 in July to 20.6 in November (Macha, Semuguruka and Mwambene 1986).

3.2.2 The Sampling method

The Mafinga pyrethrum extraction plant was purposely selected for this study as it is the main plant which is processing pyrethrum from the study area.

Villages falling in the sample were selected on the criteria of accessibility through public transport and have a considerably high pyrethrum output sales. A list of such villages was obtained from the cooperative union at Njombe. A systematic random sampling procedure was then used to draw a sample of representative villages for this study.

Farmers for the interview were selected by a systematic random sampling procedure after obtaining a list of people who grow pyrethrum from cooperative societies which buy the crop.

3.3 Data Collection

3.3.1 Types of data

Both primary and secondary data were used in this study. Primary data are mainly those on the socio-economic characteristics of the household like age, gender, marital status, education level, number of fulltime members of the

households, types and acreage of the crops grown, total land area under the household, production costs and agricultural incomes. Pyrethrum production data, producer price of major crops and the processing coefficients of the Mafinga plant form part of the secondary data used in the study.

3.3.2 Source of data

The main source of the primary data was the household heads in the survey area. However additional data were obtained from extension agents, the cooperative societies and union, the pyrethrum board officials at both Njombe office and the Head office Iringa, and the MPEP management who also provided some secondary data.

3.3.3 Methods of data collection

A questionnaire was developed and used to collect household data from smallholder pyrethrum producers. Simple lists of major items for discussion were prepared and used as a guide for obtaining information from other sources like the files of the pyrethrum board, Mafinga plant and cooperatives and during informal discussions with various targeted officials.

3.4 Method of Data Analysis

3.4.1 Introduction

Field data were coded and stored into a dBase computer program at the University. After that the data were retrieved into an SPSSPC program where descriptive statistics and gross margin were computed. Multiple regression analysis was done by use of a TSP computer program.

3.4.2 The Gross Margin analysis

In this study it was deemed useful to study the gross margin of the main crops grown in the study area in order to establish the relative economic profitability of pyrethrum to household labour. The basis for this analysis is the argument that most farm activities in smallholder agriculture are dependent on manual household labour.

According to Mwamfupe (1987), MDB (1987a) and PPMB (1984) smallholder farm producers tend to allocate their resources more to those enterprises which pay more returns to labour days. Therefore it was recommended that, relative profitability of various smallholder production activities be compared in terms of the returns per man-day or the gross margin per man-day instead of the gross

margin per ha. The former takes care of not only the farm cash expenses but also the household labour used in the production process, unlike the latter which does not account for household labour. It is on these premises that gross margins per man-day have been worked out for maize, potatoes and pyrethrum in this study.

Essentially the gross margin per man-day is the difference between the gross revenue and the costs of the variable inputs divided by the amount of labour utilised in that enterprise. Therefore, for each i^{th} crop, its gross margin per man-day can be expressed as

$$GM/L_i = \frac{TR_i - TVC_i}{L_i}$$

where GM is the gross margin per hectare (Tsh/ha), TR is the total revenue (Tsh/ha), TVC is the total variable costs (Tsh/ha) and L is the labour used in man-days.

3.4.3 The chi-square analysis

This is essentially a tool which is used to test whether given variables are independent or not. The chi-square, χ^2 , for a contingency table with i rows and j columns is calculated as :

$$\chi^2 = \sum_i \sum_j \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

Altitude ranges from 1500 to 2250 m above sea level. Most of the pyrethrum comes from the south and west parts of the district where altitude is higher than in the north and east.

In terms of transportation, Njombe district is crossed by the Makambako - Songea highway, the Dar es salaam - Tunduma highway and the famous Tanzania - Zambia Railway (TAZARA). This makes it easily accessible from outside. However within the district the road network is not very smooth as some roads are only seasonally passable especially in the main pyrethrum growing area where rainfall is higher and falls for nearly ten months a year.

3.2. Research Methodology

3.2.1 Sample size

A sample of 60 smallholder pyrethrum producers was used for this study. These were selected from a total of 10 villages.

where O is the observed frequency and E is the expected frequency in the i^{th} row and j^{th} column.

In this study the tool has been used to test variable independence in cross tabulations under the following general hypotheses:

HO_1 : Pyrethrum plot weeding frequency is independent of the amount of labour available per household.

HO_2 : Pyrethrum flower picking interval is independent of the amount of labour available per household.

HO_3 : The observed pyrethrum output per hectare in Njombe district is independent of the observed weeding frequency, age of the pyrethrum bush, age of the household head and years which the sampled households have been engaged in pyrethrum production.

Merging of cells has been done in order to satisfy the condition that the minimum expected frequency in each cell must be at least five.

3.4.4 The Multiple regression analysis

3.4.4.1 The model of total pyrethrum output

In this study it is proposed that the total pyrethrum produced per farm is influenced by factors such as the total land under pyrethrum, costs of variable inputs used in the farm and the amount of labour used in production of

that output. As the pyrethrum plant remains useful in the farm for three years, all the above factors were to be averaged on a three year basis.

To estimate this function, a Cobb - Douglas production function is used, i.e.

$$\text{OUTFA} = A_0 (\text{VARCO})^{\beta_1} (\text{ARPY})^{\beta_2} (\text{NPHA})^{\beta_3}$$

Applying logarithmic transformation we get:

$$\begin{aligned} \log(\text{OUTFA}) = \log A &+ \beta_1 \log(\text{VARCO}) + \beta_2 \log(\text{ARPY}) \\ &+ \beta_3 \log(\text{NPHA}) + U_t \end{aligned}$$

where OUTFA is the average of pyrethrum produced per farm in three years (kg of dry flowers), A is a constant term, ARPY is the area under the crop in hectares, VARCO is the average costs of variable inputs (Tsh/farm), NPHA is the number of permanent household working members, β_i is the regression coefficients and U_t is the error term.

It is expected that the quantity of pyrethrum produced will be positively related to all the three independent variables.

3.4.4.2 Model on pyrethrum output per unit area

In order to know the factors which determine the per unit area output (OUTH) of pyrethrum in Njombe district, a log linear multiple regression equation with weeding frequency per season (WEDFR), age of pyrethrum bush in years (APYBU), education level of the household head (EDUC), years of pyrethrum production (YRGPY) and age of the household head (AGHHA) as independent variables was fitted. The model was designed to accommodate two more variables i.e. the amount of fertilizer used per ha in kg (FERUS) and an extension contact dummy variable (EXTN). Fieldwork, however, revealed that these variables are not applicable and were thus not considered in the analysis. The estimated specific model for pyrethrum output per unit area in log linear form is as follows:

$$\begin{aligned} \log(\text{OUTH}) = \log A + \beta_1 \log(\text{WEDFR}) + \beta_2 \log(\text{APYBU}) \\ + \beta_3 \log(\text{EDUC}) + \beta_4 \log(\text{AGHHA}) \\ + \beta_5 \log(\text{YRGPY}) + U_t \end{aligned}$$

where β_i is the regression coefficients and U_t is the error term. The expected results are *a priori* that the per unit area output will be positively related with all the variables estimated except for the age of the pyrethrum bush.

3.4.4.3 Model on pyrethrum output supply response

The model looks into the effect of own producer prices, price of potato and price of maize on the quantity of pyrethrum supplied from the district. All prices are lagged two periods under the assumption of a lagged response of production to price changes over time. This is because once pyrethrum is planted, a better crop is usually expected in the second year after which it declines.

Under normal circumstances, crop production is not controlled by price incentives alone, (Minde 1990, Mwamfupe 1987, Ellis 1982). Other many non - price factors may be responsible. It is therefore not very appropriate to use the output response model to study the effect of price changes on agricultural production. Acreage supply response is the better way of studying this (Jones and Mutuura 1989, Mlay 1988). However the difficulties in getting acreage trends under the crop have forced various studies to opt for the output supply response model. It is on the basis of this fact that this study made use of the output supply response model. The model is as follows:

$$PYOUT_t = \beta_0 + \beta_1 PYPR_{t-2} + \beta_2 MZPR_{t-2} + \beta_3 POTPR_{t-2} + U_t$$

where PYOUT is the quantity of pyrethrum procured from Njombe district in tonnes, PYPR is the price of pyrethrum

lagged two periods (Tsh/kg), MZPR is the price of maize lagged two periods (Tsh/kg), POTPR is the price of potatoes lagged two periods (Tsh/kg), β_i is the regression coefficients and U_i is the error term.

The quantity of pyrethrum supplied was expected to vary positively with its own price showing that producers are rational and respond according to price changes.

Furthermore the quantity of pyrethrum produced was expected to vary negatively with the prices of maize and potatoes under the assumption that maize and potato compete with pyrethrum over resource allocation.

During the study it was established that, pyrethrum is only traded in the official market. This means that producers only receive the official price of the product. Although provisions are usually made by the TPB for second payment to producers, the same could not be incorporated in the preceding analysis because of unavailability of records. Thus, only one price alternative has been used for pyrethrum in this analysis.

For maize, which is one of the major crops grown in the survey area, two market alternatives are available for it, namely the unofficial and the official market. Although the unofficial market dominates in the survey area as the main outlet for the surplus maize produced,

both real unofficial and official market prices have been used in the analysis. The national consumer price index based on 1986/87 prices was used as a deflator. The aim was to see the difference in smallholder pyrethrum output supply responsiveness with respect to the two maize market price alternatives. The potato crop is only traded in the open market. Therefore only one price alternative was used.

Theory on supply response studies suggests that price relatives are the best measures of producers' responsiveness unlike the annual price changes. Therefore price relatives are used in this study for this purpose. On this basis the following specific models were estimated.

$$PYOUT_t = \beta_0 + \beta_1 CPYPR_{t-2} + \beta_2 PRELA1 + U_t$$

$$PYOUT_t = \beta_0 + \beta_1 CPYPR_{t-2} + \beta_2 PRELA2 + U_t$$

$$PYOUT_t = \beta_0 + \beta_1 CPYPR_{t-2} + \beta_2 PRELA3 + U_t$$

Efforts were also made to estimate the same models with prices lagged one year in order to measure the timeliness of pyrethrum producers' response to changes in producer prices of the main crops grown in the survey area.

The specific models estimated therefore are as follows:

$$PYOUT_t = \beta_0 + \beta_1 CPYPR_{t-1} + \beta_2 PRELA1 + U_t$$

$$PYOUT_t = \beta_0 + \beta_1 CPYPR_{t-1} + \beta_2 PRELA2 + U_t$$

$$PYOUT_t = \beta_0 + \beta_1 CPYPR_{t-1} + \beta_2 PRELA3 + U_t$$

In the above models CPYPR stands for real pyrethrum price, PRELA1 for real pyrethrum producer price relative to real unofficial maize price, PRELA2 for real pyrethrum price to official market maize producer price and PRELA3 for real pyrethrum producer price relative to real potato price.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of the Sampled Households

In studies that seek to find out how the farm producer conducts his farm business and know the factors which shape his farm production processes, it becomes important to analyze his socio-economic characteristics because these have a bearing on the production decisions and resource allocation. They determine the human potentials to produce and the capacity to change the production practices in the ever changing social and economic environment.

With reference to the facts above, this study has observed that, the average age of the household head was 40.72 years, 60 % of whom were adults of 26 to 45 years of age (Table 4.1). Out of the 60 households heads interviewed, 87 % of them were married and had an average of one wife each. Of these, 95 % were male heads. On average, the surveyed household heads had attended primary education, that is had seven years of formal schooling. About 40 % of them were standard seven leavers and 23.3 % were standard four leavers. Only 15 % did not

Table 4.1: Njombe district: Summary of sampled household socio-economic characteristics

| Variable measured | Number | % | Distance(km) |
|-----------------------------------|--------|-------|--------------|
| Average age of household head | 40.72 | - | - |
| 18 - 25 years (youth) | 4.00 | 6.70 | - |
| 26 - 45 years (adults) | 36.00 | 60.00 | - |
| Above 45 years (old) | 20.00 | 33.30 | - |
| Marital status of household head | | | |
| Married | 52.00 | 87.00 | - |
| Single | 8.00 | 13.00 | - |
| Average number of wives | 1.00 | - | - |
| Gender of household heads | | | |
| Male heads | 56.00 | 93.00 | - |
| Female heads | 4.00 | 7.00 | - |
| Formal education attained by head | | | |
| None | 9.00 | 15.00 | - |
| Adult education | 9.00 | 15.00 | - |
| Standard four | 14.00 | 23.30 | - |
| Standard seven | 24.00 | 40.00 | - |
| Secondary education | 4.00 | 6.70 | - |
| Average household size | 7.00 | - | - |
| Average number of children | 5.00 | 71.00 | - |
| Children at school and underage | 3.00 | 43.00 | - |
| Fulltime work force per household | 2.48 | 50.00 | - |
| Household members outside village | 2.51 | 50.00 | - |
| Average household farm size (ha) | 3.54 | - | - |
| Household farm distribution (ha) | | | |
| Pyrethrum | 0.49 | 14.00 | 3.90 |
| Maize | 1.80 | 51.00 | 2.56 |
| Potatoes | 0.24 | 8.00 | 2.54 |
| Other crops | 0.40 | 11.00 | 1.23 |
| Fallow | 0.61 | 17.00 | 4.01 |

Source: Survey data, 1992.

go to school while another 15 % and 6.7 % had attended adult education and secondary education respectively.

The observed data roughly shows that, the surveyed households heads had an adequate formal education as farm producers. This potentially enables them to receive or seek better agricultural production knowledge from technical personnel in the agricultural sector like the extension agents, reading various publications and from the mass media.

On household population characteristics, the average number of individuals per household was observed to be seven (Table 4.1). Of these 2.48 individuals were permanently at home in the 1990/91 farming season providing labour to household agricultural activities. Each household had an average of five children, three of them being either at school or below 7 years of age. An average of two members of the household had stayed outside their respective homes and villages in the 1990/91 crop season.

These observations indicate that although the households are large with an average of five potential labour providing people per household, only 50 % of them, are effectively engaged in household agricultural production activities. Another 50 % of the potential household labour had migrated outside their household and

village cycles. This limits labour availability in respective households, bearing in mind that 43 % of the household members are either still at school, underage or too old to effectively work in the farms.

With reference to farm size, each household had an average farm of 3.54 ha. An average of 51 % of the farm had been allocated to maize production, 14 % to pyrethrum production and 8 % to commercial potato. Other crops, which include wheat, peas, vegetables and fruits, have been allocated an average of 11 % of the farm size. About 17 % of the farm is left fallow.

The fact that maize occupies more land area of the farm than any other crop shows that the crop has more importance to the household than either pyrethrum and potatoes grown in the area.

This observation matches with the locations of the various crop plots. For example, maize plots are more closer to the households than pyrethrum plots. This makes it potentially possible for the crops near the households to receive more attention than the distant ones in crop management practices. So far the long distance to the farm limits the effective working time in travelling to and from the farm. Thus although pyrethrum is potentially the best regular income earner in the district, less resources

have been allocated to it.

4.2 General Farming Patterns

The study area is characterised by different farm types which are categorized according to their locations. There are farms which are located in river valleys. These are locally known as *vinyungu*. The *vinyungu* are normally small in size and are cultivated as large ridges. They are prepared as ridges because they are located in areas which are susceptible to water logging and floods.

The *vinyungu* are normally cultivated during the end of the rainy season and are used as dry season farms for production of green vegetables and a variety of other crops like green maize, beans, potatoes and pumpkins in a small scale. Intercropping is very common in these farm plots. Generally, the *vinyungu* are used for provision of green or fresh foodstuffs during the dry season and between harvests of main crops. This is a security against failure of the main crop. Normally planting of these farm plots is done under irrigation to initiate seed germination except when potatoes alone are grown.

The second farm plots are those which are found on the upland areas. These are normally planted during the rainy season only. These are usually large plots of not

less than an acre where the main crops are grown for both commercial and household purposes. The plots are locally known as *migunda*. The *migunda* can be located near or away from the households depending on the availability of land. Currently most of the *migunda* are located far from the households due to the nature of the village settings whereby each household is supposed to own not more than an acre around the homestead. Thus most of the farming activities are done outside the villages.

Within the *migunda* pure stand crops are normally grown. The crops include wheat, peas, beans, maize, pyrethrum, sunflower and commercial potato. It is believed that these are important as they are used as fast food to people when doing some farm operations like weeding and harvesting of the main crop, which is maize, in distant farms. Thus this reduces the burden of people carrying food with them to their distant farms. When mixed farming is practised in these plots, usually maize and sunflower or beans do appear in same plots with beans on separate rows.

The one acre plot close to the households is locally known as *hivanja*. In this plot households cultivate and grow a mixture of crops like maize, potatoes, and a variety of vegetables especially pumpkin leaves and onions. The crops grown in these plots are regarded as

crops which can provide an immediate food in case of emergencies and provision of refreshing food for children like green maize and potato for roasting.

Traditionally such a plot is treated as an area where children can practice farming. Children are therefore encouraged to cultivate, plant, weed and harvest from these plots as a way of acquainting them with farming methods when they are still young. The plots are also used as household waste dumping places. The wastes acts as manure. Hence in most cases crop production from these plots rarely use artificial fertilizer. When used, only small amounts of fertilizer are applied. By tradition, each household should have such a plot however small it may be.

4.3 Ownership and Use of Farm Tools, Implements and Other Farm Inputs

The hand hoe is the main farm implement used in farming for both cash and food crops. It is used by 93 % of the surveyed households in all the farm operations (Table 4.2). The other 7 % had used hired oxen with ox plough and oxcart in land preparation and crop transportation while weeding was done by hand hoe. None had used a tractor in farm operations.

Table 4.2 Njombe district: Ownership and use of farm inputs

| Input used | Source | Households | Percentage |
|------------------------|--------|------------|------------|
| Hand hoes | Own | 56.00 | 93.00 |
| Oxen/Ox plough/ox cart | Hired | 4.00 | 7.00 |
| Fertiliser | Njombe | 45.00 | 75.00 |
| Improved seeds | Njombe | 53.00 | 88.00 |
| Local seeds | Njombe | 7.00 | 12.00 |

Source: Survey data, 1992.

The hand hoe is the main implement because of the nature of the landscape in most of the pyrethrum growing areas in the district, whereby the land is hilly with slopes which limit the use of tractors and oxen.

Although the situation is like this in the main pyrethrum growing areas of the district, the Njombe district agricultural office estimates that 74 % of the farming population in the northern part of the district, covering the Mtwango and Makambako areas, use oxen in most of the farming activities. These include land cultivation, planting, weeding and crop transportation.

The use of fertilizer is common among the surveyed households as 75 % of the pyrethrum growing households had used fertilizer, mainly CAN and TSP, in maize production. None of them however had used fertilizer in pyrethrum production. Pyrethrum producers only remember that the input was used by large scale farmers in the 1960s. The same situation apply for the use of other agrochemicals like insecticides, whereby none of the surveyed households have used them in pyrethrum production but only in maize production. The Tanganyika Farmer's Association (TFA) which is based at Njombe, is the main supplier of the inputs in Njombe district. However, cooperatives in the district provide similar services though not to the TFA standard.

In the case of improved seeds, only maize get priority. About 88 % of the respondents indicated to have used improved maize seeds in their plots especially in plots meant for commercial purpose maize in order to get higher output.

Improved potato seed use is limited to commercial potato producers only because of its high output. Potatoes for household consumption are produced from local varieties which are more palatable though not highly productive. Thus in this case the choice and use of inputs is determined by tastes and preferences, and the type of use in which the crop is to be put.

4.4. Resource Ownership and Use

4.4.1. Capital

Pyrethrum producers in the study area own no major capital items. Only the hand hoe, bush knives and axes have been identified as being the capital items owned by households. This is why even those who had used oxen and their accessories have to hire them at an average of Tsh 3000 per acre for land cultivation.

Crop sales proceeds form the main source of farm operating capital. Such capital is used to hire services, purchase of fertilizer, seeds and other agrochemicals. Thus after crop sales each household need to keep a certain amount of money as working capital for the next crop season before they commit such farm proceeds on other consumption and investment expenditure.

4.4.2. Labour

On average each household had 2.48 individuals who provide labour permanently to the household agricultural production activities. This is an average of 52.91 man-days per household per year using Norman (1973) labour equivalents.

Usually this labour is organised in working groups during execution of main farming activities due to its inadequacy in individual households. In this case, the households organise what is locally known as *migowe*, which literally means working groups, for a specific activity which need to be done. A particular organiser will have to pay all the participants in kind, usually by preparing food and local brew.

Apart from paying them in kind, the labour provided becomes a liability to be returned in labour terms. Thus the working group organiser is required to appear for a *mgowe* of each of those who have come to provide labour to his farm when required to do so. Essentially this is a social organisation of farm production labour which helps to bridge the gap of labour deficits which could have been experienced if each household had done all the household farm activities alone. It helps also to solve the problem of unavailability of hired labour in the survey area.

4.4.3 Land

It has already been established that the observed average farm size per household was 3.54 ha in the survey area of which an average of 0.61 ha had remained fallow in the 1990/91 crop season. This shows that land is not a major problem among pyrethrum producing households in

Njombe district. This argument can be supported by the observation that, of the 39 household heads who had wished to increase the area under pyrethrum in response to the higher current producer prices, 71.8 % of them had indicated to have enough additional land for the purpose. Due to this, fallow agricultural production system and crop rotation are practised by the pyrethrum producing households in Njombe district as a measure to rest the soil and allow it to regain natural fertility. However its timeliness on pyrethrum plots remains to be desired.

4.5. The Marketing Outlet Of Major Crops

Essentially all crops produced by the pyrethrum producing households in the survey area are sold in the open market except for pyrethrum itself which does not have an alternative market. Cooperative societies in the area thus purchase mainly pyrethrum from the farmers.

The inability of the cooperative societies to purchase the other crops is due to unavailability of own funds for that purpose. The cooperative societies depend on funds which the cooperative union in the area, that is NJOLUMACU, obtains on credit from financial institutions like the National Bank of Commerce. Such funds are always obtained in small quantities than what is required and, at times, too late for proper timing of crop procurement

activities. This makes it difficult for the cooperative societies to purchase even the pyrethrum crop which has no alternative market. Essentially, however, financial difficulties emanates from the cooperatives themselves in the district through misuse of the loaned funds. This makes the cooperatives to be not financially worth to financial institutions.

4.6 Labour Availability and Requirement by Major Crops

Table 4.3 shows the amount of labour potentially available in man-days for the sampled households. The man-days have been calculated using Norman (1973) labour equivalents. An average of 2.48 individuals per household has been used in man-days computations. Public holidays have been subtracted from the effective working days per month.

On average each Njombe district pyrethrum producer has 52.91 man-days potentially available for all the household activities including non farm activities. However, the analysis which follows is based on household main agricultural production activities only.

Table 4.3 Njombe district: Potential labour availability and requirements by main crops

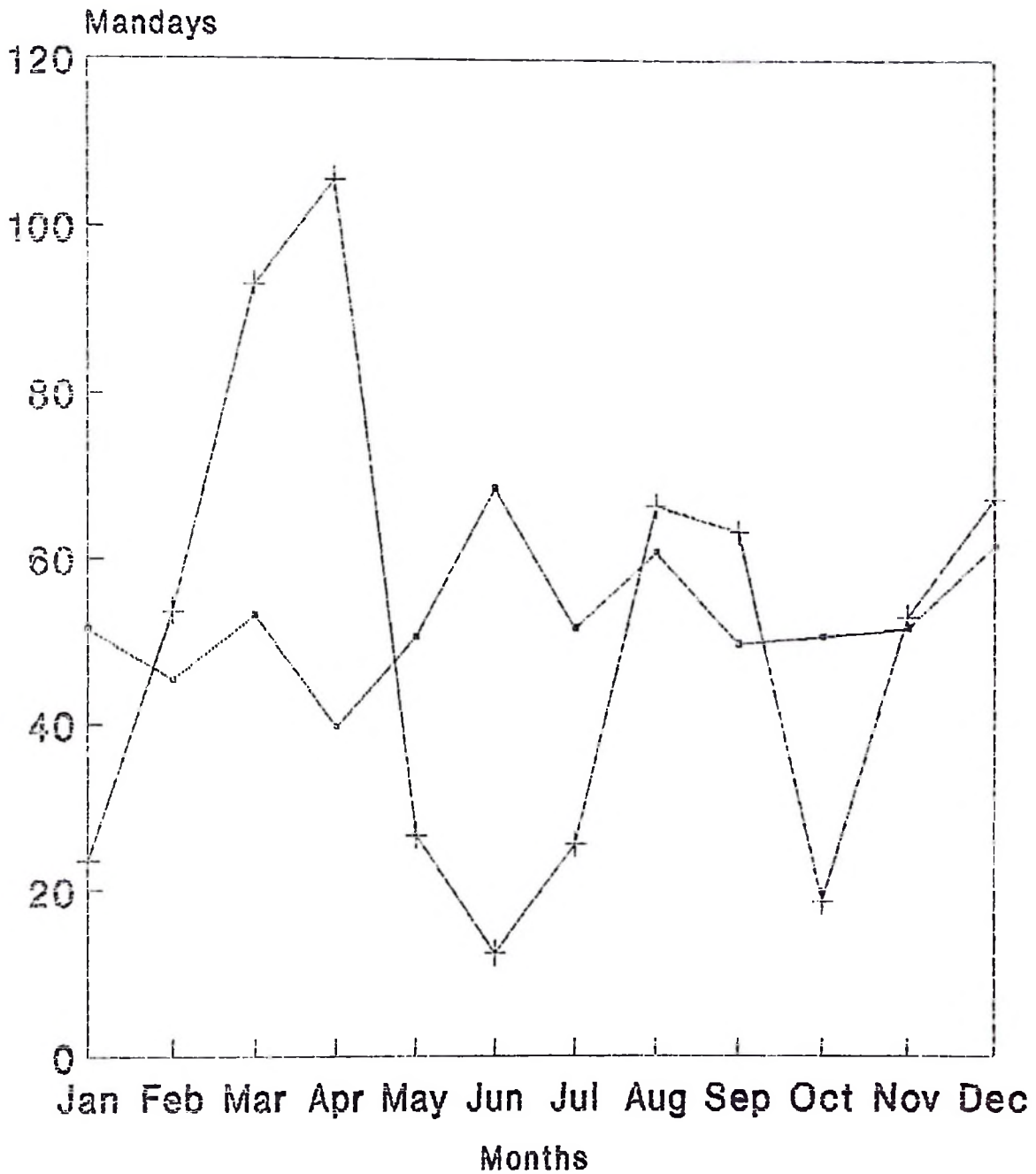
| Month | Labour available | Labour requirement | Surplus/ deficit(-) |
|-----------|---------------------|-----------------------|------------------------|
| | —————Man-days————— | | |
| January | 51.55 | 23.67 | 27.88 |
| February | 45.43 | 53.76 | -8.33 |
| March | 53.23 | 93.01 | -39.78 |
| April | 39.71 | 105.61 | -65.90 |
| May | 50.65 | 26.63 | 24.02 |
| June | 68.46 | 12.40 | 56.06 |
| July | 51.64 | 25.52 | 26.12 |
| August | 60.72 | 66.33 | 5.61 |
| September | 49.73 | 63.21 | -13.48 |
| October | 50.62 | 18.64 | 31.98 |
| November | 51.64 | 53.00 | -1.36 |
| December | 61.50 | 67.25 | -5.75 |
| Average | 52.91 | 50.75 | 2.15 |

Source: Survey data, 1992.

The month of April has the lowest labour force potentially available. This is because of many public holidays in that month which have reduced the number of effective working days. The month of June has the highest potential labour force.

The average labour requirement by crops per month over the twelve months is 50.75 man-days. More labour is required in the months of April followed by March. This is normally the peak period for weeding maize, potatoes and pyrethrum, harvesting of pyrethrum and land preparation and planting of wheat and peas. The lowest labour requirement is experienced in June followed by October.

When labour potentially available is compared to labour requirement by major crops, the situation is as shown in figure 4.1. Generally, more labour is required by crops than what the households can provide. The month of April has the highest labour deficits, that is 65.90 man-days followed by March which experiences a labour shortage of 39.78 man-days. Both fewer effective working days and a coincidence of many farm operations in the months of April and March account for this.



—●— Labour available -+ - Labour required

Fig 4.1 Njombe district: Labour availability and requirement by major crops, Mandays.

The highest labour deficits in the month of March and April highly limit the allocation of household labour in pyrethrum weeding because for pyrethrum this is the period when weeding is supposed to be intensive as weeds grow fast suppressing the growth of the short pyrethrum plants. At the same time food crop farm operations reach a critical point. In such cases no single farm producer will opt for pyrethrum at the expense of losing food crops. As a result attention to pyrethrum plots is delayed.

Labour deficits are also a result of labour movement to urban areas. The Njombe and Makambako towns, which are the only two major towns in the district, absorb a reasonable amount of labour from the rural areas apart from the more distant towns of Iringa, Dodoma and Dar es salaam. In these towns, individuals engage themselves in petty business or look for employment to large private business concerns, government departments, parastatals and as housemaids.

Tea estates and factories at Luponde and Lupembe and wattle estates near Njombe town also absorb a large number of labour from the rural Njombe district. This is because most of the activities in these estates need manual labour especially in tea plucking and wattle stripping. Therefore, both urbanisation and large scale agricultural

production account for labour deficits in the pyrethrum growing areas of Njombe district.

The month of June has the highest labour surplus, that is 56.06 man-days. Most of the labour required in this month goes to pyrethrum production. In most parts of the survey area this period is used for off-farm activities. The activities include preparation of bricks for house building, making mats, and baskets among others. These activities continue up to July as these are the most cold months in a year. During these months people, therefore, prefer to work in light activities which involve staying indoors except for brick making. The slack period in October is mainly for recreation.

4.7 Labour Requirement by Crops by Farm Activities

Labour requirement by crops varies, so is the labour requirement by major farm operations among crops. Table 4.4 shows these variations.

An assessment across the table shows that weeding is the most labour demanding farm operation for pyrethrum followed by maize while potato requires only half of the pyrethrum labour needs for weeding. Higher frequencies for pyrethrum weeding accounts for this.

Table 4.4 Njombe district: Labour requirement by crops by farm activities

| Activity | Pyrethrum <u>a/</u> | Maize | Potato | Wheat | Peas |
|------------------------|---------------------|------------|------------|-----------|-----------|
| | Man-days | | | | |
| Land preparation | 22 | 35 | 35 | 35 | 35 |
| Planting | 10 | 10 | 8 | 10 | 3 |
| Infilling | 1 | - | - | - | - |
| Fertiliser application | - | 10 | 5 | - | - |
| Weeding | 60 | 40 | 30 | 6 | 6 |
| Harvesting/shelling | 41 | 35 | 27 | 32 | 25 |
| Drying | 12 | - | - | - | - |
| Marketing/transport | 4 | 10 | 17 | 5 | 5 |
| Cutting back | 3 | - | - | - | - |
| Total | 153 | 140 | 122 | 88 | 79 |

Notes: a/ Based on three year average labour requirements.

Source: Survey data, 1992.

Wheat and peas virtually needs an insignificant weeding in Njombe district. The plant population, nature of plant growth for these crops and the timing of planting which comes after the peak rain season account for these as they tend to suppress weeds.

The second farm operation to absorb more labour force is harvesting and flower picking. Pyrethrum again needs more labour force as compared to other crops grown in the area. The requirement that pyrethrum flowers should be

harvested after every two weeks (14 days) accounts for this. Maize harvesting ranks second in labour requirement. This includes shelling labour. Peas rank last in this aspect followed by potatoes.

Marketing and transport labour is higher for potatoes due to the nature of the crops' weight and the higher output per unit area compared to other crops.

In general, pyrethrum is more labour intensive than all the other crops requiring an average of 153 man-days of labour per annum for the first three economic growing years. Maize ranks second while peas requires nearly only half the labour force required for pyrethrum.

Although pyrethrum is the most labour demanding crop, its output per ha seem to be independent of the available labour per household. This is indicated in table 4.5 whereby, the calculated chi-square is statistically insignificant even at 0.05 significance level given a tabulated chi-square value of 3.84. This provides enough evidence that the two variables are independent.

The possible reason for this is that there was a rather uniform distribution of the number of fulltime members of the household who had been permanently at home providing labour to the household agricultural production

Table 4.5 Njombe district: Number of fulltime members of the household and output per hectare

| | | Output per ha (kg) | | |
|---|------------|--------------------|-----------|-------|
| | | 15 to 150 | above 150 | Total |
| Number of fulltime household members | One or two | 22 (40.7) | 32 (59.3) | 54 |
| | Above two | 1 (16.7) | 5 (83.3) | 6 |
| | Total | 23 (38.3) | 37 (61.7) | 60 |

Notes: Figures in brackets are row percentages.

Calculated chi-square 0.50

Observed significance level 0.48

Source: Survey data, 1992.

activities. A total of 54 (90 %) had one or two permanent household members at home and only 6 (10 %) had above two members with a standard deviation of 0.89.

4.8 Main Income Generating Activities

In the current economic system whereby even the most rural people need some money as a medium of exchange for goods and services in the market place, each household strives to have a source of income with which to meet some consumption and investment expenditure.

In Njombe district farm producers depend most on maize production for generation of household income (Table 4.6). About 45 % of the interviewed households depend on maize production as the major source of income.

It should however be recalled here that, although pyrethrum is the only main smallholder export cash crop in the survey area, producers depend more on maize than pyrethrum for income generation. Several factors are responsible for this.

In the face of serious official marketing setbacks in the district, pyrethrum producers have a justification for depending more on maize as a source of income than pyrethrum. This is because of the availability of

Table 4.6 Njombe district: Main income generating activities

| Activity | Observed value | Percentage |
|----------------------|----------------|------------|
| Maize production | 27 | 45.0 |
| Pyrethrum production | 17 | 28.3 |
| Potato production | 8 | 13.3 |
| Brewing | 5 | 8.3 |
| Wheat production | 2 | 3.3 |
| Peas production | 1 | 1.7 |
| Total | 60 | 100.0 |

Source: Survey data, 1992.

alternative market for maize unlike for pyrethrum which must be sold to the official market only. Njombe district is crossed by reliable road and railway networks which connect the district to the major maize consuming urban area of Iringa, Dodoma, Morogoro and Dar es salaam. This makes it easy for the business community to purchase the Njombe maize crop when the official marketing agents fail to purchase it. By so doing farm producers are easily guaranteed cash for their harvest as compared to pyrethrum.

The maize crop can also be put into alternative uses unlike pyrethrum which has limited local uses before processing. Maize can be used in brewing or easily sold to neighbours all of which guarantee the producer of income from his surplus production.

Pyrethrum ranks second in importance as a source of income to the surveyed households in Njombe district. It is the main income generating activity to 28.3 % of the surveyed households. The high price per unit for pyrethrum and its potentials to generate income at regular intervals, when marketing takes place regularly, are some of the factors contributing to it being ranked second. Its ability to be harvested in short intervals of two weeks for a larger portion of the year, that is 7 to 11 months consecutively, makes possible for it to generate regular income over time should the marketing system act well. The erratic nature of the marketing system in the district however has made pyrethrum producers fail to realise fully these potentials . Therefore households opt for maize as source of income which also guarantee them of food supply unlike pyrethrum.

The third important income generating activity to pyrethrum growing households is potato production. Although the crop is grown by 93 % of the surveyed households, only 13.3 % grow commercial potato.

Essentially, potato is the most paying crop as compared to pyrethrum and maize. However, the crop ranks third in the district because potatoes from Njombe district do not compete favourably in the main markets with the higher quality Makete and Mbeya districts produced potatoes.

The potato crop is more perishable when compared to pyrethrum and maize. This causes some transport and storage problems unlike the latter which can be stored for reasonably longer periods. Thus the crop is more susceptible to deterioration in quality hence its lower preference as a source of income. This shows that Njombe district pyrethrum producers are risk averse. They are not prepared to grow the more risky potato crop although the crop is cheaper to produce and can pay highly to labour.

Only a small fraction of the sampled households rely on brewing as a major source of income (8.3 %) while 3.3 % and 1.7 % of the sampled households depend on wheat and peas respectively as their major source of income.

In general, however, agricultural production activities are a major source of income to the majority of the sampled households in Njombe district as compared to non farm activities.

4.9 Pyrethrum Production Patterns in Njombe District

Pyrethrum in Njombe district is a smallholder crop grown in small plots ranging from 0.20 ha to 2.00 ha with an average of 0.49 ha. The crop is grown in pure stand, usually on ridged plots.

When crop rotation is done on pyrethrum plots, wheat, peas and maize are used in the rotations. However, the sampled households prefer to leave their pyrethrum plots fallow than do crop rotation. This is because land is not limiting.

4.10 The Role of the Tanganyika Pyrethrum Board in Pyrethrum Production

The pyrethrum board has several obligations to fulfil in the work of assisting smallholder pyrethrum producers. The pyrethrum board is supposed to promote smallholder pyrethrum production through provision of various services which include extension services, production inputs and other production incentives to encourage the producer to produce a high quality and quantity of output to feed the Mafinga plant.

4.10.1 Extension services

Provision of extension services to pyrethrum producers is controlled by the pyrethrum board but the extension agents belong to the Ministry of Agriculture. They are only attached to the pyrethrum board which is supposed to guide them on where, when and what to do.

In Njombe district there is only one extension agent who is based at the regional office. There are no subject matter specialists at either ward or division level to serve specifically the pyrethrum producers more closely. The one based at the regional office lacks the essential facilities for field visits. Thus no effective field visits are made. This leaves pyrethrum producers unattended. The other ward and division based extension agents have no specialised knowledge on pyrethrum production. Also these are responsible for promotion of all the other main crops in their areas of operation. Therefore they can't effectively help in pyrethrum production.

Failure by cooperatives to buy the pyrethrum crop from the producers have exegerated this problem. This is because the other ward and division based extension officers shy away from pyrethrum production promotion as they may be held responsible by the farmers for the non

buying of their pyrethrum output.

The extension service problem started to be an issue way back in the 1970s and early 1980s when pyrethrum production continued to decline despite various measures, like those of the EEC and the World Bank, to revive the crop. Extension workers were previously given most of the means necessary for execution of their duties like motorbikes for transport, gum boots and raincoats apart from other incentives like night allowances when in the field. These extension workers had full knowledge of pyrethrum production and guided producers on production of the crop from nursery preparation up to marketing. Absence of such incentives have drawn extension agents away from pyrethrum production.

The outcome of all the above is that current pyrethrum producers mostly depend on long time producers (neighbours and friends) for knowledge on pyrethrum production (Table 4.7).

About 73 % of the sampled households depend on this source while 17 % had received the same from village government officials. However, the sources were explained as not being specific to the producers' needs. Only 10 % had grown it through experience. These were the long time pyrethrum growers.

Table 4.7 Njombe district: Source of pyrethrum production
knowledge

| Source | Observed frequency | Percentage |
|------------------------------|--------------------|------------|
| Neighbours and friends | 44 | 73 |
| Village government officials | 10 | 17 |
| Did not receive any | 6 | 10 |
| Total | 60 | 100 |

Source: Survey data, 1992.

Absence of extension agents has made pyrethrum producers in the district to be cut off from the pyrethrum research centre at Uyole as the research results have no means of reaching the user.

4.10.2 Provision of production inputs

The pyrethrum board is the main institution which advocate the production of pyrethrum in the Njombe district in order to supply raw materials for its plant at Mafinga. It therefore have the obligation of providing production inputs to pyrethrum farmers which ranges from farm implements to planting materials.

On farm implements, pyrethrum growers have no much problem in acquisition of inputs like hand hoes, circkles and bags because these are available easily in private shops up to village level. The main pressing issue on this account is the unavailability of drying materials i.e. the wire trays. Previously this input was provided on credit terms. Nowadays the pyrethrum board does not provide this service such that drying and drying facilities have been ranked as the number one constraint in pyrethrum production.

Currently pyrethrum producers in Njombe district use trays made from bamboo for pyrethrum drying by fire. The disadvantage of this is that, the bamboo trays do not last long and thus are more costly compared to the coffee tray wire which can be used for over three years.

Another disadvantage is that bamboo trays easily catch fire when pyrethrum is dried by fire. This can bring disasters of burning the whole harvest and even drying sheds or houses when drying takes place at fire tops in living houses. It is on this basis that a large section of pyrethrum producers in Njombe district are compelled to dry their pyrethrum flowers by sun rather than by fire (Table 4.8). About 86.67 % of pyrethrum and growers in Njombe dry pyrethrum by sun. Only 13.33 % dry by fire.

Table 4.8 Njombe district: Pyrethrum drying methods

| Drying method | Observed frequency | Percentage |
|---------------|--------------------|------------|
| Sun | 52 | 86.67 |
| Bamboo trays | 12 | 23.08 |
| Mats | 40 | 76.92 |
| Fire | 8 | 13.33 |
| Bamboo trays | 5 | 62.50 |
| Wire trays | 2 | 25.00 |
| Potable drier | 1 | 12.50 |

Source: Survey data, 1992.

Planting materials are other important inputs which the pyrethrum board is supposed to offer the pyrethrum producer in Njombe district. These can be in form of seeds, seedlings or splits. In order to fulfil this obligation, the pyrethrum board needs to have an establishment of farms in which seeds, seedlings or splits can be produced. Currently the pyrethrum board does not have such facilities in Njombe district to satisfy the ever increasing number of producers in response to the current higher producer prices. Hence it only encourages producers to cooperate amongst themselves in obtaining the necessary planting materials, especially the splits. This is because the few planting materials,

particularly seeds, which are mobilized from as far as Makete district, are distributed to the most needy only (Circular letter No. TPB/MICH/123/Vol3/4 of 26/9/1991).

The current problem which faces the pyrethrum producers in Njombe district, therefore, is the unavailability of adequate and appropriate planting materials. The ones which most of them use i.e. the splits (table 4.9), are obtained from old pyrethrum bushes of up to over four years of age. Such splits are of low quality and do not produce a good crop. New producers and those who want to increase production are highly constrained with this factor.

Most of the used splits are obtained from neighbours and friends. Figures in table 4.9 show that, 61.7 % of the sampled farmers have obtained their planting materials from this source. Only 28 % obtained from their own farms and 10 % from the pyrethrum board. The later source has been reported to be an unreliable one because of delays in delivery, inadequate supply and poor quality of the supplied materials.

As this study was done during the planting season, sample farm visits were made. The main observation is that farmers seem to be working in a hurry as they were anxious to get immediate money from pyrethrum sales due to the higher producer prices. In so doing they neglect

Table 4.9 Njombe district: Type and source of pyrethrum
planting materials

| Variable measured | Observed frequency | Percentage |
|------------------------------|--------------------|------------|
| Type of planting materials | | |
| Splits | 47 | 78.0 |
| Seedling | 10 | 17.0 |
| Both | 3 | 5.0 |
| Source of planting materials | | |
| Own prepared | 17 | 28.3 |
| Neighbours and friends | 37 | 61.7 |
| TPB | 6 | 10.0 |

Source: Survey data, 1992.

some of the principles of proper preparation of splits for planting. Old flower stalks are not properly trimmed nor are the leaves and roots, all of which are otherwise important to initiate a growth of healthy new plants.

In some cases, it was observed that this is due to inadequate pyrethrum production knowledge rather than mere hurry for immediate money. It is possible that the lack of specific extension agents who can advice new growers on best ways of growing the crop is the major cause of inadequate knowledge for pyrethrum production in Njombe

district.

The pyrethrum board has a provision also of establishing farm service centres to provide the pyrethrum producer with various services like sales of consumer goods and tractor hire services. These are aimed at reducing travelling costs by the farmer when looking for such services far away from villages as doing so will entail wasting precious farming time. The regional office at Njombe reported that such services are not common in Njombe district instead they are plenty in Makete district where pyrethrum production is higher. Low pyrethrum production in Njombe district has, therefore, made pyrethrum growers to miss the farm service centres.

4.11 Limiting Farm Operation in Pyrethrum Production

In an assessment to obtain the main limiting farm operation to pyrethrum producers in Njombe district, drying and drying facilities happens to be the first as explained by 36.7 % of the respondents (Table 4.10).

Drying seem to be a problem to pyrethrum producers because most of the harvest comes in during the peak rainy season which makes it difficult for producers to dry their crop by sun which is easier to undertake in the absence of alternatives.

Table 4.10 Njombe district: Most limiting farm operations

| Farm operation | Observed frequency | Percentage |
|------------------------------------|--------------------|------------|
| Drying and drying facilities | 22.0 | 36.7 |
| Weeding | 19.0 | 31.7 |
| Flower picking | 15.0 | 25.0 |
| Nursery preparation and management | 4.0 | 6.7 |
| Total | 60.0 | 100.0 |

Source: Survey data, 1992.

This problem is worsened by the unavailability of proper drying materials, that is the wire trays which is appropriate for fire drying of pyrethrum. This makes the whole task of flower drying to be very tiresome and risky because the harvested flowers becomes susceptible to rot or insufficient drying which leads to disposal or lower quality of the crop respectively.

Various undertakings have already been done in the work of trying to solve this drying problem mainly through researching on the most appropriate methods of pyrethrum drying in Njombe district but results have been frustrating to pyrethrum growers. This is because of the inapplicability of these methods at smallholder level.

Reports from the pyrethrum board head office shows that, under the 1981 - 1985 IRADEP, the EEC had undertaken some drying trials at Mahenye and Lugenge village in Njombe district using a modern drier imported from the then West Germany. The modern drier had proved to be effective in producing high quality pyrethrum dry flowers of an average of 1.53 % pyrethrin content and 100 kg of wet flowers had produced an average of 32 kg instead of the 19 kg obtained through local drying methods. Drying time was also reduced five times using the modern drier.

The could be modern drying method in Njombe district, involved the establishment of a central drying system at Lugenge whereby producers had only to sell their wet flowers to the pyrethrum board which then had to dry them. Although the EEC trial runs proved to be applicable, later trials by the pyrethrum board indicated some discouraging results as the whole exercise proved to be uneconomical i.e. the pyrethrum board proved to have worked at a loss during the trials.

In order, at least, for the pyrethrum board to work at a break even point it was necessary to reduce producer price of the wet flowers by four folds. This had its own implications to the grower as price cut means a disincentive to producers. Thus the pyrethrum board decided to abandon the whole idea of the central drying

system.

Various factors had contributed to the non viability of the central drying facility at Lugenge in Njombe district. These included the high initial costs of the drier, 82 % of which was to be foreign component. The cost of a single drier was Tsh 275 000 at 1982/83 prices. The system also was too expensive to run due to its excessive need for diesel which was to be imported. This accounted for about 26.4 % of total running costs on trials. The system thus had higher drying costs as compared to local drying methods.

The system also had failed to dry flowers to the required moisture content of 10 %. It produced dry flowers of an average of 22.3 % which is too high for effective and economical processing. The system proved to be difficult during flower collection from the already inaccessible and scattered villages around Lugenge due to both poor road networks and inadequate vehicles owned by the TPB. Likewise it was anticipated that, should the drier fail during the peak period, serious losses to the pyrethrum board could have resulted. Thus the whole idea was abandoned.

The department of agricultural engineering of the Sokoine University of Agriculture had also done some pilot studies to establish the kinds of pyrethrum drying systems possible for pyrethrum producers in Njombe district between 1985 and 1988. The results of the studies, however, could not be disseminated further to producers because the pyrethrum board could not finance a proposed grand study to establish the suitability of the various devised drying systems to various environmental and resource conditions in Iringa and Mbeya regions which are the main pyrethrum producing regions in the country. Due to all the above factors, the burden of pyrethrum drying has been left in the hands of the smallholder producer himself.

Next in importance is weeding. This is essentially posed by inadequate labour force. Labour deficits in the peak period coupled with the high recommended weeding frequency accounts for weeding being ranked second.

Cross tabulation results in table 4.11 further clarifies this aspect as it shows that, low weeding frequencies are associated with low numbers of fulltime household members who provided labour to the farm. Given the critical chi-square value of 3.84, the calculated chi-square value of 5.822 is statistically significant at 97.5 % confidence level.

Table 4.11 Njombe district: Number of fulltime people per household by weeding frequency

| | | Weeding frequency | | Total |
|---|---------|-------------------|----------|-------|
| | | 1 to 3 | Above 3 | |
| Number of fulltime people per household | 1 to 2 | 50 (92.6) | 4 (7.4) | 54 |
| | Above 2 | 3 (50.0) | 3 (50.0) | 6 |
| | Total | 53 (88.3) | 7 (11.7) | 60 |

Notes: Figures in brackets are row percentages.

Calculated chi-square 5.822

Observed significance level 0.025

Source: Survey data, 1992.

Basing on these results, the hypothesis that the amount of labour force available per household and weeding frequency are independent is rejected and concluded that, with 97.5 % confidence, weeding frequency and household labour availability behave dependently.

Flower picking ranks third. This has been ranked after both flower drying and weeding because of easiness of timing the operation when relatively more labour force is available in households. Pyrethrum producers in Njombe district do most of the flower picking during weekends when school children are not at school so that they can assist in this farm operation. Thus this constraint does

not seriously affect this operation.

Chi-square results between labour available per household and flower picking interval shows that the two variables are not dependent (Table 4.12). Figures in the table show that, flower picking interval was generally good irrespective of the number of fulltime people in the household. Also, basing on the tabulated chi-square value of 3.84, the calculated chi-square statistic of 0.01 is insignificant at 0.05 level of significance. Therefore, on the basis of these results, we fail to reject the hypothesis that flower picking interval and labour availability per household are independent.

Table 4.12 Njombe district: Number of fulltime members of the household by flower picking interval

| | | Flower picking interval (days) | | |
|---|---------|--------------------------------|-----------|-------|
| | | Below 16 | Above 16 | Total |
| Number of fulltime people per household | 1 and 2 | 37 (68.5) | 17 (31.5) | 54 |
| | Above 2 | 4 (66.7) | 2 (33.3) | 6 |
| | Total | 41 (68.3) | 19 (31.7) | 60 |

Notes: Figures in brackets are row percentages.

Calculated chi-square 0.01

Observed significance level 0.92

Source: Survey data, 1992.

So far children have been reported to be more efficient at flower picking provided they are well guided on which flowers are to be picked. Thus, as most of those people who were permanently at home providing labour to household activities were old ones, it justifies the independence between this variable and the flower picking interval.

Further evidence for the above is shown in table 4.13 that, 61.7 % of the respondents had indicated that household flower picking labour was adequate against 38.3 % who indicated labour to be a constraint in flower picking.

Table 4.13 Njombe district: Adequacy of household weeding and pyrethrum flower picking labour

| Type of response | Observed frequency | Percentage |
|-----------------------|--------------------|------------|
| Weeding labour | | |
| Adequate | 27 | 46.7 |
| Inadequate | 32 | 53.3 |
| Flower picking labour | | |
| Adequate | 37 | 61.7 |
| Inadequate | 23 | 38.3 |

Source: Survey data, 1992.

Only 6.7 % of the respondents had indicated nursery preparation and management to be a limiting farm operation. These were the new growers who had to establish nurseries to produce seedlings. They were yet to experience the difficulties of other farm operations by the time of this survey.

4.12 Pyrethrum Output per Farm

Using a Cobb-Douglas production function, factors which influence the pyrethrum output per farm were estimated. The estimated model is as follows:

$$\begin{aligned} \log(\text{OUTFA}) = & 0.81 + 0.40\log(\text{VARCO}) + 0.54\log(\text{ARPY}) \\ & (5.03)^* \quad (7.23)^* \quad (6.56)^* \\ & + 0.22\log(\text{NPHA}) \\ & (1.76)^{***} \end{aligned}$$

$N = 60$, $R^2 = 0.78$, $\text{SER} = 0.12$, $F = 68.17$, $\text{DW} = 1.54$

Notes: Figures in brackets are t - values.

Using a two tailed test:

* means statistically significant at 0.01

*** means statistically significant at 0.10.

The results indicate that, the independent variable accounts for 78 % of the variations in the observed output per farm. All the variables had the expected positive signs showing that pyrethrum output per farm in the survey area could increase if more variable costs, more labour

force and more land will be devoted into pyrethrum production.

The independent variables are statistically significant at 0.01 significance level except for the variable labour which is statistically significant at only 0.10 level.

The calculated Durbin Watson statistic is 1.54. Using the Durbin Watson lower (d_l) and upper (d_u) limit criteria of assessing serial correlation, the estimated DW statistic value is between the two limits, that is $d_l < DW < d_u$. This imply that, the results are inconclusive and hence we can't say anything about serial correlation in the model.

The estimated partial regression coefficients in this function are the production elasticities and their sum indicates the returns to scale. Estimated results shows that, a one percentage change in area under pyrethrum will cause a 0.54 % change in pyrethrum output production per farm while a one percentage change in variable costs will cause a 0.40 % change in output per farm. Therefore, basing on these coefficients, pyrethrum output per farm is more responsive to area under the crop than all the other variables in the model.

This observation gives the highlight that there are prospects of an increase in total pyrethrum output in the near future in Njombe district. This is because more acreage is being put under pyrethrum in response to the current high producer price. For example, among the surveyed villages, Uwemba village farmers had increased acreage under pyrethrum by 17 % between June 1990 and December 1991, Makanjaula village farmers by 45 % and Njomlole village farmers by 650 % at the same period. In Matola ward, a total of 1053 acres have been put under pyrethrum between June 1990 and December 1991. It is on this basis that the pyrethrum board had estimated an increase in dry flower output by an average of 32 % from 1590.7 tonnes in 1990/91 to 2100 tonnes in 1991/92.

The sum of the estimated production elasticities in the model is 1.16. In order to test the null hypothesis that the production elasticities does not differ from unity, a two tailed t-test was employed. The calculated t-value is 10.32 and the critical t-value is 2.005 at 0.05 significance level. On the basis of these results the null hypothesis is rejected and concluded that, with 95 % confidence, the observed production elasticities differ from unity. Therefore, the 1.16 sum of production elasticities depicts that, there are increasing returns to scale from pyrethrum production in Njombe district.

4.13 Pyrethrum Output per Hectare

4.13.1 Introduction

Pyrethrum output per unit area at national level is as shown in table 4.14. Figures show that output per ha decreased from 177 kg in 1980/81 to 141 kg in 1982/83. After that it increased to a peak of 197 kg in 1984/85. Later output dropped to 124 kg.

Table 4.14 Tanzania: Pyrethrum output per hectare, 1980/81 - 1988/89

| Year | Output (kg) | Comments |
|---------|-------------|----------------|
| 1980/81 | 177 | |
| 1981/82 | 168 | Years of World |
| 1982/83 | 141 | Bank and EEC |
| 1983/84 | 195 | > pyrethrum |
| 1984/85 | 197 | improvement |
| 1985/86 | 163 | programme |
| 1986/87 | 124 | |
| 1987/88 | 125 | |
| 1988/89 | 150 | |

Note: The World Bank and EEC programmes ended in 1985/86.

Source. URT (1990).

This trend can be categorized into two phases. Phase one being between 1980/81 and 1985/86 and phase two the period after 1985/86. Within the first phase there was an EEC and World Bank pyrethrum improvement programmes in Iringa and Mbeya regions. Thus output per hectare was relatively higher as relatively more production services were made available to producers through the programmes.

The second phase represents the period after the EEC and World Bank programmes. In this phase production per hectare had dropped because of little production services and incentives which were to be provided by the TPB alone.

No trend data on pyrethrum dry flower output per unit area in Njombe district were made available during this study. This is due to unavailability of a specific institution responsible for monitoring area under the crop. However figures obtained from the pyrethrum board regional office at Njombe shows that, output ranged between 175 and 200 kg per hectare since the 1988/89 crop season in farms with pyrethrum bush of not more than three years. From the sampled households this stands at 185 kg per ha and an average of 147.95 kg per ha for all age groups of the pyrethrum bush (Table 4.15).

This output level is very low as compared to a potential of about 800 kg of dry flowers per hectare. Main reasons which causes output per ha to be low are that, in Njombe district the main pyrethrum farm operations are not properly followed. The observed average age of the pyrethrum bush was 4.02 years which is above the recommended level of 3.00 years. This implies that crop rotation or clonal replacement was not done timely.

Table 4.15 Njombe district: Summary of important pyrethrum production variables from the sampled households

| Variable | Units | Mean | Standard dev. | Min | Max |
|----------------------------|-------------------|--------|---------------|-------|--------|
| Output per farm | kg | 72.88 | 51.32 | 15.00 | 301.00 |
| Output per hectare | kg | 147.95 | 50.95 | 21.00 | 230.00 |
| Area under pyrethrum | ha | 0.49 | 0.32 | 0.20 | 2.00 |
| Age of the pyrethrum bush | years | 4.02 | 1.61 | 2.00 | 9.00 |
| Weeding frequency | number/ season | 2.50 | 0.93 | 1.00 | 4.00 |
| Flower picking interval | days | 16.07 | 2.67 | 14.00 | 21.00 |
| Years of growing pyrethrum | years | 10.47 | 8.52 | 2.00 | 30.00 |

Source: Survey data, 1992.

The average weeding frequency was 2.50 instead of the recommended six times per annum and majority of producers use improperly selected and prepared splits as the main planting materials.

Other factors include non adherence to the recommended flower picking intervals as the observed average was 16.07 days instead of 14 days, inadequate use of farm inputs like fertilizer, inadequate deployment of labour into pyrethrum production for the main farm operation as the main farm participants do not include the more energetic youth, inadequate extension services and low education levels which limit acquisition of better production methods.

4.13.2 Regression and chi-square analysis results

A multiple log linear regression model was fitted to determine the strength and nature of relationship between the above factors and the observed output per hectare. Results obtained were as follows:

$$\begin{aligned} \log(\text{OUTH A}) = & 1.96 + 0.06\log(\text{AGHHA}) + 0.34\log(\text{WEDFR}) \\ & (4.78)* \quad (0.23) \quad (3.4)* \\ & + 0.39\log(\text{EDUC}) - 0.40\log(\text{APYBU}) \\ & \quad (3.48)* \quad (-1.91)* \\ & + 0.001\log(\text{YRGPY}) \\ & \quad (0.07) \end{aligned}$$

$$N = 60, R^2 = 0.70, \text{Adj. } R^2 = 0.67, \text{SER} = 0.12, F = 25.09$$

Notes: Figures in brackets are t-values.

Using a two tailed test:

* means statistically significant at 0.01

Generally the independent variables explains about 70 % of the variation in output per ha in Njombe district. Age of the pyrethrum bush has a negative coefficient as expected and was statistically significant at 0.01 significance level. This implies that output declined as the pyrethrum bush becomes older such that the ability to produce an economical crop declines with age. This is indicated in table 4.16.

Table 4.16 Njombe district: Age of pyrethrum bush by output per hectare

| | | Output per ha (kg) | | |
|-----------------------------|---------|--------------------|-----------|-------|
| | | 15 to 150 | Above 150 | Total |
| Age of pyrethrum bush | 1 to 3 | 2 (6.7) | 28 (93.3) | 30 |
| | Above 3 | 21 (70.0) | 9 (30.0) | 30 |
| | Total | 23 (38.3) | 37 (61.7) | 60 |

Notes: Figures in brackets are row percentages.

Calculated chi-square statistic 22.84

Observed significance level 0.01

Source: Survey data, 1992.

From the table it is shown that, the calculated chi-square value of 22.84 proves that the two variables in the contingency table are not independent at 99 % confidence.

Weeding frequency has a positive sign and statistically significant at 0.01 significance level. This indicates that output per hectare increases the more one weeds his pyrethrum plot. This is also shown in contingency table 4.17 in which the calculated chi-square of 12.25 is statistically significant at 0.01 significance level given the critical value of 3.84. Therefore the results show that weeding frequency and pyrethrum output per ha are dependent.

Table 4.17 Njombe district: Weeding frequency by output per ha

| | | Output per ha (ha) | | |
|----------------------|---------|--------------------|-----------|-------|
| | | 15 to 150 | Above 150 | Total |
| Weeding frequency | 1 to 3 | 17 (65.4) | 9 (34.6) | 26 |
| | Above 3 | 6 (17.6) | 28 (82.4) | 34 |
| Total | | 23 (38.3) | 37 (61.7) | 60 |

Notes: Figures in brackets are row percentages

Calculated chi-square 12.25

Observed significance level 0.01

Source: Survey data, 1992.

Education level was statistically significant at 0.01 significance level and had a positive sign as expected. This shows that more educated pyrethrum growers have the ability to produce more output per hectare as compared to lowly educated growers.

Individuals in the low or no formal education cadre takes a longer time to adjust their resource allocation in response to price changes. This may be because of either their unwillingness to take risks or due to delay in getting access to new production knowledge or new packages of production incentives.

As expected, the age of the household head variable was positively related to the output per hectare. However, the variable was not statistically significant. The positive sign may be interpreted as the increase in output per hectare due to the increase in experience in growing the crop over time.

Unlike the above regression results, results in contingency table 4.18 between pyrethrum output per hectare and age of the household age indicates that, at two degrees of freedom, the critical chi-square value was 5.99 and hence the calculated chi-square value of 17.11 was statistically significant at 0.01 level of significance. The implication is that, the two variables

under the test are dependent.

Table 4.18 Njombe district: Age of the household head by pyrethrum output per ha

| | | Output per ha (kg) | | |
|---------------------------|----------------|--------------------|-----------|-------|
| | | 15 to 150 | Above 150 | Total |
| Age of the household head | Youth (18-25) | 1 (25.0) | 3 (75.0) | 4 |
| | Adult (26-45) | 7 (19.4) | 29 (80.6) | 36 |
| | Old (Above 45) | 15 (75.0) | 5 (25.0) | 20 |
| Total | | 23 (38.3) | 37 (61.7) | 60 |

Notes: Figures in brackets are row totals

Calculated chi-square 17.11

Tabulated chi-square 5.99

Observed significance level 0.01

Source: Survey data, 1992.

The factor which can explain these observations is that, pyrethrum is a crop which is relatively grown far away from the households than all the other crops grown in the survey area (Table 4.1).

As one becomes older over time, the ability to walk and work at long distances tends to diminish. Thus old people will tend to grow and look after their crops which are closer to their households. Priority however, is given

to food crops which can bring food security and income when surplus is produced. On this account, old people will tend to grow and comparatively manage better their food crop plots rather than the more distant pyrethrum plots. This factor, together with the fact that pyrethrum is more labour intensive to grow and difficult to market than other crops grown in the survey area, outweighs the effect of long time experience in pyrethrum production by old growers and hence they produce less output per unit area.

The number of years of growing pyrethrum variable happened to be positively related to pyrethrum output per ha in the model results. The variable was statistically insignificant. Table 4.19 shows that the two variables are statistically dependent to one another at 0.01 level of significance.

Basing on the postulated hypothesis number three on section 3.4.3 and the chi-square analysis in this section, the null hypothesis is rejected and concluded that, with 99 % certainty, the observed pyrethrum output per hectare in Njombe district is dependent on the observed age of the pyrethrum bush, weeding frequency, age of the household head and years of growing pyrethrum.

Table 4.19 Njombe district: Years of growing pyrethrum by
output per ha

| | | Output per ha (kg) | | |
|-----------|-------------|--------------------|-----------|-------|
| | | 15 to 150 | Above 150 | Total |
| Years of | New growers | 2 (10.0) | 18 (90.0) | 20 |
| growing | Medium term | 7 (29.2) | 17 (70.8) | 24 |
| pyrethrum | Long term | 14 (87.5) | 2 (12.5) | 16 |
| | Total | 23 (38.3) | 37 (61.7) | 60 |

Notes: Figures in brackets are row percentages
Calculated chi-square statistic 24.01
Observed significance level 0.01

Source: Survey data, 1992.

4.13.3 The pyrethrum production elasticity

From the foregoing section, the regression coefficients are the estimated production elasticities. Out of the five independent variables in the model, pyrethrum output per hectare seem to be more responsive to the age of the pyrethrum bush which has the production elasticity of 0.40 followed by education level and then weeding frequency.

Therefore, timely crop rotation or pyrethrum clonal replacement, improvement in the education level of the farmers and more frequent weeding is highly needed if pyrethrum output per unit area is to be improved in Njombe district.

The sum of the production elasticities is 0.40, a value which is well below 1.00. This shows that pyrethrum output per hectare in the district experiences decreasing returns to scale unlike for the case of output per farm. This is a true case basing on the fact that, the pyrethrum bush in the study area have an average of 4.02 years of age which was higher by 34 % of the recommended age of 3 years. This factor plus the fact that little attention is paid to the pyrethrum plots in terms of timely and frequent weeding and more use of splits instead of seedlings justifies the observation of decreasing returns to scale per hectare.

4.14 Pyrethrum Output Supply Response

4.14.1 Introduction

Pyrethrum output trend in Njombe district is as shown in figure 4.2. The trend however, represent only the output received at the Mafinga plant instead of the actual amount procured at the smallholder level. Figures from the two are expected to differ because of the losses in storage and transportation, from the buying centres to the Mafinga plant, through both pilferage and spillage.

Unavailability of production data at the smallholder level is due to unavailability of a specific institution to monitor production trends in the district and the changes in pyrethrum marketing institutions in the country at large. As a result, only final procurement

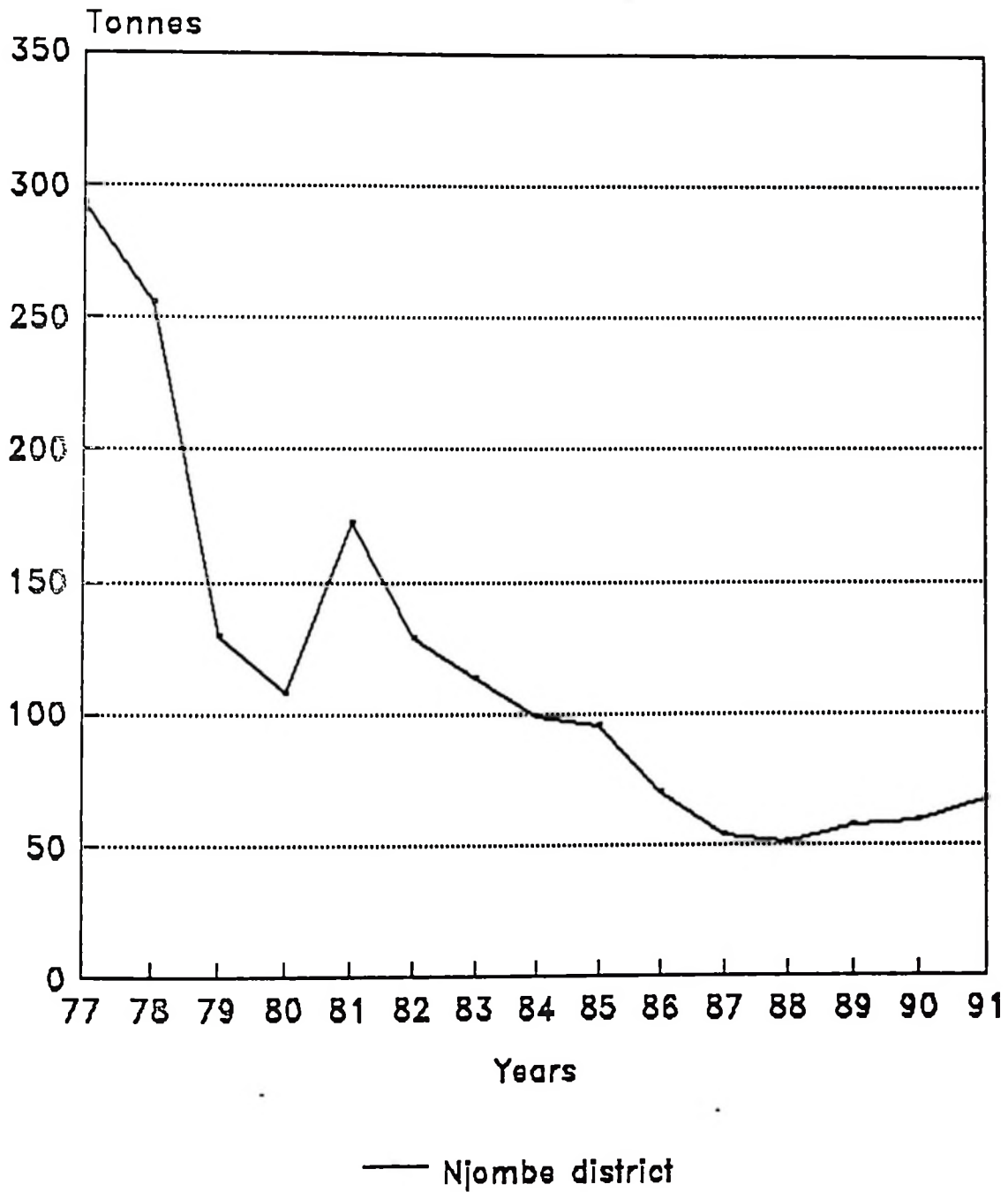


Fig 4.2 Njombe district: Pyrethrum production, 1976/77 - 1990/91.

data were available instead of the production data. For example, cooperatives have marketed the crop in Njombe district only from 1987/88. Its pyrethrum purchases data were made available during this study, but such data could not be used in this analysis because of its short duration.

4.14.2 Some useful results

The results obtained from the two sets of equations are as shown in appendix A.10. The results in general shows that, the real potato producer price, real official and unofficial market maize prices were inversely related to the pyrethrum output supplied from Njombe district. Only own pyrethrum real price was observed to be positively related to the output supplied in the district as expected.

A general comparison of the two sets of results (that is between one and two year price lag results) show that, in one year price lag, the independent variables had higher explanatory powers (r^2) than those in the two year price lag. For example, while the r^2 for the ratio of real price of pyrethrum relative to the real price of maize in unofficial market for one year price lag was 0.78, that in a two year lag model was only 0.68.

The main conclusion which can be drawn from the outgoing observation is that, pyrethrum output supply in Njombe district responds faster to changes in producer prices than how it was expected during the planning stage of this study. The expectation was that, a two year time lag could better explain the trend in pyrethrum output supply in the district than the one year time lag. The observed results might be because of the fact that, the sampled farmers (78 %) use splits as the main planting material instead of the seedlings. Splits normally give an effective crop earlier than the seedlings however, the effective crop lasts only for a shorter period as compared to when seedlings are used.

A comparison between the pyrethrum supply responsiveness to real official price of maize on one hand and the real unofficial maize price and potato on the other shows that, pyrethrum output supply was affected more significantly by the unofficial prices than by official prices. This is based on the size of the coefficient of determination which was higher for unofficial maize (78 %, 68 %) and potato prices (80 %, 71 %), than for official maize price equations (68 %, 60) at the two price lags and the observed level of statistical significance of the variables in the model in which the former two were statistically significant at 0.5 level or above while the later was statistically non significant.

4.15 The Effect of the 1974/75 Villagization Programme to Pyrethrum Production in Njombe District

Between 1973 and 1976 most of the rural Tanzanians underwent some settlement restructuring in which the traditional settlements were replaced by modern, government planned settlements. The aim of settlement restructuring was to transform the traditional peasant society and bring the previously scattered traditional land cultivators into planned village communities in areas of high potential physical resources in order for them to benefit from economies of scale due to increased agricultural productivity of land and labour.

In Njombe district resettlement exercise involved concentration of people in certain villages and abandonment of others. In so doing pyrethrum producers who had to shift to new settlement areas had to abandon their farms while others had to divide their farms to a larger number of incoming population. This resulted into a decline in pyrethrum production in the district. For example in 1973/74 when production of dry flowers dropped from 301 tonnes in 1972/73 to only 192 tonnes in 1973/74, i.e. a 36 % decline.

The fact that pyrethrum plots are more distant than other crops partly emanates from the villagization programme. This is because the relative land shortage had forced producers to go back to their previous distant farms for pyrethrum production leaving the nearby areas for the food crops.

Likewise for households which reported to have fallow land in the 1990/91 season, such fallow land is located at distant places than the areas already under crops. Essentially these areas are located in the former living areas i.e. before the villagization programme, and are too distant for effective exploitation.

The Ujamaa doctrine which was carried along with the villagization programme also had a negative effect on pyrethrum production in Njombe district. The doctrine required people to work communally and divide the production proceeds equally among them according to ones contribution in the production process. This made people fail to get time to do personal agricultural production activities especially cash crop production. When time was available this was utilized on food crop production as people had to strive for survival first.

The communal production doctrine as well drove away hired labour making crop production in relatively large pyrethrum plots to be impossible. Therefore, people continued to reduce their plot sizes and even abandoned pyrethrum production altogether.

Mistakes were also made during selection of new village locations which seriously hampered production of pyrethrum among other crops. New village locations were based on non - agricultural production factors like accessibility to main roads. As a result people found themselves living in land which could not support proper crop production nor easily supply them with water and firewood as it previously was in the properly selected traditional settlements.

4.16 Pyrethrum Marketing Arrangements

Since 1960s pyrethrum marketing in Njombe district, like in all other parts where the crop was grown, was marketed by the pyrethrum board. This continued to work up to 1987/88 when the cooperatives took over the marketing of the crop from the board. The board is now only responsible for promoting production, processing and sales of the crop products to both local and foreign markets apart from purchasing the crop from producers in Mbeya region.

Cooperative societies have the responsibility of collecting pyrethrum dry flowers from producers regularly as the crop is produced continuously for over 7 months per year in the district. The services of these institutions in Njombe district are, however, not satisfactory because of their irregular operations which result into long irregular flower collection intervals. Due to this, producers stay with their produce for up to four months before the cooperative societies can collect it. Low quantity of pyrethrum produced in the district may account for this as cooperatives would not like to work frequently at such small scale of production to reduce operational costs.

Under normal circumstances, cooperatives are expected to be more successful when they are organised around a specific export crop. The main reason behind is that export crops, when well established in an area, do provide economies in handling, transportation and general marketing and provide an assurance to cooperatives of something to deal with over time. This is the potential area which cooperatives in Njombe district could have exploited in order to ensure their economic survival. However, the low production is a limiting factor unless the cooperatives work hand in hand with the pyrethrum board in promoting more smallholder pyrethrum production by provision of various incentives and directly engaging

in production of the only smallholder cash export crop in the district.

Once the cooperative societies have procured the dry flowers, the cooperative union makes arrangements for transportation of the same to Mafinga plant where the flowers are sold to the marketing board at an into store price. The cooperative union therefore have stationed a representative at Mafinga plant to record, monitor and crosscheck the consignments of dry flowers delivered from the various cooperative societies.

4.17 Transportation of Pyrethrum Flowers

Pyrethrum drying in Njombe district mainly takes place at home rather than on the farm. This means that wet flowers once harvested need to be transported home for drying. Transportation of the wet flowers is done manually whereby people carry their loads in sacks on their heads. This activity is not difficult because of the small acreage and output owned by the households in the survey area and the fact that households with large acreage usually break the farms into smaller plots in which flower picking takes place at varying intervals. The sloping landscape in most of the pyrethrum plots also prohibit the use of other means of transportation in the survey area.

Apart from simplifying transportation of wet pyrethrum flowers varying flower picking intervals assist growers in scheduling their labour force. For example flower picking mostly falls on weekends so that school children labour can be deployed into this activity.

After drying, the dry flowers need to be transported to the buying centres. This activity is done by head and at times by use of bicycles. Animal power use has not been reported. Since each village has a crop buying post, transportation of dried flowers at smallholder level is not a serious problem. Buying posts are within 3 km from households which is a convenient walking distance.

4.18 The Producer Payment Arrangements

In principle, pyrethrum producers are supposed to be paid promptly during sales of their pyrethrum flowers to the cooperatives. This, with the fact that pyrethrum is harvested/picked for a large section of the year, presses the cooperatives to always have adequate funds for purchases of the dry flowers.

Producers normally receive the price of the fifth grade pyrethrum after flower sales. Farmers are then promised a second payment should the flowers prove to be of a higher quality in terms of pyrethrin content.

Pyrethrum producers in Njombe district are not paid promptly as required. This is because the cooperatives have inadequate funds to finance the purchases. The cooperative union personnel attribute the inadequacy of funds to two factors. The first is the delay by the pyrethrum board, which buys the pyrethrum from the cooperatives, to effect payments for the produce delivered to the Mafinga plant. The second is the rigidity of the financial institutions to give the cooperatives more loan for pyrethrum purchases as prices of pyrethrum has been increasing fast since 1990/91 at the time when the cooperatives are in the red. Although these can be true, the financial administration and use by the cooperatives themselves remains to be desired.

The pyrethrum board also does not advance funds to cooperatives for pyrethrum purchases because the pyrethrum board wants itself to control overall pyrethrum purchases, the way it used to do before 1987/88. The pyrethrum board had the opinion that if the cooperatives have failed to market the produce they should surrender and let it take over the business. Producers are of the opinion that marketing services previously provided by the pyrethrum board were better than the current services provided by the cooperatives. So long as the two institutions are marketing the crop, though in different geographical area, a comparative marketing study is desired in order to

establish which institution works better and recommend it to work for the producers.

On second payment, although the pyrethrum board budgets have shown to include second payment or what they call bonus in the costs of procurement, rarely producers receive this and when received it is too small an amount to justify the amounts sold per year.

Incidencies have been reported whereby the second payment which is brought to producers through cooperative societies or villages do not reach its destination. The funds ends up financing these institutions which always have inadequate funds to finance their activities.

In order for each pyrethrum producer to receive the second payment directly from the pyrethrum board, they are required to obtain a pyrethrum growers licence from the pyrethrum board. However, its acquisition is under the conditions that the respective producer should have three acres under the crop which the majority of the producers in Njombe district do not qualify for. This forces the producers to have a pooled delivery of their second pay through village governments or cooperative societies which sometimes does not deliver to the intended destination.

The current system of judging whether the pyrethrum producer should get an additional pay or not in general differs much from the systems which are used for other crops like coffee and tobacco. The later are judged in terms of the final net sales proceeds from both the external and local markets unlike pyrethrum which is judged in terms of pyrethrin content which is evaluated before even processing the crop.

The issue which the producers do not understand therefore is why a crop which is 98 % exported does not bring them a second payment like coffee ?. On this the pyrethrum board asserts that, the current marketing system, which is a three tier, together with processing are very costly in a way that final sales proceeds do not justify another payment to pyrethrum producers.

4.19 Pyrethrum Marketing Costs

It has already been established that the pyrethrum board purchases pyrethrum from cooperatives at an into-store price. The into-store price accounts for all the cooperative society marketing costs from procurement at farmer level up to the time when the dry flowers are delivered to the Mafinga plant. The trend in the pyrethrum marketing costs are as presented in table 4.21.

Table 4.21 NJOLUMACU: Pyrethrum marketing costs and the into store prices, 1987/88 - 1990/91

| | 1987/88 | 1988/89 | 1989/90 | 1990/91 | 1991/92a/ |
|--|---------|---------|---------|---------|-----------|
| Producer price | 35.40 | 47.80 | 60.00 | 120.00 | 230.00 |
| Marketing costs | 16.77 | 17.25 | 28.37 | 41.70 | 71.03 |
| Into store price | 52.17 | 65.05 | 88.37 | 161.70 | 301.03 |
| Marketing cost as % of into- store price | 32.14 | 26.52 | 32.10 | 25.99 | 23.60 |
| Producer price as % of into- store price | 68.00 | 73.00 | 68.00 | 74.00 | 76.00 |

a/ Estimates

Source: Appendix A.7.

Figures in the table show that, on average, the marketing costs are 27.67 % of the grade five pyrethrum into-store price implying that, producers receive 72.33 % of the into-store prices.

Analysis of the marketing cost elements shows that, the crop transport cost element has increased fast between 1990/91 and 1991/92, that is an increase of 130 % (Appendix A.7). The actual transport cost which is recommended by regional authorities for Njombe district for the 1991/92 is Tsh 35 per km per ton. Thus the cooperative union budgeted transport costs are questionable. This is therefore one of the potential areas

The fact that pyrethrum proceeds go into solving some important household problems indicates that, with reasonable improvements in pyrethrum producer prices, people will continue producing the crop and more might come in as these costs continue to soar high.

4.21 The Relative Profitability of Pyrethrum in Njombe District

4.21.1 Introduction

It has already been established that the main crops grown in Njombe district are maize, potatoes, wheat, peas and pyrethrum which is the only smallholder export cash crop. Maize is grown by all the pyrethrum producing households in the district (Table 4.23).

Potato is grown by 93 % of the households while wheat and peas are grown by 15 % and 12 % of the respondents respectively. This shows that pyrethrum growers grow less wheat and peas in their farms. The relatively low number of both wheat and peas producers in the district made the availability of some valuable production data for gross margin analysis unavailable and the ones available were not reliable enough to make use of them in this aspect.

Table 4.23 Njombe district: Number of respondents growing various crops

| Crop | Number of Growers | Percentage |
|-----------|-------------------|------------|
| Maize | 60 | 100 |
| Potatoes | 56 | 93 |
| Pyrethrum | 60 | 100 |
| Wheat | 9 | 15 |
| Peas | 7 | 12 |

Source: Survey Data, 1992.

4.21.2 The gross margin per hectare

Table 4.24 show the gross margin per ha for maize, pyrethrum and potato. A comparison between crops show that potato has the greatest gross margin per ha followed by maize (basing on open market price) and pyrethrum from bushes of three or less years of age.

The pyrethrum gross margin per ha has been divided into two categories in order to show the difference between the gross margin based on the pyrethrum output of all the pyrethrum bush age groups and that which is based on the pyrethrum bush of below or equal to three years which is the maximum recommended.

Table 4.24 Njombe district: Gross margin per ha for maize,
pyrethrum and potato, Tsh/ha

| Crop | 1990/91 | 1991/92 |
|-----------------------|------------|------------|
| Pyrethrum <u>a/</u> | 17 085.25 | 33 359.75 |
| Pyrethrum <u>b/</u> | 20 782.00 | 39 565.00 |
| Maize | | |
| Open market price | 24 082.00 | 48 485.00 |
| Official market price | 12 482.00 | 34 085.00 |
| Potatoes | 149 368.00 | 260 285.00 |

Pyrethrum a/ Based on average output of 147.95 kg per hectare as per sample size of 60 households which represent output from pyrethrum bush of all the recorded age groups.

Pyrethrum b/ Based on average output of 185 kg per ha from a sample of 30 which represent output from pyrethrum bush of 3 years and below.

Source: Appendix A.8.

where marketing costs can be reduced to a reasonable amount. The amount so saved can be paid to producers as second payment or bonus.

4.20 Uses of Pyrethrum Proceeds

The income obtained from pyrethrum sales is mainly used for education and health purposes as indicated by 53.3 % of the respondents in the district (Table 4.22). The rest of the proceeds goes to food and clothing (28.3 %), housing (13.3 %) and recreation (5.0 %).

Table 4.22 Njombe district: Important use of pyrethrum proceeds

| Uses | Observed frequency | Percentage |
|-----------------------------|--------------------|------------|
| Education, health and taxes | 32 | 53.3 |
| Food and clothing | 17 | 28.3 |
| Housing | 8 | 13.3 |
| Recreation | 3 | 5.0 |
| Total | 60 | 100.0 |

Source: Survey data, 1992.

The first category pyrethrum gross margin was less than that of the second category by 22 % in 1990/91. This shows that households which had left their pyrethrum bush for more than three years in the farm has reduced the overall average output per ha and hence the average net returns per ha when compared to the higher output and net returns per ha of the second category.

Therefore it is not economical enough for a pyrethrum producer to attend to pyrethrum bushes of more than three years and to sell the surplus maize to the official market. However, so long as the later does not operate i.e. the official market, pyrethrum producers who grow maize are not disadvantaged. That is why more households prefer maize as the first source of income to pyrethrum which is negatively affected by the non functioning official market. Likewise, more resource land has been allocated to maize production than pyrethrum production.

4.21.3 The crop returns to household labour

The gross margins per man-day of the three crops (maize, potato and pyrethrum) are shown in table 4.25. From the table it is implied that, pyrethrum ranked third in its relative profitability to household labour by providing Tsh 136 and Tsh 258 to each man-day in 1990/91 and 1991/92 respectively. The 1991/92 figures for maize

and potatoes are based on prices and market cost estimates covering the period from June to December 1991 only.

Table 4.25 Njombe district: Crop returns to household labour,
1990/91 and 1991/92

| Particulars | 1990/91 | 1991/92 ^{a/} |
|-------------------------|---------|-----------------------|
| —————Tsh/man-day————— | | |
| Maize | | |
| Official price | 88.00 | 240.00 |
| Unofficial market price | 169.00 | 341.00 |
| Pyrethrum | 136.00 | 258.00 |
| Potatoes | 1224.00 | 2133.00 |

^{a/} Based on June - December 1991 prices.

Source: Appendix A.8.

Maize ranks second, but this is true only when open market maize prices are used in the analysis. Ranking is based on the unofficial market prices because of the fact that all the surplus maize produced in 1990/91 by the respondents was sold on the open market.

In 1990/91 the unofficial market maize gross returns per man-day was higher than the official market maize price by 54 %. This is due to the higher producer prices in the open market than in the official market. The 1991/92 estimates shows that, the maize gross margin per man-day using unofficial market prices will be higher by 42 % when compared to the official market prices gross margin per man-day.

The non functioning of the official market is thus a blessing in disguise to Njombe maize producers because of the higher pay they receive from the alternative market. The poor food crop production in neighbouring regions of Dodoma and Morogoro has made it economically possible for businessmen to move even to the most interior parts of the district like Mbega, Makowo, Mtila, Makoga and Madope in search of maize using light vehicles like pick ups and land rovers to ferry the crop to the main roads.

The first crop in relative profitability to household labour is potato which earned the producer Tsh 1224 per man-day in 1990/91 and is expected to pay Tsh 2133 per man-day in 1991/92. The relatively low labour requirement of the crop i.e. 122 man-days, and high output per ha makes the crop to be relatively superior over both maize and pyrethrum which require 142 man-days for maize and an average of 153 man-days for pyrethrum. Otherwise potato

production is the most expensive in terms of variable costs and lower in per unit price followed by maize (Appendix A.8). Pyrethrum production is cheaper in terms of variable costs but its relative low output per unit and high labour consumption makes it a disadvantaged crop in terms of returns to labour.

In terms of producer price, pyrethrum is more valuable than either maize and potato. Maize ranks second both when open market and official market prices are used and potato last. Thus potato survives high in relative profitability only on account of its higher output per unit area.

Basing on these findings, it can be concluded that potato and maize traded in the open market compete unfavourably with pyrethrum production in Njombe district. For maize this can further be justified by the land allocation order shown in section 4.1 of this text.

4.22 Pyrethrum processing at the Mafinga plant

The pyrethrum board is the owner of the Mafinga plant. Thus it is the pyrethrum board which need to ensure that the factory receives adequate raw materials for its functioning. It is also supposed to ensure that the factory runs smoothly and it is responsible for final

sales of the processed output from the Mafinga plant.

The performance of the plant since 1982/83 is best summarised in table 4.26. Data in the table shows that instead of processing 4500 tonnes of dry flowers per year, only an average of 1290.80 tonnes of dry flowers have been processed over the period of nine years. This is an average of only 29 % working capacity. This low amount of flowers processed is due to low amount of dry flowers received from producers which is an average of only 1300 tonnes per year ie 29 % of the expected amount of 4500 tonnes.

Although only 29 % of the expected flowers were processed per year, working days per year have remained as high as 212 in three shifts per day. This is 85 % of the expected 250 working days. The reason behind this is the low dry flower intake per day which has remained at an average of only six tonnes per day. This is only 33 % of the expected 18 tonnes per day. Essentially machinery breakdown at the plant is the underlying reason for this, whereby some days pass without being effectively utilised when the machinery undergoes or waits for some repairs.

Table 4.25 MPEP: Pyrethrum processing coefficients, 1982/83 - 1990/91

| | 1982/83 | 1983/84 | 1984/85 | 1985/86 | 1986/87 | 1987/88 | 1988/89 | 1989/90 | 1990/91 |
|-----------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Pyrethrum received (tons) | 1460.69 | 1082.02 | 1373.43 | 1005.75 | 1205.82 | 1292.01 | 1231.40 | 1464.80 | 1590.70 |
| Pyrethrum processed (tons) | 1460.04 | 1099.87 | 1373.43 | 1005.75 | 1183.03 | 1307.91 | 1196.77 | 1458.59 | 1532.20 |
| Pyrethrin content (%) | 1.01 | 1.14 | 1.22 | 1.22 | 1.22 | 1.25 | 1.16 | 1.19 | 1.18 |
| Working capacity (%) | 32.00 | 24.00 | 31.00 | 22.00 | 26.00 | 29.00 | 27.00 | 32.00 | 34.00 |
| Working days (number) | 223.00 | 133.00 | 200.00 | 182.00 | 207.00 | 200.00 | 215.00 | 282.00 | 259.00 |
| Labour force (number) | - | - | - | - | 92.00 | 93.00 | 105.00 | 112.00 | 106.00 |
| Daily throughput (tons) | 6.26 | 6.27 | 6.87 | 5.59 | 5.71 | 6.54 | 5.55 | 5.17 | 5.91 |
| Hexane consumption (l/ton) | 109.93 | 115.00 | 104.02 | 110.25 | 128.63 | 105.67 | 106.24 | 130.38 | 132.87 |
| Gas oil consumption (l/ton) | 217.28 | 226.00 | 225.70 | 253.18 | 254.81 | 245.33 | 238.61 | 277.35 | 179.97 |
| Furnace oil cons. (l/ton) | 114.11 | 76.80 | 89.11 | 169.80 | 159.97 | 119.22 | 141.11 | 170.08 | 163.59 |
| C E recovery (kg/ton) | 29.93 | 29.01 | 32.88 | 32.64 | 32.90 | 43.11 | 33.40 | 33.45 | 31.74 |
| Dry marc recovery (%) | 86.00 | 73.00 | 80.00 | 82.00 | 71.00 | 82.00 | 79.00 | 75.00 | 15.00 |

Notes: 1. The plants' installed capacity is 4500 tonnes of dry flowers per year.

2. The expected minimum pyrethrin content of incoming dry flowers is 1.3 % w/w.

3. Expected working days is 250 days per year.

4. Expected throughput per day is 18 tonnes.

5. Expected crude extract recovery rate is 40 kg per one tonne of dry flowers.

6. Expected dry marc recovery is 0.95 kg per one kg of dry flowers.

7. Expected hexane consumption is 30.00 litres per tonne of dry flowers.

Source: MPEP, 1992.

On dry pyrethrum flower quality, the received flowers had an average of 1.16 % pyrethrin content instead of the assumed 1.3 % minimum. In effect this resulted into a lower amount and quality of crude extract recovered. Low pyrethrin content of dry flowers processed is due to both loss of pyrethrin on flower storage in flower silos especially when processing is delayed due to machinery breakdown. Another reason is the delay in delivery of the dry flowers to the Mafinga plant by the cooperatives and the pyrethrum board itself which buy the produce from growers in Iringa and Mbeya regions respectively. The delay is normally caused by transportation problems considering that high pyrethrum output is obtained during the peak rain season.

Apart from the low pyrethrin content of the dry flowers, the Mafinga plant receive dry flowers of an average of 12 % moisture content which goes to as high as 15 % during the rain season. This higher moisture content poses difficulties in both flower storage and processing because of possibilities of flower rot in the already defective silos at Mafinga plant and clogging in the machinery during processing.

The consumption of extraction reagents is also not proportional to the expected rates. For example, while hexane consumption was designed to be 30 litres per tonne of dry flowers, an average of 115.89 litres has been used over the past nine years. This is higher by 286 %. It is reported that leakages in the machinery results into these higher consumption rates of the main extraction ingredients.

Output recovery rates for the crude extract has remained at an average of 32 litres of crude extract per tonne of dry flowers. This is 80 % of the expected rate. Dry marc recovery rate is averaged at 0.71 which is 75 % of the expected rate. Among other reasons, shortcomings in the plant layout in which the number of extractors is inadequate, and frequent drier failure have significantly contributed to the lower rates of recovery of both the dry marc and crude extract. Drier failures has caused much losses to the Mafinga plant because its failure means the marc must be thrown away after extraction of crude extract as it can't be dried to a useful product.

Other attributes which are of importance for the proper functioning of the Mafinga plant included the laboratory. In this incoming dry flowers need to be evaluated for quality, that is determine the flowers' pyrethrin and moisture contents. The shortcomings which

have been experienced by the Mafinga plant in this facility is the breakdown of the instrument used for pyrethrin content evaluation, that is the spectrophotometer. This forces the Mafinga plant to collect samples and take them to as far as Uyole research centre in Mbeya region for pyrethrin content evaluation. The whole exercise becomes time consuming and expensive to carry out. Fairness in pyrethrin content evaluation of the many samples from licensed growers also becomes questionable and hence the second payment received which is based on the evaluation results.

The Mafinga plant also has an inadequate storage space to accommodate incoming flowers especially when the dry flower intake continues to increase overtime due to relatively higher production and discontinuity of flower processing. The space is needed to temporarily store the received dry flowers before samples are taken for quality evaluation after which they are emptied into the silos for storage to await processing.

It is unfortunate that the silos also are not properly working due to improper design. Of the two silos which are present, each has a capacity to store 3000 tonnes but their layout allows accommodation of only a maximum of 50 tonnes each at a time. This means that they work at an approximately two percent of their installed

capacity. The machines which are supposed to mechanically propel the flowers from the silos to the processing system are defective. Thus when more than 50 tonnes are put in the silos, the result is flower rot which is a financial loss to the pyrethrum board.

4.23 Refinery of the Crude Extract

By its very nature, the crude extract has limited uses unless it is refined. A refined product, apart from having a variety of uses, fetch a higher price in the world market.

The pyrethrum board exports the crude extract because of having no refinery facilities at the Mafinga plant. By so doing it loses alot in foreign exchange. Thus, generally, Tanzania is a disadvantaged exporter of pyrethrum products. It could have done better had the pyrethrum board introduced refinery facilities at the Mafinga plant.

4.24 Pyrethrum Processing Costs

Table 4.27 shows the pyrethrum board's administration and pyrethrum processing costs. The figures shows that the into store price has continued to increase over time since 1987/88. This is due to both the increase in producer prices of the crop and the marketing costs by the cooperatives which buy the crop from the producers and sell it to the pyrethrum board.

Direct processing costs has also continued to increase since 1987/88 to 1991/92 and an increase of 229 % has been recorded. The cost items in this case includes such elements as the cost of the extraction solvent hexane, gas oil used in power generation (electricity is supplied by gas oil powered generators), costs of furnace oil which is used as a boiler fuel to produce steam, packing materials and all other expenses which are directly linked with the throughput. The continued increase in these cost items is due to the ever increasing usage of these inputs which is a result of leaking pumps, steam pipes and condensers and higher prices of both gas and furnace oil.

Unless a solution is found for this, the processing costs will continue to rise overtime threatening the financial position of the pyrethrum board

Table 4.27 TPB: Costs of administration and pyrethrum processing, 1987/88 - 1991/92

| Particulars | 1987/88 | 1988/89 | 1989/90 | 1990/91 | 1991/92a/ |
|---|------------|---------|---------|---------|-----------|
| | ——Tsh/kg—— | | | | |
| Into-store price | 52.17 | 65.05 | 88.37 | 161.70 | 301.03 |
| Direct processing | 40.31 | 87.13 | 91.43 | 105.55 | 132.80 |
| Other variables | 9.19 | 19.64 | 33.37 | 32.19 | 31.71 |
| Selling expenses | 4.50 | 5.21 | 9.22 | 12.05 | 13.90 |
| Administration | 76.58 | 122.18 | 155.22 | 130.14 | 125.98 |
| Total costs | 182.75 | 299.21 | 377.61 | 441.63 | 605.42 |
| Direct processing as % of total cost | 22.06 | 29.12 | 24.21 | 29.90 | 21.94 |
| Administration as % of total costs | 41.90 | 40.83 | 41.10 | 29.47 | 20.81 |
| Average salesprice | 193.83 | 241.35 | 406.99 | 468.64 | 578.51 |
| Net profit/loss | 11.08 | (57.86) | 29.38 | 27.01 | (26.91) |

a/ Estimates.

Source: Appendix A.9.

as already shown by 1991/92 budget that, the board will incur a loss of Tsh 26.91 per kg of dry flowers processed. This loss will occur despite the fact that the average sales price of the industrial products i.e. crude extract and dry marc has continued to increase over time. The average sales price has increased by 198 % over the last five years.

When a comparison is made between the increase in processing costs and average sales price, the former has increased faster than the later by 16 %. This accounts for the deficit balance of the TPB sales proceeds.

Although the proportion of the administration costs shows a declining trend, still there are more potentials of making the total administration costs lower than the observed ones. This can be achieved by streamlining the amount of the supporting staff at both the Mafinga plant and the pyrethrum board offices in line with the volume of business and type of work done.

For example, at Mafinga plant the total work force by January 1992 was 109 employees. Of these, only 24 (22 %) are involved in direct processing of the dry flowers. Thus 78 % is the proportion of the supporting staff at the plant. At the pyrethrum board level, the situation is as shown in table 4.28.

The Njombe office has more employees than the Mbeya office. Njombe and Mbeya offices are regional offices which were established to offer extension services to pyrethrum producers, prepare and distribute planting materials, procure the crop and give some other production promotional services to producers. None of

Table 4.28 TPB: Number of employees by operational area

| Area | Male | Female | Total |
|--------------------|------------|-----------|------------|
| Arusha office | 13 | 1 | 14 |
| Iringa head office | 30 | 14 | 43 |
| Mbeya office | 39 | 6 | 45 |
| MPEP | 92 | 17 | 109 |
| Njombe office | 36 | 12 | 48 |
| Supplies DSM | 11 | 5 | 16 |
| Total | 221 | 55 | 275 |

Source: TPB head office - Iringa.

these is currently being effectively done by the Njombe office in favour of Njombe pyrethrum producers unlike in Mbeya where the office is involved in procurement of the crop. Therefore, the presence of the 48 employees at the Njombe office is not justifiable at current work load.

At the pyrethrum board head office there are two key departments. These are the production and marketing departments. There are also four supporting departments. These are the accounts, audit, administration and supplies. The production and marketing departments happen to absorb only 7 % and 5 % of all the head office labour force of 43 employees. Alternatively each employee in the key department need some nine employees to support him at the head office. Because of these, the quantity of dry flowers processed by each pyrethrum board employee has remained at an average of 66 % of the planned eight tonnes per employee per year. This implies that, the pyrethrum board is generally over staffed and hence this is a potential area for reduction of its operational cost and improve its financial performance.

4.25 Producers Share of the TPB's Average Sales Price

The current producer price policy in Tanzania is to continuously adjust upward these price until the producer receive about 60 % of the average sales price. Pyrethrum producers still, however, receive very low amounts of the average pyrethrum sales price as shown in table 4.29. The table shows that pyrethrum producers' share of the average sales price has continued to decline since 1984/85 up to 1989/90 when the lowest share of 17.3 % was recorded. This was a decline of 81 %. After that, the

producers' share increased by 74 %. Using 1991/92 prices the producers' share is anticipated to rise by 34 %.

Table 4.29 Tanzania: Producers' share of the TPB average
pyrethrum sales price, 1984/85 - 1991/92

| | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 ^{a/} |
|----------------|------------------|-------|------|-------|-------|-------|-------|--------------------|
| | —————Tsh/kg————— | | | | | | | |
| Average sales | | | | | | | | |
| price | 29.8 | 45.5 | 98.1 | 193.8 | 241.8 | 407.0 | 468.6 | 578.5 |
| Producer price | 19.7 | 23.6 | 32.8 | 38.9 | 51.3 | 70.4 | 141.0 | 230.0 |
| Producer price | | | | | | | | |
| as % of sales | | | | | | | | |
| price | 66.0 | 52.0 | 33.4 | 20.1 | 21.2 | 17.3 | 30.1 | 40.0 |
| TPB's costs | 39.4 | 64.4 | 73.9 | 130.5 | 234.2 | 289.2 | 279.9 | 304.4 |
| TPB's costs as | | | | | | | | |
| % of sales | | | | | | | | |
| price | 132.2 | 141.5 | 75.3 | 67.3 | 96.8 | 71.1 | 59.7 | 52.6 |

Notes: ^{a/} Estimates.

Years 1985 refers to 1984/85.

Producer prices have been adjusted for second payment.

Source. Computed from appendix A. 8 and A.9).

In this analysis the producer price has been adjusted upwards for the second payment as budgeted by the pyrethrum board. However the second payment rarely reaches the producer. Thus the producers' share is exaggerated. However, the share can increase should the pyrethrum board manage to pay producers more in second payment or bonus.

The pyrethrum board has not been able to pay producers more due to financial constraints in previous years as implied from the board's share (in form of operational costs) of the average sales proceeds. On average, the board's costs have absorbed 87 % of the average sales price of its output. It is therefore only through reduction in the board's costs of operation (both in form of administration and processing) that the producer will be able to get a higher share of the average sales price.

CHAPTER FIVE

5.0 SUMMARY AND CONCLUSION

5.1 Summary

5.1.1 Socio-economic characteristics of the households which are related to agricultural production activities

5.1.1.1 Sampled household characteristics, resource ownership and use

The study has established that, a typical household head in the survey area has 40.72 years of age and has a average of standard seven education level.

The observed labour available per household for agricultural activities is only half of the total potential labour force available per household. This means that, although households are large, labour availability does not match properly to the household sizes. Migration of household members out of their villages into urban areas and large scale agricultural production units within and outside the district accounts for this. The result is labour deficits in major crop production activities and the inability by the households

to meet the recommended specifications in pyrethrum production husbandry practices like weeding.

Statistically, however, the variable labour has been observed to be non significant in explaining the variations in pyrethrum output production per farm. Basically this was observed to be due to a rather uniform distribution of the amount of people who were permanently at home providing their labour to the household agricultural production activities. About 90 % of the sampled households had one or two household members who were permanently at home working at the farm and only 10 % had above two members.

The average land owned by each household was observed to be 3.54 ha. Of this 51 % is under maize, 14 % under pyrethrum and eight percent under commercial potato. An average of 17 % of the area is left fallow and 11 % of it is under other crops which include vegetables, wheat, peas, fruits, pumpkins, beans and sunflower. On the distance of the various crop plots from the household centres, maize plots have the shortest distance while pyrethrum plots are more distant from the households when compared to both maize and potato. These two factors, land and distance from home, lead to a conclusion that maize is potentially more important to pyrethrum producers in Njombe district than pyrethrum itself. This

has been further justified by the fact that, 45 % of the sampled households had indicated maize to be their first important source of household income with pyrethrum coming second in the ranking.

The availability of an average of 0.61 hectares of fallow land in the survey area indicates that, land is not a serious problem like labour in agricultural production. Land has been a statistically significant factor in explaining the variations in pyrethrum output per farm with a positive sign. This means that pyrethrum producers can increase their output by allocating more of their fallow land into pyrethrum production. Should one increase acreage under pyrethrum by one percent, pyrethrum output per farm is estimated to increase by 0.54 %.

The main capital items for agricultural production owned by the sampled households is the hand hoe, bush knives and axes. Oxen use in the survey area is very limited and when used it is often hired. Crop sales proceeds form the major source of farm operating capital in which one need to keep aside a certain amount of money for such activities as fertilizer and insecticide purchases before committing such funds into consumption and other household investment expenditures.

The open market is the main market for the major crops produced in the survey area except for pyrethrum which is only sold to the official market. Cooperatives in the district have failed to absorb the agricultural surplus produced because of financial constraints which have made even pyrethrum marketing to be irregular.

5.1.1.2 Availability of farm inputs

The main planting materials used by pyrethrum producers in the study area is the splits. It is used by 73 % of the sampled households. Friends and neighbours form the main source of such planting materials. The pyrethrum board which has the task of promoting pyrethrum production provides only 10 % of the planting material required mainly in form of seeds. Such seeds however come late in the season, in small quantities than required and in questionable qualities, all of which make the source to be unreliable. As a result, availability of planting materials has become a serious constraint in pyrethrum production especially now when more individuals are going into pyrethrum production in response to the current higher producer prices of the crop.

Among the other main inputs required in pyrethrum production, wire trays are not easily available in shops in the study area. The input is useful for pyrethrum

flower drying . Neither the pyrethrum board which advocate production of pyrethrum nor the cooperatives which buy the crop has managed to make the commodity easily available to pyrethrum producers. This has made pyrethrum flower drying to be the main limiting farm operation in pyrethrum production.

Use of fertilizer is not common in pyrethrum production among the sampled households, neither is the use of other agrochemicals. However, the same are commonly used in production of other crops like maize by the same households. This therefore rules out the possibility of input scarcity in the district although sometimes these are only available at Njombe town and not in respective villages. The problem thus becomes of transportation of these inputs and not of availability.

5.1.2 Husbandry practices and economic factors which affect pyrethrum production

5.1.2.1 Pyrethrum output per farm

Variable costs, area under pyrethrum and the amount of labour force available per household have been identified, using a Cobb-Douglas production function, to shape the observed pyrethrum output produced per farm.

Output per farm was more responsive to area under pyrethrum (0.54 %) followed by variable costs (0.40 %) and lastly labour (0.22 %). However labour was statistically significant at only 0.10 significance level unlike the other variables. The independent variables together had an explanatory power of 78.50 %. The total of the partial elasticities of production shows that pyrethrum producers in Njombe district experience increasing returns to scale per farm.

5.1.2.2 Pyrethrum output per hectare

The study has observed that, pyrethrum output per hectare in the survey area is affected negatively by the age of the pyrethrum bush which was statistically significant at 0.01 significance level.

Education level, weeding frequency, age of the household head and the number of years which the producer has been engaged in pyrethrum production had a positive effect on pyrethrum output per hectare, however age of the household head and years of growing pyrethrum variables were not statistically significant. The independent variables together had explained about 70.00 % of the observed variations in pyrethrum output per hectare in the study area. However, the chi-square analysis had indicated that pyrethrum output per hectare

was dependent with all the above five variables at 95 % confidence.

The partial elasticities of production shows that, among the above five factors, pyrethrum output per hectare is more responsive to the age of the pyrethrum bush followed by the education level. However, unlike for the case of total output per farm, output per hectare happened to experience some decreasing returns to scale with partial elasticities summing up to only 0.40. The high age of the pyrethrum bush, which was about 34 % above the recommended was responsible for this observation.

5.1.2.3 Pyrethrum output supply response

Pyrethrum producers in Njombe district have been observed to respond inversely to changes in relative real potato producer price, real unofficial market maize producer price and real official maize market producer price. Only changes in own real producer price was observed to be positively related to the changes in the output supply. This means that the two crops, maize and potatoes, are competitors for resources with pyrethrum.

With respect to timeliness in responsiveness, pyrethrum producers have been observed to respond faster than expected to potato, maize and the pyrethrum producer price. The use of splits which give the first harvest earlier than seedlings is responsible for this.

Output responsiveness has been observed to be more significant for unofficial maize and potato real prices than for the official market real maize prices. Hence pyrethrum producers in Njombe district are rational producers, responding accordingly to price signals, because the unofficial prices are always higher than the official prices.

5.1.2.4 Pyrethrum marketing

The marketing of pyrethrum in the survey area, which is under the control of cooperatives, is not regular. Cooperative societies remain closed most of the time due to unavailability of funds for frequent purchases of the crop. Hence producers are compelled to remain with their crop for a longer time than necessary posing dangers of quality deterioration of the produce. This also overrides the potential advantages of the pyrethrum crop as a source of regular income to producers.

Payment to producers is not done promptly and second payment is rarely paid. When made available producers receive only the price difference between the fifth grade, which is paid to all producers during sales of the produce, and the actual grade of the flowers after pyrethrin content ovulation at the Mafinga plant as second payment. What is therefore said to be a second payment is actually not as it is not based on the net final sales proceeds from both the domestic and foreign markets.

Marketing costs are high. The pyrethrum board attributes the high marketing cost to the long marketing channel which involve the cooperative societies, the cooperative union and the board itself. However, the study has identified that general inefficiency in the whole marketing system contributes to this.

The proceeds accrued from pyrethrum sales at a smallholder level are mainly used in education and health. This absorbs about 53.3 % of the total proceeds. Food and clothing forms the second major important use of the pyrethrum proceeds in the survey area.

5.1.3 The pyrethrum relative profitability

When compared to potato and maize, pyrethrum ranks third in relative profitability, although the crop is cheaper to produce in terms of variable costs and has a higher price per unit. The high labour requirement and low output per unit area, has made pyrethrum to have lower relative returns to labour. Poor crop husbandry practices have been observed to contribute significantly to the low unit output. For example, the higher age of pyrethrum bush has been observed to lower the pyrethrum gross margin per hectare by 22 % due to its effect on per unit area output.

The above applies better when maize was evaluated using unofficial market prices. When official market prices for maize are used, pyrethrum ranks second.

5.1.4 The Mafinga Pyrethrum Extraction Plant (MPEP)

The plant has operated under capacity (it has worked at an average of only 29 % of its installed capacity) since it was commissioned in 1981. Its daily throughput is only 33 %. The major ingredient for extraction is used at an average of 286 % above the expected consumption rate thus highly contributing to the already high processing costs. The crude extract and dry marc recovery

rate is only 80 % and 75 % respectively.

Low quality of the incoming flowers, shortcomings in the plant layout, old age of the machinery, frequent drier breakdown, discontinuity in processing and inappropriate storage facilities are some of the causes of the lower performance indicators of the plant.

High administration costs have also posed some financial constraints to the plants' performance as these have made the plant to operate at negative net returns. The ultimate result is the inability of the pyrethrum board to offer more incentives to pyrethrum producers in terms of a second payment and bonus after export of its products. Hence the pyrethrum producers' share of the board's final sales proceeds has remained low over time.

5.2 Conclusion

From the foregoing observations, it can be concluded that the observed pyrethrum production in general in Njombe district is determined by factors which range from socio-economic ones like the number of fulltime members of the household which determine the effective size of the household labour force, through husbandry practices like the weeding frequency, to price factors like the price of competing crops which include maize and potato. The factors have resulted into a general low pyrethrum output production, low output per hectare and poor quality of the crop produced.

More pyrethrum production services to producers are still needed from both the pyrethrum board and the cooperative societies in order to make pyrethrum producers work under conducive environment in terms of input supply like the wire trays for flower drying, the planting materials and better marketing services.

Pyrethrum flower drying at a smallholder level, which is the main constraint among the many production practices, need a specific policy on how to solve it.

Due to the shortcomings which have been addressed in reference to the performance of the Mafinga plant, the plant is unlikely to accommodate and process all the expected incoming dry flowers from producers in the coming years. Fairness in determining the quality of the producers' output at the Mafinga plant is also expected to deteriorate further. This will likely make producers continue to get both lower returns and lower share of the pyrethrum board's average pyrethrum sales.

Although the country has big potentials of gaining more from pyrethrum sales in the world market, these potentials are and will not be fully exploited because of the inability of the Mafinga plant to refine its crude extract, improve its selling methods and lower its processing and administration expenses.

5.3 Recommendations

So long as both non price and price factors are responsible for low pyrethrum output production in Njombe district, both price and non price measures need to be taken into account in order to attract production of more quantity and quality of the crop in the district. Possible measures include:

The pyrethrum board which is responsible for promoting production of the crop in the district should try to encourage the youth to engage in pyrethrum production instead of working in none farm activities outside their villages for wages. This can take the form of educational campaigns on the relative advantages of growing pyrethrum, to school leavers at the current high producer prices, to doing temporary employments outside their villages. This will not only ensure more labour force but also the right labour force for production of the crop as the elderly alone can not properly provide the right pyrethrum production labour.

Pyrethrum producers should be encouraged to add more of their fallow land and farm inputs to pyrethrum production through provision of better production knowledge, input supply especially the drying materials, and better marketing services. However, farmers will not

adopt improved farming methods if the additional costs to be involved will not be justified through more returns.

Therefore, higher pay in form of producer prices and second payment should be considered. This can easily be implemented now when the government has decontrolled the price determination role for the major export crops. What is needed therefore, is more financial worthiness and efficiency in the pyrethrum handling institutions in the country.

Production knowledge should also stress on improvement in the production husbandry practices which lead to higher output per unit area and better quality of the produce, through timely and more frequent weeding and timely rotation or replacement of the pyrethrum plots. The knowledge also should include proper selection and preparation of planting materials, following the recommended flower picking intervals, use of fertilizer during planting and proper drying of the flowers.

For proper drying of the pyrethrum flowers, cheaper but better drying methods need to be explored. This will be achieved if the pyrethrum board and the cooperatives will cooperate with other institutions which have some specialized skills and some interest on the pyrethrum industry in the country like the department of

agricultural engineering of the Sokoine University of Agriculture. However, for this to be successful, a proper policy or strategy regarding improvement in pyrethrum drying methods need to be charted out and all the concerned parties be well informed in *a priori*, including the farm producer who might be involved in research. Such a policy should also point out that the pyrethrum board should be prepared to finance such research.

Should flower drying involve the use of more fuel wood, afforestation campaigns should go hand in hand with other pyrethrum production related campaigns. This will ensure both environmental conservation and a sustainable supply of fuel wood. These in return will ensure a sustainable agricultural production in the long run.

Marketing services should include timely flower collection, prompt payment to pyrethrum producers, a fair and represented quality determination of the dry flowers at Mafinga plant and a fair second payment. The second payment should be based on the pyrethrum board's final sales proceeds rather than the quality difference of dry flowers before processing.

The marketing costs should be reduced. This can be achieved by shortening the marketing channel through giving up the pyrethrum marketing function by either the pyrethrum board or the cooperatives.

Should the cooperatives remain in business, the same should run the Mafinga plant if they will be financially worth. This will enable the cooperatives in future to harmonise producer prices and the average sales price of the Mafinga plant pyrethrum products. Determination of the quality of the producers' output at the plant will also be more reliable on the producer side because the cooperatives are essentially a property of the producers unlike the pyrethrum board. Hence farmers are likely to receive fair returns from their crop sales. The pyrethrum board then can be an agent of the cooperatives, just like the coffee board, in selling pyrethrum products from the Mafinga plant both in the local and the foreign markets (see appendix A.11 for the proposed pyrethrum handling channel). However the proposed system will only work if economically strong, self sustaining cooperative societies will be established. A thorough research into the economic viability of the current cooperative societies which handle pyrethrum is necessary if they are to enter in this trade.

Should the pyrethrum board (which is a government institution owning the Mafinga plant and autonomously controlling the pyrethrum industry in Tanzania) remain in business, it is recommended that it should relieve some of its duties by selling some of the Mafinga plant shares to other private business firms which are interested in the pyrethrum industry. Cooperatives, if are financially sound, may then buy shares in the plant in order to properly represent producers especially in determination of the quality of the output delivered to the Mafinga plant and the control and management of the pyrethrum product sales proceeds for the benefit of the farm producer. This might help to improve the working efficiency of the plant because the pyrethrum board has already shown signs of failing to economically run it. The pyrethrum board then will have to concentrate more on production promotion at the smallholder level.

The Mafinga plant should be urgently rehabilitated in order to improve its working capacity and general efficiency. A joint venture approach could facilitate this. The plant should also be connected to the national power grid, which is only about 60 km away, in order to lower the fuel costs in the long run and hence the processing costs.

Administration costs should be checked first by reviewing the manpower needs of the Mafinga plant and the pyrethrum board regional offices, especially that of Njombe which does relatively less activities.

In order for the pyrethrum industry to generate more foreign exchange, a refinery facility should be introduced at the Mafinga plant. Although this will mean more financial costs in the short run, it will be an economically viable exercise in the long run. This is because it will enable the country to export a high quality and high valued product with many users unlike today when only countries with refinery facilities import the product.

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APPENDIX

Appendix A. 1. Tanzania: Volume of pyrethrum production by
regions, tonnes

| Year | Iringa | | Mbeya | | Northern zone | | Total volume |
|---------|--------|----|--------|----|---------------|----|-----------------|
| | volume | % | volume | % | volume | % | |
| 1967/68 | 2 864 | 55 | 1 338 | 26 | 1 014 | 19 | 5 216 |
| 1968/69 | 2 747 | 57 | 1 387 | 29 | 708 | 14 | 4 842 |
| 1969/70 | 1 279 | 53 | 764 | 32 | 373 | 15 | 2 416 |
| 1970/71 | 1 484 | 54 | 960 | 35 | 288 | 11 | 2 731 |
| 1971/72 | 2 333 | 55 | 1 505 | 35 | 438 | 10 | 4 271 |
| 1972/73 | 2 364 | 59 | 1 291 | 32 | 361 | 9 | 4 016 |
| 1973/74 | 1 904 | 58 | 951 | 29 | 425 | 13 | 3 282 |
| 1974/75 | 2 244 | 47 | 2 060 | 44 | 437 | 9 | 4 741 |
| 1975/76 | 2 130 | 57 | 1 130 | 30 | 506 | 13 | 3 766 |
| 1976/77 | 1 918 | 57 | 1 029 | 31 | 388 | 12 | 3 335 |
| 1977/78 | 1 730 | 68 | 643 | 25 | 173 | 7 | 2 547 |
| 1978/79 | 1 125 | 70 | 430 | 27 | 48 | 3 | 1 603 |
| 1979/80 | 962 | 59 | 637 | 39 | 25 | 2 | 1 624 |
| 1980/81 | 1 213 | 61 | 730 | 36 | 59 | 3 | 2 002 |
| 1981/82 | 1 108 | 58 | 722 | 38 | 69 | 4 | 1 899 |
| 1982/83 | 1 034 | 65 | 535 | 33 | 32 | 2 | 1 601 |
| 1983/84 | 950 | 66 | 469 | 33 | 20 | 1 | 1 439 |
| 1984/85 | 981 | 64 | 580 | 38 | 21 | 1 | 1 582 |
| 1985/86 | 848 | 63 | 491 | 36 | 12 | 1 | 1 351 |
| 1986/87 | 707 | 57 | 513 | 42 | 12 | 1 | 1 232 |
| 1987/88 | 805 | 57 | 600 | 43 | 6 | — | 1 411 |
| 1988/89 | 746 | 57 | 559 | 43 | 8 | — | 1 313 |

Source: MDB (1989).

Appendix A. 2. Tanzania: Pyrethrum producer prices by
grade

| Year | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | CPG5a/ |
|------------------|---------|---------|---------|---------|---------|--------|
| —————Tsh/kg————— | | | | | | |
| 1966/67 | - | - | - | - | 5.00 | - |
| 1967/68 | - | - | - | - | 4.00 | - |
| 1968/69 | - | - | - | - | 3.50 | - |
| 1969/70 | - | - | - | - | 3.00 | - |
| 1970/71 | - | - | - | - | 2.75 | - |
| 1971/72 | 4.00 | 4.00 | 4.00 | 4.00 | 2.75 | 55.14 |
| 1972/73 | 3.21 | 3.21 | 3.21 | 3.21 | 2.75 | 49.19 |
| 1973/74 | 4.21 | 4.21 | 4.21 | 4.21 | 2.75 | 42.74 |
| 1974/75 | 4.21 | 4.21 | 4.21 | 4.21 | 4.21 | 53.21 |
| 1975/76 | 6.50 | 5.50 | 4.21 | 4.21 | 4.21 | 43.59 |
| 1976/77 | 6.50 | 5.50 | 4.21 | 4.00 | 4.00 | 39.92 |
| 1977/78 | 6.50 | 5.50 | 4.21 | 4.00 | 4.00 | 35.77 |
| 1978/79 | 6.50 | 6.00 | 4.50 | 4.50 | 4.00 | 30.83 |
| 1979/80 | 7.50 | 7.00 | 6.50 | 6.00 | 5.50 | 36.23 |
| 1980/81 | 11.00 | 9.50 | 8.50 | 7.50 | 6.50 | 35.91 |
| 1981/82 | 13.20 | 12.00 | 11.00 | 10.00 | 9.00 | 38.38 |
| 1982/83 | 13.20 | 12.00 | 11.00 | 10.00 | 9.00 | 28.64 |
| 1983/84 | 18.50 | 16.80 | 15.40 | 14.00 | 12.60 | 33.10 |
| 1984/85 | 25.50 | 23.50 | 21.60 | 19.60 | 17.60 | 33.30 |
| 1985/86 | 31.00 | 28.20 | 25.90 | 23.50 | 21.10 | 31.11 |
| 1986/87 | 43.30 | 39.40 | 36.20 | 32.80 | 29.50 | 32.85 |
| 1987/88 | 51.90 | 47.30 | 43.40 | 39.40 | 35.40 | 31.52 |
| 1988/89 | 70.00 | 63.90 | 58.60 | 53.20 | 47.80 | 35.22 |
| 1989/90 | 87.50 | 80.00 | 73.25 | 66.50 | 60.00 | - |
| 1990/91 | - | - | - | - | 120.00 | - |
| 1991/92 | 477.00 | 397.40 | 331.20 | 276.00 | 230.00 | - |

a/ Real prices for grade 5 at 1888/89 prices.
Source: MDB (1989).

Appendix A.3. Tanzania: Volume and value of TPB crude

extract sales to export and domestic
market, 1972/73 - 1988/89.

| Year | Export | | | Domestic | | | Total | |
|-----------------------|--------|---------|--------|----------|---------|--------|-------|----------|
| | tons | Tsh'000 | Tsh/kg | kg | Tsh'000 | Tsh/kg | tons | Tsh(000) |
| 1972/73 | 150 | 18 500 | 123 | 400 | 47 | 118 | 150 | 18 500 |
| 1973/74 | 112 | 14 600 | 130 | 400 | 45 | 113 | 112 | 14 600 |
| 1974/75 | 93 | 15 700 | 168 | 300 | 37 | 123 | 93 | 15 700 |
| 1975/76 | 162 | 32 500 | 200 | 600 | 111 | 185 | 163 | 32 600 |
| 1976/77 | 134 | 25 100 | 188 | 500 | 97 | 194 | 134 | 25 200 |
| 1977/78 | 91 | 18 600 | 205 | 1 400 | 332 | 237 | 92 | 19 000 |
| 1978/79 | 51 | 17 900 | 350 | 1 100 | 338 | 307 | 52 | 18 200 |
| 1979/80 | 40 | 21 000 | 525 | 800 | 322 | 402 | 41 | 21 300 |
| 1980/81 | 23 | 13 400 | 582 | 1 700 | 814 | 479 | 25 | 14 200 |
| 1981/82 | 30 | 13 500 | 450 | 2 000 | 1 280 | 640 | 32 | 14 800 |
| 1982/83 | 66 | 31 200 | 475 | 1 000 | 764 | 764 | 67 | 31 900 |
| 1983/84 | 20 | 10 300 | 515 | 3 000 | 3 118 | 1 039 | 23 | 13 400 |
| 1984/85 | 41 | 27 200 | 664 | 2 100 | 3 563 | 1 697 | 43 | 30 800 |
| 1985/86 | 42 | 37 300 | 888 | 500 | 978 | 1 956 | 43 | 38 200 |
| 1986/87 | 41 | 114 400 | 2 790 | 500 | 1 096 | 2 192 | 42 | 115 500 |
| 1987/88 | 43 | 218 622 | 5 084 | 1 000 | 3 882 | 3 882 | 44 | 222 504 |
| 1988/89 | 40 | 330 700 | 8 267 | 600 | 3 089 | 5 148 | 41 | 333 800 |
| 1989/90 | 48 | 496 671 | 10 347 | 304 | 2 609 | 8 583 | 48 | 499 280 |
| 1990/91 | 48 | 717 320 | 14 944 | 1 007 | 11 569 | 11 489 | 49 | 828 889 |
| 1991/92 ^{a/} | 25 | 378 488 | 15 140 | 152 | 2 631 | 17 280 | 26 | 381 119 |

^{a/} Apply up to December 1991 only.

Source: MDB (1989) and TPB head office - Iringa.

Appendix A.4. Tanzania: Export market prices for crude
extract, 1970 -1989

| Year | Nominal price US \$/kg fob | Constant 1994 prices |
|------|-------------------------------|-------------------------|
| 1970 | 18.30 | 49.64 |
| 1971 | 18.30 | 47.17 |
| 1972 | 18.20 | 43.07 |
| 1973 | 18.20 | 37.16 |
| 1974 | 20.80 | 34.86 |
| 1975 | 22.60 | 34.09 |
| 1976 | 23.50 | 34.97 |
| 1977 | 25.00 | 33.86 |
| 1978 | 28.00 | 32.93 |
| 1979 | 37.20 | 33.62 |
| 1980 | 63.40 | 60.04 |
| 1981 | 46.50 | 43.78 |
| 1982 | 41.00 | 39.79 |
| 1983 | 41.00 | 40.26 |
| 1984 | 35.00 | 35.00 |
| 1985 | 33.50 | 33.16 |
| 1986 | 36.00 | 30.13 |
| 1987 | 43.20 | 34.16 |
| 1988 | 54.00 | 38.38 |
| 1989 | 60.00 | 40.13 |
| 1990 | 66.00 | - |
| 1991 | 72.00 | - |
| 1992 | 74.00 | - |

Source: MDB (1989) and TPB Head Office - Iringa.

Appendix A.5. Tanzania: Volume and value of TPB pyrethrum
dry marc sales to export and
domestic market, 1978/79-1987/88

| Year | Export | | | Domestic | | | Total | |
|-----------|--------|---------|--------|----------|----------|--------|-------|----------|
| | tons | Tsh'000 | Tsh/t | tons | Tsh'000 | Tsh/t | tons | Tshs'000 |
| 1978/79 | 965 | 1 322 | 1 370 | 270 | 334 | 1 237 | 1 235 | 1 656 |
| 1979/80 | 665 | 1 015 | 1 526 | 216 | 550 | 2 546 | 881 | 1 565 |
| 1980/81 | 824 | 1 258 | 1 527 | 303 | 885 | 2 921 | 1 127 | 2 143 |
| 1981/82 | 252 | 400 | 1 590 | 189 | 983 | 5 200 | 441 | 1 383 |
| 1982/83 | 640 | 886 | 1 383 | 345 | 1 330 | 3 854 | 985 | 2 216 |
| 1983/84 | 539 | 715 | 1 321 | 428 | 1 739 | 4 062 | 967 | 5 385 |
| 1984/85 | 753 | 1 423 | 1 890 | 373 | 1 585 | 4 256 | 1 126 | 3 008 |
| 1985/86 | 650 | 2 030 | 1 320 | 207 | 1 419 | 6 856 | 858 | 2 739 |
| 1986/87 | 638 | 3 740 | 5 863 | 278 | 1 492 | 5 376 | 916 | 5 232 |
| 1987/88 | 600 | 5 405 | 9 009 | 252 | 2 521 | 10 000 | 852 | 7 926 |
| 1988/89 | 520 | 7 350 | 14 135 | 152 | 1 589 | 10 454 | 672 | 8 939 |
| 1989/90 | 800 | 16 049 | 20 061 | - | - | - | 800 | 16 049 |
| 1990/91 | 208 | 4 480 | 21 538 | 235 | 2 499 | 10 634 | 443 | 6 979 |
| 1991/92a/ | - | - | - | 0.4 | 4 10 000 | | 0.4 | 10 |

Notes: a/ Apply up to December 1991 only.

Source: MDB (1989) and TPB head office - Iringa.

Appendix A.6. Iringa region: Pyrethrum production by
districts, 1976/77-1990/91

| Year | Makete | | Matamba | | Njombe | | Ludewa | | Mufindi | | Iringa | | Total tcs |
|------|--------|----|---------|----|--------|----|--------|---|---------|---|--------|---|--------------|
| | tons | % | tons | % | tons | % | tons | % | tons | % | tons | % | |
| 1977 | 1370 | 72 | - | - | 293 | 15 | 132 | 7 | 84 | 4 | 39 | 2 | 1918 |
| 1978 | 1280 | 74 | - | - | 256 | 15 | 68 | 4 | 66 | 4 | 60 | 3 | 1730 |
| 1979 | 857 | 76 | - | - | 130 | 12 | 50 | 4 | 47 | 4 | 41 | 4 | 1125 |
| 1980 | 762 | 79 | - | - | 108 | 11 | 50 | 5 | 26 | 3 | 16 | 2 | 962 |
| 1981 | 960 | 79 | - | - | 172 | 14 | 49 | 4 | 20 | 2 | 12 | 1 | 1213 |
| 1982 | 907 | 82 | - | - | 129 | 12 | 43 | 4 | 19 | 2 | 10 | 1 | 1108 |
| 1983 | 864 | 83 | - | - | 113 | 11 | 38 | 4 | 14 | 1 | 5 | 1 | 1034 |
| 1984 | 337 | 35 | 475 | 50 | 99 | 11 | 31 | 3 | 6 | 1 | 1 | - | 950 |
| 1985 | 310 | 32 | 542 | 55 | 95 | 10 | 30 | 3 | 2 | - | 2 | - | 981 |
| 1986 | 263 | 31 | 480 | 57 | 70 | 8 | 30 | 3 | 3 | 1 | 2 | - | 848 |
| 1987 | 213 | 30 | 413 | 58 | 54 | 8 | 24 | 3 | 2 | 1 | 2 | - | 707 |
| 1988 | 273 | 34 | 462 | 57 | 51 | 6 | 18 | 2 | 1 | 1 | 1 | - | 805 |
| 1989 | 250 | 33 | 418 | 56 | 57 | 8 | 19 | 2 | 1 | - | 1 | - | 746 |
| 1990 | 309 | 39 | 405 | 50 | 59 | 7 | 23 | 3 | 2 | 1 | 1 | - | 799 |
| 1991 | 219 | 33 | 345 | 51 | 67 | 10 | 31 | 5 | 3 | - | 5 | 1 | 670 |

Years 1977 refers to 1976/77

Source: TPB Head Office - Iringa.

Appendix A.7. NJOLUMACU: Pyrethrum into-store price, 1987/88
- 1991/92

| Particulars | 1987/88 | 1988/89 | 1989/90 | 1990/91 | 1991/92 |
|--|----------|---------|---------|---------|---------|
| | —Tsh/kg— | | | | |
| Producer price | 35.40 | 47.80 | 60.00 | 120.00 | 230.00 |
| Society levy | 1.77 | 2.88 | 3.15 | 3.94 | 6.00 |
| Bag and twines | 2.22 | 2.66 | 4.86 | 7.82 | 7.76 |
| Union levy | 3.00 | 2.39 | 3.60 | 5.25 | 8.00 |
| Cash transport | 1.88 | 0.80 | 0.27 | 0.33 | 0.54 |
| Crop transport | 3.16 | 2.10 | 7.67 | 9.87 | 22.70 |
| Cash insurance | 0.21 | 0.12 | 0.12 | 0.10 | 0.17 |
| Handling charges | 0.21 | 0.30 | 0.30 | 0.30 | 0.30 |
| Crop insurance | 0.28 | 0.19 | 0.20 | 0.37 | 0.69 |
| Shrinkage | 0.71 | 1.44 | 1.60 | 2.40 | 4.60 |
| Marking ink | 0.07 | 0.14 | 0.14 | 0.14 | 0.17 |
| Bank interest | 2.54 | 2.70 | 4.91 | 9.03 | 16.86 |
| Stamp duty | 0.07 | 0.64 | 0.65 | 1.25 | 2.24 |
| District cess | 0.65 | 0.90 | 0.90 | 0.90 | 1.00 |
| Into store price | 52.17 | 65.05 | 88.37 | 161.70 | 301.03 |
| Marketing cost as % of producer price | 47.00 | 36.00 | 47.00 | 35.00 | 31.00 |
| Producer price as % of into store price | 68.00 | 73.00 | 68.00 | 74.00 | 76.00 |

Source. NJOLUMACU - Head office, Njombe.

Appendix A.8 Tanzania: Returns to labour for maize, pyrethrum and potatoes

| Particulars | Units | Maizea/ | | Maizeb/ | | Pyrethrum | | Potatoes | |
|-------------------|-------------|---------|--------|---------|--------|-----------|--------|----------|---------|
| | | 1991 | 1992c/ | 1991 | 1992c/ | 1991 | 1992 | 1991 | 1992c/ |
| Average yield | kg/ha | 1 800 | 1 800 | 1 800 | 1 800 | 185 | 185 | 12 500 | 12 500 |
| Producer price | Tsh/kg | 20 | 38 | 13 | 30 | 120 | 230 | 15 | 25 |
| Gross revenue | Tsh/ha | 36 000 | 68 400 | 23 400 | 54 000 | 22 200 | 42 550 | 187 500 | 312 500 |
| Input costs | Tsh/ha | 10 918 | 19 918 | 10 918 | 13 918 | 1 418 | 2 355 | 58 132 | 52 215 |
| Returns per ha | Tsh/ha | 24 082 | 48 485 | 12 482 | 40 085 | 20 782 | 39 565 | 149 368 | 260 285 |
| Labour input | Man-days | 142 | 142 | 142 | 142 | 153 | 153 | 122 | 122 |
| Returns to labour | Tsh/man-day | 169 | 341 | 88 | 282 | 135 | 258 | 1 224 | 2 133 |

Years: 1991 refers to 1990/91

1992 refers to 1991/92

a/ Based on unofficial market prices

b/ Based on official market prices

c/ Based on prices applicable up to December 1991 only.

Source: Survey data, 1992.

Appendix A.9. TPB: Costs of pyrethrum processing and administration

| Particulars | 1987/88 | 1988/89 | 1989/90 | 1990/91 | 1991/92 ^{a/} |
|------------------------------|------------------|---------|---------|---------|-----------------------|
| | —————Tsh/kg————— | | | | |
| Into store price | 52.17 | 65.05 | 88.37 | 161.70 | 301.03 |
| Processing costs | 40.31 | 87.13 | 91.43 | 105.55 | 132.80 |
| Packaging and bags | 0.40 | 1.26 | 2.43 | 3.18 | 4.42 |
| Flower transport | 8.79 | 18.38 | 30.94 | 29.01 | 27.29 |
| Selling expenses: | | | | | |
| Transport | 2.56 | 3.33 | 5.81 | 7.59 | 8.98 |
| Godown | 1.94 | 1.88 | 3.41 | 4.46 | 4.92 |
| Administration costs: | | | | | |
| Staff | 12.01 | 25.54 | 32.21 | 31.42 | 33.25 |
| Training | 0.27 | 1.16 | 12.65 | 1.75 | 1.49 |
| Administration | 15.81 | 33.92 | 57.36 | 48.43 | 41.28 |
| Fuel | 1.94 | 2.65 | 3.58 | 5.41 | 5.09 |
| Maintenance | 3.36 | 6.73 | 7.42 | 8.84 | 8.36 |
| Financial charge | 39.78 | 49.50 | 38.13 | 30.66 | 33.12 |
| Depreciation | 3.41 | 2.68 | 3.87 | 3.63 | 3.39 |
| Total costs | 182.75 | 299.21 | 377.61 | 441.63 | 605.42 |
| Average salesprice | 193.83 | 241.35 | 406.99 | 468.64 | 578.51 |
| Net profit/loss | 11.08 | (57.86) | 29.38 | 27.01 | (26.91) |
| Quantity of flower processed | 1307.91 | 1196.77 | 1458.59 | 1532.20 | 2100.00 |
| Total profit/loss | 14.49 | (69.25) | 42.85 | 41.38 | (56.51) |

^{a/} Estimates.

Source: MDB, 1991.

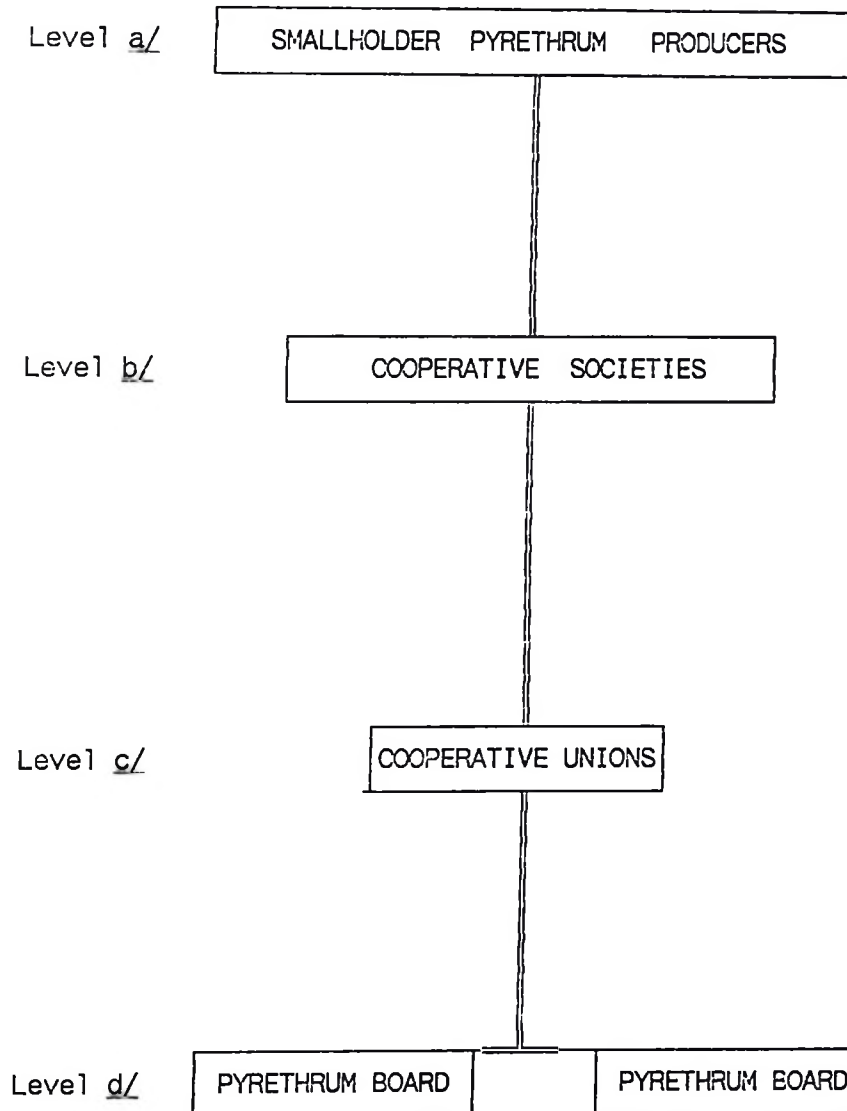
Appendix A.10. Njombe district: Multiple regression
results

Dependent variable: Pyrethrum output supply in Njombe district
(PYOUT_t)

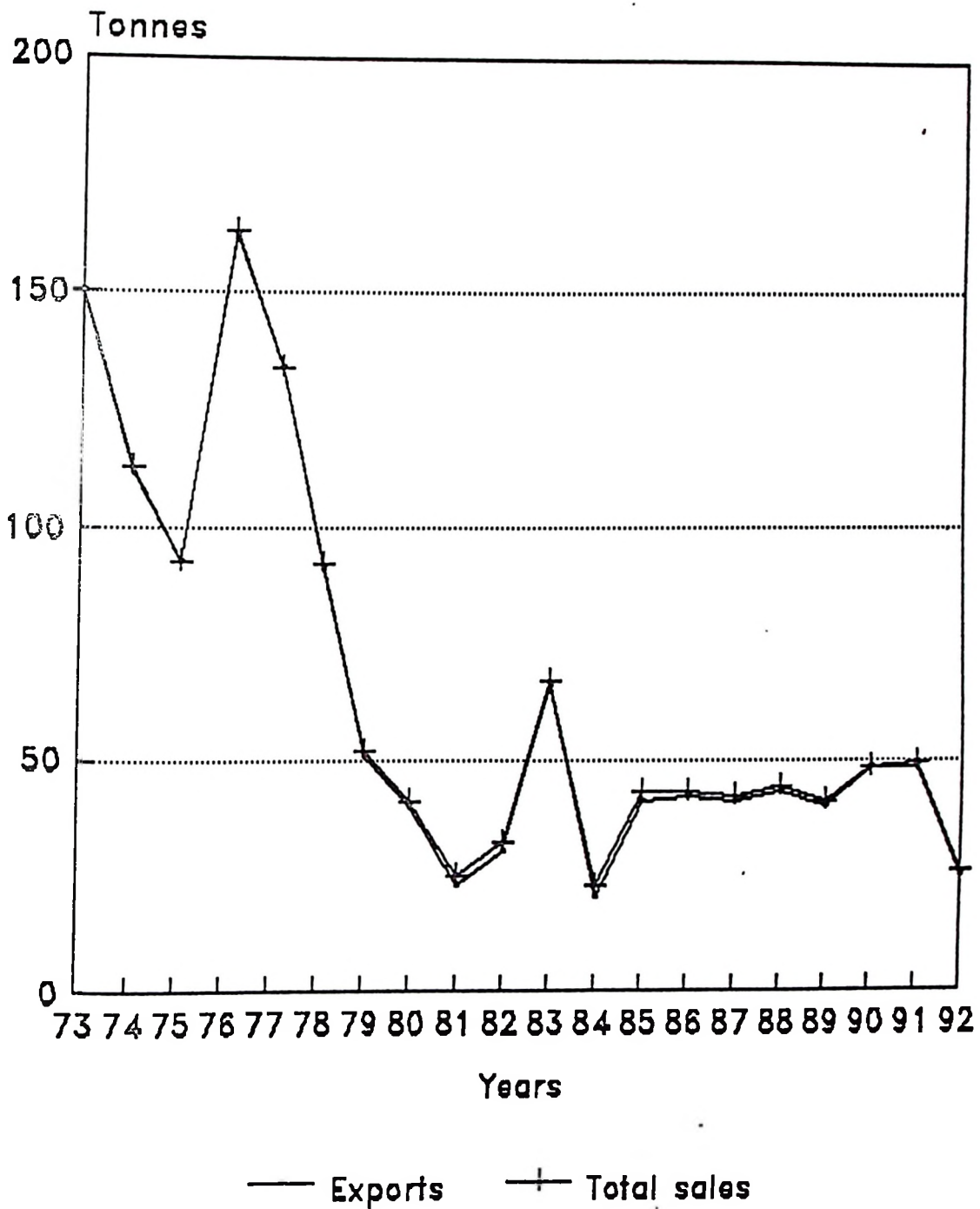
| Variable | Coefficient | | Stand. error | | T-statistic | | Sign. level | |
|----------|-------------|---------|--------------|--------|-------------|-------|-------------|------|
| | t-1 | t-2 | t-1 | t-2 | t-1 | t-2 | t-1 | t-2 |
| C | -108.03 | -96.81 | 79.27 | 91.96 | -1.36 | -1.05 | ns | ns |
| CPYPR | 7.83 | 7.06 | 1.86 | 2.16 | 4.21 | 3.28 | 0.01 | 0.01 |
| PRELA1 | -384.88 | -327.83 | 143.49 | 166.48 | -2.68 | -1.97 | 0.01 | 0.05 |
| R2 | 0.78 | 0.68 | | | | | | |
| SER | 49.13 | 57.00 | | | | | | |
| F | 26.98 | 15.67 | | | | | 0.01 | 0.01 |
| C | -333.07 | -143.00 | 182.93 | 196.41 | -1.82 | -0.73 | ns | ns |
| CPYPR | 11.69 | 8.49 | 2.85 | 3.06 | 4.10 | 2.77 | 0.01 | 0.01 |
| PRELA2 | -261.02 | -217.50 | 507.79 | 545.21 | 0.51 | -0.41 | ns | ns |
| R2 | 0.68 | 0.60 | | | | | | |
| SER | 59.24 | 63.61 | | | | | | |
| F | 16.22 | 11.11 | | | | | 0.01 | 0.01 |
| C | -42.33 | -29.42 | 88.06 | 102.13 | -0.48 | -0.29 | ns | ns |
| CPYPR | 6.59 | 5.78 | 1.97 | 2.29 | 3.34 | 2.53 | 0.01 | 0.05 |
| PRELA3 | -381.21 | -346.03 | 124.63 | 144.54 | -3.06 | -2.39 | 0.01 | 0.05 |
| R2 | 0.80 | 0.71 | | | | | | |
| SER | 46.90 | 54.94 | | | | | | |
| F | 30.34 | 17.94 | | | | | 0.01 | 0.01 |

Source: Computer output, 1992.

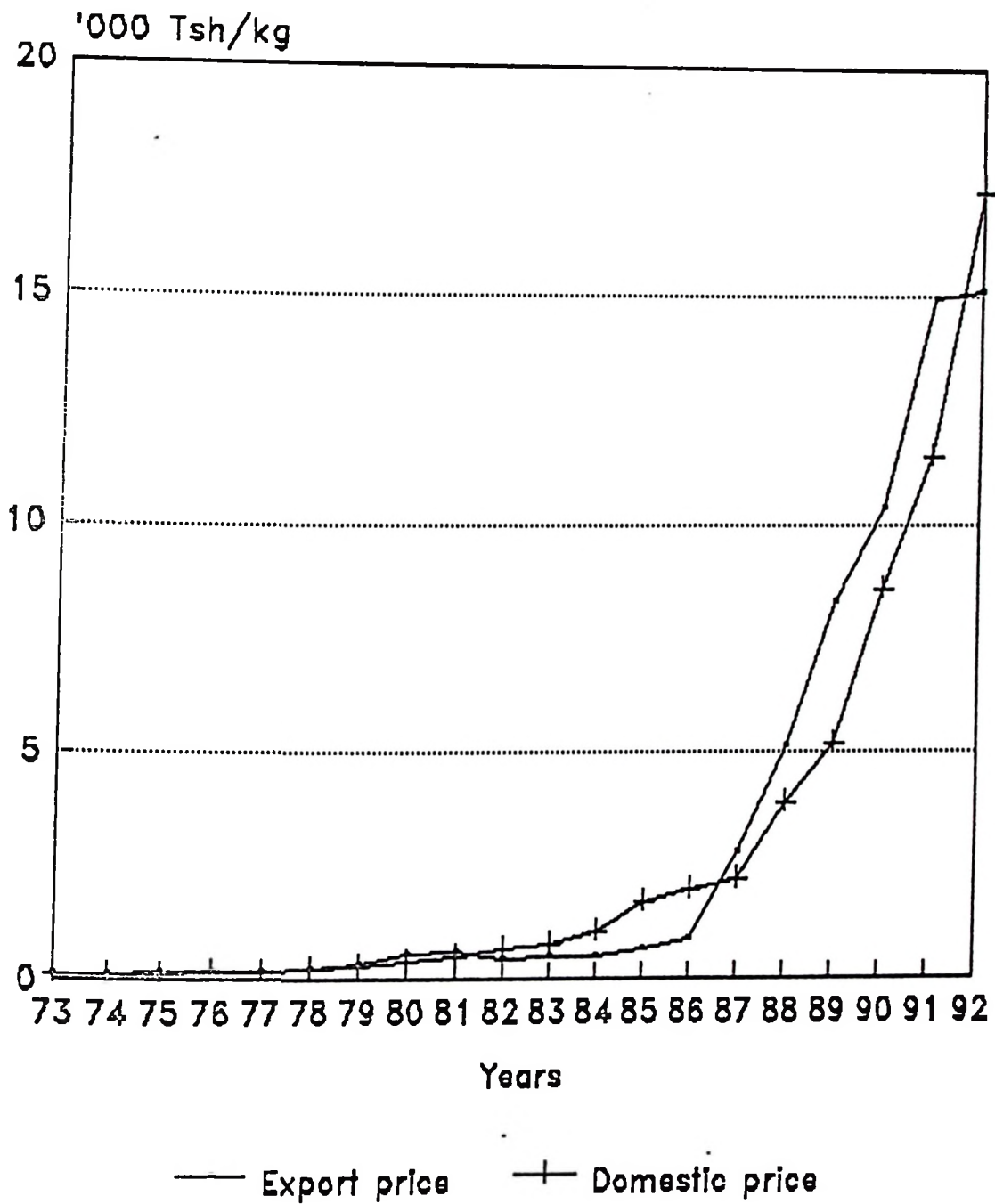
Appendix A.11 Tanzania: Proposed pyrethrum handling channel



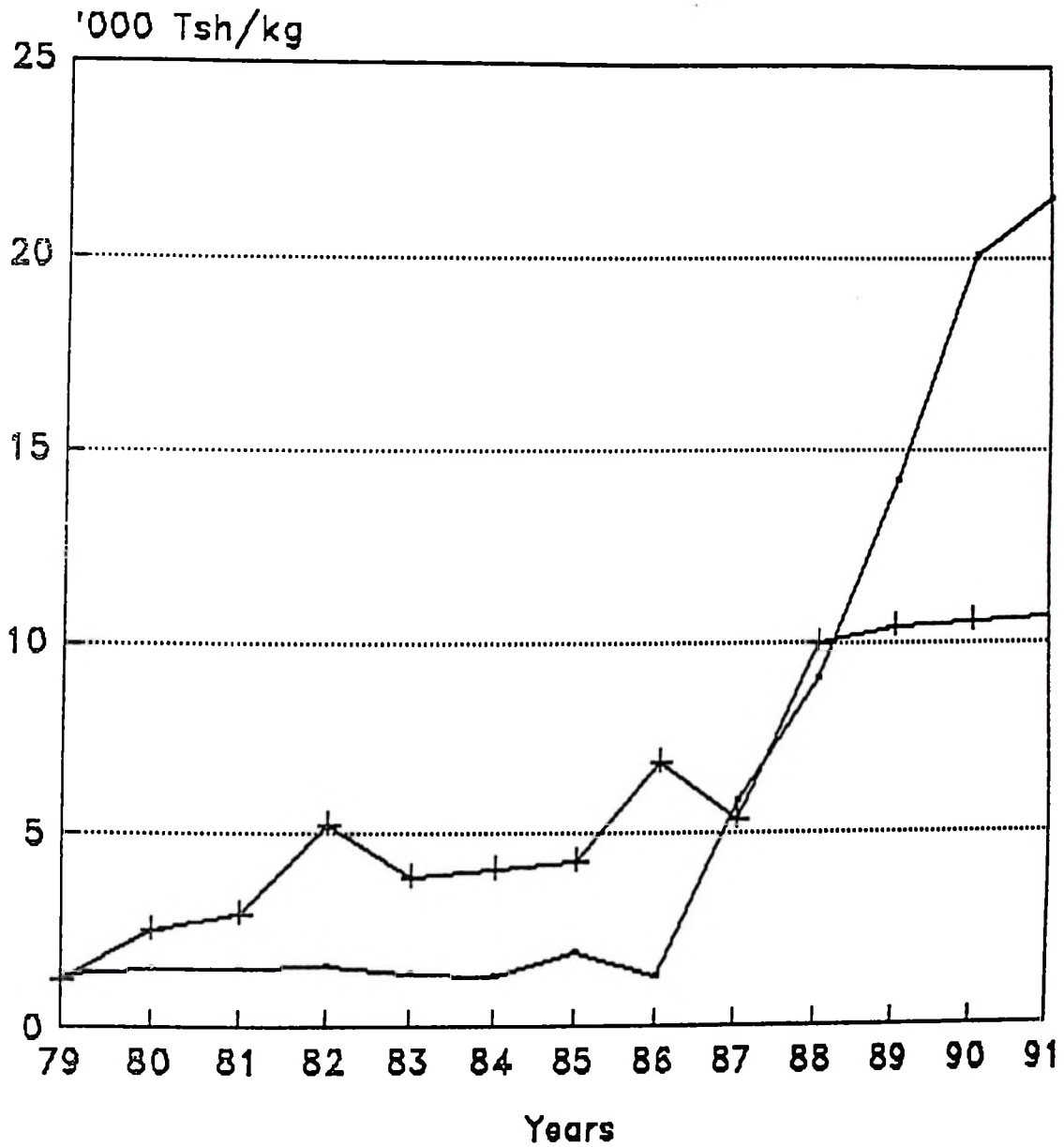
- Notes : Levels
- a/ Production.
 - b/ Primary marketing.
 - c/ Primary and secondary processing - all cooperative unions which handle pyrethrum as a major crop can work jointly in operating the plant.
 - d/ Secondary marketing in domestic and foreign markets.



Appedix B.1 Tanzania: Crude extract sales, 1972/73 - 1991/92

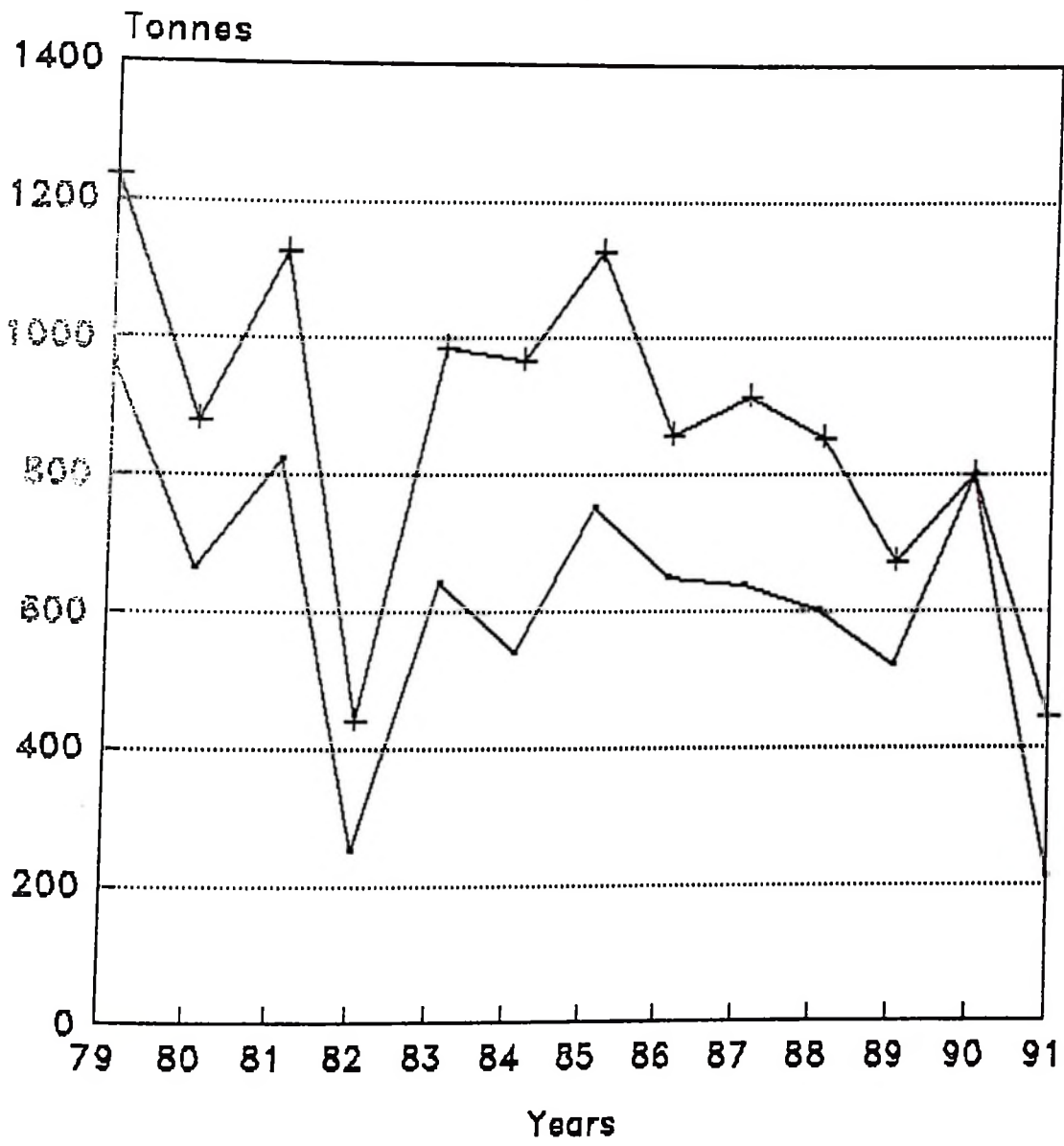


Appendix B.2 Tanzania: Price of crude extract in the export and domestic market, 1972/73 - 1991/92.



— Export price + Domestic price

Appendix B.3 Tanzania: Dry marc prices
In the export and domestic markets,
1978/79 - 1990/91.



— Exports + Total sales

Appendix B.4 Tanzania: Crude extract sales in the domestic and export market, 1978/79 - 1990/91.



SPE
HΔ 9650
P3
N3
WA