IRRIGATION AND DRYLAND FRUIT PRODUCTION: OPPORTUNITIES AND CONSTRAINTS FACED BY SMALL-SCALE FARMERS IN VENDA

BY

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ABSTRACT

In developing rural areas of South Africa that are mainly occupied by small-scale farmers, the productivity of tropical/subtropical fruits is relatively low. This study has been focusing on the opportunities and constraints faced by small-scale farmers on irrigated and dryland orchards farms in Venda. This was done by attempting to gain realistic understanding of what shapes small-scale farmers and how the various influencing factors can be adjusted so that, taken together, they produce more beneficial outcomes.

The specific objectives of the study were to look at the cropping practices by smallholders in Venda for the purpose of acquiring a sound insight in present status, future and constraints of tropical/ subtropical fruit production based on literature and case study; understand the needs and aspirations of these farmers, and to ascertain how support rendered to small-scale farmers can be improved. In order to satisfy these objectives, a questionnaire was developed for specific use among small-scale farmers and a sample of 66 respondents was drawn from Tshakhuma, Muledane, Mukula and Tshifudi areas in Venda. A questionnaire also included details on personal characteristics of farmers, cropping practices and their problems. Frequency tables were utilized to analyse the data. The results of this study indicated that the there is a significant relationship amongst the cropping techniques. Looking at the orchard size and the type of fertilizers applied by the farmers, it has been revealed that farmers owning the small size of the land mostly apply the organic fertilizers, while depending on the family labour. The results also indicated that farmers owning dryland orchards apply the inputs differently from those who practice irrigation farming. Most of the farmers who practice irrigation farming, as compared to dryland farmers, apply inputs such as inorganic fertilizers, supplemental water through irrigation, and hire labourers.

A review of historical background of Vhavenda people was also included in this study to look at their attitudes towards developmental issues. Among the Vhavenda people there

are a number of cultural factors which tend to impact on socio-economic development. These factors, among others, include traditional and polygamous marriages, male dominated authorities, sharing of goods, worshiping of ancestors, and extended families. Historical background indicated that modern cropping methods of tropical/subtropical fruit production are not part of Vhavenda culture, and as a result people relied on indigenous fruits of veld and relishes for their diet.

A survey on climatic conditions and current situation revealed the extent of cropping practices on tropical/subtropical fruit production with regard to small-scale farming techniques, and limiting factor on production and marketing of tropical/ subtropical fruits in Venda. Areas in Venda where small-scale tropical/subtropical farmers is actively practiced and where the research was conducted, small-scale farmers were divided into three categories, namely, home garden owners, farmers who produce under dryland conditions, and the farmers who produce under irrigation systems.

It was clear that the study areas had a great potential with regard to physical aspects that promote sustainable production of tropical/subtropical fruits, but this potential is not fully utilized. The reasons for failure of tropical/subtropical fruit projects are ascribed to be uneconomic farm units, lack of knowledge and skills, lack of funding, lack of reliable markets due to fruit loss at the storage facilities, lack of infrastructure in general and lack of land use planning and management. Mismanagement of orchards in the research areas has resulted in poor cropping performance (yield). It was evident that in this survey that the infrastructure used by the farmers is poor. In terms of support service, small-scale farmers faced serious challenges as they depend on their incomes to render cropping practices. It is difficult whether or not they will function independently in the long run. It seems unlikely that small-scale farmers can survive if struck by a sudden disaster such as fire or drought.

Small-scale farmers need an extremely diverse range of training to facilitate the development of managerial and technical skills. Results of this study revealed that the type of support needed by the farmers include the financial assistance, training, technical

advice, marketing of fruits and advice on marketing, continued assistance on existing tropical/subtropical fruit projects, and assistance in acquiring a farm or more land.

CHAPTER 1: GENERAL INTRODUCTION

1.1. Introduction

It is well known that productivity of tropical/subtropical fruit in the developing areas of South Africa, mainly occupied by small-scale farmers, is relatively low. This is associated with the behaviour and characteristics of farmers who are not properly understood by researchers and developing agents. According to Nthakheni (1993) this could be so because the productivity expected from them is based on the standards and norms of the commercial farmers. In most cases, the commercial farming sector in South Africa exists alongside small-scale, subsistence-oriented farming (Naledzani, 1992). Despite the ever-increasing investment in the rural agriculture, indications are that the production gap between the small-scale farming and the commercial agriculture has been widening consistently. At the same time the Venda population has increased at a rate of 6%, resulting in the rural areas becoming increasingly dependent on fruit from the commercial sectors.

Naledzani (1992) indicated that the commercial farming systems in Venda have been found to be operating on business principles, and substantially supported by specialized private sector service institutions and organizations such as the Land Bank and research institutions. On the other hand, small-scale farming in the rural areas operates largely outside this comprehensive institutional support structure, with restricted access to support services and opportunities to compete on agricultural markets (D'Haese e*t al*., 1999).

Small-scale farmers also face problems related to insecure and fragmented land rights, non-viable and small farm units, deterioration of natural resources, lack of infrastructures, water supplies, transport network, financial support, research and extension services. Theoretically commercial farming and small-scale farming should not necessarily differ in efficiency levels and therefore, this study was undertaken to supply answers on critical issues.

1.2. Motivation of the study

In former homeland areas of South Africa, income and livelihood opportunities remain scarce for some people and this is also happening in Venda (*sensu stricto*). Being in a tropical region, the potential for tropical/subtropical fruit production should be high, whereas the worse poverty, security of livelihood and income options is prevailing. Fruit production may be an option for generating income through marketing.

Looking at the population growth in Venda and other areas in South Africa, the production of tropical/subtropical fruit could be practiced to close the gap that exists between the demand and the supply of fruits. The farmer must therefore, accept responsibility for finding both the foreign and domestic consumers of fruits. According to the Statistics South Africa (2001), the South African population was 43 486 095 of which Vhavenda forms 11.8% (1 199 854) and all these people need fruits as part of their diet. Fruit production can also supply employment opportunities for the many unemployed people in Venda.

Commercialisation of tropical/subtropical fruit production in Venda is about the development of farming practices from subsistence to the regular production. This could also be done by increased participation, or rather, an improved ability to participate in markets. Most of the farmers in Venda are not really part of commercial agriculture. This is one of the reasons that the contribution of smallholder agriculture to the gross national product (GNP) is still limited.

In order to determine the potential of small-scale farmers, this research will strive to get a better understanding of tropical/subtropical fruit production opportunities, constraints and challenges faced by small-scale farmers in Venda.

1.3. Importance of the study

Since agricultural research and extension in South Africa have traditionally been focused, with rare exceptions, on the commercial farming sector, the technology for

the resource-poor is not well developed. Most farmers in Venda are "resource-poor". Additional research of all kinds is of importance for these resource-poor areas and the resource poor farmers. Knowledge concerning productivity difference may be useful for the extension officers in Venda in deciding the cropping practices required by small-scale farmers. It will form the basis or determine the types and level of assistance needed by these farmers from the Government and other support service institutions in order to improve their incomes and their standards of living. By this, they may improve national food security and export earnings of farmers, particularly small-scale farmers. An improvement in the lives of small-scale farmers in the rural areas would also contribute to minimize the rural-urban migration of labour. At present most graduates of local education centres prefer to work in urban areas rather than working in their home villages to uplift the standards of local communities and small-scale farmers in Venda.

1.4. Research questions

Looking at the potential of Venda as a tropical/subtropical fruit production area in general and for small-scale farmers in particular, the following questions can be asked:

a. How do tropical/subtropical fruit production systems fit into the history and culture of the Venda people? What are the main features of the current tropical/subtropical cropping practice, as actually performed by smallholders? This includes description of crop management operations (including water management), their scheduling, inputs, labour features, irrigation practices, production and productivity patterns, marketing practices, etc.

b. What are the reasons, motives, causes, etc. underlying those practices? This includes identification of technical, social, environmental and economic constraints, local knowledge features, etc.

c. To what extent and to what conditions smallholding farmers could improve tropical/subtropical fruit production, and adopt some intensified production

techniques?

1.5. Research methods

A study like this would be futile without a proper understanding of the history, culture and the natural resources in Venda. For this reason a major portion of the study was devoted to gathering information about these aspects.

A questionnaire was designed to acquire details about farmers' characteristics, general household information, land size (ha), type of crops, cropping practices and levels of inputs applied and yield. Questionnaires were handed out to farmers and 66 respondents were used as a tool to collect the data.

Data were analysed by means of both the one-way and the two-way frequency tables from the SAS® PROC GLM[1] package. The main aim of using two-way frequency tables was to identify the relationship in terms of percentage of respondents to the variables (Class variables) such as orchard size (ha), farming system, decision-making and support service, type of fertilizers applied, irrigation method installed, farm workers and yield. Yield variable (Dependent) was categorized into three levels (classes) and expressed as t/ha/year. One-way frequency tables were used to look at the personal characteristics and farmers' problems to determine their attitudes towards adapting to the new cropping methods.

Due to availability of variety of soil types in Venda, more specific data on soil qualities from the study areas were required. Soil samples were taken with a soil auger from each of the four study areas during the survey and analysed at the University of Pretoria. The main aim of taking soil samples was to determine the suitability of soil for tropical/subtropical fruit cultivation under both dryland and irrigation farming. Soil samples from both A and B-horizons were used for identifying colour, texture, consistency and roots availability. Percentage of slope and the land form (topography) were also identified in order to look at the suitability of land for growing fruit trees.

[1] SAS® V 8.2 is supplied by SAS Institute, SAS Campus Drive, CARY, NC 27513, USA.

Photographs were taken during the farm visits for illustrating the condition of existing fruit trees as well as farming.

The most valuable information for this thesis was obtained from the following sources:

- Small-scale farmers;
- Extension offices in the former ARDC/ Agriven offices in Thohoyandou;
- Records of population census in 1996 from the Municipal Demarcation Board (www. dermacation.org.za);
- Climatic data from the Institute for Soil, Climate and Water (Agricultural Research Council);
- Literature; and
- Own observations.

The aim of this project is to discover the cropping practices by small-scale farmers in Venda in detail for the purpose of acquiring a sound insight in present status, future and constraints of tropical/subtropical fruit production based on literature and case study with the emphasis on production by focusing on the following aspects:

a. A survey of natural and climatic conditions which reflect the potential of tropical/subtropical fruit production in Venda with more focus on four different areas such as Tshakhuma, Muledane, Mukula, and Tshifudi. These areas are located in the southern region of Soutpansberg.

b. A survey of the current farmers' practices with regard to tropical/subtropical fruit production in Venda by looking at the difference in tropical/subtropical fruit production on irrigated orchards, dryland conditions and home gardens, and the opportunities as well as the constraints on the marketing and distribution of subtropical fruits to the market place;

c. A comparison between commercial and small-scale farming techniques with the emphasis of evaluating the gap between these two types of

farmers;

d. Identification of the limiting factors on the production and marketing of tropical/subtropical fruits on small-farming systems; and

e. Recommendations on the relationship between farmers' practices (application of labour, inputs, and capital) and cropping systems, input requirements and production of tropical/subtropical fruits, depending on the extent of situation.

CHAPTER 2: HISTORY AND CULTURE OF VHAVENDA

Introduction

Agricultural practices applied in a country form an integral part of the culture of the people and it is therefore important to become acquainted with the history and cultural development of the Vhavenda, that is the people living in Venda. Matata *et al* (1998) confirmed that farmers' cultural background and social history could also influence their attitudes towards risk. Tropical/subtropical fruit production was not part of culture and tradition of the Vhavenda. A number of indigenous fruits species were identified in Venda that played an important role in the nutrition of the people before the introduction of tropical/subtropical fruits. Due to lack of inputs, information and agribusiness infrastructures faced by rural people in Venda, fruit production has mostly been practiced in home gardens and dry land farming systems where inter-cropping with cash crops was applied. This describes the history and culture that prevails in Venda.

2.1. History of Venda

The Vhavenda nation traditionally occupied the north eastern part of the former Northern Transvaal (now Limpopo Province) in South Africa. It lies 22°15' and 23° 30'S and 30° 50' and 31° 15'E where it was bounded by Gazankulu in the south east, Kruger National Park on the east, Zimbabwe/Limpopo River in the north, and Transvaal province on its other boarders (Booysen, 1987; Naledzani, 1992) (Figure 2.1).

The nation comprised a number of groups and these include Vhadau, Vhalaudzi, Kwinda, Singo, Vhalemba, Vhangona, Ndou, Vhakwevho and Mutovhele (Singo, 1996).

Before the 18th century there was no paramount chief as each tribe in Venda was ruled by an independent chief, who was responsible for the government districts within each tribal territory of which the head was under him (independent chief). Most of the

Venda chiefs belonged to the same clan. They crossed the Limpopo River from the north and subdued those whom they found living in the Zoutpansberg in the 18th century. In terms of social organization, Venda people were divided between commoners (*vhasiwana)* and the children of chiefs and their descendants (*vhakololo)*. In the 18th century there were about 12 Venda chiefs in the district of Sibasa (Ha-Tshivhasa) of which some were appointed by the government and others were the descendants of brothers who were the sons of a ruling chief but broke away and established an independent chiefdom somewhere else. By then, there were differences in the customs of the various clans, especially in religious ritual, but there were no distinct differences between the tribes (Van Warmela, 1932)

In 1872, the first Berlin Lutheran settled amongst Vhavenda, although they finally submitted to the authority of the Transvaal Republic in 1899. The Vhavenda were the last black people in South Africa to be seriously affected by contact with the Europeans. Missions, churches, schools, and hospitals were founded in the Sibasa District wherein the Venda government began to subsidize other services like wholesale association for Venda shopkeepers, and, had launched forestry and agricultural schemes. In spite of these developments, European influence remained relatively superficial due to the following three reasons. Firstly, as it has already been mentioned the Vhavenda lived in the mountainous hills thereby making much of their country remote and inaccessible. Such environment had helped them to avoid conquer by Pedi and Zulu aggressors. Secondly, the district of Sibasa was not yet a seriously depressed area, so that there was no urgent need for men to work away from home, compared to other reserves. The country was still fertile and well watered, though deforestation and some ruthless cultivation had made soils less naturally productive than it seems to have been at the turn of the century. Thirdly, during the 19th century, the presence of Europeans had become a factor since Louis Trichardt was introduced in 1939 to interfere in a dispute between two factions. These factions led by the sons of a deceased chief resulted in the preoccupation of Venda in settling political controversies (Van Warmelo, 1932). During that time the Shangaan were immigrant refugees without political organization involving headmen and chiefs, so it was easier for them to adopt influences from Europeans. Most of the Venda political feuds took place between rival ruling families and clans, and the majority of commoners had to

be content to look on, while they waited to see which side to back (Blacking, 1962).

Under the South African Parliament Acts (before 1979), land was set aside for blacks in homelands in order to allow blacks to practice self-government and cultural preservation. Thus Venda was designated for only Venda-speaking people. In real sense, the homelands allowed the white government to control blacks and exclude them from political process. In 1973, Venda was granted self-government, and became the 3rd homeland to be granted independence from the Republic of South Africa in 1979 (The Bureau for Economic Research: Co-operation Development Studies, 1979). The boarders of the Republic of Venda are indicated in Figure 1.1. As an independent state, all the Vhavenda people were treated as foreigners in the remainder of South Africa. The UN Security Council condemned the homelands policy as an attempt by the white government to further their policies of apartheid. Due to this isolation, Venda was not recognized internationally as an independent state. In 1994, Venda was reabsorbed into the new democratic South Africa. The following map in Figure 2.1 illustrates the boarders of the pre-1994 Republic of Venda.

After 1994, part of the former **Northern Transvaal** including Venda became the **Northern Province** as one of the nine new provinces of South Africa with Polokwane (Pietersburg) as the province's capital. On 12 February 2002, a new name, Limpopo Province, was suggested, subject to the approval of the central government (Oettle, 2002). The resent map of the **Limpopo Province** is presented in Figure 2.2 with the blocked area designating Venda. The outer block marks the area belonging to Venda as a whole while the inner block indicates the area where the surveys and observations were made.

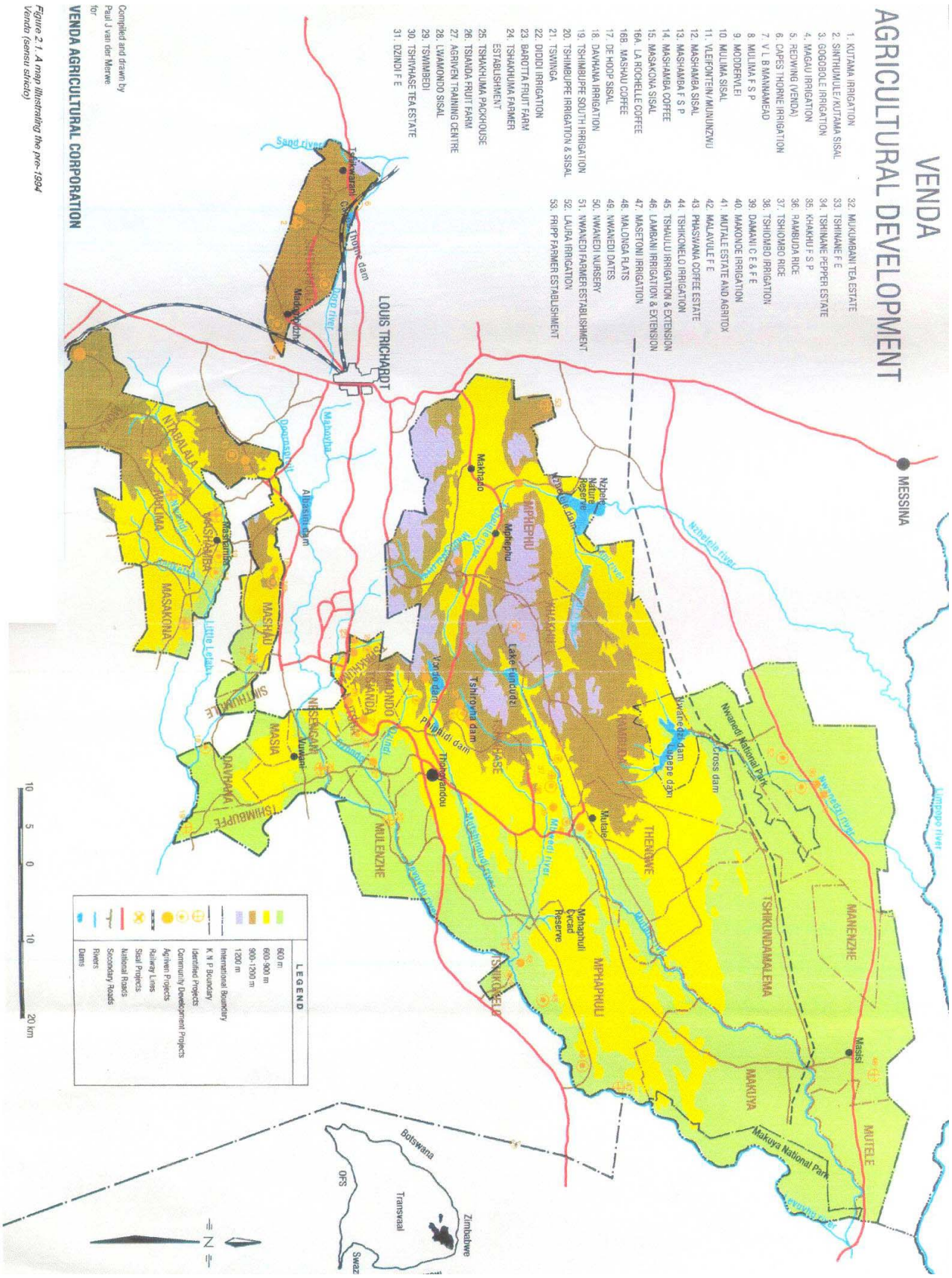

Figure 2.1. A map illustrating the pre-1994 Venda (sensu stricto)

Compiled and drawn by
Paul J van der Merwe
for
VENDA AGRICULTURAL CORPORATION

Figure 2.1. A map illustrating the pre-1994 Venda (*Sensu stricto*)

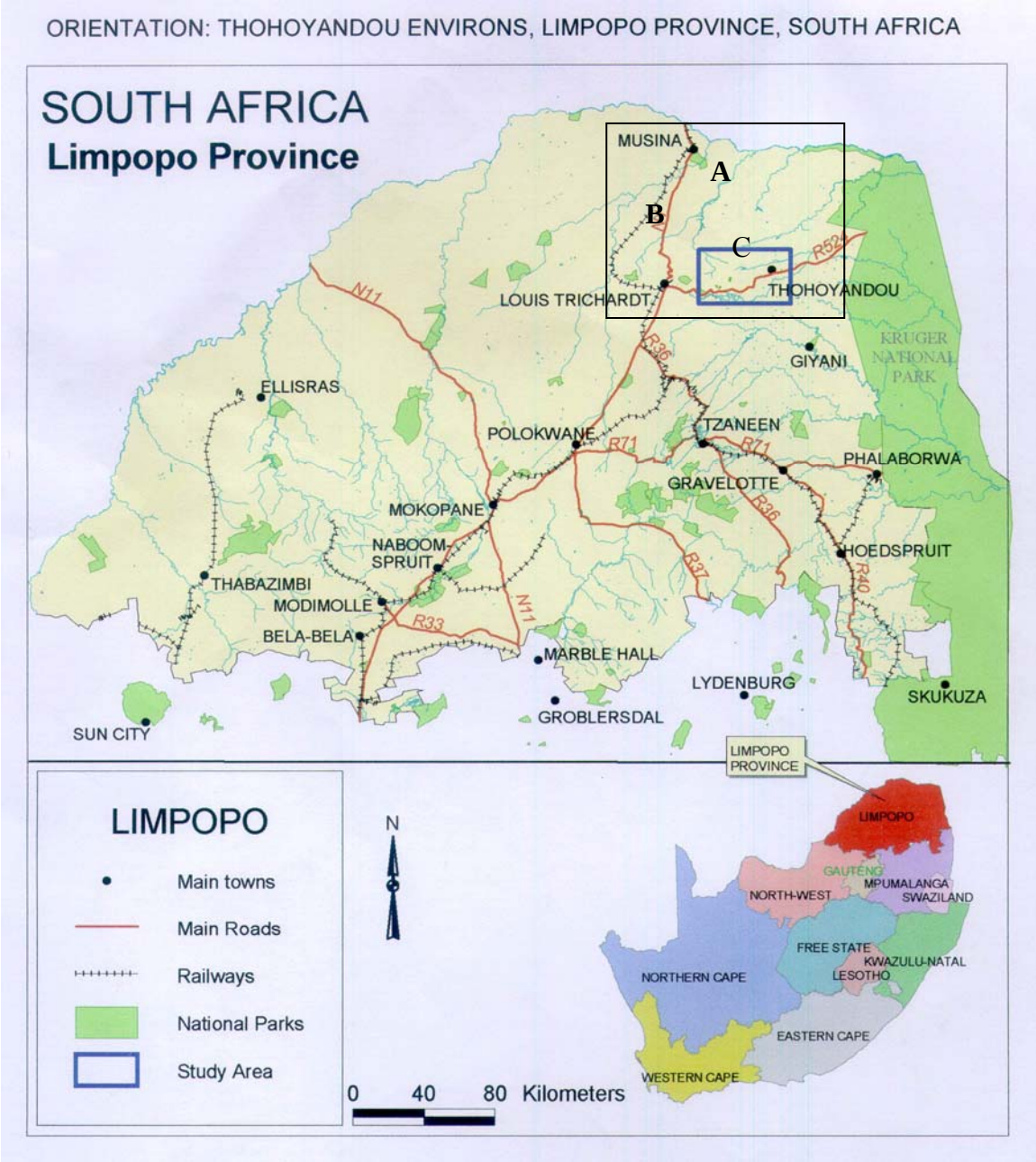

Figure 2.2. A map showing the location and boarders of the Limpopo Province with blocked region indicating the location of Venda.

For the sake of clarity in the rest of this thesis, the expression Venda (*sensu stricto*) refers to the ex -Republic of Venda, excluding the Levubu commercial farmers, while the expression Venda (*sensu latum*) includes the Levubu commercial farmers.

2.2. Demographic situation

2.2.1. Population

The main towns in Venda (*sensu stricto*, Figure 2.1) are Thohoyandou, Sibasa, Tshilamba, Makwarela and Makhado. In most countries, a process of urbanization, as the role of non-agricultural activity, increases economic development. This process has hardly started in Venda as alternative, employment opportunities were mostly situated outside Venda. Concentration of the population occurred mainly in Thohoyandou where the urbanization processes were evident (see Figure 2.3.). Sibasa, Makwarela and Shayandima surround Thohoyandou as the capital city of Venda. A map illustrating the recently populated areas in the Limpopo Province is shown in Figure 2.3 with the blocked area covering Venda (Demarcation Board, 2003).

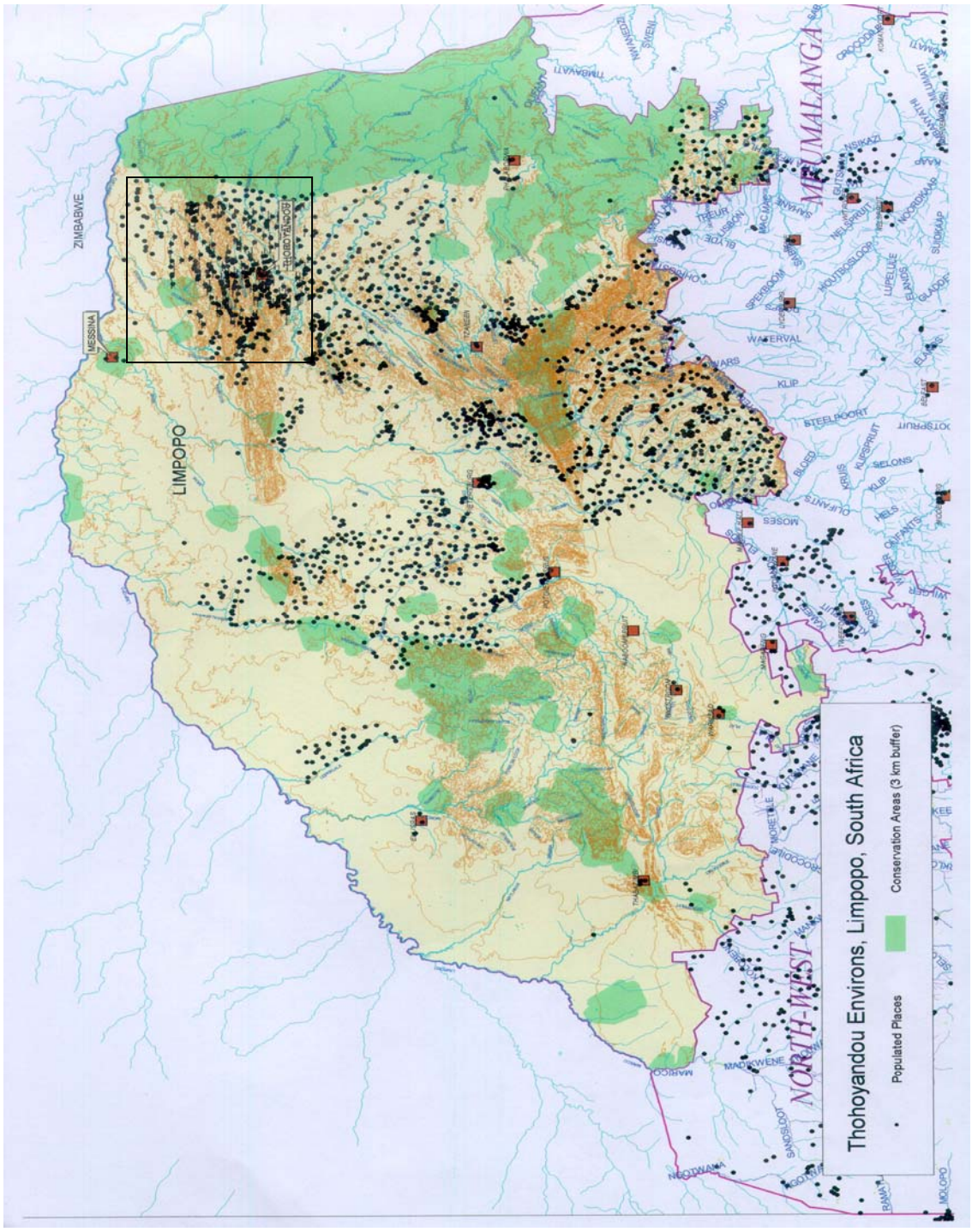

Figure 2.3. A map showing the populated areas of the Limpopo Province, including Venda (blocked area) of the Limpopo Province (See Figure 2.1 and 2.2).

In terms of population distribution within Venda, the Vhavenda people are organized

into several traditional and political units of which the chief's territory is the largest. A chief's territory is divided into different districts with each district being under the control of a headman. Each district is further divided into sub-district under its head that in turn consists of several villages under the village head.

At the present situation, there are two ways to define the population known as the *de facto* and *de jure* population. The population residing within Venda is known as the *de facto* population and this includes even those people who do not speak Venda but live in Venda. While the former Venda government has accepted responsibility for all its citizens, those Vhavenda residing inside or outside Venda, are known as the *de jure* population. Some of the Venda-speaking people do not reside in Venda due to migration. Those who reside in Venda experience many challenges in terms of development. The *de jure* population of Venda is fairly homogenous. This factor is important as it implies that the ethnic often hampers development efforts in many societies, but is absent in Venda (The Bureau for Economic Research: Co-operation Development Studies, 1979). *De jure* population forms about 90% of Venda speaking people. Therefore socio-cultural and ethnic features would not hamper development efforts.

According to Statistics South Africa (1996), the population of Vhavenda was 1 199 854. Therefore, the population of Venda is growing at a 6% growth rate. Having this rate of population growth, sustainability in production systems is necessary in order to maintain the resources that facilitate production. The higher the population, the bigger the potential market but also the higher the pressure on natural resources.

As one of the determinants of productive potential and marketing opportunities of the country, the size of the population, given its other resources such as land and capital, also affect development. Population growth rate determines the rate at which economic growth has to take place to ensure that the income per head does not decrease (VNDC, 1990). If the population growth becomes lower, it will be easier for economic growth to outstrip population growth to enable the government to make more resources available for agriculture, education, health services, and infrastructure.

When looking at the HIV/AIDS status, South Africa is experiencing an explosive epidemic of HIV/AIDS (Williams e*t al*., 2000a). Williams *et al*. (2000b) further confirmed that demographic forecasting of the South African population, incorporating geographical distribution and age prevalence data on HIV infection have been used to predict future mortality due to AIDS. In the year 2010, approximately 500 000 AIDS-related deaths are predicted, up from 2000. Therefore, the population of South Africa may be reduced drastically due to HIV/AIDS infections.

2.2.2. Culture of Venda people

In any programme of intervention aimed at bringing about beneficial change, knowledge of socio-cultural environment is essential. Among the Vhavenda people there are a number of cultural factors, which tend to impact on decision-making and socio-economic development. This include traditional culture, sharing of goods and traditional ceremonies, extended families, male dominated power and authority, all of which may have a negative or positive influence on the household economy and agricultural development.

On the agricultural side, the traditional intercropping of grains/legumes with tropical/subtropical fruit still persists. There has been a tendency among extension officers not to recommend traditional crop growing, but rather to advocate inappropriate commercial farming methods.

2.2.2.1. Social life

The Vhavenda people have shielded themselves from foreign cultural influences for a considerable period of time. They are closely linked with the ancient cultures of southern Zimbabwe. Their language, Tshivenda, as an example, is more related to those tribes of Zimbabwe with its close similarity to the Kalanga (Shona) group as far as the grammatical structure is concerned. This language is sharply distinguished from the languages of the Sotho, Zulu, Xhoza, and Shangaan (Van Warmela, 1932).

The most important primary social grouping in Venda is the nuclear family consisting of the husband/father, his wife or wives, and children. His family respects the father as the head and decision-maker on the family and farming matters. The family head is responsible for providing his wife and children with clothes, food, and medical care. As head of the family, he bears responsibility for the conduct of his family and settles all household disputes (The Bureau for Economic Research: Co-operation Development Studies, 1979). The wife is also responsible for the provision of cash crop production for the family while the head is working somewhere outside Venda.

In terms of fruit production, the head of the household is responsible for the decision-making process about the techniques used.

2.2.2.2. Religious life

Before the advent of Christianity, the Venda people believed in a supreme being, Khuzwane, who had created all things and can be compared to the Hebrew Jehovah. People believed that he has disappeared and left his footprints on a rock near the Luvuvhu River in the land of Lambani.

The second god was *Raluvhimba* or *Mwali*, the reward of good and the punisher of evil. During the eclipse of December 2002, some of the Venda people gathered next to the Soutpansberg Mountain's cave (*Bakoni la Nwali*); at Makonde village to worship Nwali as it is believed that the presence of the eclipse means that the god is angry. The third god, Thovhela, was an intermediary between the Supreme Being and man and favourably inclined towards mankind (The Bureau for Economic Research: Co-operation Development Studies, 1979). However, the fourth level of deities was the most important *Mudzimu* (plural *Vhadzimu*), the totality of good soils of the ancestors who were believed to exercise some influence on the living.

Resurrection such as in Christianity was not known, but the immortality of the soul was expressed in the fact that the souls of the dead became *Vhadzimu*. The first missionary to pay attention to the Venda people was MacKid of the Dutch Reformed Church, who founded the first mission station for Blacks of the Soutpansberg in 1963,

named Goedgedacht. At the present moment there are several churches around Venda such as Apostolic Faith Mission, Lutheran Church, Apostolic Unity Church, and others.

Formerly cultivation of crops was affected by religion due to the fact that all the Venda people believed in their ancestors for high output. Raluvhimba as the Venda god was responsible for rain. Before planting Vhavenda people used to ask for the rain protection of crops against pests and good harvest. Recently most of the Vhavenda people rely on the potential of an area and implementation of good agricultural practices for crop production although some of the Vhavenda people still believe in the gods. If the area has the potential for production of fruits, proper knowledge and cultural practices (cropping system) is applied to obtain high output from the crop. This could lead to the conflict between the older traditional people and younger, more modern people as far as transformation of agriculture is concerned.

2.2.2.3.Education

2.2.2.3.1. Primary and secondary education

There are many schools in Venda that are supported by the government to provide education and in each village; there are both the primary and the secondary schools. The rapid rise in enrolment in primary schools started in the late 1960s and is continuing. Children start attending primary education at the age of 6. Most of the primary schools commence from grade 1 to grade 7. This is due to the fact that school attendance became compulsory and was free for each and every learner. At present, learners are paying school fees of R50-60 at the primary level while paying R100-200 at secondary level on an annual basis.

2.2.2.3.2. Tertiary education

The University of Venda for Science and Technology, which is situated in Thohoyandou, is the only university in the Venda area and other neighbouring Provinces. Other tertiary institutions are Madzivhandila College of Agriculture,

Makhado College of Education, Tshisimani and Ramaano Mbulaheni Training Centre (For education). The School of Agriculture, Rural Development and Forestry at the University of Venda for Science and Technology and Madzivhandila College of Agriculture provide education of tropical/subtropical fruit production.

Most of the Venda graduates from these institutions do not work in Venda due to job opportunities in other provinces of South Africa. This situation affects the fruit production in Venda due to the fact the graduates do not have the chance to apply their knowledge to the local farms.

2.3. Agriculture in Venda

2.3.1. Traditional agriculture

Traditional economic life of Venda people is totally bound by agriculture (both animal and crop production). The chief, as the head of the territory, selects land for himself and his village's needs before allocating the rest to the headman. They in turn allocate agricultural land to their subjects but the grazing land is communal, that is, any member of the community has access to using it for grazing. There are certain rules that control sustainable usage of land for the benefit of all the people of a particular village. On the land owned by the tribes, this system is still functioning in an unaltered way but on state-owned land allocated to tribes, there are some limitations on the allocation of land to the absent tenants, depending on the number of cattle allowed on the land and on the other misuses of the land. All the tribesmen retain their inalienable rights to cultivate the land, notwithstanding population pressure on available resources, with the result that the shortage of land has become a considerable problem in recent years (The Bureau for Economic Research: Co-operation Development Studies, 1979). Those who are running short of land, produce fruits in their gardens, although they realize that it is not profitable, the aim is merely to serve the family.

Formerly, when the *per capita* demand for land (*tsimu*) was less, it was possible to have land lie fallow for some time before being re-cultivated.

Zea mays L. [maize (m*avhele*)] is the staple food, but *Sorghum bicolour* [sorghum (*mukhaha*)] and *Eleusina coracana* [Finger millet (*mufhoho*)] are also very popular. The usual sowing time is from October to January, after the first rains. The chief used to initiate the sowing and reaping ceremonies. The reaping ceremony was one of thanks giving at the family level, held after the chief has performed his own ceremony. These ceremonies are no longer as widely practiced as in the past.

Although plant production is more important than cattle farming, cattle were most sought after by the Venda people as a source of wealth and prestige. Cattle also played an important role in the religious life and bride price (lobola) (The Bureau for Economic Research: Co-operation Development Studies, 1979).

During the introduction of fruit growing in orchards, the system of fallowing ceased to exist due to shortage of land. It was the responsibility of women to plough the land although these days men also help in cases where the mechanical means are available. Cultivating of land was a festive occasion, during which one member of the work party dances ahead of the workers, with the beer waiting in the shadow of the tree (The Bureau for Economic Research: Co-operation Development Studies, 1979). These traditions have never been translated to tropical/subtropical crops.

2.3.2. The role played by indigenous fruits and relishes

Before the introduction of cropping practices for producing foreign tropical/subtropical fruit (such as the mango, avocado, citrus, papaya, macadamia, and others) the Venda, people used to eat indigenous fruits of the veld. Venda has many kinds of indigenous fruits that served as a diet for the Venda people (Table 2.2). According to Singo (1996), the term "indigenous" is used in a broad sense to include naturalized alien species that have been in Venda for decades but socially regarded as indigenous to the region. Small boys learned which fruit they can and cannot eat when out in the veld. Later when herding, this knowledge would grow rapidly. Similarly the girls as they helped their mothers collecting firewood would acquire that knowledge about the fruit of the veld. Traditionally, the nuts from *Sclerocarya birrea* are milled to produce a fine powder that is often used when cooking certain relishes to

improve the taste, flavour and nutritional value. Due to the fact that relishes like *Grewia occidentalis* and *Corchorus tridens* have a slippery character, they cannot be mixed with nuts. Recently the use of these nuts has been substituted by groundnuts (*nduhu*) (*Arachis hypogeae*). According to Singo (1996), the term "relishes" (*muroho*) refers to a mainly herbaceous plant or portion of a plant that is consumed as a side dish with the starchy staple as a traditional green vegetable and these are shown in Table 2.1:

Table 2.1. Relishes (*Miroho*) used in Venda (Singo, 1996)

Botanical name	**English name**	**Venda name**	**Afrikaans name**
Amaranthus hybridus	Cape pigweed	Vowampengo	Misbredie
A. standleyanus	Pigweed	Vowa	Misbredie
A. viridis	Pigweed	Vowa/Gang	Misbredie
Bidens pilosa	Spanish blackjack	Mushidzhidonga	Spaanse knapsekerel
B. bipinnata	Common blackjack	Mushidzhi	Gowene knapsekerel
Chenopodium polyspermum		Daledale	Goosefoot
Citrullus lanatus	Wild watermelon	Mutshatsha	Karkoer
Cloeme gynandra	Spider-wisp	Murudi	
C. monophylla	Spindle pod	Mutohotoho	Rusperbossie
Corchorus tridens	Wild-jute	Delele	Wildejute
Cucumis africanus	Bitter apple	Tshinyangu	Bitterappel
C. zeyheri	Wild cucumber	Tshifhafhe	Wilde komkommer
Grewia occidentalis	Crossberry	Mulembu	Kruibessie
Hibiscus tronum	Bladder weed	Delelemukhwayo	Terblansbossie
Ipomoea plebeia		Muduhwi	
Laportea peduncularis	Stinging nettle	Dzaluma	Bosbrandnetel

Limeum viscosum		Tshitopitopi	Klosarbossie
Momordica balsamina	African cucumber	Tshibavhe	Laloentjie
M. charantia		Lugu	
M. foetida	Bushman karo, karu	Nngu	
Pouzolzia mixta	Soapbush	Muthanzwa	Seepbos
P. parasitica		Makhulu-wa-dzaluma	
Solanum nigrum		Muxe	Nastergal
Sonchus oleraceus	Sow-thistle	Shashe	Melkdissel/ Sydissel
Vernonia sp.		Tanyi	

Some of these species are regarded as problem species (weeds) where cultivation of crops is practiced. During the period of weed control, relishes such as *Momordia balsamina, M. charantia, M. foetida, Corchorus tridents,* and *Solanum nigrum* are not removed. They form part of intercrop with maize. The rest of the relishes could be left on the field as intercrop only if the main crop could no longer be interrupted by these relishes. Harvesting the relishes can form part of biological weed control.

Indigenous fruit trees (Table 2.2) such as *Adansonia digitata, Anona senegalensis, Diospyros mesapiliformis, Lannea discolor, Parinari capensis, P. curatellifolia, Sclerocarya birrea, Trichilia dregeana, T. emetica, Vangueria infausta, Ximenia americana* and *X. caffra* are usually not removed during bush clearing. They are kept to serve as intercrop species within the main agronomic crop. It is against the law to remove marula trees (*Sclerocarya birrea*), as it is an important tree for marula beer during the period of weeding of the chief's field (*dzunde*). Indigenous trees also play a very important role as they provide shade to labourers during the period of planting, weeding and harvesting (Mashela and Mollel, 2001).

Table 2.2. Indigenous fruits from the veld found in Venda

Botanical name	**English common name**	**Venda common name**	**Afrikaans common name**
Adansonia digitata	Baobab	Muvhuyu	Kremetartboom
Annona senegalensis	Wild custard apple	Muembe	Wilde vla- appel
Antidesma verosum	Tassel berry	Mukwalikwali	Voëlsitboom
Berchemia zeyheri	Red ivory	Muhuhuma	Rooi- ivoor
Boscia albitrunca	Caper bush	Muthovhi	Witteboom
Bridelia micrantha	Mitzeeri	Munzere	Mitserie
Carissa edulis	Arabian numnum	Murungulu/ Mutungulu	Noem- noem
C. bispinosa	Num num	Mutungulu	Noem- noem
Cassia petersiana	Monkey pod	Munambinambi	Apiespent
Cephalanthus natalensis	White strawberry bush	Murondo	Witaarbeibos
Cordyla africana	Sunbird tree	Mutondo	Suikerbekkieboom
Cussonia spicata	Common cabbage tree	Musenzhe	Gewone kiepersol
Diospyros mespiliformis	African ebony/ Ebony	Musuma	Jakkalbessie
D. pallens	Monkey plum	Muthala	Bloubos/ swartbas
Euclea crispa	Blue guari/ Guari	Mutangule	Bosghwarri
E. divinorum	Majic guari		Towerghwarrie
Dovyalis zeyheri	Wild apricot	Mutu	Wilde appelkoos
Ficus ingens	Red-leaved rock fig	Mukululu/ Tshikhululu	Rooibladrotsvy
F. sycomorus	Sycomore fig	Muhuyulukuse/ Muhuyuvuvha	Gewone trosvy

Flacourtia indica	Governor's plum	Mutuzwu	Goewerneurspruim
Garcinia livingstonei	Forest mangosteen		Bosgeelmelkhout
Gardenia amoena	Thorny gardenia	Murombe	Doringkatjiepiering
G. thunbergii	White gardenia	Tshiralala	Witkatjiepiering
Hexalobus monopetalus	Baboon's breakfast	Muhuhuma	Shakamapruim
Hyphaene natalensis	Lala palm	Mulala	Lalapalm
Kirkia acuminata	White syringa	Mubvumba	Witsering
Kraussia floribunda	Wild kornel	Muvhibvela	Renosterkoffie
Lannea discolor	Living long	Munii	Dikbas
Lantana rugosa	Bird's brandy/ Chameleon's berry	Tshidzimbavhalisa	Wilde salie
Landolphia kirkii	Rubber vine/ Wild peach	Muvhungo	Wildeperske
Maytenus undata	Koko tree/ South African holly	Mutepe	Kokoboom
Mimusops zeyheri	Transvaal redmilk wood	Mubululu/ Mutawi	Moepel
Myrica serrta	Lance-leaf wax berry		Smalblaarwasbessie
Oncoba spinosa	Snuffbox tree	Mutudzwi	Snuifkalbassie
Parinari capensis	Sand apple/ Dwarf mobolo	Muvhula	Bosappel
P. curatellifolia	Cork tree/ hissing tree/ sand apple	Muvhula	Boomgrysappel
Rhus dentata	Nanaberry	Muthakhuthaku	Nanabessie
R. pantheri	Nanaberry	Mutasiri	Gewone kraaibessie

Rubus pinnatus	Bramble/ South African black berry	Munambala	Braambos
Sclerocarya birrea	Marula	Mufula	Maroela
Strychnos spinosa	Green monkey orange		Groenklapper
Tabernaemontana elegans	Lowveld load tree	Muhatu	Paddaboom
Trichilia dregeana	Forest mahogany	Mutshikili	Bosrooiessenhout
T. emetica	Natala mahogany	Mutshikili	Rooiessenhout
Vangueria infausta	Medlar	Muzwilu	Wildemispel
Ximenia americana	Small sour plum	Mutanzwa	Kleinsuurpruim
X. caffra	Large sour plum	Mutanzwa	Grootsuurpruim
Ziziphus mucronata	Buffalo thorn	Mutshetshete	Blinkblaar

Due to population growth and adoption of new lifestyle of Vhavenda people, indigenous fruits have lost their attractiveness and are seldom used. The main factors resulting in the diminishing use of indigenous fruit trees are overexploitation (for firewood), overgrazing as well as tree destruction for the purpose of housing. Tropical fruit like mangoes, avocados, banana, citrus and others, however have not yet become part of culture of Venda people.

2.3.3. Small-scale agriculture

Venda agriculture consists of two types of cropping systems, namely large-scale or commercial farming and small-scale farming system. Understanding the nature of agriculture in rural areas also referred to as "small-scale" agriculture is fundamental for understanding development, as rural agriculture remains an important activity in rural areas of Southern Africa including Venda (D'Haese *et al*., 1999; D'Haese *et al*., 2001).

In order to define small-scale agriculture an understanding of historical, political and socio-economic conditions is required. Small-scale farmers can be regarded as the "resource-poor farmers", "subsistence farmers", “small growers", "small-holder farming", "emerging" or "developing farmers" as opposed to the "commercial farmers" or "large-scale farmers". All these concepts exclude commercial farmers at Levubu in Venda (*sensu latum*).

According to Leroy *et al*., (2001), the concept of small-scale agriculture in South Africa is subjected to non-productive agriculture. In recent years, some efforts have been made to find a socio-economically accurate definition for a small-scale farmer that was relevant to South Africa. An appropriate definition would then enable the Government to make black farmers the target of various support measures that would improve their access to resources. The problem is that black farmers are not a homogenous group and a number of them cannot be defined as small-scale, whether "small" refers to size of land, income or labour utilization (Alien and Perry, 1996; Meyer, 1998).

2.3.4. Commercial agriculture

Presently commercial fruit production plays an important role in the economy and society of Venda (*sensu latum*). As had been said in the historical review, tropical fruit production was not part of Venda culture. According to The Bureau for Economic Research: Co-operation Development Studies (1979), before 1979 fruit production provided more than one-fifth of the jobs for economically active population within Venda, although a large proportion of the agricultural labour force is economically under-employed. During 2001 tropical fruits such as banana, avocado, citrus, guava and macadamia nuts were regarded as the Venda's main products, generating more than R115m a year in both exports and local markets (Business Day News Working Knowing, 2002).

As far as marketing of fruits is concerned, Levubu Cooperatives play an important role in the distribution of fruits to local markets, national markets and export markets. In terms of the processing of fruits such as mango into archar, Shayandima factory

(situated 1 km, west of Thohoyandou) has given a boost to mango producers, and is assured for a local market for their produce. Avocado and banana, and to lesser extent guavas and citrus, are regarded as important crops with considerable potential in Venda.

Tea is particularly well adapted to the climatological and pedological conditions in Venda. The Sapekoe Company produces tea at Mukumbani, Tshivhase, Phiphidi and Hamashau. Another condition increasing the desirability of tea production in Venda is the large supply of unemployment or underemployment labourers. Increasing tea production in Venda would contribute toward alleviating underemployment labourers. Coffee is another product that could be successfully grown in Venda. For example, before the introduction of banana at Khubvi (Damani), Damani Coffee Estate was one of the best producers of coffee in Venda.

Intercropping of fruits with cash crops is the main system that is practiced in Venda by small small-scale farmers in order to avoid the risk of total crop loss. Leroy *et al.* (2000) confirmed that crops most often cultivated in Venda include maize (96% of the farmers), relishes (50%), groundnuts (48%), cabbage (48%), tomato (37%), onions (21%) and pumpkins (17%).

2.4. Conclusion

The culture of the Vhavenda did not part of commercial fruit production. Tropical/subtropical fruit production had been practiced on a subsistence-farming basis. This is because according to the culture and history of the Vhavenda agricultural practices, indigenous tree species played an important role in the supply of fruits for human diet. After the introduction of commercial farms in the Levubu area in Venda, fruit production became an important practice by small-scale farmers in close proximity to large-scale farms. Failure of high productivity of the small-scale farming is due to land size, lack of knowledge, support service and inputs for the commercialisation of tropical/subtropical fruit production. These issues are investigated and addressed in the following chapters.

CHAPTER 3: THE NATURAL RESOURCES AND INFRASTRUCTURE IN VENDA

Introduction

The total area within the boundaries of Venda is about 6 899 km², lying at an elevation above sea level starting from 240 m in the northern regions and rising up to 1 400 m in the mountain ridges of the southern regions. The local topography varies from flat and gently sloping lands in the valley and plateaux, to undulating and rolling hills and steep stony slopes (Naledzani, 1992).

According to Decoteau (1998), plants have certain environmental requirements such as abiotic (physical) and biotic (biological). To attain the highest potential yields a crop must be grown in an environment that meets these requirements. A crop can be grown with minimal adjustments if it is well matched with its climate or growing condition depending on the available natural resources. The question is whether Venda has a suitable environment and the necessary natural resources for viable tropical /subtropical fruit production. These issues will be addressed in this chapter.

3.1. Climate: temperature, rainfall and wind

Climate largely determines the type of vegetation that grows naturally in any part of the world and the kinds of agricultural production that are possible. The three most important factors in climate from the standpoint of plant response are temperature, water supply, and light (Community Development Counselling Service, 1964). Temperature and water supply are the main factors that determine where native species are growing and a good indication where crop plants can be grown. Other elements of climate are less important from the standpoint of crop production although wind increases transpiration and therefore the water requirement of plants. Hailstorms and strong winds can damage or destroy crops (Community Development Counselling Service, 1964).

Each kind of crop grows and develops most rapidly at a favourable range of air temperatures (Decoteau, 1998). For most crops the optimum functional efficiency occurs mostly between 12 and 24°C. Susceptibility to extreme temperatures varies with different species and there may be differences among varieties of the same species. This limiting influence on crop distribution results primarily from too short a period of favourable temperature for floral induction; unfavourably high or unfavourably low growing-season temperatures for proper development of the crop.

Venda's temperature has an average minimum range of 10-15°C and an average maximum of 25-30°C, with almost all regions of Venda free from frost and suitable for intensive agriculture (Naledzani, 1992). The evaporation rate during mid-summer season is in the range of 5-7 mm per day.

Venda region is characterized by summer rainfall with little or no rain during the winter months in some areas (See Figure 3.4). In order to meet the water requirements of the fruits such as mango, avocado, citrus, and others, water should be regularly supplied through irrigation as it is at this season where those fruit trees are at the critical stage of flowering (Joubert and Bredel, 1998).

According to Naledzani (1992), the rainfall in Venda has been classified according to distribution and number of rainy days into four levels to define the physiographic nature of the region as follows:

- Very low rainfall with annual precipitation of less than 400 mm and the number of 25-30 rain days. This level of rainfall occurs on the northern part of Venda (Region A- see Figure 3.2);
- Dry or medium to low rainfall with annual precipitation of 400-600 mm and number of annual rainy days ranges from 40-45 as in the western side of Venda (between Region A and B- see Figure 3.2);
- Medium rainfall with annual precipitation of 600-900 mm and 90-100 rainy days occurring in the south eastern part of Venda (Region C- see Figure 3.2); and
- High rainfall with annual precipitation of 1000-2000 mm and 90-100 rainy days occurring in the middle part of Venda along the mountains (Region B-

see Figure 3.2).

The south-eastern area, with high summer rainfall could be recommended for tropical/subtropical fruit production, more especially where commercial, small-scale, home garden, and dryland farming is in existence. Regular irrigation water supply is required in areas with low summer rainfall. Region B has the highest rainfall but due to the hilly nature of the region, tropical/subtropical fruits could not be produced commercially (Figure 3.4). Region A is regarded as the low rainfall area with little possibility of producing tropical/subtropical fruit unless irrigation water is applied to crops on a regular basis. Climatologically, Region C is regarded as the best tropical/subtropical fruit production area because of its high rainfall. The distribution of the precipitation through the year also is important (Auchier and Knapp, 1932).

Wind is another aspect of climate that could affect plant growth. Wind can cause physical damage to plant organs (Morwat and George, 1996). The trees require staking when young and the development of a strong branch framework to reduce tree damage by wind in future years is required. Physical damage of emerging shoots and leaves, by spring winds, reduces the potential bearing surface and leaf area in an orchard. Plant pathogens that cause diseases such as bacterial blast (*Pseudomonas syringae* van Hall) and grey mold (*Botrytis cinerea* Persoon) can enter leaf tissue through lesions on wind-damaged leaves and shoots causing further loss in leaf area. According to the South African Weather Services (2001), the average wind speed in Venda is 11 km/h. This figure gives the potential of fruit production with minimum wind damage to crops. High-speed winds in Venda occur occasionally with long intervals, more especially in the Mphaphuli area. Plant species like *Casuarina cunninghamiana* can be grown on the boarders to limit wind damage to crops that are susceptible to high-speed winds (Bredell and Joubert, 1982).

Avocado tends to have brittle branches that are damaged easily by wind. The majority of blemishes causing a downgrading of fruit most probably also result from wind damage. Certain mango cultivars such as Zill, Haden and Kent are more prone to fruit loss under windy conditions than others (NDA, 2000).

From a climatological point of view, Venda has similar conditions as Tzaneen, Nelspruit and Kwazulu-Natal where tropical/subtropical fruit production are practiced commercially. This gives a good indication that there is a possibility of Venda to produce fruit (Phillips *et at*., 2003).

3.2. Water resources in Venda

There are two primary catchment areas in Venda. The river with the largest catchment area in Venda is the Sand River which covers 823 851 ha, but also the lowest annual precipitation (431 mm) and run-off (38 mm). The highest annual precipitation and run-off appears in the Luvuvhu area. The annual precipitation is 731 mm and the annual run-off is 563 mm while the lowest annual precipitation occurs in the north-western section of Venda (Naledani, 1992).

The following dams are situated in the Luvuvhu Catchment area (See Figure 3.1): Thathe Vondo in the Mutshindudi River, Upper and Lower Damani in the Mbwedi River, Tshaphele in the Mutshindudi River, Mutoti in the Luvuvhu River, Albasini in the upper part of the Luvuvhu River, Tshakhuma in the Tshakhuma River, Phiphidi in the Tshinane River, Dzindi in the Dzindi River, Phaswane in the Mutshindudi River and Nandoni in the Luvuvhu River play a very important role for both agricultural and household purposes (See Figure 3.1).

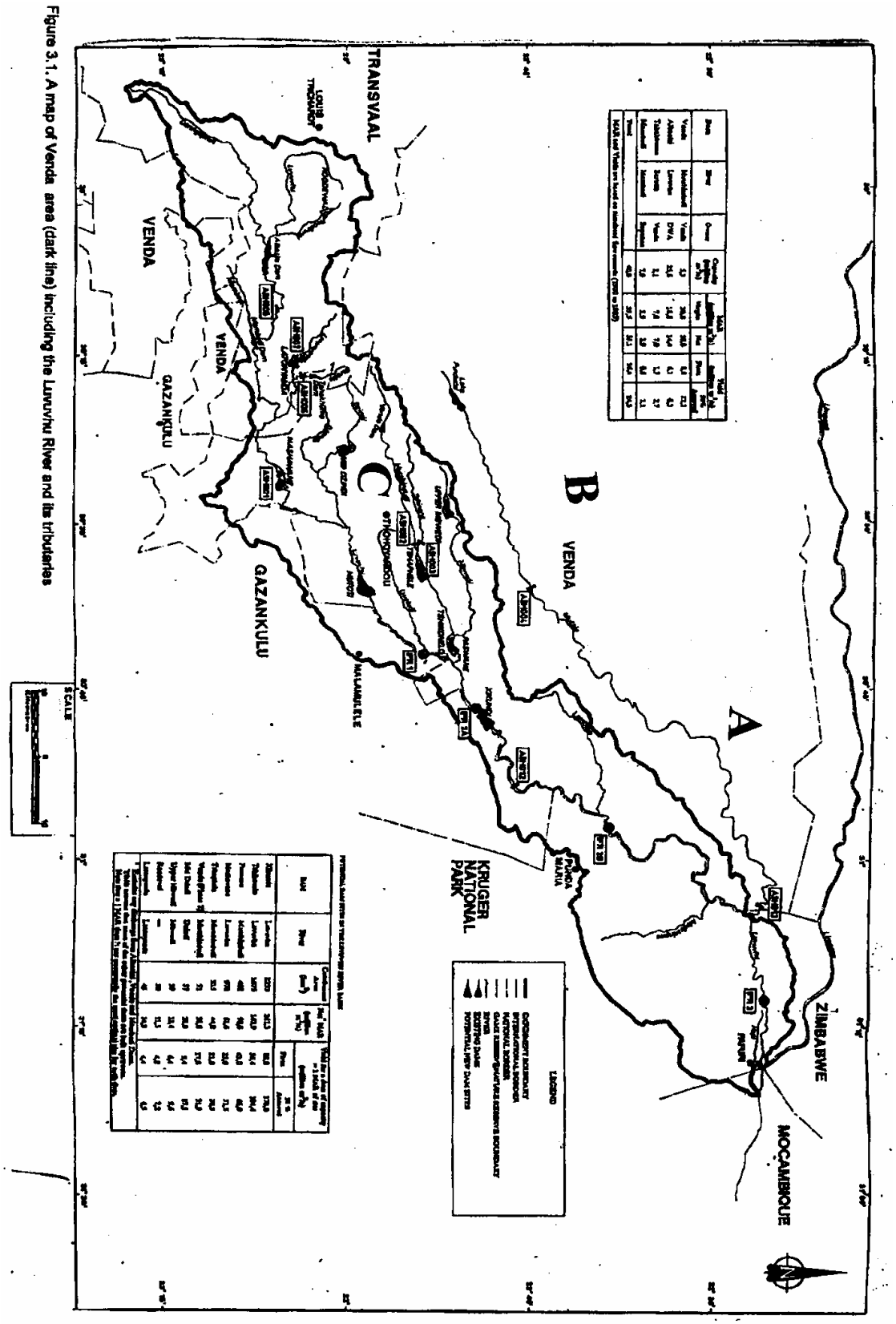

Figure 3.1. A map of Venda area (dark line) including the Luvuvhu River and its tributaries

Figure 3.1. A map of Venda area (dark line) including the Luvuvhu River and its tributaries

Though Venda is rich in water resources, it has in recent years become necessary to

pay special attention to conservation practices of water. This is due the increasing population densities that result in higher demands for household, but also a high demand for agriculture and more specific for tropical/subtropical fruit production. Most of the people are advancing from dryland system of fruit production to irrigation farming which is more profitable (Alien and Perry, 1996; Chikanda and Kirsten, 1998).

According to Singo (1996) and Naledzani (1992) the water in most areas is of good quality except in the Sinthumule-Kutama area where the water supply comes from the boreholes. This water contains high nitrate concentrations that could cause excess nitrogen in the soil. For normal growth of plant, this element is required in large quantity but excess amounts could damage the crop physiologically. Thus, water affects the performance of crops not only directly but also indirectly by influencing the availability of other nutrients and the timing of cultural operations. Water and other production inputs interact with one another. In proper combinations, the crop yields can be boosted manifold under irrigation (ITSC, 1991; Jackson and Looney, 1999).

3.3. Agro- ecological regions of Venda

As already mentioned, Venda can be divided into three regions based on the annual rainfall, namely Regions A, B and C (See Figure 3.2). These regions can, however, also be categorized in accordance with the vegetation, altitude and the soil type.

The vegetation of an area may help to indicate the suitability of such area for fruit production (Samson, 1980). This can be done if the climatic data of an area is not available to the farmer. Climate, soil and topography influence site suitability for fruit growing and the value of natural vegetation indicates environmental conditions (Booth, 2003).

Mopaniveld covers a large area in the north of Venda in the Limpopo Province. Smaller areas of different veld types earmark the southern part of Venda including the North Eastern Mountain Sourbush, Soutpansberg Arid Mountain Bushveld,

Mopaniveld, and Sour Lowveld Bushveld. The drier northern parts have sweeter grasses, indicating higher soil pH, while the southern wetter parts have more sour grasses (low pH), in line with the increase in rainfall from north to south (Low and Rebello, 1996).

It has already been pointed out that that region C has a better climate, better water resources and better soils than the other two regions, but the vegetation occurring in this region should also support these evaluations.

Sour Lowveld Bushveld characterizes Region C. Dominating trees are *Terminalia sericea, Combretum collimum, Acacia sieberiana, Parinari curatellifolia, Pterocarpus angolensis, Ximenia caffra, Ficus thonningii* and *Strychnos madagascariensis*. The shrub layer is characterized by *Dichrostachys cinerea, Ximenia caffra, Piliostigma thonningii, Antidesma venosum* and *Maytenus heterophylla*. The grass constituent is tall, tufted and relatively dense, and the common species are *Hyperthelia dissolute, Elionurus, Hyparrhenia hirta, Setaria sphacelata, Melinis nerviglumis, Cymbopogon excavatus* and *Heteropogon contortus.*

The combination of rainfall, especially its distribution and the length of the dry seasons, and the temperature regime that determines what species grow or can grow in an area, subject to modifications brought about by the soil, particularly its water holding capacity. Natural distribution of a species provides a first indication of its environmental requirements climatic requirements as to the tropical and subtropical fruit. Therefore, vegetation of an area can provide good climatological information of an area before the introduction of new species such as fruits (Samson, 1986). The vegetation type found in Region C, therefore, also supports the suitability of this region for subtropical fruit production.

3.4. Study areas selected in Region C of Venda

Since Region C shows the highest potential for tropical/subtropical fruit production, it was decided to select four areas in this region for a more intensive survey. These areas are, Tshakhuma, Muledane, Mukula and Tshifudi. It is of importance to briefly

discuss the reason why the study areas have been chosen (See Chapter 1 for more details). As far as tropical/subtropical fruit production is concerned, there are three levels of small-scale farming to be investigated, namely irrigation farming, dryland farming, and garden systems.

The Tshakhuma area was chosen due to the fact that it is close to Levubu where tropical/subtropical fruits are produced commercially. Muledane and Tshifudi areas were previously empowered by the ARDC/Agriven in terms of agricultural inputs and choice of farming practices. The objective of choosing these two areas was to look at the reasons why there was downfall in fruit production in these areas since the withdrawal of ARDC/Agriven. The other reason is to look at the importance of natural resources as the indicators of tropical/subtropical fruit production, more especially by small-scale farmers in this area. Mukula area was chosen to look at the possibility of fruit production based on the dryland farming system. Since many home-gardens contain fruit trees, it was also essential to take this system into consideration.

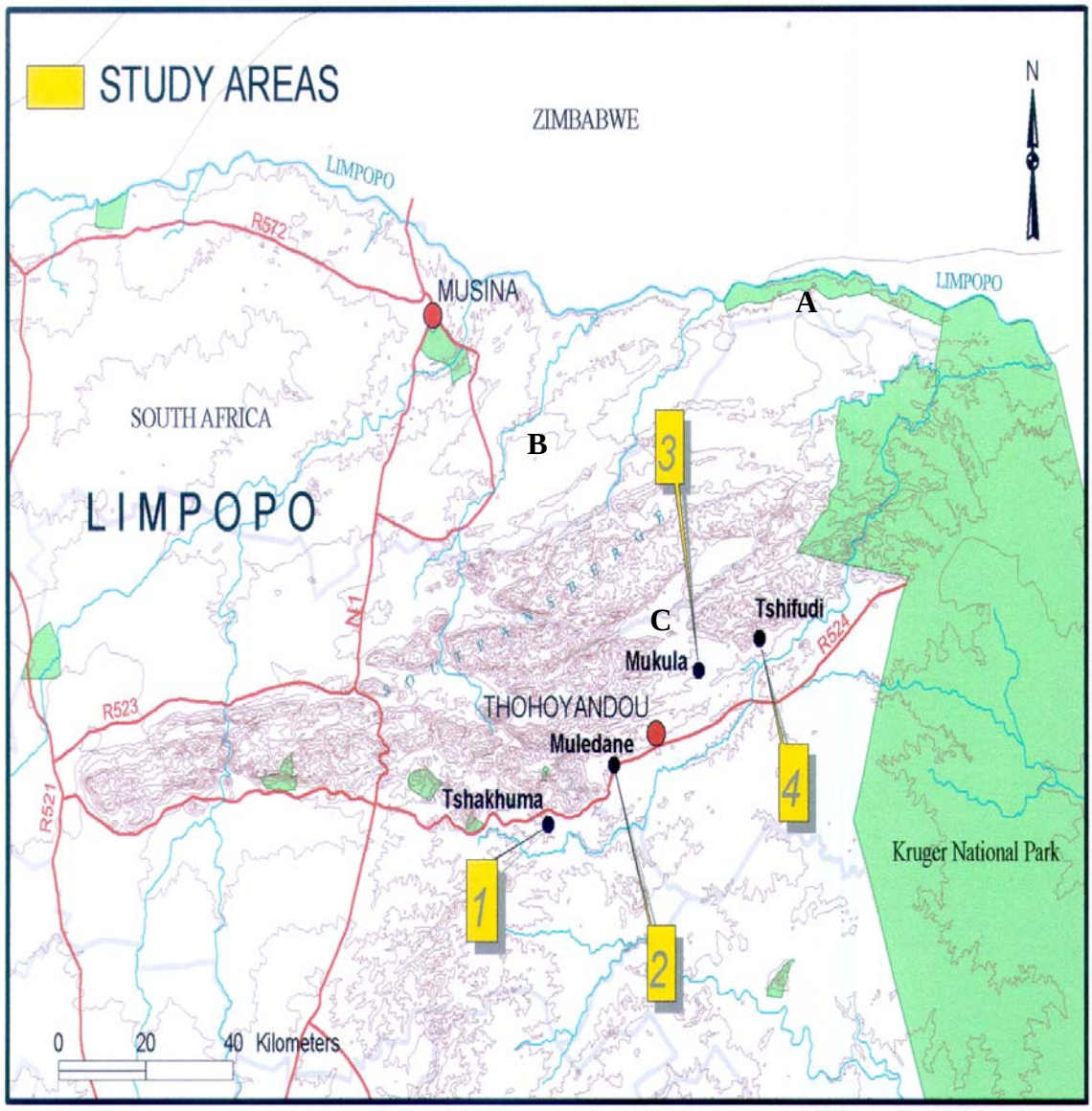

Figure 3.2. A map of Venda illustrating the ecological Regions A, B and C; and location of the study areas 1-4. The contour lines on the map illustrate the topography of Venda.

3.4.1. Topographic situation in the study areas

The selected study areas lie on the altitude between 300-600 m above the sea level, 23°15'- 23°45' latitude and the longitude of 30°15'-30°45' (Figure 3.2). Tshakhuma is situated 25 km west of Thohoyandou and Tshifudi approximately 40 km east of Thohoyandou. The latter area lies within both the Tshidzini and Tshifudi Tribal areas

of the Mphaphuli Territorial Council in the Thohoyandou District. The main boundaries are the Levubu and Mutshindudi rivers. Muledane is situated about 3 km south-west of Thohoyandou while Mukula is located approximately 20 km north of Thohoyandou Town. The main boundaries of Mukula village are Mbwedi and Mutshindudi Rivers.

3.4.2. Climatic requirements of tropical/subtropical fruits

Before dealing with the suitability of these areas for tropical fruit production, it is important to determine the general crop requirements. Landis *et al.* (2003) indicated that fruit crop ecology is the study of interactions among the many biological, environmental and management factors that must make up and influence fruit production. An ecological approach to fruit production recognizes that these factors interact in a changing environment and that it is impossible to change one aspect of a cropping system without affecting another. The productivity of trees basically depends on the cultivar and climatic conditions. Also under such conditions there might be greater fluctuations in yield of a particular cultivar over seasons, solely due to climatic conditions prevailing during a specific season (Naville, 1995; Skog, 1998).

3.4.3. Water requirement by crops

The amount and annual distribution of rainfall should supply a sufficiency of water for the tree at all seasons (Bachelor and Webber, 1948). When considering planting of an orchard, it is important to estimate both the water requirements of the tree and the loss from the soil in any particular area. The average total rainfall and its distribution should then be determined and set opposite of data for water requirements. Figure 3.3 illustrates rainfall requirements depending on the fruit type. Most trees need an average of about 750-1 250 mm of water per year (Phillips *et al*., 2003). This can be supplied in the form of either rainfall or irrigation. Supplemental irrigations often used in low rainfall areas to supply water when it is needed.

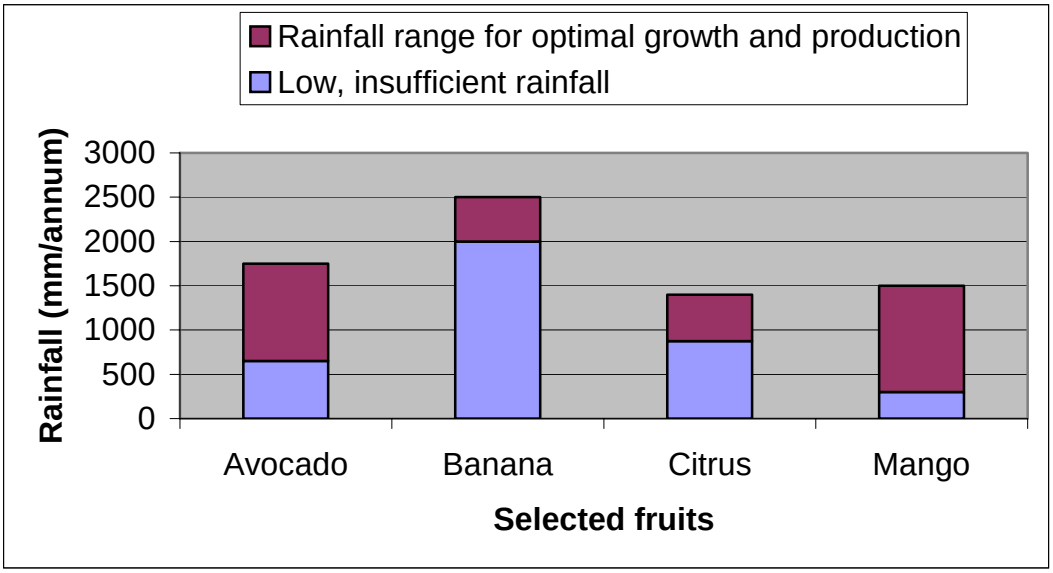

Figure 3.3. Average annual minimal and optimal rainfall requirements for growth, development and production of avocado, banana, citrus and mango (Samson, 1980; Samson, 1986; Nakasone and Paull, 1998; de Villiers, 1998; Whiley *et al*., 2002; Singh, 1960; NDA, 2000; Robbinson, 1996).

According to Samson (1986), Nakasone and Paull (1998) and NDA (2000), avocado trees require 650-1 750 mm of rainfall per year. Most avocado cultivars are sensitive to water stress and excess moisture caused by poor drainage. Almost all the avocado growing areas such as Venda have wet and dry periods, necessitating some form of supplemental irrigation.

Mango trees are drought tolerant and can withstand occasional flooding. Good rainfall distribution is crucial for flowering and fruit set, rather than total rainfall. A dry, or even more effective, cool period preceding flowering is necessary for reliable mango production, as it promotes flower induction. Mango trees require about 200-500 litres of water every 15 days (Nakasone and Paull, 1998). According to De Villiers (1998), in order to meet mango tree requirements, an annual rainfall of 11 000 m^3/ha/year or 20-44 mm/month is required.

Bananas require a regular water supply that matches or slightly exceeds the free-water evaporation rate. Irrigation is essential for high yield if rainfall is less than evaporation. Areas with very high rainfall may be too overcast for optimum photosynthesis, have more disease problems and require extensive drainage. Banana trees require an annual rainfall of 2 000-2 500 mm depending on the cultivar and the type of soil (Robbinson, 1996).

According to Citrus and Subtropical Fruit Research Institute (1990), citrus tree require an average of 1 440 mm/year.

3.4.4. Water supply in study areas

Venda is well known for its high summer rainfall and warm tropical climate (Naledzani, 1992). Summer months with high rainfall and humidity are October-February and Autumn months with lower rainfall include March – May.

The monthly rainfalls for the study areas are shown in Figure 3.4.

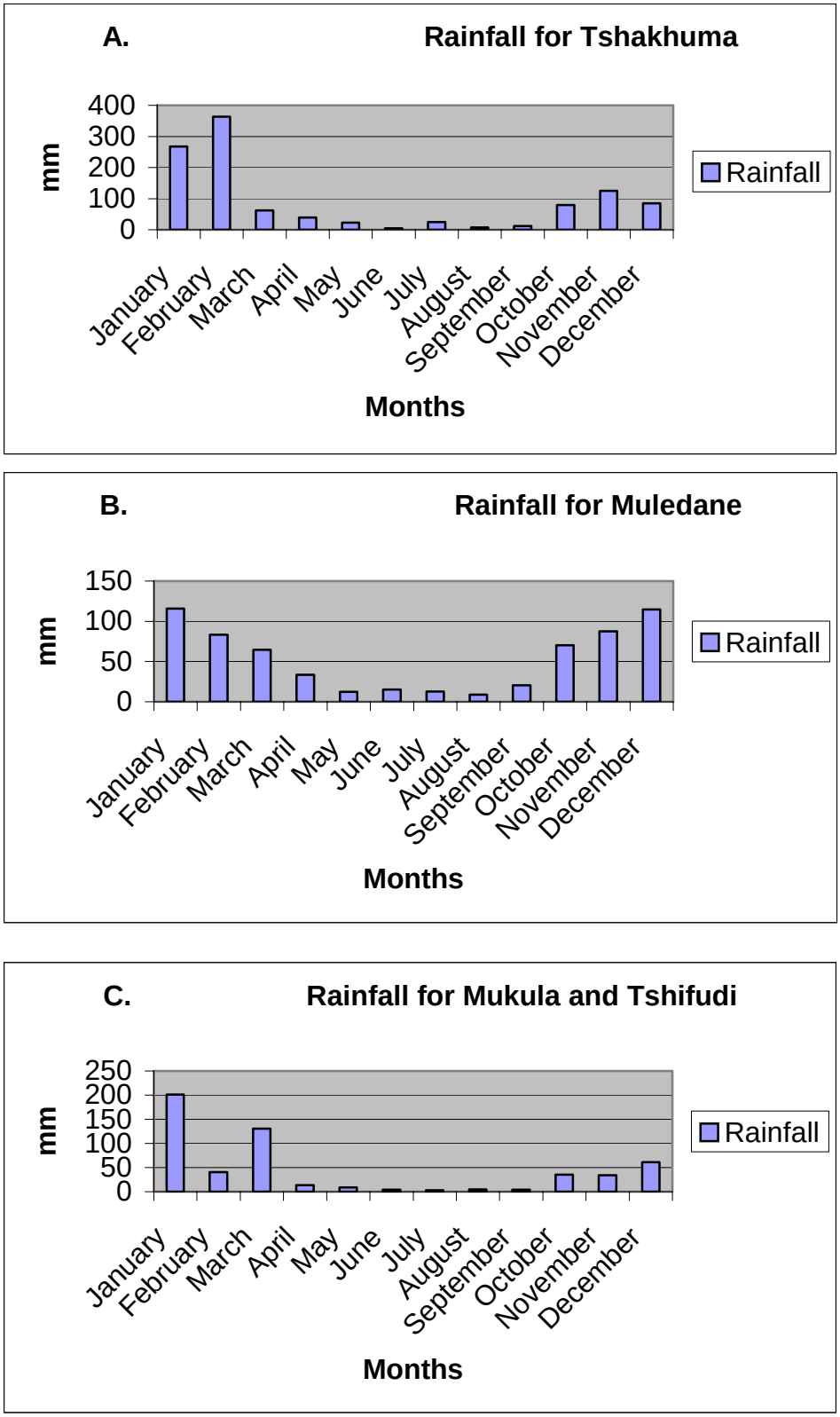

Figure 3.4. Monthly average rainfall for Tshakhuma (A), Muludane (B), Mukula (C) and Tshifudi (C) areas over a period of 14 years, 1982 -1996 (Source: Institute for Soil, Climate and Water (ISCW), Pretoria).

According to Figure 3.4 none of the four study areas receives more than 1 000 mm of rain per year, while according to Figure 3.3; all the mentioned crops need more than 1000mm of rain per annum for optimum production. This means that additional irrigation would be required (Norman, 1992).

The following rivers and dams serve an important role in the irrigation of several tropical/subtropical farms in Venda in the study areas (See Figure 3.1). The main river in Venda is the Luvhuvu. The Luvuvhu Catchment forms part of the larger Limpopo system, which extends into Mozambique. The Luvuvhu River and some of its tributaries (including the Mutshindudi and Mutale rivers) starts in the Soutpansberg Mountains. The Luvuvhu River flows for about 200 km through a diverse range of landscapes before it joins the Limpopo River near Pafuri in the Kruger National Park.

Dams in the Luvuvhu River catchment include the Albasini Dam and the smaller Mambedi, Tshakhuma, Damani, Vondo, and Phiphidi Dams, of which the latter two lie in the Mutshindudi River. The Nandoni Dam has been constructed in the middle section of the Luvuvhu River east of the confluence with the Dzindi tributary and east of the town Thohoyandou (See Figure 3.1).

As mentioned above, the inadequate rainfall in the four study areas calls for additional water supply for tropical/subtropical fruit production and as shown above, irrigation water is available. Irrigation can be applied to supplement rainfall and its scheduling requires a calculation of amount and frequency (Samson 1980; Robbinson, 1998). Scheduling can be based on evaporation pan, soil-water holding capacity and effective root depth, water depletion and crop water use. The stage of growth or development at which water stress occurs greatly affects the final yield. Many factors influence the amount of rainfall available to plants, including evaporation and transpiration rates, surface runoff, and soil water holding capacity and percolation through the soil profile beyond the rooting area. Higher rates of 10-15 mm/ day occur for irrigated crops in the semiarid tropics (such as Venda). Rainfall and irrigation need to replace this evaporative loss, and a mean monthly rainfall of 120 mm would be required.

Tropical/subtropical trees like mango, litchi and avocado require a water stress period during May and June to force them into a dormant period before flower induction. From July to October, when there is no or little rain (Figure 3.4.), additional water is required (Figure 3.3).

According to the water requirement for avocado, banana, and mango (Figure 3.3), the annual rainfall should range from 300-2500 mm /annum. Due to the fact that the rainfall in these selected areas in Venda is low during the winter months, irrigation needs to be applied to supplement the rainfall (De Villiers; Robbinson, 1998).

Table 3.1. Annual rainfall, rivers (catchment areas) and dams (capacity) in the study areas (Department of Water Affairs and Forestry, 1998)

Study area	Annual rainfall (mm)	Dam	River	Catchment area (Km^2)	Yield for a dam capacity (million m^3/annum)
Tshifudi	541.1	Tshikonelo	Luvuvhu	1675	104.4
Muledane	638.5	Mid-Dzindi	Dzindi	57	17.5
Mukula	541.1	Upper Mbwedi	Mbwedi	39	9.6
Tshakhuma	1095.3	Latonyanda	Latonyanda	45	6.5

Figure 3.4 indicates that Venda is a summer rainfall area with little or no rainfall during the winter months. In order to maintain the water requirements of about 30 mm/month for tropical/subtropical fruit, supplemental water needs to be applied through irrigation. When looking at the rainfall distribution over the Venda region, the supplemental water demand is very low in winter and therefore the amount of water in the dams and rivers should be adequate for profitable production of tropical/subtropical fruit.

3.4.5. Temperature requirements for tropical/subtropical fruits

Temperature is a crucial climatic factor that influences the growth and development of fruit tree (See Figure 3.5). Most tropical/subtropical fruit crops thrive in areas where the air temperature varies from 9-35^{0}C (Nakasone and Paull, 1998; Samson 1980; De Villiers, 1998, Whiley *et al*., 2002; Singh, 1960; Robbinson, 1996).

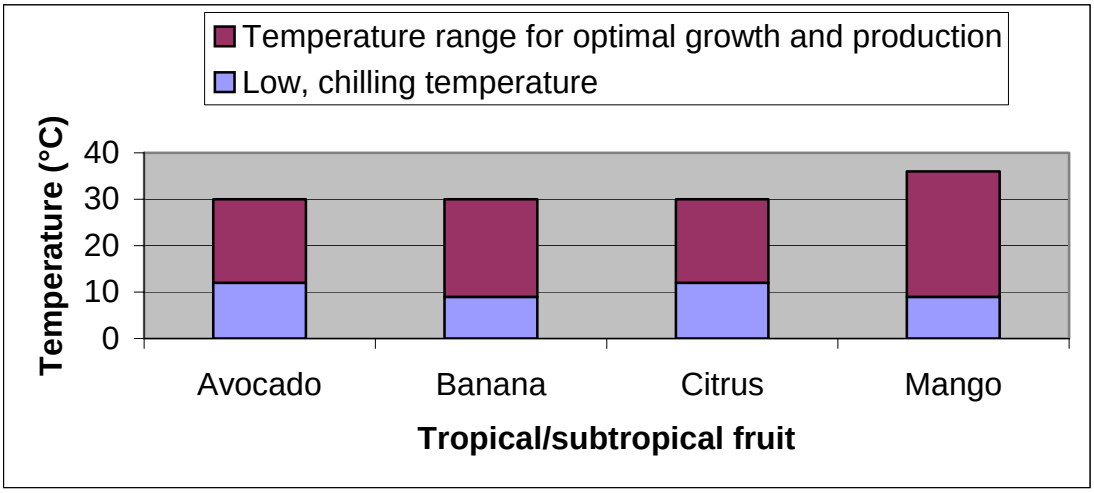

Figure 3.5. Average temperature range for the optimal growth, development and production of avocado, banana, citrus and mango (Samson, 1980; Samson, 1986; Nakasone and Paull, 1998; De Villiers, 1998, Whiley *et al*., 2002; Singh, 1960; NDA, 2000; Robbinson, 1996).

Mango can be grown in areas lying 1 200 m above the sea level in the tropics, although the best production is at altitudes of at least 800m. Air temperature in the range of 24-30° C is needed. Leaf and fruit burn can occur when the temperatures reach 48° C during fruit development. Pollen viability declines if its development takes place at temperatures higher than 35°C or below 15° C (NDA, 2000; Singh, 1960; Nakasone and Paull, 1998).

A temperature range of 12–38°C occurs in most production areas, with the optimum temperature being 27°C (Samson, 1980; Nakasone and Paull, 1998). Temperature higher than 38°C causes growth cessation and leaf burn in banana. Plants growing in the subtropics produce fewer leaves per year than those in the tropics and take longer

to produce and develop fruits.

Citrus trees are subtropical in origin and cannot tolerate severe frost (NDA, 2000). Citrus production in South Africa is therefore confined to areas with mild and almost frost-free winters where temperatures (not more than once in several years) drop below –2°C. The average minimum temperature for the coolest month should not be below 2 to 3°C if no protection is provided. According to Figure 3.6, Venda temperatures range from 9-35°C.

Avocado trees require cool subtropical conditions. The optimum growth temperature requirement is 15 to 30°C, and high temperatures, especially during flowering, are not tolerated (NDA, 2000; De Villiers, 1998; Whiley *et al*., 2002). Light frost can be tolerated, except during flowering and fruit set (August and September). The Fuerte cultivar, which is the most popularly grown cultivar in South Africa, is probably a natural hybrid between the Mexican and Guatemalan races and has a wider climatic tolerance to cold than the pure Guatemalan types. It is more sensitive to unfavourable weather conditions during flowering. Hot, dry conditions could result in low yields because of fruit and flower drop (Demirkol, 1995).

The average monthly temperatures in the selected study areas in Venda are shown in Figure 3.6. During the summer months, November to February, the average temperature is 28°C (Figure 3.6). During the winter months, May to August, the average temperature is 15°C. When looking at the temperature requirements for the most tropical/subtropical fruit, these temperature figures should allow successful fruit production in Venda, provided that other cultural practices are operated according to crop requirements.

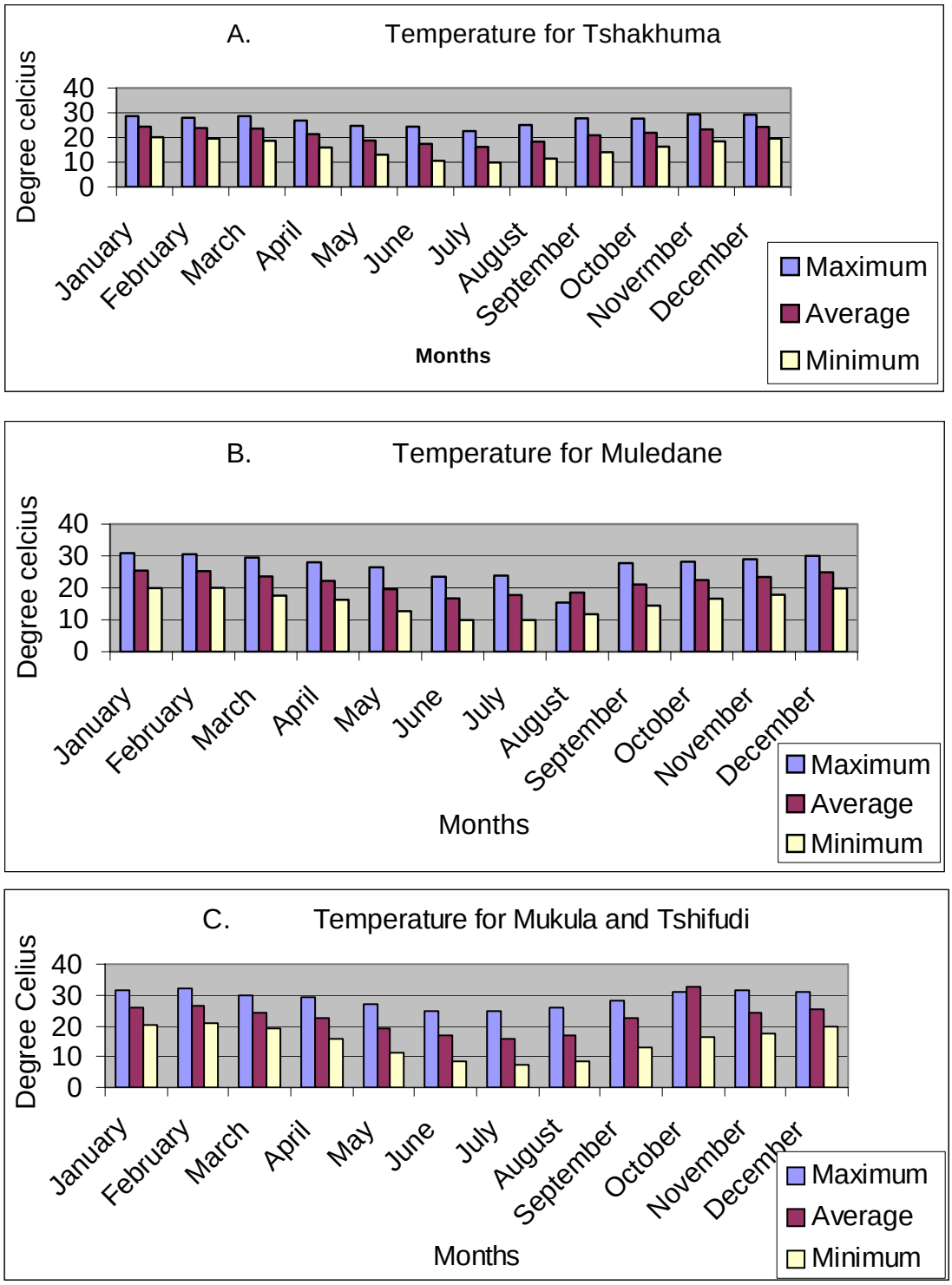

Figure 3.6. Monthly temperature for Tshakhuma(A), Muludane (B), Mukula (C) and Tshifudi (C) areas over a period of 14 years, 1982 -1996 (Source: ISCW, Pretoria)

3.4.6. Soil types and quality in the study areas

Tropical and subtropical fruits generally prefer deep soils with good drainage and permeability to enable these plants to develop an extensive root system necessary for optimum growth (Phillips *et al*., 2003). According to Nakasone and Paull (1998), tropical/subtropical fruit crops have shown a wide range of adaptability and have observed to grow and produce well in wide variety of soil types, provided other factors are favourable. In some areas, considerable management skill is required to maintain the crops in good growth and production. Soil pH can be corrected by liming during field preparation, with most fruit trees preferring 5.5-6.5 (De Villiers, 1998; Whiley *et al*., 2002; Singh, 1960; Samson, 1980; Nakasone and Paull, 1998; Stover and Simmonds, 1987; Robbinson, 1996; NDA, 2000). A prime soil requirement for all tropical/subtropical fruits is good drainage to prevent waterlogging, which leads to root diseases (Nakasone and Paull, 1998). Drainage is crucial for crops that are susceptible to *Phytophthora* root rot, such as avocado. The soils in the study areas conform to all these requirements.

The soil types described in chapter 2 show a variety of soil forms. However, soil samples taken from each study areas were Hutton, Oakleaf and Bainsvlei soil forms (Table 3.2).

The dominant soil form of Tshakhuma is a Hutton type indicating a higher potential soil for crop production, due to its depth and good drainage. In Muledane, the dominant soil form is Oakleaf.

Table 3.2. Soil information of Tshakhuma (1), Muledane (2), Mukula (3) and Tshifudi (4)

Particulars	Study area							
	Tshakhuma (1)		**Muledane (2)**		**Mukula (3)**		**Tshifudi (4)**	
% Slope	3		1		2		1	
Land form/ topography	3 units		1 unit		1 unit		2 units	
Soil use	Avocado, Banana, Citrus and Mango production		Citrus production		Citrus, Mango and Avocado production		Banana production	
Horizon	Orthic A	Red Apedal B	Orthic A	Neocut-anic B	Orthic A	Red Apedal B	Orthic A	Red Apedal B
Transition	Gradual	Gradual	Distinct	Distinct	Gradual	Gradual	Gradual	Gradual
Depth	0-40cm	>90cm	0-30cm	70cm	15cm	65cm	0-40cm	>90cm
Moisture	Dry	Moist	Dry	Moist	Moist	Dry	Dry	Moist
Colour	10R (4/8)	10R (5/8)	5YR (4/5) Reddish brown	5YR (4/2) Dark reddish gray	2YR (3/4) Dark reddish brown	2YR (3/6) Dark red	5YR (4/6) Yellowish red	2.5YR (4/2) Weak red
Texture	Sandy clay loam	Sandy clay	Sandy	Sandy loam	Sandy loam	Sandy loam	Sand	Sandy loam
Consistency	Slightly hard	Soft	Soft	Soft	Soft	Soft	Soft	Soft
Form	Hutton	Hutton	Oakleaf	Oakleaf	Hutton	Hutton	Bansvlei	Bansvlei
Roots availability	Seldom	Seldom	Seldom	Seldom	Seldom	Frequent	Seldom	Seldom

Mukula soil samples comprise Hutton form with reddish brown (2YR 3/5) Orthic A horizon on a dark red (2YR 3/6) on red apedal B horizon (See Table 3.2).

The soil sample that was taken from an orchard that was part of the Tshifudi Banana Project was identified as a Bainsvlei form and this reflects the deep soil suitable for tropical/subtropical fruit cultivation. This form has an Orthic A and a Red apedal

horizon (See Table 3.2). When using Munsell Soil Color Charts (1954), this form consists of the yellowish red (5YR 4/6) and the weak red (2.5 YR 4/2) soils.

The soil functions principally as a container for water and plant nutrients. According to NDA (2000), the combination of soil forms such as Hutton, Clovelly and Oakleaf are suitable for cultivation of tropical/subtropical fruit crops under irrigation. Hutton, Bainsvlei, Avalon and Oakleaf are suitable for dryland production of tropical/subtropical fruit production because of their texture, structure and porosity. Therefore all the areas surveyed were found to have suitable soils for tropical/subtropical fruit production.

The physical characteristics of the soil are of primary concern for tropical/subtropical fruit production, with soil nutrients being secondary because nutrients necessary for good growth and development can be supplied as fertilizers (Nakasone and Paull, 1998). Soil structure and texture, soil-water holding capacity and drainage are crucial. Under natural conditions, most soils considered for fruit crops should have a good topsoil structure. Loss of organic matter may lead to loss of structure and crusting of these soils after heavy rains. Some soils, however, do not favour root development due to a dense subsoil layer, which needs to be broken down during soil preparation to avoid shallow root system.

3.5. Human and economic resources

3.5.1. Demographic situation in the study areas

Table 3.3 was compiled from information obtained from the Municipal Demarcation Board (2003).

Table 3.3. Population, household income, gender, and age breakdown for the study areas (Demarcation Board, 2003)

Particulars	Study areas			
	Tshakhuma	**Muledane**	**Mukula**	**Tshifudi**
No. of households	5008	14365	3418	2359
Estimated total household income	R255 948 00	R202 863 600	R164 930 0	R108 876 00
Population				
African	11144	30099	7572	5237
Colored	3	95	0	4
Indian	3	647	2	0
White	0	176	0	0
Other	57	336	89	98
Gender				
Male	5008	14365	3418	2359
Female	6200	16990	4236	2976
Age breakdown				
0-4	1656	3612	1016	824
5-19	4704	10952	3281	2215
20-29	6200	6738	1079	796
30-49	1820	7023	1247	792
50-64	654	1439	411	307
0ver 65	616	1008	504	346
Age unknown	128	578	114	47

The most important aspect on Table 3.2 is the size of the population, reflecting the demand for fruits in the area. The higher the population, the higher the fruit demand, and vise versa. Most of the people are residing around Muledane, indicating the market potential in this area. Fruits to play an important role in human diet; therefore, production of fruits should be increased in accordance with the size of the population available. The production of tropical/subtropical fruit in Venda may not only refer to

its own needs but also on the national and export needs.

Gender also plays an important role in determining who is participating in decision-making, production, harvesting and marketing of fruits. In most rural villages in Venda women play a role in cultural practices such as weed control and harvesting of fruits, whereas men are responsible for decision-making on cultural practices and marketing of fruits (Van Rooyen *et al*., 1987; Van Rooyen *et al*., 1998).

Age reflects the members of communities who are active in participation for tropical/subtropical fruit production. In developing areas such as Venda, active members of the community are between 30-60 years of age where most of the people are responsible for supporting their families through fruit production.

3.5.2. Education in study areas

Formal education starts in grade 1-7, at the age of 6 years old in primary schools while the secondary education provide education from grade 7-12. Education has got the effect on the fruit production in the sense that there should be an adoption and application of new information regarding fruit production. It is not easy for an illiterate farmer to adopt new practices through articles. Those farmers who are able to write and read can receive both the theoretical and practical knowledge about farming systems and also apply sound production principles. The basic knowledge about tropical/subtropical fruit production is obtained from grade 4 to 12.

The University of Venda for Science and Technology, Madzivhandila College of Agriculture and Ramanno Mbulaheni Training Center provide tertiary education in agriculture for Venda people. All these institutions also provide knowledge about tropical/subtropical fruit production in detail.

3.5.3. Extension service in study areas

Before the withdrawal of ARDC from Agriven projects, extension officers were operating at the Tshifudi where banana plantations were established. According to

Venda National Development Cooperation (VNDC) (1993), all the projects in surrounding villages such as Tshikonelo, Tshaulu, Lambani, Malavuwe and Matsika relied on the extension service provided from the Tshifudi Banana Project. Farmers at Muledane Citrus Project received extension service from the former ARDC/ Agriven in Thohoyandou.

Since the withdrawal of ADRC/ Agriven from assisting Venda farmers with the extension service, the Limpopo Department of Agriculture took over the responsibility, while the Madzivhandila College of Agriculture is now training students and farmers. This institution provides both the theoretical information and practical skills to the farmers in Venda. The type of training received by the farmers improves their methods of tropical/subtropical fruit production.

3.5.4. Road network in study areas

Road network provide the channels for transportation of raw materials to the farms and fruits to the market place. In Venda, most of the people who are staying in towns (such as Thohoyandou) either do not produce fruit or they produce small amounts of fruit in home gardens for own consumption. An effective road network is therefore essential in order to reach the consumers or retailers.

The regional tarred road R524 (to Punda Maria) that branches from N1 in Makhado (former Louis Trichardt) to Thohoyandou and Kruger National Park provide the transport service of fruits from the Tshakhuma to Louis Trichardt, Malamulele and Thohoyandou (See Figure 3.2). There are gravel roads branching from the main tarred road along which fruit can be transported. The regional road from the main tar road (from Sibasa to Tshikondeni) runs from Mukula to Tshaulu and passes Tshifudi. The road provides services to the community of Tshifudi and transportation of fruits from Tshifudi Banana Project Levubu Co-operatives for the marketing. The tarred road from Sibasa to Tshikondeni provides transport service for the Mukula community. Other roads that branch from the tarred road serve farmers along the way.

3.5.5. Electricity supply in study areas

Eskom provide electricity for both household and project usages at Tshifudi, Mukula, Muledane and Tshakhuma villages. Electricity has gotten a major impact on fruit production. All the agricultural projects (including tropical/subtropical fruit production) in Venda rely on Eskom for electricity to operate certain functions such as pumping of water from the dam/rivers for irrigation, post-harvest handling of fruits in the storage houses, household and other purposes.

3.6. General

Agriven was responsible for planning, promoting, undertaking and financing the training of citizens in the field of agriculture, and to initiate, plan, finance, promote or carry-out, or to assist in planning, financing, promoting or carrying-out, any agricultural development of the country or its people or any part thereof, and for the exploitation, development or utilization of agricultural resources such as rainfall, temperature and soil (Naledzani, 1992).

Since the withdrawal of Agriven from empowering small-scale farmers in Venda, all the projects collapsed. This caused an initial steep decline in fruit yield and finally a total collapse of orchards in many areas in Venda because most of the farmers did not make provision in terms of financing and knowledge for sustaining the projects. This happened in spite of the great potential and the initial success of the projects. Renewed initiatives and inputs are required to get production on track again.

CHAPTER 4: RESULTS OF A SURVEY

Introduction

The results discussed in this chapter are based on a survey conducted in the four study areas mentioned in the previous chapters, namely Tshifudi, Mukula, Muledane and Tshakhuma. Most of the small-scale farmers in these villages engaged themselves in crop production, while livestock production plays a secondary role.

During the survey different aspects were addressed, like the farmers' characteristics, percentage of farmers partaking in tropical/subtropical fruit production; available resources; orchard size; farming system; decision-making bodies; type of fertilizer applied; irrigation system installed; the type of farm labour employed by the farmer and the number of farm workers employed on the farm. Relationships between some of these aspects are also determined. Challenges and constraints were also addressed in this chapter.

As mentioned in Chapter 2 (Research methods), the data was obtained from 66 respondents (observations) through the use of questionnaire although a variety of additional means like field observation and discussions with key informants were also implemented. The data were analysed by means of one-way and two-way frequency tables from SAS® PROC GLM package. The aim of using two-way was to look at the relationship between a certain parameter and a combination of others. For example, orchard size was analysed with the purpose of relating it to other parameters such as farming type, type of fertilizer, type of farm workers, number of farm workers as well as the yield. Yield LS Means (as expressed by t/ha/year) were used to determine at the effect of main parameters such as decision-making, farming system and orchard size. One way frequency tables were used to look the characteristics of farmers and their problems.

The term "orchard" as applied in this chapter will refer to any piece of land, irrespective of its size, planted with fruit trees.

4.1. Results and discussion

4.1.1. Farmer's personal characteristics

Potential small-scale farmers in the study areas were predominated mainly by males (89.39%) as compared to female farmers (10.61%) in an age group of over 45 years (Table 4.1). Most fruit growers (51.51%) were married, 16.66 % were single and never married, while 6.06% were widowed. 13.63% had received no schooling, 6.06 % received primary education, 46.96% received secondary education and 33.34% received tertiary education. This means that most farmers were literate and likely to be responsive to written forms of communication. 54.54% were fulltime farmers who rely on tropical/subtropical fruit production for their daily living and income, 37.87% were pensioners, and 7.59% had other occupations apart from farming.

Table 4.1. Frequency of farmers' characteristics

Characteristics	**Respondents (N=66)**			
	Frequency	%	Cumulative Frequency	Cumulative %
Gender				
Male	59	89.39	59	89.39
Female	7	10.61	66	100
Age group				
<45 years	27	40.90	27	40.90
46-60 years	34	51.51	61	92.41
>60 years	5	7.59	66	100

Education				
None	9	13.63	9	13.63
Primary	4	6.06	13	19.69
Secondary	31	46.96	44	66.65
Tertiary	22	33.34	66	100
Marital status				
Married	51	77.28	51	77.28
Single	11	16.66	62	93.94
Widowed	4	6.06	66	100
Occupation				
Full-time farmer	36	54.54	36	54.54
Pensioners	25	37.87	61	92.41
Other	5	7.59	66	100

N= Number of respondents participated

%= Percentage frequency of respondents

4.1.2. Cropping practices

4.1.2.1. Fertilizers

The result of this exercise is presented in Table 4.2. The majority of farmers owning <5 ha of land practiced home gardening and dryland farming systems. A significant percentage of farmers practicing irrigation farming were those with a relatively large orchard size. A possible explanation that can be suggested for this observation is that usually farmers with relatively larger orchard size (>5 ha) were those with high socio-economic status who can afford to manage their orchards.

Looking at the relation between orchard size and the type of fertilizer applied by the respondents revealed that farmers owning < 5 ha mostly applied organic fertilizers, while most of the farmers owning 6-10 ha and 11-20 ha applied inorganic fertilizers. Organic fertilizers in the form of kraal manure were freely available compared to the more costly inorganic fertilizers.

According to Antwi (1998) one of the main causes of low fruit yield by the traditional local farmers is that most of these farmers do not apply inorganic fertilizers, due to lack of capital. These farmers are predominantly subsistence farmers who produce mainly for their own consumption with small quantities being sold to local consumers for income (D'Haese and Kirsten, 2001).

4.1.2.2. Farm labour

In most developing countries, traditional agriculture depends heavily upon the family labour. From Table 4.2 it is clear that most of the farmers owning <5 ha either used family labour (help) or the owner worked the orchard himself/herself. Depending upon the availability of labour, it is possibly economic and efficient for those farmers not to hire labourers due to a relatively small orchard size, hence the use of unpaid labourers. Farmers owning larger orchards employed paid workers. For instance, 33% and 23% of the respondents owning between 6-10 ha and 11-20 ha indicated that they make use of hired labourers.

Table 4.2. Relation between orchard size and factors such as cropping system, type of fertilizer applied, type of farm labour, number of farm workers and the yield, based on the percentage of respondents

Parameters	**Orchard size (ha) and % respondents**			
a. Cropping system	**< 5ha** %	**6-10ha** %	**11-20 ha** %	**Total (N)**
Home garden	8	0	0	5
Dryland	8	0	0	5
Irrigated	2	47	36	56
b. Type of fertilizer	%	%	%	**Total (N)**
Organic (O)	14	2	0	10
Inorganic (I)	3	21	23	31
Combination (OI)	0	24	14	25
c. Type of farm labour	%	%	%	**Total (N)**

Owner	12	0	0	8
Family help (labour)	2	14	14	19
Hired labour	3	33	23	39
d. Number of labourers	%	%	%	**Total (N)**
1-3	14	0	0	9
4-6	3	17	15	23
7-10	0	30	21	34
e. Yield (t/ha/year)	3a	16b	18b	66

N= Total number of observations (respondents)

%= Percentage frequency of respondents

Means indicated with the same letters do not differ significantly from each other at P≤ 0.05 (PROC GLM with Class Variables)

Farmers with the smallest orchard (<5 ha) employed fewer labourers compared to farmers in the two higher farm size categories (6-10 ha and 11-20 ha). Depending on the nature of production the demand for labour varies. Normally one would expect that farmers with large orchard size under tropical/subtropical fruit production would employ many labourers during the critical period such as harvesting. In contrary, however, more labourers were found on the medium-sized farms. A survey conducted by Antwi (1998) revealed that traditional agriculture is characterized by labour intensive production and excessive numbers of labourers are often deployed during periods of land preparation, weeding and harvesting. According to Antwi (1998) labour is normally measured in man-days, man-hours or in value terms. Labour availability is another often-mentioned variable affecting farmers' decision making concerning the adoption of new agricultural technology. High yielding fruit varieties generally require more labour inputs, particularly during the harvesting which could lead to labour shortages or smaller orchards. Selective employment could also lead to more effective outputs by labourers and this might explain why owners of larger orchards employed fewer labourers, but obtained higher yields (D'Haese and Mdula, 1998).

4.1.2.3. Relation between cropping system and other factors (Table 4.2)

4.1.2.3.1. Irrigation method

Home garden owners used buckets and hosepipes for irrigation and their main water source was tap water. Irrigation farmers used drip and microjet systems with rivers and dams as the main water. Dry land fruit farmers obviously did not apply supplemental irrigation but relied on rainfall.

There were three decision-making bodies that are not mutually exclusive, namely farm owner and the extension officer. Home garden owners were the sole decision-makers regarding farming operations as shown in Table 4.3. Furthermore, important to note is that farmers under irrigation production of fruit largely depend upon two decision-making bodies, namely, successful farmers (friends) and extension officers.

Table 4.3. Relation between cropping system and other factors based on the percentage of respondents

Other factors	**Cropping system and % respondents**			
	Home garden	**Dry land farming**	**Irrigation farming**	
a. Water source	%	%	%	**Total (N)**
Tap	8	0	0	5
Rain	0	8	0	5
River/ dam	0	0	84	56
b. Decision-maker	%	%	%	**Total (N)**
Owner	8	3	6	11
Knowledgeable friend	0	5	29	22
Extension officer	0	0	50	33
c. Yield (t/ha/year)	0.5a	3a	20b	66

N= Total number of observations (respondents)

%= Percentage frequency of respondents

Means indicated with the same letters do not differ significantly from each other at P≤ 0.05 (PROC GLM with Class Variables)

4.1.2.3.2. Decision-making

Decision-making in relation to other variables is analysed in Tables 4.3 and 4.4. Most farmers relied on guidance from either knowledgeable friends or extension officers (Table 4.3) and were advised to use a combination of organic and inorganic fertilizers (Table 4.4). In both instances good yields were obtained. From this analysis it is clear that fruit farmers in Venda are lacking the required knowledge for successful fruit production and programmes need to be put in place to educate them.

Table 4.4. Percentage of respondents according to decision-making and variables such as irrigation method and the orchard size.

Other factors	Decision-maker and % respondents			
a. Fertilizer type	**Owner** %	**Knowledgeable friend** %	**Extension officer** %	**Total (N)**
Organic (O)	11	3	2	10
Inorganic (I)	3	18	26	31
Combination (O+I)	3	12	23	25
b. Orchard size	%	%	%	**Total (N)**
<5ha	11	6	0	11
6-10ha	5	15	27	31
11-20ha	2	12	23	24
e. Yield (t/ha/year)	5a	18b	20b	66

N= Total number of observations (respondents)

%= Percentage frequency of respondents

Means indicated with the same letters do not differ significantly from each other at P≤ 0.05 (PROC GLM with Class Variables)

4.2. Identified constraints encountered by the farmers in the study areas

The following constraints encountered by the small-scale farmers originated from both organizational and lack of agricultural skills.

4.2.1. Organizational constraints

Small-scale farmers do not consider formulating a business plan as the first step of farming practice. Small-scale farmers are traditionally not keeping records because they see no benefit in this type of exercise (Table 4.5). A good business plan can help the farmers to campaign for the sponsorship to overcome financial and other constraints. Lack of capital for the acquisition of inputs can be regarded as the major

constraint encountered by small-scale farmers in Venda. Most of the small-scale farmers who did not have access to support services experienced serious problems affording fertilizers, pesticides, and irrigation equipment (Table 4.6).

Table 4.5. Farmers' response on the keeping of farm records

Keep cropping record/ Formulate business plan	**Respondents (N=66)**			
	Frequency	**%**	**Cumulative Frequency**	**Cumulative %**
Yes	8	12.12	8	12.12
No	58	88.18	66	100

N= Total number of respondents

%= Percentage frequency of respondents

The exponential increase in population size of the Vhavenda people needs food to survive and although fruit production would not solve the problem, it can make a huge contribution.

Table 4.6. Farmers' response on the problems with regard to lack of support services, lack of skills, and lack of finance.

Problems faced by farmers	**Respondents (N=66)**			
	Frequency	**%**	**Cumulative Frequency**	**Cumulative %**
Lack of support service				
Big problem	53	80.30	53	80.30
Minor problem	13	19.70	66	100
Lack of skills				
Big problem	50	75.75	50	75.75
Minor problem	16	24.25	66	100

Lack of finance				
Big problem	54	81.81	54	81.81
Minor problem	12	18.19	66	100

N= Total number of respondents

%= Percentage of respondents

4.2.2. Lack of practical management skills

The choice of wrong cultivars made by small farmers (mostly home garden owners and dry land farmers) contributes to the problems of the farmers. Small-scale farmers tend to select those cultivars that are drought tolerant or resistant to harsh environmental conditions to avoid production costs such supplemental water, pesticides, nutrients and weedicides. Misunderstanding these requirements can lead to low yields, and poor fruit quality. Other production skills like pruning, mulching, monitoring for pests, diseases and general crop management are mostly lacking and needs to be put in place.

Table 4.7. Farmers' response on the knowledge of cultivars grown

Farmers' knowledge about cultivar	**Respondents (N=66)**			
	Frequency	**%**	**Cumulative Frequency**	**Cumulative %**
More	27	40.90	27	40.90
Little	39	59.10	66	100

N= Total number of respondents

%= Percentage of respondents

Weed control is one of the major practices in which the small-scale farmers always neglect. Neglect of weed control, more especially the grass weeds, could lead to a serious or total loss of fruit trees in the orchard as a result of veld fire. Figure 4.1.A illustrates the result of allowing the grass weeds to take over. This led to the destruction of the orchard by fire (Figure 4.1.B).

Table 4.8. Farmers' response on the pest, disease and weed control

Pest, disease and weed control	Respondents (N=66)			
	Frequency	**%**	**Cumulative Frequency**	**Cumulative %**
Yes	47	71.21	47	71.21
No	19	28.79	66	100

N= Total number of respondents

%= Percentage of respondents

A

B

Figure 4.1. Citrus plantation under irrigation in Venda. In this plantation production of citrus was zero due to improper management. Figure 4.1.A illustrates poor weed control between the rows in one of the citrus plantation in Venda. Figure 4.1.B illustrate hazard caused by veld fire due to poor weed control between the rows and borders of the orchard.

Since the withdrawal of Agriven from empowering small-scale farmers in Venda, all the projects collapsed. This caused an initial steep decline in fruit yield and finally a total collapse of orchards in many areas in Venda because most farmers did not make provision in terms of financing and knowledge for sustaining the projects. This happened in spite of the great potential and the initial success of the projects. Renewed initiatives and inputs are required to get production on track again.

Maintenance of equipment is another problem. Figure 4.2 illustrates a damaged

irrigation system in a banana orchard. A serious flood that washed away a section of the main pipeline caused the damage. Due to a lack of funding the pipeline was not repaired, with the result that the orchard was neglected, overgrown by weeds and finally the irrigation system was destroyed by fire.

Figure 4.2. Improper management of irrigation pipelines by small-scale farmers in Venda.

Figure 4.3 illustrates the potential small-scale banana orchard in one of the study areas in Venda. This figure indicates that production can be high if the right procedures (good farming practices) are followed by the farmer.

Figure 4.3. Good agricultural practices of banana orchard by small-scale farmer in Venda. This picture illustrates that fruit production can be high if the right procedures are followed.

4.2.3. Post-harvest handling and marketing of fruit

Fruits are basically horticultural products, which deteriorate fast after harvest. High moisture contents and tenderness characterize them (Kasimila *et al*., 2001). The importance of fruit consumption is not basically of their flavour and good appearance to our daily food; rather they are the major source of calories, minerals, proteins, vitamins and fibres.

Of 66 respondents, 80.30% of the farmers indicated that they experienced a serious problem with regard to fruit loss at the storage or pack houses, 19.70% had little problem. These problems jeopardized the market access of tropical/subtropical fruit produced by these farmers thereby limiting their business opportunities to those markets. Agricultural marketing is a means for increasing the values of fruits through the application of marketing functions, that is, exchange of physical and facilitating. Storage life of fruit is extended under refrigerated storage conditions and this provides

more optimum time of marketing of products. The advantages of technical storage facilities including extending marketing season, gives longer shelf- life of fruits (Kasimila *et al*,. 2001).

Table 4.9. Farmer' response on the problem regarding the loss of fruits during storage

Loss fruits during storage	**Respondents (N=66)**			
	Frequency	%	Cumulative frequency	Cumulative %
Big problem	53	80.30	53	80.30
Minor problem	13	19.70	66	100

N= total number of respondents

%= Percentage frequency of respondents

4.3. Conclusion

It is widely accepted and reported that fruit production practices in the developing areas of Southern Africa, including Venda, is subjected to a low-cost inputs and uneconomic units land. The situation in the study areas in this study is not different, although some of the respondents indicated that they were able to make basic inputs like installing irrigation systems, buying pesticides and inorganic fertilizers, as well as marketing of their products. Most of the respondents could, however, not comply with the basic needs for establishing and maintaining their crops. Venda has a great potential for the production of tropical/subtropical, but due to the mentioned constraints, this has not yet materialized and huge forts need to be made to let this come true.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

The potential for agricultural development and poverty reduction is heavily influenced by the socio-cultural aspects and institutions. Actions to improve the functioning of the government and social institutions improve both growth and equity by reducing bureaucratic and social constraints to economic action and upward mobility. Government can do much to influence public debate to increase awareness of the societal benefits with regard to agricultural development programme to improve tropical/subtropical fruit production.

Surveying the climate and natural resources in Venda, it is clear that Region C in Venda has a great potential for sustainable production of tropical/subtropical crops. It is also clear that this potential is not fully utilized. The reasons for this can be mainly ascribed to uneconomic units, lack of knowledge and skill, lack of funding, lack of land use planning and management. From information supplied in Chapter 2, traditional cultural practices in Venda are still strong and some of these are directly or indirectly constraining the adaptation of modern farming systems. The question is how to address these issues.

There are opportunities, challenges, and constraints faced by small-scale farmers in Venda with regard to agricultural development and these needs to be addressed in this chapter.

5.1. Opportunities

Venda region is comprised of aspects that can facilitate sustainable production of tropical/subtropical fruit production, and these include both physical aspects and education.

5.1.1. Physical aspects

Venda's temperature has an average minimum range of 10-15°C and an average maximum of 25-30°C, with almost all regions of Venda free from frost and suitable for intensive agriculture (Naledzani, 1992). The evaporation rate during mid-summer season is in the range of 5-7 mm per day. Venda region is characterized by summer rainfall with little or no rain during the winter months in some areas. In order to meet the water requirements of the fruits such as mango, avocado, citrus, and others, water should be regularly supplied through irrigation as it is at this season where those fruit trees are at the critical stage of flowering (Joubert and Bredel, 1998).

The rivers and dams serve an important role in the irrigation of several tropical/subtropical farms in Venda in the study areas (See Figure 3.1). The main river in Venda is the Luvhuvu. The Luvuvhu Catchment forms part of the larger Limpopo system, which extends into Mozambique. The Luvuvhu River and some of its tributaries (including the Mutshindudi and Mutale rivers) starts in the Soutpansberg Mountains. The Luvuvhu River flows for about 200 km through a diverse range of landscapes before it joins the Limpopo River near Pafuri in the Kruger National Park.

Venda is well known for its high summer rainfall and warm tropical climate (Naledzani, 1992). Summer months with high rainfall and humidity are October-February and Autumn months with lower rainfall include March – May. Dams in the Luvuvhu River catchment include the Albasini Dam and the smaller Mambedi, Tshakhuma, Damani, Vondo, and Phiphidi Dams, of which the latter two lie in the Mutshindudi River. The Nandoni Dam has been constructed in the middle section of the Luvuvhu River east of the confluence with the Dzindi tributary and east of the town Thohoyandou.

The soil types described in Chapter 3 show a variety of soil forms. However, soil samples taken from each study areas were Hutton, Oakleaf and Bainsvlei soil forms. The soil functions principally as a container for water and plant nutrients (Klocke and Hergert, 1990). According to NDA (2000), the combination of soil forms such as

Hutton, Cloverly and Oakleaf are suitable for cultivation of tropical/subtropical fruit crops under irrigation. Hutton, Bainsvlei, Avalon and Oakleaf are suitable for dryland production of tropical/subtropical fruit production because of their texture, structure and porosity. Therefore all the areas surveyed were found to have suitable soils for tropical/subtropical fruit production.

5.1.2. Education

In spite of the schools, the University of Venda and the Madzivhandila College of Agriculture, practical skills and theoretical information about farming do not seem to filter down to the farmer on the land. Looking at the successful farmers in Chapter 4, it came out that most of them were educated people, farming on a part-time basis. These farmers made use of extension officers for advising them about the newest production methods and these were then successfully applied. When the former ARDC/AGRIVEN were operating in Venda (when farmers exposed to relevant knowledge and skills), high producing citrus and banana orchards were established, but due to lack of knowledge, these orchards were neglected after the withdrawal of the mentioned organizations. This clearly shows that there is a great need for educational upliftment of the Venda farmers. A proper planning needs to be done and farmers must be persuaded to form study groups where they can stimulate each other and where information can be made available to them. Extension officers also need to be made available to the farmers to help them with the planning and production techniques.

5.2. Challenges and constraints

5.2.1. Population growth

According to Statistics South Africa (2001), the population of Vhavenda was 1 199 854. Therefore, the population of Venda is growing at a 6% growth rate. Having this rate of population growth, sustainability in production systems is necessary in order to maintain the resources that facilitate production. The higher the population, the bigger the potential market but also the higher the pressure on natural resources.

5.2.2. Farming units and financing

As is widely common in the communal land areas, the majority of farmers had inadequate land holdings (< 15 ha) and farming equipments to derive a reasonable living from tropical/subtropical fruit production alone. They also lacked capital for inputs. In Chapter 4 it was pointed out that farming units are very small and that farmers with larger orchards obtained higher yields. The small units may be due to lack of finance or even due to cultural practices. To solve this problem will not be easy, but farmers may start to form co-ops in an effort to pool their resources.

Lack of finance is regarded as the major problem faced by the farmers in the study areas. This is due to low level of earning capacity and lack of suitable credit facilities. Financing for co-ops might be easier to acquire than for individuals on small units.

Generally, yields from fruit trees were found to be considerably below optimum.

5.2.3. Management

Among the Vhavenda people there are a number of cultural factors, which tend to impact on decision-making on cropping system with regard to tropical/subtropical fruit production. These include traditional and polygamous marriages, extended families, male dominated power on decision making and ownership of farm units, sharing of agribusiness facilities, traditional and cultural ceremonies. These may have a negative or positive influence on the selection of fruit cultivars and cropping system.

The productivity of tropical/subtropical fruit of the selected study areas was generally low due to both the organizational and managerial constraints that were encountered by the farmers. Small-scale farmers in the study areas indicated that they did not formulate a business plans to run their orchard operations because they do not have technical knowledge on good farming practices. Most of these farmers did not keep their farm record for the previous seasons of fruit growing. The farmers whose main source of information was the extension officers had higher productivity than those

who relied on other information sources (knowledgeable farmers or friends).

5.3. General

It is a pity that people should go hungry and unemployed in a region with such a potential for crop production. Limited efforts by individuals or small organizations to solve the problem will not help. National as well as provincial efforts are required to address the problem (Kirsten and van Zyl, 1998).

Researchers, extension officers, industrialists, educators, policy makers, and decision makers should understand commercial as well as small-holder farming systems. They should be trained to consider the socio-economic circumstances, needs, capacity to adopt change, of the potential beneficiaries (fruit growers) of a project. They have to be innovative and able to improve standard methods, products and resources, be prepared to learn from global experiences and eager to promote and implement more effective and efficient methods of tropical/subtropical fruit production.

The students graduating from the University of Venda, Madzivhandila College of Agriculture, University of the North and other neighbouring agricultural institutes are regarded as people who will promote leadership in the planning and management of fruit production in Venda. They can be divided into two categories, namely:

- **Specialists in a particular discipline who understand rural development issues**. These are particular professionals who specialize in rural development in rural activities; their rural development training will add value to the specialist professionals such as horticulturalists.
- **Specialists in rural development, with a sound knowledge of one or more discipline focused on an integrative area of analysis and practice**. These are "generalists" educated in a number of disciplines, who operate in a leadership or facilitating role and among rural communities. Their subject matter education will add value to the ability of the graduates to manage and direct rural development.

6. REFERENCES

ANTWI, M.A. 1998. An assessment of efficiency of small-scale farmers in Venda and Lebowa, Northern Province. Department of Agricultural Economics and Extension, Faculty of Natural and Agricultural Sciences, University of Pretoria.

ALIEN, H. AND PERRY, E. 1996. Human Powered Irrigation for Smallholders: Approach to Implementation. Addis Ababa: CARE International and Appropriate Technology International.

AUCHIER, E.C. AND KNAPP, H.B. 1932. Orchard and small fruit culture. Second Edition. New York Jon Willey and Sons. Inc. London: Chapman and Hall, Limited, 1932.

BLACKING, J. 1979. The Venda Children's Songs: A Study in Ethnolmusicogical Analysis. Johannesburg: Witwatersrand University Press. 15-16.

BOOTH, J.H. 2003. Where in the World? New Climatic Analysis Methods to Assist Species and Provenance Selection for Trials. Division of Forestry and Forest Product of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Canberra, Australia.

BOOYSEN, M. 1987. Venda Agricultural Development. Venda National Development Cooperation (VNDC).

BREDELL, G. AND JOUBERT, A.J. 1982. Climatic Requirements for Tropical and Subtropical Crops Grown in South Africa. Report: Citrus and Subtropical Fruit Research Institute, Nelspruit.

BUSINESS DAY NEWS WORKING KNOWING. 2002. Rich In Entrepreneurs Poor Industrial Investment. BDFM Publishers (Pty) Ltd.

CHICANDA, M. AND KIRSTEN, J.F. 1998. Improving smallholder's access to

agricultural inputs and services: Lessons for South Africa. AIPA/ Francolin Publishers (Pty) Ltd.

CITRUS AND SUBTROPICAL FRUIT RESEARCH INSTITUTE. 1990. Department of Agricultural Development. Nelspruit.

COMMUNITY DEVELOPMENT COUNSELLING SERVICE. 1964. Remote Areas Development Manual. Self- help Projects for Community Development. Peace Corps.

DECOTEAU, D. 1998. Plant Physiology: Environmental Factors and Photosynthesis. Department of Horticulture. The Pennsylvania State University. 102 Tyson Building. University Park, PA 16802.

DEMIRKOL, A. 1995. Avocado Growing in Turkey. Proceedings of the World Avocado Congress III. Citrus and Greenhouse Crops Research Institute. P.O. Box 35, 07100 Antalya, Turkey.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY. 1998. Luvuvhu and Its Tributaries. DWAF.

DE VILLIERS, E.A. 1998. The cultivation of Mangoes. Agricultural Research Council (ARC).

D' HAESE, M. L. AND MDULA, R. 1998. The Agricultural Democratisation of South Africa. The Effects of Disempowerment: On Farm Problems Related to Restricted Access to Resources, Support Services and Rights. Francolin Publishers (Pty) Ltd. Kendal News, Conner Main and Kendal Roads, Diep River, 7800 Cape Town.

D' HAESE, M. 1997. Socio-economic Studies of Mango Production in Venda (South Africa). Unpublished. University of Ghent, Ghent, Belgium.

D' HAESE, M. AND KIRSTEN, J.F. 2001. Student notes compiled from various

sources through a networking activity between academics attached to the University of Antwerp and Gent in Belgium, and the Universities of Pretoria, Zimbabwe, Zambia, Nairobi, Sokoine, Fort Hare, Stellenbosch and Eduardo Modndlane. Funded by the Belgian Government via the Flemish Interuniversity Council.

D' HAESE, L., LEROY, D. AND VAN ROOYEN, C.J. 1999. Food Security on Small-scale Farms in Venda, South Africa.

D'HAESE, M., VAN HUYLENBROECK., VAN ROOYEN, C.J. AND D'HAESE, L. 2001. Financial Analysis of Mango Production on Small-scale Emerging Commercial Farms in the Venda Region of South Africa. Agrekon, 38:209-216.

FOX, F.W. 1982.Food From The Veld: Edible Wild Plants of Southern African Botanically Identified and Described by Francis William Fox and Marion Emma Norwood Young. Johannesburg: Delta, 1982.

INSTITUTE FOR TROPICAL AND SUBTROPICAL CROPS (ITSC). 1990. Avocado. Institute of Tropical and Subtropical Crops. Agricultural Research Council (ARC). Private Bag X11208, Nelspruit 1200.

INSTITUTE FOR TROPICAL AND SUBTROPICAL CROPS (ITSC). 1991. Mango. Institute of Tropical and Subtropical Crops. Agricultural Research Council (ARC). Private Bag X11208, Nelspruit 1200.

JACKSON, D.I. AND LOONEY, N.E. 1999. Temperate and Subtropical Fruit Production. Wallingford: CAB International.

JOURBERT, A.J. AND BREDELL, G.S. 1998. Climatic Requirements for Tropical and Subtropical Crops Grown in South Africa. Institute for Tropical and Subtropical Crops. Agricultural Research Council. Private Bag X11208, Nelspruit 1200, South Africa.

KASAMILA, B.J., WAMBURA, R.M. AND NNKO, S.A.M. 2001. The Effects of

Unavailability of Technical Storage Facilities to the Marketing of Fruits and Vegetables for Economic Development in Morogoro Rural and Urban Districts. South African Journal of Agricultural Extension, *Vol 30 (2001).*

KIRSTEN, J.F., VAN ZYL., AND VINK, N. 1998. Agricultural Democratisation in South Africa. AIPA/ Francolin Publishers (Pty) Ltd.

KIRSTEN, J.F. AND VAN ZYL, J. 1998. Access to Productive Resources and Issues of Sustainability. AIPA/ Francolin Publishers (Pty) Ltd.

LANDIS, N., SANCHES, J.E., LEHNERT, R.H., EDSON, C.E. BIRD, G.W. AND SWINTON. 2003. Fruit Crop Ecology and Management.

LEROY, L.J.P., VAN ROOYEN., LENERT, R.H., EDSON,. AND DE WINTER, A. 2000. Business Orientation and Food Security Status of Small-scale Producers in the Venda Region, South Africa. Crop Research Bulletin 39, p90-98.

LOUW, A.B. AND REBELLO, A.G. 1996. Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

MATATA, J.B.W., ANANDAJAYASEKARAM, P., KIRINO, J.N., DIXON, J. AND NANDERA, E.O. 1999. Framing Systems Approach to Technology Development and Transfer. FARMESA. P312.

MASHELA, P.W. AND MOLLEL, N. 2001. Farmer-identified Indigenous Fruit Tree with Suitable Attributes for the Semi-Arid Northern Province of South Africa. South African Journal of Agricultural Extension, *Vol 30 (2001).*

McCASLIN, N.L. AND TIBEZINDA, J.P. 1997. Assessing Target Group Needs. Pp.29-46. In: SAMSON, B.E., BENTZ, B.E. AND SOFRANKO, A.J. Improving Agricultural Extension. FAO, Rome.

MEYER, N.G. 1998. The Agricultural Potential of South Africa: A Provincial

Perceptive on Food Security and Land Reform. Department of Agricultural Economics, Extension and Rural Development, Faculty of natural and Agricultural Sciences, University of Pretoria, Pretoria 0001.

MOWART, A.D. AND GEORGE, A.P. 1996. Environmental Physiology of Persimmons. The Horticultural and Food Research Institute of New Zealand (Pty) Ltd.

MUNICIPAL DEMARCATION BOARD. 2003. Population, households, gender, and age breakdown for Tshakhuma, Muledane, Mukula and Tshifudi. Ground Floor, Block B2, 1166, Park Street, Hatfield 0028.

MUNSELL SOIL COLOR CHARTS. 1954. Munsell Soil Colour Charts. Baltimore: Munsell Color Company, 1954.

NALEDZANI, A.T. 1992. Farmers Support Programme and Agricultural Development in Venda. Pretoria (s.n.), 1992.

NATIONAL DEPARTMENT OF AGRICULTURE (NDA). 2000. Cultivating Citrus. National Department of Agriculture, Pretoria 0001.

NATIONAL DEPARTMENT OF AGRICULTURE (NDA). 2000. Cultivating Avocadoes. National Department of Agriculture, Pretoria 0001.

NATIONAL DEPARTMENT OF AGRICULTURE (NDA). 2000. Cultivating Mangoes. National Department of Agriculture, Pretoria 0001.

NAKASONE, N.Y. AND PAULL, R.E. 1998. Tropical Fruits: Crop Production in Horticulture. CAB International. Wallingford, Oxon OX10 8de, UK.

NAVILLE, R. 1995. Le marche'des fruits tropicaux et subtropicaux en 1974, *Countries,* 30: 359-366. In: SAMSON, J.A. 1980. Tropical Fruits. New York: Longamn, 1980.

NORMAN, W.R. 1992. A Field Manual for Water Lifting and Management in Small-scale Irrigation Systems in Niger. Niamey, Niger/ Morrilton, Arkansas: Government of Niger and Winrock International.

NTHAKHENI, N.D. 1993. Productivity o Measures and Dynamics of Cattle Herds of Small-scale Producers in Venda. Thesis (MInst. Agrar). University of Pretoria, 1993.

OETTLE, M. 2002. Limpopo Province, South Africa. (www.hampshireflag.co.uk/world/allflags/za-np.html).

PERRY, E. 2003. Low- cost Irrigation Technologies for Food Security in Sub-Saharan Africa. Appropriate Technology International, Washington D.C., USA.

PHILLIPS, B., RENNER. AND WILLIAMSON, J. 2003. Fruit and Nut Production. University of Florida.

ROBBINSON, J.C. 1993. Handbook of Banana Growing in South Africa. Institute of Tropical and Subtropical Crops. Agricultural Research Council.

ROBBINSON, J.C. 1996. Bananas and Plantains. Crop Production Science in Horticulture. CAB International. Wallingford, Oxon OX10 8de, UK.

SAMSON, J.A. 1980. Tropical Fruits. New York: Longman, 1980.

SAMSON, J.A. 1986. Tropical Fruits. Essex: Longman Scientific & Technical New York: Longman, 1986.

SINGO, N.M. 1996. A Survey of the Indigenous Relishes of the Vhavenda and their Agricultural Potential. Thesis (M.Sc in Botany). University of Pretoria, 1996.

SINGH, L.B. 1960. The Mango: Botany, Cultivation, and Utilization. Interscience Publishers, New York.

SKOG, L.J. 1998. Chilling Injury of Horticultural Crops. Ministry of Agriculture and Food. Ontaro.

SOUTH AFRICAN WEATHER SERVICES. 2001. Current Conditions for Thohoyandou. SA Weather Services © 2001.

STATISTICS SOUTH AFRICA. 2001. Population data of 2001. The de Bryun Park, 170 Andries Street, Pretoria.

STOVER, R.H. AND SIMMONDS, N.W. 1987. Bananas. Longman Group UK.

THE BUREAU FOR ECONOMIC RESEARCH: CO-OPERATION AND DEVELOPMENT STUDIES. 1979. The Republic of Venda. Chris van Rensburg Publication (Pty) Ltd. Johannesburg, RSA.

THE BUREAU FOR ECONOMIC RESEARCH: CO-OPERATION AND DEVELOPMENT STUDIES. 1979. The Independence Venda. Published by Benso. Pretoria, RSA.

VAN ROOYEN, C.J. AND NENE, S. 1998. Experiences with Small Farmers Support Programme. AIPA/ Francolin Publishers (Pty) Ltd.

VAN ROOYEN, C.J. VINK, N. AND KRISHANA, N.T. 1987. Access to the Agricultural Market for Small Farmers in Southern Africa. AIPA/Francolin Publishers (Pty) Ltd.

VAN ROOYEN, C.J., GROENEVELD. J.A., NGQANGENI, S. AND FENYES , T. 1998. Agricultural Policy Reform in South Africa. AIPA/ Francolin Publishers (Pty) Ltd.

VAN SCHALKWYK, H.D. AND GROENEWALD, J.A. 1992. Regional Analysis of South Africa. Agricultural Resource Use and Productivity. Agrekon 31 (3).

VAN WARMELA, N.J. 1932. Contribution Towards Venda History, Religion and Tribal Ritual. Pretoria: Government Ethnological Publication 3.

VENDA NATIONAL DEVELOPMENT COOPERATION (VNDC). 1990. Venda Agricultural Development. VNDC.

WHILEY, A.W., SCHAFFER, B. AND WOLSTENHOLME, B.N. 2002. Environmental physiology of Avocado: Botany, Production and Uses. CABI International Press.

WILLEMSE, W. AND HERBST, L. 1998. Banana Production. National Department of Agriculture. Pretoria 0001.

WILLIAMS, B., GOUWS, E. AND KARIM, S.S.A. 2000. South African Journal of Science. National research Foundation. Volume 96 Number 6, June 2000.

WILLIAMS, B., GOUWS, E., COLVIN, M., SITAS, F., RAMJEE, G. AND KARIM, S.S.A. 2000. South African Journal of Science. National research Foundation. Volume 96 Number 6, June 2000.