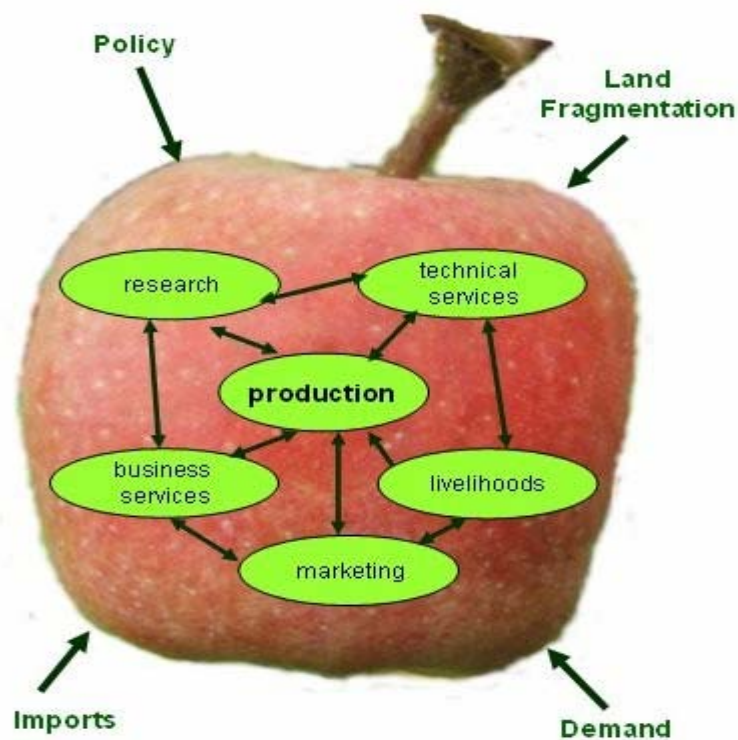




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in Agriculture



National Agriculture Research  
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## KABALE APPLES: BOOM OR BURST?

A study to develop strategies to exploit market opportunities  
for apple farmers in Kabale, Uganda

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for apple farmers in Kabale, Uganda

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## ABSTRACT

This study was conducted by an inter-institutional group of research and development professionals from Kenya and Uganda, as part of a broader process of capacity building in Integrated Agricultural Research for Development (IAR4D). Following the identification of apple production and marketing as a priority issue in the South Western Highlands of Uganda by NARO and the local government, the team spent 6 weeks reviewing stakeholder perceptions, and analysing the apple enterprise from the ecological, technical, economic and social perspectives, and developing a strategy that can contribute to apple becoming a significant cash crop in the South Western Highlands of Uganda.

The apple industry is in its infancy in Uganda. Grafted seedlings and ungrafted rootstock (for in-situ grafting) have been distributed to small-holder farmers through a number of farmers' groups. Major challenges currently facing the apple enterprise include the development of appropriate horticultural practices (grafting, defoliation, fertilization, pest and disease control), as well as availability and organization of financial and technical services. So far, few apples have been sold from local production; although current plans envisage a production considerably in excess of current consumption in Uganda. If apples from the South Western Highlands are to compete with imports of fresh fruit (mainly from S.Africa, Kenya) in the local markets (Kampala) or regionally (e.g. DR Congo), farmer organization, collective marketing and strong links to major outlets (e.g. supermarkets) will be essential.

A number of agricultural enterprises have been tried and have failed in the past in this region of Uganda. As yet, the team found no shared and coherent vision of future apple production and marketing among the different stakeholders in the S.W.Highlands. If apples are to provide a significant means of livelihood for small-scale producers in this region, there is a need to coordinate stakeholders actions through some sort of industry steering committee or task force; it is hoped that the "monitoring group" established to liaise with the team conducting this study can develop into such a grouping.



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Final editing of the report was done by Ans Brom.



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## LIST OF ACRONYMS

ARDC	Agricultural Research and Development Centre
AHI	African Highland Initiative
AEZ	Agro-ecological zone
ADF	African Development Fund
ARC	Agricultural Research Council
CIAT	International Centre for Tropical Agriculture
CGIAR	Consultative Group on International Agricultural Research
CG	Central Government
DRC	Democratic Republic of Congo
EAC	East African Community
EACU	East African Customs Union
ICRAF	International Centre for Research in Agro forestry
IARC	International Agricultural Research Centers
ICRA	International Centre for development oriented Research in Agriculture
KARI	Kawanda Agricultural Research Institute
LG	Local Government
MAAIF	Ministry of Agriculture Animal Industries and Fisheries
MAK	Makerere University
MG	Monitoring Group
MoU	Memorandum of Understanding
NGO	Non Governmental Organization
NARO	National Agricultural Research Organization
NAADS	National Agricultural Advisory Services
PEAP	Poverty Eradication Action Plan
PMA	Plan for Modernisation of Agriculture
RSA	Republic of South Africa
TOR	Terms of Reference
USAID	United States Agency for International Development
NARO	National Agricultural Research Organisation
Tons	Tonnes
USD	US Dollars
Kg	Kilograms
Km	Kilometer
Ush	Uganda shillings
DRC	Democratic Republic of Congo
Ha	Hectares
NPV	Net Present Value
IRR	Internal Rate of Return
a.s.l.	Above sea level
IAR4D	Integrated Agricultural Research for Development
A2N	Africa 2000 Network

## EXECUTIVE SUMMARY

The apple enterprise, like many crop enterprises before it, has created excitement in the local community. It has also attracted many stakeholders whose perceptions, interests and objectives are either shared or conflicting. The presence of many factors involved in the enterprise warrants the use of a multiple stakeholder problem solving approach in its development. This report provides the initial steps of this approach, commonly known as Integrated Agricultural Research for Development (IAR4D), in addressing apple development in Kabale.

The report is divided into five chapters; Chapter 1 defines the apple problem that was addressed by the study. Chapter 2 describes the IAR4D procedure that was used in the study. Chapter 3 analyses the current factors involved in the apple enterprise development and defines the system of interest and likely future scenarios of the apple industry in Kabale. Chapter 4 gives an elaborate analysis of the apple enterprise in the district from agro-ecological, technical, economic and social perspectives. Chapter five summarizes the analytical perspectives into development strategies that if employed will result in the apple enterprise becoming a significant cash crop in south-western highlands.

The thrusts of the report are found in the following highlights:

1. The districts in south-western highlands, including Kabale, lack a reliable perennial cash crop. Perennial crops can provide cash income and contribute to better management of natural resources. Tobacco, coffee and pyrethrum were introduced and received with excitement in Kabale but they all failed to become significant in the local economy. Among fruit crops, avocado was introduced but has remained a subsistence crop with a few farmers having a few trees in their plots.
2. Apple development is a new initiative for increasing farm income under the Plan for Modernisation of Agriculture (PMA). The initiative has been heavily promoted by national and local Governments and has been received with a lot of enthusiasm and interest from farmers.
3. The objective of this study was to support the local development actors in their pursuit of making the apple a significant cash crop in the district. This report is the main output of the study and proposes development strategies that would be in line with the development plans of the various stakeholders.
4. The IAR4D approach was applied in the study. It involved iterative steps that revolved around field visits, market surveys, and interviews with key informants, informal interactions with different stakeholders and analysis of primary and secondary data.
5. The main factors affecting the apple enterprise were analyzed, including interests, perceptions on concerns and opportunities, objectives and roles of the different stakeholders. The report defines the system of interest as a system for coordinating stakeholders' actions to support small scale farmers to profitably produce apples to satisfy local and national market demands. The major driving forces for this system of interest are competition from apple imports, apple technologies, and the policy on commercialization of agriculture. The future evolution of these driving forces together with the actions of local stakeholders will determine the success of apples as a commercial venture.
6. Major challenges facing the apple enterprise include low production, access to appropriate apple technologies, limited stakeholder organization, lack of clear market structure, shortage of technical skills, and threats from apple imports.

7. Major opportunities include great interest from farmers and strong political will in the promotion and funding of the crop. Other opportunities are good market prospects, access to Rwanda and DR Congo markets and feasibility of starting cottage industries.
8. From the agro-ecological perspective, apple growing may be a feasible undertaking in the south-western highlands. However, technological and management issues such as appropriate varieties, timely defoliation, synchrony in flowering, pests and disease control, post-harvest management and marketing need urgent attention.
9. Zonation of the region based on agro-ecological zones and putting the fragmented plots into blocks would facilitate good farming, which is recommended for effective management of the trees. Only grafted apple seedlings should be distributed to farmers for planting to maintain quality of the trees. The current practice of supplying non-grafted rootstocks to farmers and grafting *in situ* later should be discontinued.
10. The economic viability of the Kabale grown apples will be determined by (1) the market share they command in the local and national markets and (2) the profit margin the farmers will get from sales of the produce or products. Market prospects for local apples are good due to the steady increase in fresh apple consumption. In addition, the Kabale grown apples are reputed to be tastier than imported ones. However, the market requirements include supply of the right variety, quality, quantity and consistency. Supermarkets request for sizeable samples to gauge the demand before entering contractual arrangements. The Kabale grown apples were said to be small in size and limited in supply to-date, falling short of satisfying some of the supermarket requirements.
11. The fresh market should be the main target for local apples as supply of apples to large juice processors is unlikely to compete with cheap imported concentrates. However, the district target is to establish 800,000 apple trees in the next five years. This will equal to 40 times the current annual consumption (190 metric tonnes) in the country. This calls for an aggressive marketing strategy.
12. In order to meet market requirements, collective production and marketing is a prerequisite. Farmers should be organized into groups and associations. This will enable them to enter into partnerships and collaboration with other key players in the apple market chain. Purchase of inputs in bulk and working in groups will reduce costs of production. Selling in bulk will increase the bargaining power for better producer prices and ensure quality, quantity and consistency in supply of apples.
13. Promotion of the crop for nutritional purposes alone is too narrow and may lead to fast disappearance of the farmers' interests. Experience shows that like every business person, farmers' main objective is to earn income to improve their livelihood. Hence, apple promotion should target both home consumption and income generation.
14. There is a strong recommendation that business plans for apple production and marketing be prepared at all levels. Business plans are a guide to produce what you can sell. They may provide an assessment of the competitiveness and profitability of the Kabale grown apples. The farmers' groups will get to know the specific market requirements and only produce for those markets.
15. For a commercial crop, district level farmers' association and production factors are being put in place. But as yet, the team found no shared and coherent vision of a marketing strategy for the crop.
16. The Monitoring Group should transform itself into a strong local "apple steering committee" to refine and co-ordinate implementation of the development strategies outlined in this report. There is need to co-ordinate stakeholders' actions for the farmers to produce apples to satisfy local and national markets.





# 1 INTRODUCTION

## 1.1 General background of Kabale District

Kabale District is located in south-western Uganda and is bordered by the Democratic Republic of Congo (DRC) to the West, and Rwanda to the Southwest. To the East it is bordered by Ntungamo District and by Kanungu and Rukungiri Districts to the North. It borders Kisoro District to the West.

The district covers an estimated area of 1,695 km<sup>2</sup> made of 3 counties, Ndoorwa, Rukiga and Rubanda, and a municipality. Lake Bunyonyi, the largest water body in Kabale, covers an area of 132 km<sup>2</sup>. Kabale District was part of the former Kigezi District which has been split into four districts, viz. Kabale, Rukungiri, Kanungu, and Kisoro.

Kabale District is in the South-western highland region. This is part of a high, hilly plateau area with hill summits reaching up to 2800 m. The hills are separated by uniform, steep valley slopes, and valley bottoms are relatively narrow. The altitudes range in general from 1500 to 2400 m a.s.l.

The South-western highland region has two distinct rainy seasons, one from March to May and a second from September to December. Table 1 shows rainfall from 1987 to 1994 while Table 2 shows temperatures in the period 1993-1999 for Kabale District. The mean annual rainfall varies from 800-1000 mm, whereas temperatures range from 8.3°C to 27.2°C with June/July being the coldest months. The relative humidity ranges between 90% and 100% in the mornings and decreases to between 42% and 75% in the afternoons throughout the year (Kabale Meteorological Department, 2000).

**Table 1: Total monthly rainfall (mm) for Kabale District from 1987 to 1994**

	J	F	M	A	M	J	J	A	S	O	N	D
1987	82.7	92.2	113.5	131.1	178.4	44.6	3.9	23.3	108.0	129.1	261.5	31.3
1988	83.9	90.9	161.7	139.1	82.2	4.0	64.2	142.6	166.0	132.8	60.8	47.0
1989	34.7	99.8	82.0	89.6	134.9	35.6	10.1	74.7	180.8	128.5	72.3	74.3
1990	49.0	161.8	128.4	182.6	72.6	0.0	0.0	45.0	158.5	66.5	93.6	68.9
1991	72.1	73.2	158.1	108.7	116.7	39.0	17.3	17.5	53.7	134.9	51.1	70.9
1992	17.5	49.4	158.0	76.2	44.2	53.8	26.9	15.6	148.8	204.6	81.2	101.9
1993	95.5	28.4	172.0	86.5	159.7	33.3	0.0	60.8	9.7	58.9	94.9	76.6
1994	58.0	70.0	125.6	149.9	87.1	2.1	1.9	70.1	145.6	125.5	134.5	93.1

Source: Meteorology Department, Kabale District 2000

The soils of Kabale are mainly ferralitic, volcanic and peat, the ferralitic soils being the most widespread in the district. They have been declining in soil fertility over the years due to continuous cultivation and soil erosion. Natural vegetation is almost lacking due to human activity. Established forest plantations are conserved by the Government. Ecuya Forest is the only natural forest reserve still present in the district.

**Table 2: Mean annual maximum and minimum monthly temperatures (°C) for Kabale District from 1993 to 1999**

		J	F	M	A	M	J	J	A	S	O	N	D
1993	Max	23.9	25.2	24.3	24.2	23.6	22.8	24.7	24.2	26.1	25.5	24.5	24.2
	Min	11.4	11.1	10.6	11.4	12.4	11.3	8.3	10.3	10.0	11.1	11.8	11.6
1994	Max	24.0	25.2	23.4	23.6	23.0	24.2	24.0	24.2	25.1	23.6	23.0	23.6
	Min	11.2	11.7	11.5	12.2	12.8	10.1	9.7	11.1	11.7	11.9	12.8	12.5
1995	Max	24.6	24.4	23.9	23.7	23.9	24.0	24.1	25.2	23.7	24.0	22.9	23.0
	Min	11.2	11.4	11.9	11.9	12.9	11.7	10.3	9.8	11.7	12.3	12.3	10.6
1996	Max	24.1	23.8	24.1	23.6	22.9	23.0	23.3	24.5	24.5	23.8	23.2	23.9
	Min	10.9	11.3	11.9	12.3	12.5	11.9	10.0	10.2	11.8	12.4	12.2	11.9
1997	Max	23.9	25.8	24.3	23.2	23.3	23.8	23.9	25.5	27.2	25.1	23.3	23.1
	Min	11.9	10.5	11.8	12.9	12.3	10.6	10.4	11.5	10.6	12.5	13.4	13.0
1998	Max	24.2	24.7	25.3	24.3	23.8	25.4	24.3	25.0	25.2	25.1	24.5	24.3
	Min	13.0	13.3	13.0	13.6	13.3	10.9	10.0	10.6	11.1	12.8	12.1	10.4
1999	Max	24.4	26.2	23.6	23.5	23.1	24.5	24.8	23.2	24.4	23.9	22.8	23.5
	Min	11.4	10.4	11.9	11.8	10.9	9.8	9.6	13.3	10.7	11.0	11.5	11.9

Source: Meteorology Department, Kabale District 2000

## 1.2 Problem statement and justification

South-western Uganda is among the regions with the highest population pressure in Uganda (400 persons/km<sup>2</sup>), severe land degradation, and low household income. Most households derive their income from less than 1 hectare of land on which they largely subsist. Yields are low and gaining significant income from current food crops is almost impossible. Most of the crop enterprises are annual crops.

Kabale District, which is the focus of this study, is probably the most affected by the factors mentioned above. The landscape is mountainous with deep valleys and steep slopes, favouring soil loss by erosion. Most of the valleys are swampy and liable to flooding and water logging.

Kabale District lacks perennial cash crops, making people rely on annual crops for their livelihood. This means that all farm operations are repeated every season making most of the enterprises very costly. A few perennial crops like pawpaw and guava are grown mainly for subsistence. The main crops grown in Kabale include a range of annual crops such as sorghum, beans, field peas and sweet potatoes. Banana is gaining importance and is widely grown to the east of Kabale District. Arabica coffee has been promoted in lower elevations of the district with limited influence on household income. Irish potatoes were introduced in the 1970s (note that local varieties existed before that time) and have become an important cash and food crop and influential commodity in the farming system. Attempts to grow wheat and barley raised a lot of hope but did not succeed neither did pyrethrum largely due to marketing constraints, poor quality of products and failure to meet the quantities required at the agreed time.

A wide range of temperate vegetable crops were introduced and are currently widely grown in the region. These include cabbages, cauliflower and carrots. For a long time (1960-1990) Kabale District monopolized the vegetable markets in Kampala until other regions started producing vegetables.

Livestock in Kabale is an important source of livelihood for cash, food and social commitments. Improved breeds have been promoted and successfully raised for milk and

beef. There is no documented use of livestock in cultivation in Kabale and use of manure is minimal due to steep slopes, land fragmentation, and long distance of fields from households.

Local and national policies have been geared towards eradicating poverty by increasing income at household level. In this regard, high income generating enterprises are being sought for adoption by farmers. Temperate fruit growing has been selected as a strategy to commercialize farming and raise farm incomes.

Fruit growing and consumption was for a long time not an important component of the diet of the people of the highlands of south-western Uganda. Apples are adaptable to various climates but can be considered best adapted to the cool temperate zone of latitudes 35-55<sup>0</sup> North/South. Kabale District does not fall in this geographical location but its high elevation provides a climate that is similar to temperate climate although lacking winter.

In 1999, four varieties of apples namely Anna, Golden Dorset, Rome Beauty, and Winter Banana were planted on-station in Bugongi, Kalengyere and Kachwekano stations, Kabale District (1830 m a.s.l) by NARO. Earlier agroforestry research did not include fruit trees but fruit trees were introduced following farmers' demand for fruit trees. Nine more varieties were introduced in 2000 for further evaluation on-station. Other temperate fruits introduced for evaluation included 5, 7 and 8 varieties of peaches, pears and plums respectively

Following on station trials, two varieties of apples and two of pears were taken for on-farm trials with promising results (Levand, 2005). Kabale, with a temperate-like climate is considered favourable for the growing of apples for income generation. So far several hundred apple trees have been given to farmers in the district and their performance is not yet proven successful under farmer management.

Apple production is a new initiative for improving incomes at household level among communities in Southwest Uganda. Being a temperate crop, this region, at 1500-2400 masl, offers a promising climate for their cultivation. A number of challenges however exists and is listed below:

- Selecting adapted high yielding varieties suitable for markets
- Developing agronomic practices for optimum production (pruning, defoliation to create dormancy, fertilisation, etc)
- Establishing a competitive marketing chain
- Maximising value addition

The most suitable apple growing areas are the South-western highlands, Kabarole/Kasese, West Nile (Nebbi) and the Eastern highlands of Uganda (Raussen, 2003).

This study is therefore important to assess the production and market potential of apples in Southwest Uganda and eventually in Uganda.

### **1.3 Institutional context of the study**

The International Centre for development oriented Research in Agriculture (ICRA) based in Wageningen in the Netherlands offers training in building capacity to build capacity (BC2BC) in developing countries to be able to solve complex problems hindering rural development. NARO is working closely with ICRA in building capacity within its research system.

A team of five scientists from different institutions in Kenya and one Ugandan scientist from NARO are conducting a study in Kabale District to understand apple production and marketing in Uganda. The study is meant to highlight the major challenges that are faced by apple producers at the moment and to develop strategies to overcome them. NARO-Kachwekano, which is the host institution, and other stakeholders and partners are expected to follow up the strategies by developing and implementing action plans for the success of the apple enterprise in Kabale.

#### **1.4 The terms of reference (ToR) of the study**

The terms of reference as provided by NARO-Kachwekano ARDC were used in the case study. They specified that work was to be based in Kabale District and the subject would be apples and their marketing opportunities. NARO-Kachwekano ARDC formulated the ToR and gave a detailed background that was very useful in the study.

Specifically the ToR were:

- To identify market opportunities for the apples for Kabale farmers
- To specify the type of products which are to be produced and marketed.
- To carry out a farm typology in order to specify the type of farmers best suited to exploit the different fruit production and marketing opportunities.
- To identify the partnerships to be developed and come up with actors and their roles in the fruit development strategy.
- To identify the capacity development needed for different partners in order to adequately perform their roles.

#### **1.5 Objectives of the study**

The stakeholders and the Monitoring Group involved in apple promotion, and the study team together, agreed on the main objectives of the study. From the interactions, the objectives of the study were to:

1. Establish the production potential of apples in Kabale District.
2. Establish market opportunities for apples grown by farmers in Kabale District and the greater Kigezi Region.

#### **Goal**

The goal is to support the local development actors in generating development options for apple farmers in Kabale.

#### **Purpose**

The purpose of this study is to develop strategies to exploit production and market opportunities for apples in the South-western highlands of Uganda.

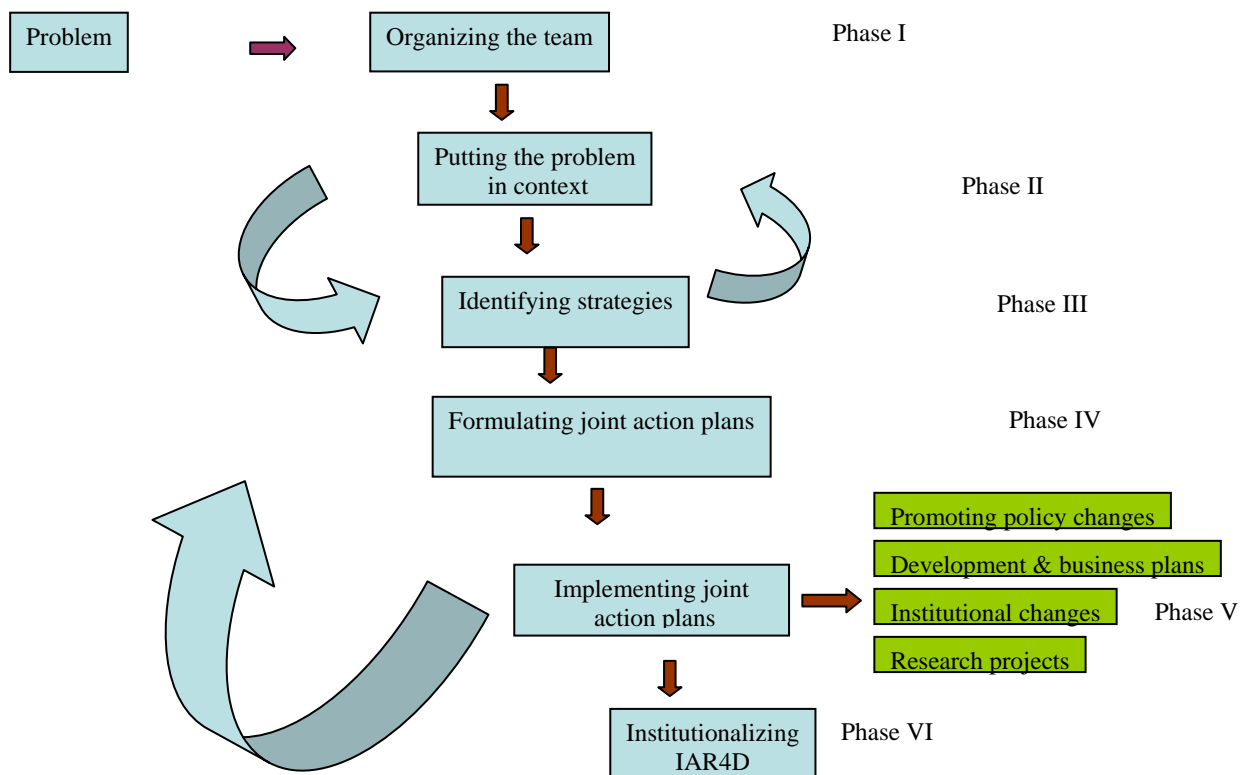
#### **Expected Outputs**

1. A report that could feed into stakeholders' apple development plans
2. Formation of Apple Task Force/Steering Committee

## 2 METHODOLOGY

### 2.1 The guiding procedure: Multi-stakeholder problem solving approach

Figure 1: The IAR4D Procedure (Visualized)



The Integrated Agricultural Research for Development (IAR4D) procedure was adopted in developing strategies to exploit market opportunities for apples in agro-ecological zones of the Southwestern highlands of Uganda. This procedure involved a series of iterative steps directed by interdisciplinary and inter-institutional teams engaging the involvement of stakeholders. It combined elements of fact finding and participatory analysis and decision making.

An inter-institutional and interdisciplinary team of six scientists performed the task presented by the client, namely NARO's Kachwekano Agricultural Research and Development Centre (ARDC). The team developed a clear common understanding of the problem statement, the outputs expected by the client on completion of the task, and the work plan. The team distributed tasks to individuals or sub-teams based on disciplinary expertise and other skills.

To put the apple enterprise problem in a developmental context, secondary data from several sources was reviewed and the central research question and secondary and tertiary research questions were formulated. These research questions, which are provided in Chapters 3 and 4, were used to develop a checklist for further clarification with stakeholders and key resource

persons. The team used visual tools in its brainstorming sessions and in meetings with stakeholders. The rich picture tool was used to gain a broader understanding of the problem situation in the apple enterprise. The team brainstormed and drew a rich picture that included stakeholders and their perspectives, interests, concerns and conflicts, as well as the driving forces relevant to the problem situation. It then defined the system of interest (change from current situation to future desired situation). Scenarios for the development of the apple enterprise were also developed.

The problem situation was analyzed from agro-ecological, technical, economic and social perspectives, based on secondary and primary information collected. Strategies for the development of the apple enterprise were developed and presented to stakeholders for feedback and discussion.

After the multi-stakeholders' workshop, the team refined the strategies and handed over the field study report to an inter-institutional monitoring group in Kabale District that was expected to form a multi-stakeholder apple enterprise steering committee. The committee is expected to prioritize strategies, formulate and implement joint action plans in respect of policy changes, development of business plans, institutional changes and research projects. The field study report is intended to demonstrate a procedure that can serve as a model for conducting research in future in south-western highlands of Uganda.

## **2.2 Collection and review of secondary sources of information**

To better understand the problem situation, information related to temperate fruit production and marketing was obtained from a variety of secondary sources including internet articles, manuals, books, newsprint articles, annual reports and local government strategic plans.

## **2.3. Primary sources of information**

### *2.3.1. Discussions with key resource persons in Kabale District*

The ICRA team held a meeting with local government leaders to explain the purpose of the study and to gauge political will and material support for apple enterprise development in Kabale. Resource persons from key institutions were interviewed. The institutions covered included NARO, local government (Production and marketing divisions), NAADS and non-governmental institutions (A2N and Africare). Production potential, costs of production, farmer organization, roles and coordination of stakeholders, constraints and challenges, level of resource commitment, extension service provision, credit services and seedling distribution were among the issues discussed.

### *2.3.2. Discussions with monitoring group*

A monitoring group (MG) consisting of six members drawn from key stakeholders (NARO, farmer organizations, NAADS, local government and African 2000 Network) was formed and launched at the beginning of the study. The team held three meetings with the monitoring group during the study period. Discussions held in the first meeting arrived at a common understanding with the MG on the terms of reference for the study. The terms of reference were renegotiated, priority crop enterprise for the study identified and composition and role of the MG defined. The second meeting provided and discussed feedback on progress

and preliminary findings of the study and identified information gaps and new stakeholders to seek information from. The third meeting followed a stakeholders' workshop held at the end of the field study to discuss the findings and strategies identified for the development of the apple enterprise in south-western Uganda and the way-forward. The future role of the MG and other stakeholders in the implementation of the strategies was discussed.

### *2.3.3. Field visits*

#### **Research stations**

The team had a guided tour of the temperate fruit nurseries and demonstration plots at Bugongi and Kalengyere substations of NARO-Kachwekano and discussed issues ranging from research and training needs to marketing with lead scientists involved in the apple enterprise.

#### **Farms**

The team visited 12 farms in three sub-counties of Kabale District targeted for apple enterprise development, namely Bubare, Kyanamira, and Bukinda. One farm had no apples whereas the rest had 20 to 156 apple trees each. At least 3 farms were visited in each sub-county. The farmers were interviewed based on an unstructured checklist of questions.

### *2.3.4. Market Survey*

The market survey was conducted during a period of two weeks and covered three major towns in Uganda, namely Kabale, Mbarara and Kampala. Secondary market information from research and development institutions, local government, non-governmental organizations and print media was reviewed and key areas of investigation and the methods to be used to examine these components developed. Key informants were identified at various levels within the apple market chain and interviewed using a semi-structured questionnaire. These included managers of processing firms, traders, agricultural research scientists, marketing consultants, supermarket managers, extension agents, and local government officials. Retail outlets visited included open-air markets, municipal markets, roadside markets, green groceries and supermarkets. Britania Allied company was the only processor visited. The list of the persons contacted is in Annex 1.



### 3 CONTEXTUAL ANALYSIS OF THE APPLE ENTERPRISE

#### 3.1 Introduction

The Kabale apple enterprise can be understood better when viewed from a wider scope as elaborated with the help of the rich picture (Figure 2). The rich picture visualizes the major elements and the interrelationships between them as they currently affect or are affected by the enterprise. The major elements visualized include farmers and farm enterprises, Government, research organisations, non-government organisations (NGOs), service providers, policy changes in agriculture, markets, and land use aspects. The interests, concerns, and interactions between these elements make the apple case a complex issue when viewed from different fronts.

From the ecological perspective, the district has no real temperate climate (i.e. a cool season that induces dormancy) that is necessary for apple production. Still, promoters of the crop wish that all farmers across agro-ecological zones (AEZs) adopt apple growing as an income generating enterprise. The crop is new and no one among its promoters has in-depth experience on the variety characteristics, management practices, and marketing aspects.

On the economic front, the varieties grown in Kabale are Anna (red) and Golden Dorset, while the main varieties seen on the market were Golden Delicious (yellow), Fuji (red), Fuji (white) and Granny Smith (green). This gives a message that these Kabale-grown apples may need special features and promotional campaigns to compete with established varieties in the current market.

From the social point of view, sorghum has a cultural attachment in the area, while Irish potato is already established as both food and cash crop. This means that introduction of apple trees will have implications on the balance of cropping systems and on the means of livelihood in Kabale.

The subsequent sections give a contextual analysis of the apple enterprise, focusing on stakeholder interactions, system of interest, driving forces and future scenarios. The analysis is in response to the following research questions that were formulated as part of the scheme to operationalise the terms of reference given in chapter one:

- Who are the major stakeholders and their relationships in the development of the apple enterprise?
- What are the perceptions, objectives and interests of the key stakeholders?
- What are the roles of the key stakeholders in the apple industry?
- What are the likely future scenarios for apple production and marketing?

The chapter concludes with the identification of hot spots that define the system of interest (desired change for the apple industry), which provides the basis for in-depth analysis in Chapter 4 and on the basis of which strategies are developed (Chapter 5) to help in solving question whether apple production is profitable in the area.

Figure 2: Rich picture of the current situation of the apple case in Kabale District



### 3.2 Stakeholders in apple enterprise development

#### 3.2.1 Key stakeholder interests

The rich picture (Figure 2) shows that problems facing the development of apples in Kabale District are the concern of different stakeholders (Table 3) who may have different perceptions, objectives, and interests in the crop. The interests of different stakeholders require that all, or groups of them, work together through established relationships to tackle the problem from different perspectives. The various stakeholders affect and are affected differently by the apple enterprise in Kabale District. They have different perceptions (Table 4) but may have common (Table 5) or conflicting objectives.

**Table 3: Key stakeholders currently involved in apple development in Kabale**

<i>Key stakeholder</i>	<i>Why and what are their interests in apples</i>
Farmers	<ul style="list-style-type: none"> <li>• Produce and sell apples</li> <li>• Are looking for reliable cash crop to increase income</li> </ul>
Central Government	<ul style="list-style-type: none"> <li>• Promoter and donor for development of the enterprise</li> <li>• The need to substitute apple imports with local production and earn foreign exchange</li> </ul>
Local Government	<ul style="list-style-type: none"> <li>• Provides an enabling policy environment for production and marketing of apples</li> <li>• Apples offer potential for income to reduce poverty and improve rural livelihoods</li> </ul>
National Agricultural Research Organization (Kachwekano ARDC)	<ul style="list-style-type: none"> <li>• Has the mandate for crop research</li> <li>• Research in apple technologies and dissemination</li> </ul>
Farmer organizations	<ul style="list-style-type: none"> <li>• Only farmers who belong to organized groups are covered under the NAADS programme</li> <li>• The need for farmers to commercialize agriculture by shifting to more income generating enterprises.</li> </ul>
National Agricultural Advisory Services (NAADS)	<ul style="list-style-type: none"> <li>• Mandate for crop research &amp; development programmes</li> <li>• Generation, development &amp; dissemination of appropriate apple production technologies &amp; marketing strategies</li> <li>• Mandate for ensuring delivery of quality agricultural services, particularly extension services</li> <li>• Ensure that extension service providers are equipped with appropriate extension packages on apple production and marketing</li> <li>• Organize farmers into groups and associations</li> </ul>
Private extension service providers	<ul style="list-style-type: none"> <li>• Contracted by farmers through the NAADS programme to provide extension services</li> <li>• Ensure that farmers have access to appropriate extension packages for apple production and marketing</li> </ul>
Africa2000network (A2N) (NGO)	<ul style="list-style-type: none"> <li>• An agricultural service provider that has strong links with farmers and donors</li> <li>• Sustainable apple farming for farmers to reap more benefits at relatively low cost of production</li> <li>• Organization of farmers into groups and associations</li> </ul>
Africare (NGO)	<ul style="list-style-type: none"> <li>• An agricultural service provider that has strong links with farmers and donors</li> <li>• Disseminate apple technologies in addressing nutritional aspects of the local population</li> </ul>
ICRAF	<ul style="list-style-type: none"> <li>• Provides technical backstopping to Collaborative NARS projects</li> </ul>
NARO-ICRAF Project at Bugongi sub-station	<ul style="list-style-type: none"> <li>• Raising and distribution of apple tree seedlings</li> <li>• Income generation, nutrition and improvement of physical soil fertility of the degraded highlands</li> </ul>
Open markets	<ul style="list-style-type: none"> <li>• Major outlets for apples e.g. Nakasero, street vendors</li> <li>• Cheap and reliable fresh apple supplies</li> </ul>
Supermarkets	<ul style="list-style-type: none"> <li>• Formal market outlets for apples</li> <li>• Availability, quantity, quality and consistency in supply</li> </ul>
Consumers	<ul style="list-style-type: none"> <li>• Buy and eat apples and its products</li> <li>• Availability and quality (size, crispiness and colour)</li> </ul>

**Table 4: Perceptions of different key stakeholders**

<b>Key stakeholder</b>	<b>Perceptions of problems</b>	<b>Perceptions of opportunities</b>
Farmers	<ul style="list-style-type: none"> <li>• Low yields and small fruits</li> <li>• Defoliation and training of the trees</li> <li>• Non-synchrony in flowering</li> <li>• Pest and disease management, including birds and goats</li> <li>• Theft of mature fruits and seedlings</li> <li>• Cost of grafted seedlings at Ushs. 4,000 and labour cost at Ushs 1000 per day for farm operations</li> <li>• Less farmer empowerment in NAADS contracts, which are also short term.</li> </ul>	View apple enterprise as a promising and more profitable cash crop than other crop enterprises
Government	<ul style="list-style-type: none"> <li>• Competition for local and national markets with apple imports</li> </ul>	Apples will become a reliable cash crop to sustain rural livelihoods and earn foreign exchange. Ushs. 3 b set aside for the crop and Ushs 65.5 m disbursed
NARO-Kachwekano ARDC and NARO-KARI	<ul style="list-style-type: none"> <li>• Research questions remain unanswered on suitable varieties, management costs and defoliation needed to stimulate flowering and bearing of fruits</li> <li>• Lack of temperate fruit specialists</li> </ul>	Apple production is ecologically feasible
NAADS	<ul style="list-style-type: none"> <li>• Inadequate training of NAADS officers on apples to provide quality control services.</li> </ul>	Apple is a viable cash crop in the area
NGOs	<ul style="list-style-type: none"> <li>• Cautious about drumming up for apples due to past experience with coffee, tobacco and pyrethrum</li> <li>• Fear that propagation and distribution of apple tree seedlings is dominated by NARO/ICRAF. A case of putting all eggs in one basket.</li> </ul>	Farmers are enthusiastic and interested in the crop
Supermarkets	<ul style="list-style-type: none"> <li>• Local consumers have a liking for large sized green apples while Kabale grown apples are small in size and red/golden in colour.</li> <li>• Quantities are limited and supply is unreliable</li> <li>• Fear of non-uniform poor quality apples</li> </ul>	Prospects for providing market for local apples are good due to the steady increase in fresh apple consumption. Kabale grown apples are tastier than imported ones.

**Table 5: Stakeholder objectives analysis**

<i>Key stakeholders</i>	<i>Shared objectives on apple enterprise</i>
Farmers and farmer organizations	To purchase inputs collectively and sell the apples in bulk for consistent supply to meet market requirements.
Government and farmers	To generate income, alleviate poverty and attain food security
Farmers, NARO, and NAADS	To achieve target yields and satisfy local and national market requirements
NARO	Ensure adaptability, profitability and sustainability of the apple enterprise in Uganda
Farmer organizations and local government	To have coordinated production and marketing of apples
NAADS and NGOs	Provide effective, efficient and relevant extension services on apples
NGOs and government	To improve food security, nutrition and reduce rural poverty through cash income from apples.
Market outlets and farmers	To satisfy consumer demands
Consumers and farmers	To produce and consume good quality apples

There are a few conflicting objectives between some key stakeholders:

- The Government wishes to consolidate land while farmers wish to continue with land fragmentation. It is the culture in the area for farmers to bequeath land to their offspring through subdivision.
- NGOs prefer starting promotion of apples with emphasis on both the nutrition aspect and income generation, while the Government stresses cash and import substitution as main market strategies.
- Farmers want high producer prices while consumers want low retail prices. Farmers and market outlets fight to control a share of the profit margin from apple sales.

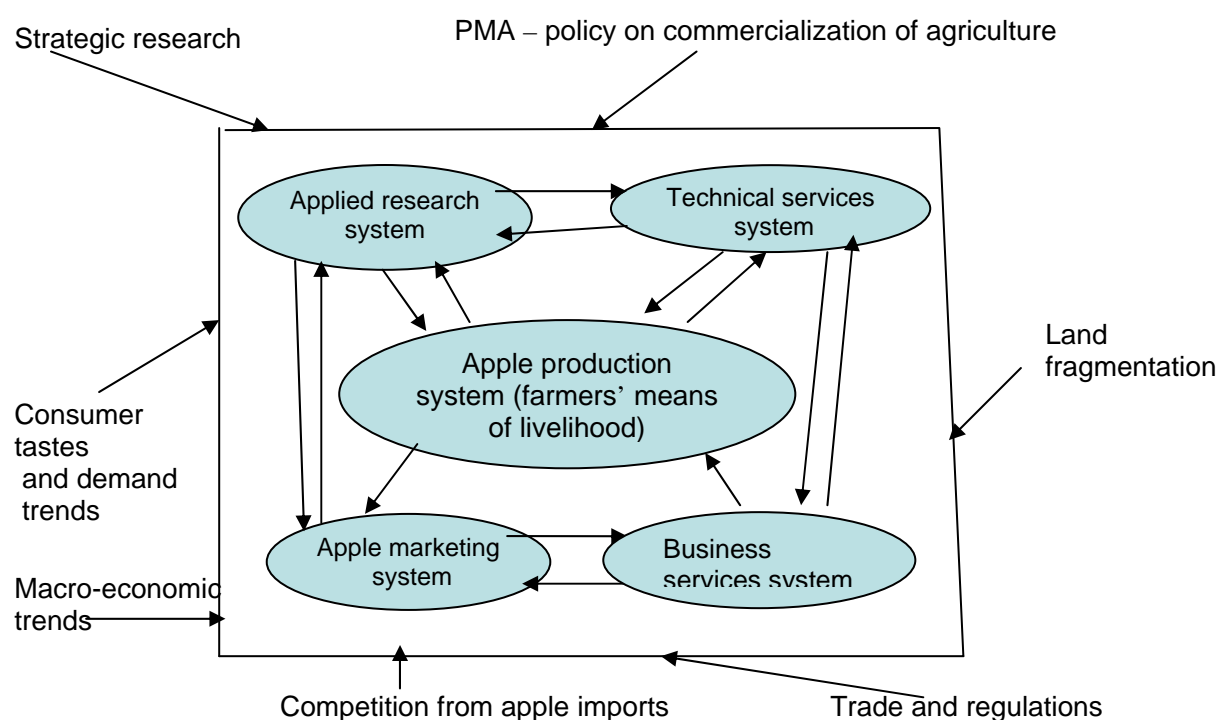
### 3.3 System of interest

From the initial stakeholder analysis, the system of interest (Figure 3) was defined, which the development strategies will strive to achieve for profitable production and marketing of apples in the South-western highlands. It is the system for coordinating stakeholders' actions to support small scale farmers to profitably produce apples in order to satisfy local and national market demands. Due to the many factors involved in the apple enterprise in Kabale, it comprises a number of other systems within it (Figure 3). The system is in turn affected by both internal and external factors (discussed in section 3.4 below) whose interplay determine the competitiveness and profitability of apples in local and national markets.

The system of interest (Figure 3) is a desire to change:

- from a non-profitable to a profitable production of apples
- from a state of dissatisfied to satisfied local and national markets
- from little organized to coordinated actions of stakeholders

**Figure 3: The system of interest for the development of the apple enterprise**



Stakeholders who belong to the system of interest will need to work together, all playing their role (Table 6) in addressing the apple case. They will need to establish interdisciplinary teams drawn from different institutions, including those who may not appear in the apple market chain but are critical in finding a solution to the exploitation of market opportunities for Kabale grown apples. They should bear in mind that continuous monitoring and evaluation of the driving forces throughout the implementation process will determine their success in realizing the desired changes. Monitoring and evaluation of the driving forces will allow adjustments during implementation and even include some of them in the system of interest.

**Table 6: Roles of stakeholders in the system of interest**

<b>Key stakeholder</b>	<b>Current role</b>	<b>Role in the system of interest</b>
Farmers	Produce apple fruits for home consumption and very little for market outlets.	Produce apples according to market demands and in line with business plans for the apples.
Government	Provide policy direction and funds for the project	Provide an enabling policy and legal environment as well as funding of the local apple industry
NARO	Provide conducive environment for research & development activities, incl. acquisition of foreign germplasm. Evaluation and selection of varieties for multiplication	Apple technology development and dissemination of findings. Ensure quality control of apple seedlings
NARO-ICRAF Project	Evaluation & selection of varieties and distribution of seedlings for planting. Training farmers in apple management & monitoring them for improvement	Evaluation and selection of varieties. Monitoring of the quality of the apple tree scions and rootstocks.
NAADS	Facilitate delivery of services to farmers interested in apple enterprise	Regulatory functions and quality control of extension service delivery on apples
Market outlets	Very minimal role	Buy apples from farmers in a structured manner.

The hot spots for the likely future scenario for apples in Kabale include:

- the political will in sustaining the apple momentum,
- competition from apple imports, and
- apple technology development.

Other driving forces to affect the system of interest are shown in Figure 3 and discussed below.

### **3.4 Driving forces and future scenarios for apple production and marketing**

Apple production and marketing in Kabale is affected by factors or driving forces that are both internal and external to the system of interest.

Internal factors include:

- land fragmentation,
- farm competition,
- Programme for Modernization of Agriculture (PMA),
- population dynamics and
- local expectations

The major external factors are:

- international trade,
- open borders,
- technology,
- funding,
- legislation,
- policies and
- shocks such as unpredictable weather,
- national politics, and
- macro-trends (liberalization, global trade, inflation & interest rates, tariffs, foreign exchange rates, taxes and statutory charges)

#### *3.4.1 Land fragmentation and competition between apples and other land uses*

The average farm size in the district is 0.88 ha (Dennis Mutabazi, 2005 Pers. Comm.). Farmers own small pieces of land (plots) scattered, in places distant from each other. They are generally unwilling to swap neighbouring plots sometimes for good reasons, particularly soil fertility. On these plots currently various crops are grown and animals reared. Crops are mainly sorghum, Irish potatoes, beans, bananas, coffee, fruits, and vegetables. Main fruits observed were avocados, oranges, mangoes, passion fruit and apples. Animals reared include cattle, goats, poultry, sheep, and pigs. Apples will have to compete with Irish potatoes as a cash crop. The latter crop is naturally adapted in the area and has already been established both as a food and a cash crop. The competition will revolve around land availability for each crop, labour and other input costs. The level of competition from other fruit trees will depend on their technical and market performance.

### *3.4.2 Population dynamics and local expectations*

Local fresh apple consumers in supermarkets are elites whose taste is already biased towards the green Granny Smith variety. They prefer large size green apples, unlike the ones grown in Kabale. The market survey revealed that the youth may be a realistic target for apple promotion. Parents are known to carry apples when they visit their children in boarding schools, making the fruit attractive to them. The children are not prejudiced against any variety in favour of the green apples and may develop a liking for the varieties they are first introduced to.

### *3.4.3 International trade and open borders*

About 90% of fresh apples are imports from South Africa whose supply is seasonal. The main supply season is February to June with shortages starting in November (Procurement Manager Shoprite, 2005 pers. comm.). Other sources are Kenya, Egypt, and China. Some of these producer countries have the right climate and soils for apples and their apple industries have well developed market chains. Production is cost effective and responds to market demand. According to supermarkets, the local apples will have to be produced at low cost price and meet quantity and quality requirements in order to be able to penetrate the formal market. It was suggested to target production to supply apples during seasons of shortages in imports. It was explained, however, that South African apples can keep for 18 months, which is a strategy that ensures continuous supply throughout the year. Fresh apples from Kabale were said to be crispier, though. They would also be cheaper, considering that no sea or airfreight transport costs would be have to made, or storage costs, unlike the South African imports.

### *3.4.4 Macro-economic environment*

The macro-economic shocks include price fluctuations, inflation, interest rates, taxation regimes and statutory charges as they affect apples like any other crop. These shocks are known to strike unexpectedly in Uganda as in other countries. A stable macro-economic environment is essential for the growth of the crop.

### *3.4.5 Government policies*

The apples are a new crop considered by policy makers to become an important factor in driving the national economy. The Central Government has pledged Ushs 3 billion to support the crop of which Ushs 65.5 million has already been disbursed. The monitoring group of key stakeholders has promised to monitor and evaluate the progress of the project so that this political will is not squandered.

The Government enacts laws and formulates rules and regulations on the way crops (including apples) are produced and marketed to ensure the safety of human health and the environment. The laws control the use of certain inputs especially agro-chemicals. Consumer demands for safe and healthy foods and the environment were said to be less pronounced in Uganda, but may soon spill over from other countries as local agro-industries grow.

### *3.4.6 Technology*

The technologies for growing apples in tropical conditions have not been developed in Uganda. The apple tree is a new crop in Uganda and in Kabale in particular. The major research activity (since 2001) on apples in Kabale was evaluation of varieties, based on

growth performance and yield criteria. The management practices that were relayed to farmers are actually meant for apple cultivation in temperate countries. It is a case of trial and error on both variety characteristics and management aspects of the trees.

#### 3.4.7 Programme for Modernization of Agriculture (PMA)

The PMA is a strategy for commercialisation of agriculture in Uganda. For Kabale District, it involves a shift towards perennial crop enterprises, which is important for natural resource conservation and fir income earning for farmers.

### 3.5 Future scenarios for apple production and marketing in Kabale

On the basis of the driving forces discussed above, the following three future scenarios are likely to be:

Scenario 1: Apples become a significant cash crop

Scenario 2: Apples become a subsistence crop

Scenario 3: The momentum on apples reduces and the enterprise fizzles out

The development strategies (Chapter 5) proposed in this report assume that any changes brought about by the critical factors or hot spots affecting the apple enterprise, will be more conducive for future scenario 1 than for scenario 2, and that scenario 3 will be the least likely one. The proposed strategies will therefore exploit scenario 1 to realize the system of interest.

### 3.6 Research questions

Having put the problem in a developmental context, analytical perspectives of the enterprise will follow in the subsequent chapter to answer the remaining research questions guided by the central research question (CRQ): *“How can apples be produced and marketed profitably in the South-western highlands of Uganda?”*

This was investigated with the help of the following secondary research questions (SRQs):

- What agro-ecological and technical aspects need to be improved in the production of apples?
- Can Kabale-grown apples command a market share with better profit margins for farmers?
- How can farmers be organized to better utilize market opportunities for apples?
- What types of farmers are best suited to exploit market opportunities for apples?

Answers to these questions are provided in Chapter 4 with respect to access to organized markets, credits, and technical and business services.



## 4 ANALYSIS OF DIFFERENT PERSPECTIVES

### 4.1 Agro-ecological perspective

- *What agro-ecological aspects need to be improved in the production of apples?*

#### 4.1.1 Climate

##### **Is the climate in Kabale suitable for apple production?**

Kabale District is situated in the southern highlands (SHL) agro-ecological zone. The mean annual rainfall ranges from 800 to 1000 mm, and has a mean maximum and minimum temperature of between 10 and 23°C. The temperature and rainfall regimes are influenced by altitude which ranges from 1500 to 2400 m a.s.l.

Apples grow well in temperate regions and have a pronounced periodicity. In spring they flower, then initiate leaves followed by active growth and fruiting in summer. They initiate leaf fall in autumn and in winter they go through a dormant cold-rest. In tropical conditions, manual leaf defoliation and training branches horizontally, as well as rest-breaking chemicals, have been used to shock the plants and initiate flowering. This manipulation of the growth cycle has been used with remarkable success in fruit production under tropical conditions at high altitudes in e.g. Indonesia (8°S, 800-1200 m asl) and Venezuela (10°N, 1200-1750 m asl) (Notodimedjo et al., 2005).

On-station experiments conducted in ICRAF field stations from 1999 found out that of the initial 13 cultivars introduced at elevations between 1830 and 2500 m a.s.l., 11 produced fruit (ICRAF, 2003). This confirmed that the climatic conditions in Kabale are suitable for the production of apples.

The following modifications to the growth cycle have been used in Kabale with limited success:

- Pruning and training branches horizontally to induce lateral bud growth and reduce regrowth of the terminal buds
- Hand defoliation to induce bud burst and flower emergence.

#### 4.1.2 Soils

Apples prefer slightly acidic and well drained soils. The best pH range is between 6-6.5, but soils with pH values below 5 may be limed before planting. Apples in poorly drained soils, for example in clayey soils in low lying areas, succumb to anaerobiosis and/or *Phytophthora* root rot (Andersen and Crocker, 2000).

The soils in Kabale are acid to slightly acidic loams with generally a good nutrient supply and medium productivity. The predominant soil types are reddish brown clay loams, humus loams, reddish brown clay loams and yellowish red clay loams. The soils are generally suitable for apple production except for the poorly drained soils of the bottomlands and the heavy clays. Soils that are acidic (pH values below 5) should be limed to improve the pH conditions for apple production.

### 4.1.3 Zonation

#### How can we relate the zonations in Kabale District with apple production?

Kabale has been divided into two production sub-systems namely subsystem 2 and subsystem 5, based on a combination of altitude, rainfall amount, crop and livestock production systems and sources of livelihood (Kashaija and Wagoire, unpublished report). The general characteristics of these subsystems are presented in Table 7. The main sources of livelihood in order of importance in the two subsystems are crop-livestock-trading in subsystem 2 and crop-livestock in subsystem 5.

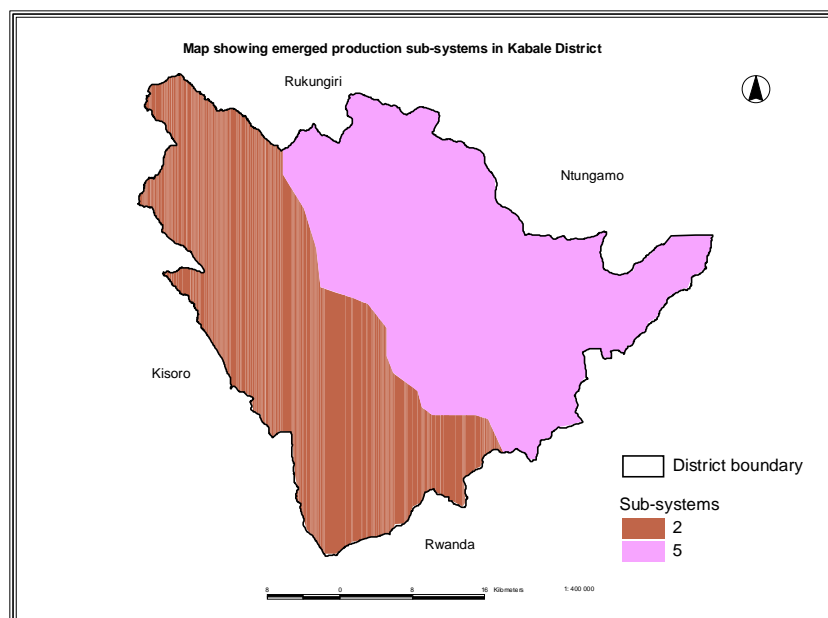
**Table 7: Classification of the agro-ecological production subsystems in Kabale District**

<i>Sub-system</i>	<i>Altitude (m asl)</i>	<i>Rainfall (mm)</i>	<i>Predominant soil types</i>	<i>Cropping system</i>
2	1600 -2400	1251 - 1500	Laterized reddish brown, humus loams with dark sub-soils	Potato, sorghum, beans (cassava and banana in lower/warmer parts)
5	1500 - 1900	1001 - 1250	Laterized reddish brown clay loams and yellowish red clay loams	bananas, coffee, tea, sweet potato and sorghum

Source: Adapted from Kashaija and Wagoire, unpublished report

The location of the two subsystems within Kabale District is as shown in Figure 4.

**Figure 4: Map showing emerged production sub-systems in Kabale District (Kashaija and Wagoire, unpublished report)**



#### What type of farmers can grow apples commercially?

The typical landholding in Kabale ranges from 1 to 3 Ha with the farm size ranging from 0.3 to 2.4 Ha and about 28% of the farms being below 1 Ha (Aluma et al., 1995, as quoted by Nyeko et al., 2004). It is thus difficult to differentiate among farmers with respect to

suitability for apple production. However, a more detailed study on farm typology may be required in the future.

Subsystem 2 is likely to have the best conditions for apple production in the district mainly because of its more suitable temperature (higher altitude) and rainfall regime. Our field observations seem to corroborate this view. For example, apples in Bubare and Kyanamira sub-counties (sub-system2) seemed to perform better than in Bukinda (subsystem 5).

### **How does land fragmentation affect apple production?**

In addition to the low landholding, many of the farms are fragmented with farmers owning plots in different topographical locations. As a result of land subdivision, farmers may operate an average of 8-10 distinct plots of land, some often less than 0.4 Ha, and as much as 5 km away from each other and from the family homestead (Dev. Plan Kabale; Raussen et al., 2002). Land fragmentation was cited by farmers as a major constraint in establishing a sizeable apple production area. Farmers consider apples as high value crops and prefer growing apples within the vicinity of their homestead to prevent theft.

## **4.2 Technical perspective**

- *What technical aspects need to be improved in the production of apples?*

### *4.2.1 Seedlings, variety development and reliability*

#### **Nursery development and scion availability**

The NARO-ICRAF Project has a central tree seedling nursery at its field station in Bugongi. The project has been training and supporting commercial nursery operators to enable them to produce quality planting material. The trained commercial nursery operators are certified for production of seedling materials. NARO/ICRAF has plans to select and train farmers so that they can produce clean scions.

The training of commercial nursery operators will greatly supplement NARO/ICRAF's effort in disseminating apple seedlings. The development of effective criteria for certification of commercial nurseries and selection of host scion centres without compromising the quality is critical. The loss of seedlings in nurseries is reported to be quite high. The central nursery at Bugongi reported a loss of about 40% of the seedlings due to powdery mildew. Whether commercial seedling nurseries can absorb such losses is questionable. In this way, disease-infected seedlings and scions are likely to be distributed out to systems that are not closely monitored by qualified specialists.

The main constraint in developing an effective dissemination system for seedling material through commercial nurseries and farmer sourced scions is in the production of uniform rootstocks and scions with desirable characteristics. At present, there are not enough well-trained advisory service providers in apple technology. The provision of training to the nursery and the host scion centres needs to be supplemented by training service providers who specialize in apple production.

### **Seedling distribution and quality maintenance**

The majority of farmers growing apple trees obtain the seedlings from NARO-ICRAF and through NAADS and NGOs promoting temperate fruit production such as Africa2N and Africare. At present, Kabale District has many commercial nursery operators represented by NGOs (24), CBOs (26) and private operators (40) (ICRAF, 2004). These nurseries currently are raising seedlings of trees other than temperate fruits. They are potential apple seedling raisers, however. Farmers receive seedlings free of charge through farmer groups although a few enthusiastic farmers purchase their seedlings from ICRAF, from Bugongi sub-station of Kachwekano ARDC, and from commercial nurseries.

Recently, farmers have been receiving un-grafted rootstock for planting, and some are selected as producers of scions to be used. Grafting is done by trained farmers and NARO-ICRAF Project staff. The following two main reasons were advanced for why NARO-ICRAF Project/NAADS/NGOs adopted this dissemination strategy:

- Mobile community grafters are able to supply more farmers with rootstocks.
- Rootstocks planted and grafted *in situ* are more likely to survive thus reducing farmers' losses.

While this approach may save farmers from losses caused by a lower survival rate of the pre-grafted seedlings, it has one major flaw, namely lack of quality assurance. It is doubtful that mobile community grafters are able to obtain consistently high quality scions for grafting as the staff of ICRAF and NARO would be able to do. Grafting by mobile community grafters, while cheaper and allowing faster diffusion of apple seedlings, is likely to be compromised by the lower quality of the scions used in grafting. The source of scions is not known and there is no data on which farmers received grafting services from the various service providers; this could prove to be a major problem in quality control and traceability of emerging problems.

Quality consistency and reliability is a major factor that determines the marketability of fresh apples. Yet these attributes cannot be guaranteed if the quality of rootstock and scion is not guaranteed. The acquisition of seedlings through the NARO-ICRAF Project is critical to the maintenance of quality seedlings mainly because they can ensure quality and disease-free seedlings. Community mobile grafters should be trained on pests and disease control to reduce the incidences of distributing disease-infected rootstock seedlings and scions.

It is difficult to maintain the uniformity of rootstock produced from seed. NARO-ICRAF is planning experiments to evaluate different vegetative rootstocks acquired through technical cooperation with the Agricultural Research Council (ARC) of South Africa. At present, five vegetative materials are being multiplied at Bugongi sub-station (ICRAF, 2004). The evaluation and production of seedlings through clonal materials will ensure the uniformity of the rootstock distributed to farmers.

### **Apple cultivars for farmers**

The choice of rootstock determines such characteristics as the growing habits of the tree, its size, the vigour of its root system, the age at which it starts bearing fruit and its suitability for different types of soil. New research challenges on apples in Kabale should focus on the choice of rootstock. This presents opportunities to solve some of the production problems related to, among others, drought resistance, soil suitability, plant nutrition, and resistance to fungal and bacteria diseases (e.g. powdery mildew, crown rot and fire-blight).

The scion is based on the characteristics of the apple one wants to grow, for example, as dictated by market demands. This could include characteristics as its flavour (taste, aroma,

and sweetness, acid), texture, appearance (colour, shape), time to ripen and keeping qualities with respect to market demand. The range of low chill apples for subtropical areas is limited.

“Anna” and “Golden Dorsett” are the two apple cultivars that are widely disseminated to the farmers in Kabale. Anderson and Crocker (2000) have discussed the characteristics of these varieties among other tropical and subtropical apple varieties. “Golden Dorsett” which has a golden skin with a red blush resembles the “Golden Delicious”. Originally from the Bahamas, it is crispy and juicy, with excellent flavour and can substitute for “Golden Delicious” that has a large market locally; at 2 to 2.5 inches it is slightly smaller than “Anna”. “Anna” originally from Israel has a red skin and resembles “Red Delicious” more than any other subtropical cultivar. It is large and can be eaten green, when it is similar to “Granny Smith”, or can be allowed to ripen to desired sweetness.

“Granny Smith” and “Golden Delicious” are the most popular apple varieties sold in Uganda. Other cultivars that are in the process of evaluation at Kalengyere sub-station include “Winter banana” and “Rome Beauty”.

The selection of apple varieties should also take into consideration the market demands. The cultivars that have shown promise and are disseminated to farmers in Kabale have good characteristics and seem to fit well into the current local market demands. Proper growing techniques should be developed to improve their quality in order to compete with the apples in the market.

Apples require cross-pollination with compatible cultivars. The selection and dissemination of apple varieties has thus to include at least two varieties that are compatible and act as pollinators to each other in close proximity.

#### *4.2.2 Apple management practices and sustainability*

##### **Apple size**

The apples produced in Kabale range from small to medium size compared to imported apples in the market. Apple farmers often obtain medium sized apples but the majority of the fruits on the 4-year old trees are still small sized. Farmers interviewed reported that the size of the fruits has been increasing with each harvest season. The variability in apple sizes poses challenges to farmers in marketing. Customers buying apples on the local market are used to large sized apples and apple traders prefer uniformly large sized apples. To compete with apples from South Africa, not only does the taste of the apples have to be “right”, but also the size has to appeal to the buyer.

The small sizes of the apples could be ascribed to a number of factors among them being the young age of the trees, the non-synchronization and timing of flowering/fruitletting within the season, nutritional strain on the tree due to the production of two crops per year in Kabale, the type of the rootstock, and the pruning method (tree size). The challenge to the researchers is to produce large, uniform sized fruits and reduce the non-marketable fruits.

##### **Pests and diseases**

The common pests of apples in Kabale are aphids and caterpillars which can be controlled with Dimethoate and Sycorin insecticides. Birds have also been reported to do a lot of damage to apple fruits. The main diseases reported were fungal leaf spot, powdery mildew, and scab

(ICRAF, 2004). Other pest problems in the future are likely to include scale insects. As apple orchards increase, more diseases and pests are likely to be encountered (Table 8).

**Table 8: Some common pests and diseases in subtropical apples and their management**

Common name	Plant part affected	Causative agent	Management
Powdery mildew	Stem and shoot	Mould	Cut off affected stem and spray Systhane systemic insecticide
Apple scab	Leaves, flowers and fruit	Fungal ( <i>Venturia inaequalis</i> )	Apply Dithane M-45
<i>Botryosphaeria</i> canker	Twigs spreading to trunk	Fungal ( <i>Botryosphaeria dothidea</i> )	No good chemical control, pruning and removing infected wood.
Bitter rot	Fruit and stem	Fungal ( <i>Glomenella cinquilata</i> )	Cankers pruned out and burned.
Mushroom root rot	Roots	Fungal ( <i>Armillaria tabescens</i> )	No satisfactory treatment.
Scale insects	Leaves, twigs, branches and fruit	Scale insects	Insecticide

Source: Adapted from Andersen and Crocker, 2000.

Aphids have been effectively controlled in on-station orchards by spraying Dimethoate or Sicorin insecticides. However, spraying was not among the recommended apple tree management practices given to farmers by NARO-ICRAF (ICRAF 2004). This may be because the problem of insect pests and diseases is not yet very serious in apple production. Indeed during farmer interviews, birds and stray domestic animals were mentioned as the major problem.

NARO-ICRAF Project, through help from plant pathology specialists from KARI, has conducted studies to assess diseases occurring in on-station and on-farm orchards. The fact that ICRAF does not have resident capacity on pests and diseases is an indication of the limitation of technical expertise on apple production. As apple production increases in Kabale, the presence of a specialist in pest and diseases will increasingly become more necessary. The availability of technical specialists in pests and diseases seems likely to become a major impediment in the promotion of the apple enterprise. The specialist should be involved in training apple advisory services personnel. With the continued absence of a specialist in Kachwekano ARDC, insufficient capacity in advisory personnel on pests and diseases is likely to persist and remain a constraint in the scaling up of apple production in Kabale. NARO, in conjunction with ICRAF, should engage a specialist in management of pests and diseases of fruits.

### **Tree management**

Young apple trees require training to obtain a tree with lateral branches almost perpendicular to the trunk and radially spaced around a central leader to encourage branching. The trees have to be pruned to remove diseased or dead wood and weak growths and to trim the tree to

the desired shape (ICRAF 2004). Pruning also opens up the tree so that light can get to all plant parts, and enables the fruit to ripen and colour evenly. The practices of tree training and pruning are important for maintaining high apple tree production.

Apple orchards at Kalengyere and Bugongi sub-stations are well managed. The same cannot be said of the farmers' trees. Tree management is an important practice in apple production. In addition to the management practices that farmers are familiar with, apple farmers also have to learn numerous specific fruit tree management practices such as tree training, staking, defoliation, fruit thinning and pruning. A survey of farmers' management practices by ICRAF showed that of the farmers given seedlings from 2000-2001, only 38% was practising the recommended practices (ICRAF 2004). Our visits to the farmers' fields confirmed that tree management is not widely practised. One reason is that many farmers receiving seedlings are not sensitized enough to invest sufficiently in apple production. Farmers still view apple trees as any other tree, which can be left to grow and produce without much management.

Fruit thinning and the removal of excess flowers from the inflorescence is an important management practice to avoid overcrowding of fruits. Thinning of fruits improves their size and quality, thereby increasing the marketable fruits.

The problems of tree management are indicative of the limitations in the provision of advisory services in apple production. The limited capacity of scientists and organizations promoting apple production technologies in Kabale is unlikely to be able to cope with the potential management problems that may emerge as more and more farmers engage in apple production. This is worsened by the fact that the first dissemination of the apples was not confined to specific zones but spread over large areas of the district, thus complicating the provision of services to farmers.

### **Synchronization of flowering and fruiting**

The synchronization of flowering and fruiting so as to obtain one crop per year has been identified by Kachwekano ARDC as a major challenge and one likely to remain so in the near future. The main problem seems to be the uniformity of bud burst after breaking dormancy. Flower buds within the same trees seem to take longer to open, causing a prolonged tree flowering/fruiting period. This can have a negative effect on fruit quality as development of the late flower buds may not fall within favourable weather for fruit development. Fruit set is likely to experience problems when flowering coincides with the wet season (Notodimedjo et al., 2005) as well as when temperatures are high (Edwards, 2005).

Other problems that apple farmers face are related to flower abortion and premature fruit falling. Ways of dealing with these problems need to be studied especially with respect to synchronization with the season. For example, are the apples fruiting at the best possible time in the season? In our visits to farmers' orchards and those of Kalengyere and Bugongi field stations, we noted that the fruits on the same tree were at different stages of growth, some trees were defoliated, while some were flowering and others were fruiting. The ability to have two fruiting seasons per year namely February to April and October to December may also present opportunities for marketing. For example, farmers in a sub-county may synchronize flowering to produce fruit around April while other groups may synchronize the flowering to exploit the market in December period. Alternatively, individual farmers could manage sections of their orchards to produce fruits alternately in the two seasons. In the future, opportunities in the use of chemicals to defoliate and break rest (where defoliation is not sufficient) should be explored (Edwards, 2005).

These flowering and fruiting problems are likely to become a major impediment to apple production. Agronomic research that addresses these problems needs to be given priority and tackled with technical backstopping from KARI.

### **Tree Nutrition**

Farmers in Kabale use manure to plant their apple seedling as recommended by the advisory services. As this is a new crop, the optimum manure and fertilizer application rates in the region are largely unknown. Research questions that emerge in nutrition include what are the optimum rates of inorganic and organic fertilizers, what are the appropriate fertilizer types, and are there any micronutrients requirement in apple nutrition in Kabale? Tree nutrition is an area that should be targeted for research as it is useful in determining the potential of apple production in the region.

### **Post harvest and handling**

The apple trees of most farmers in Kabale are young (not older than 4 years) and just starting to fruit. In many cases, the apple fruits are eaten from the tree and do not reach the market. As such, issues on post-harvest management do not currently appear so critical to the apple enterprise. However, scaling-up the production of apples is expected to result in larger harvests and availability for the market. Like many other fruits, apples are very perishable. This requires the establishment of a post harvest management system that ensures optimal handling, storage and transport of the fruit. A post harvest management system should ensure that the quality of fruits is maintained from harvest to the market, in order to:

- reduce losses and maintain high quality of produce for market
- reduce mechanical injury at harvest and during transport

The capability for traceability in a system is important as it can make it possible to identify the pitfalls and help isolate cases of poor quality from reaching the market.

The future research priorities in post harvest systems for the apples in Kabale should seek to answer the following questions:

- What are the storage characteristics of the varieties grown in Kabale?
- How can the storage characteristics be improved?
- How long can apples be stored under ambient conditions in Kabale?
- Are refrigerated cold storages necessary?
- What are the optimal harvesting time (commercial maturity) and handling procedures that minimize mechanical injury of the fruit?

Investment in cold storage may become necessary when the scaling-up of fruit production attains commercial levels.

### **Apple production and environment quality**

A key ecological question that needs to be considered is the environmental impact of apple orchards in Kabale. Due to reasons related to land scarcity and fragmentation, many apple farmers are establishing their orchards near their homesteads. However, it is conceivable that apple orchards will move beyond the homestead into the less fertile land portions, for example in the steeper slopes.

The impact of apple cultivation on the environment will largely depend on the management of the orchards. The removal of crop cover on the steep lands to establish orchards will increase soil degradation. However, as apple trees are presently considered by farmers as high value cash crops, practices such as mulching and manure application will contribute to soil

conservation through reducing erosion, and improving the physical, biological and chemical fertility of the soil. Apple trees on steep slopes that are not well managed are likely to have a negative impact on the environment mainly through soil degradation. The future implications of apple production on the soil conservation will depend on the continued perception of the apple as a valuable cash crop. The success of the apple enterprise will not only improve proper conservation practices but will depend on it.

The use of agrochemicals in apple trees is not yet widespread among the farmers. The main agrochemicals that are already in use in the area are Agrothoate (Dimethoate, insecticide/acaricide) and Dithane M-45 (a fungicide), Ridomyl (a fungicide) and Ambush CY (an insecticide). Dimethoate is moderately toxic to highly toxic to birds and moderately toxic to fish and highly toxic to honeybees. The toxicity to honeybees has a direct impact on apple production as apples are cross-pollinated and the main agents are bees. The ecological effects of agrochemical use are discussed in a study by Mbuga (2004).

Given that farmers perceive apples as a high value cash crop, it is conceivable that their promotion is likely to increase the use of agrochemicals. The use of agrochemicals should be accompanied by training of farmers in pesticide use and safety. The training programme can be conducted through NAADS and other service providers.

### **4.3 Economic perspective**

- *Can Kabale apples command a market share with attractive profit margins?*

#### *4.3.1 Introduction*

Just as consumers in northern countries have developed a great taste and enormous market for tropical fruits, so are people in Africa consuming more temperate fruits. Apples were introduced into Uganda with an economic aim of assisting to eradicate rural poverty by transforming subsistence farming into commercial high value crops. Strategies should be geared towards making this enterprise competitive, profitable and sustainable. This section seeks to explore the economic issues relating to the apple enterprise, mainly its economic feasibility and marketing. The analysis is in two broad categories: a: competitiveness of local apples at national markets (section 4.3.2) and b: the profitability of apple production at farm level (section 4.3.3).

The following tertiary research questions guided the analysis.

- What is apple competitiveness?
- Is there a market for local apples?
- What products does the market want?
- What are the product specifications required by the market?
- What are the prevailing market prices?
- What markets should be exploited?
- What are the distribution channels?
- What process would local apples go through to penetrate the market?
- Are there future opportunities for processing?
- How can value be added at household or local level?
- What packaging measures would be necessary?
- Is it profitable to produce apples locally?

#### 4.3.2 *Competitiveness of the local apples at local and national markets*

##### **The apple market**

The competitive edge of locally produced apples can be gauged on their ability to command a stable market share and even substitute imports at the national markets. The major market outlets for apples in Uganda are in Kampala, mainly in supermarkets, the main open market at Nakasero and street vendors. Nakasero and street vendors are the outlets mainly visited by the majority of local people compared to wealthy locals and expatriate customers that mainly visit major supermarkets. All apples sold in these markets are imported. According to a recent market survey (Ssemwanga Centre, 2003), the figure of imported apples per year is about 190 tons.

In all the market outlets the team visited, the varieties of apples sold have increased steadily from about three varieties two years ago to more than 5 currently and the overall quantities have also gone up. The continued importation and the increase in quantities and varieties indicate a ready local market for apples. In the recent past, USD 115,000 worth of apples have been imported annually to try to satisfy this growing demand (World Agro forestry Centre, 2003). Imported apples are expensive and most local people cannot afford them. It is assumed that locally produced apples would be more affordable to local people. There is also a ready local market in Kabale and in surrounding towns such as Mbarara and Masaka. In these towns, supermarket managers already have knowledge of and are willing to stock local apples.

In the recent past, apples from farmers and from NARO-ICRAF Project trial sites have been sold to supermarkets in Kabale who then sold them to customers at 200 Ush per apple. All supermarkets in Kabale showed demand for the local apples claiming that local apples sold better than the imported ones due to lower price, and that they tasted better. The biggest challenge sighted was the limited quantities and the inconsistent deliveries from ICRAF or farmers. There is thus a need to organize a sustainable system that can support marketing of apples in the local towns. Satisfying this local market should be a first step in future market strategies before attempting to penetrate distant markets in Kampala.

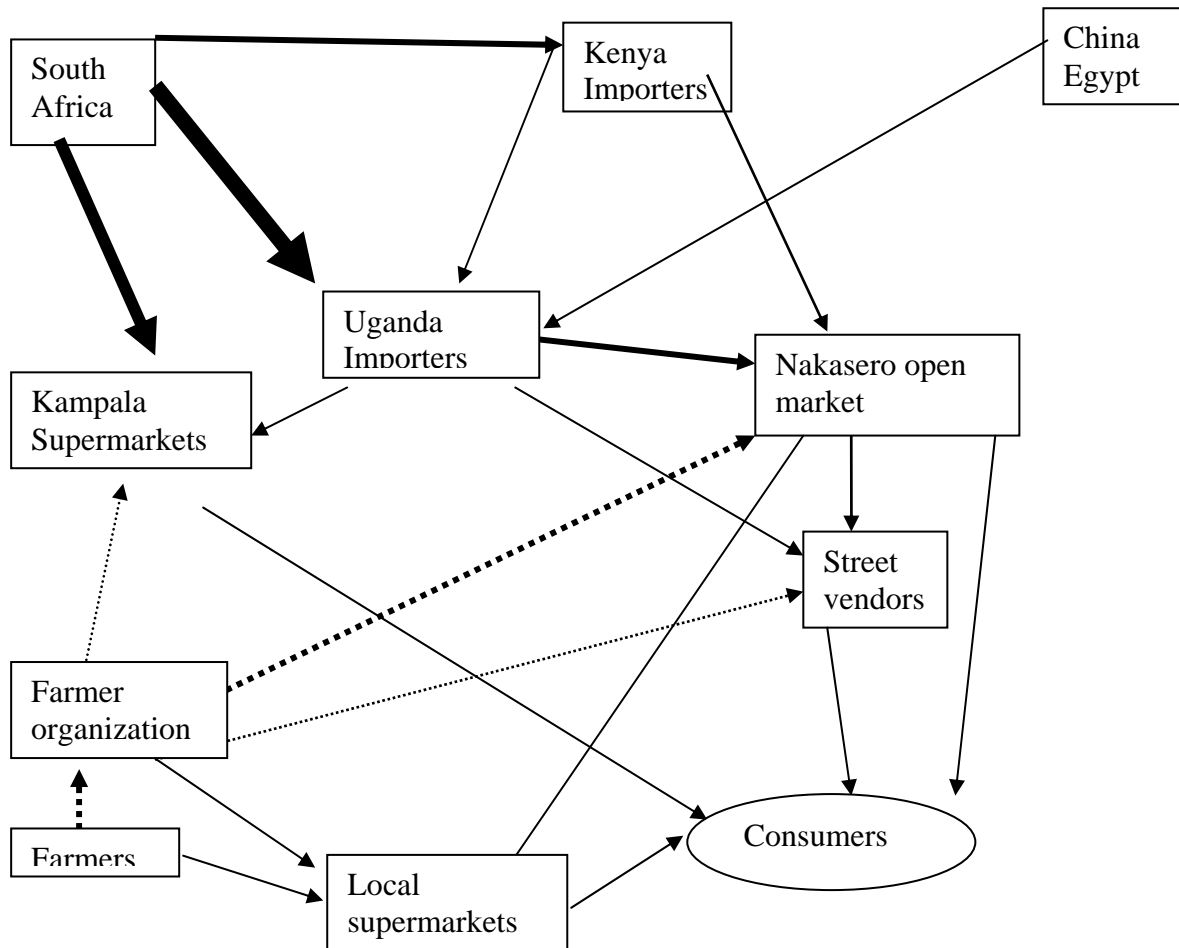
##### **Imports**

Currently, apples are mainly imported from South Africa either directly or through importers in Kenya. China and Egypt also export specific varieties to Uganda. Varieties imported include Braeburn, Cameo, Crips Pink, Crips Red, Custard, Fuji, Golden Delicious, Granny Smith, Jona Gold, Pink Lady, Royal Gala, Starking and Top Red. None of the promising varieties grown in Kabale, namely Anna and Golden Dorset, were seen on the shelves of these markets. The local fruits can penetrate this market by first selling to Nakasero, street vendors and small supermarkets. Thereafter, they will find their way into the major supermarkets especially if they withstand the competition and actually substitute imports. This market penetration could be assisted by branding the local apples: e.g “Kabale fresh, crispy, sweet apples”.

##### **Market chain**

Figure 5 shows the current and the potential future market chain for apples in Uganda.

**Figure 5: Apple market chain**



The solid lines represent the current apple chain while the dotted ones represent the future potential chain. The thickness of the lines denotes volumes moved.



### **Seasonality of apple imports**

Apples come into Uganda on seasonal basis and this could form a good basis for local fruits to penetrate the national market. Imported fruits have to be stored and transported over long distances. Quality is sometimes compromised during this period and the fruits tend to be fluffy and soft, something undesirable to customers. During the times of shortage of imports, local fruits could easily substitute imports. Figure 6 highlights the months when imported apples are in peak supply and in short supply in supermarkets of Kampala. Kabale apple farmers could exploit the months of low import supplies.

**Figure 6: Seasonal availability of imported apples**

Months	J	F	M	A	M	J	J	A	S	O	N	D
Greens												
Granny Smith												
Golden Delicilious												
Bi-coloured												
Royal Gala												
Gala												
Pinklady (Starking)												
Fuji												
Braeburn												
Red												
Top Red												

Adapted from: Ssemwanga, 2003

	Period of peak supply
	Period of low supply

### What products does the market want?

For local apples to compete in the market, quality, quantity and reliability of supply need to be absolutely assured. These variables were said to be of greater importance to retailers than the price of apple fruits. Other important factors considered include the taste (acid:sugar ratio), variety or type, colour, shape, size, texture, absence of pests and diseases and the consistency of these. The fruits have to be delivered at an agreed price, packaged as per the supermarket specifications (preferably ready for placing on the shelf) and delivered on time.

The few local apples that have reached local markets are said to have problems with quality. The fruits are smaller, of inconsistent sizes, shapes and sometimes have varied tastes mainly attributed to early harvesting before full maturity is attained. Reasons for these quality anomalies include the fact that farmers have not been trained sufficiently and, therefore, they do not have the knowledge to implement a quality control system as yet. They also have very little capital for investing in apple production and often do not have access to favourable credit schemes. These issues may be dealt with effectively if farmers are well organized.

It is important to note that consumer preferences are very dynamic. The customer demands need to be gauged and appropriate actions taken to meet these demands. To do this, appropriate capacity building is required for all chain players i.e. farmers, service providers and researchers. The national research system has to be flexible and dynamic towards dynamic consumer demands. According to a seed breeding company in the Netherlands named Meijer, a successful research on variety development has to look into the future 10 to 15 years and should not be one that reacts to a disaster.

### Prevailing market prices

The prices of imported apples were observed to range between Ush 400 and 800 per fruit in local supermarkets and Ush 4400 to 6200 per kg in supermarkets in Kampala. Retailers at the famous Nakasero open market in Kampala buy their stock from Nairobi and sell them at Ush 600 per apple. Kabale supermarkets buy Kabale apples at Ush 150 to 200 per fruit while Kampala supermarkets buy imported apples at Ush 300 to 400 per fruit.

### **What process would local apples follow in order to penetrate the markets?**

- Provide a sizeable sample for market testing
- Offer a price
- Market test sales based on taste (acid:sugar ratio), variety or type, colour, shape, size and texture

If favourably competitive with imported apples being sold, then an order would be placed, with formal supply arrangements made spelling out quantities, quality, packaging, price, time of delivery and mode of payment

Local apples will first penetrate the local markets in Kabale, Mbarara and Masaka and then national markets with Nakasero as an entry point into the Kampala market. It is envisaged that first grade fruits would be sold fresh in Kampala markets to substitute imports while second grade fruits would be sold fresh in the local markets of Kabale, Mbarara and Masaka. Any quality that does not meet fresh market would be used for processing at cottage level. Fresh juice can be made for home consumption and for sale to restaurants and cafes as fresh chilled which has to be consumed quickly as it will quickly ferment unless kept cold or frozen.

### **Distance to market**

Kampala is about 400 km from Kabale town. The road is in good condition. The challenge is the hinterland feeder roads from the villages and the hilly terrain that may cause difficulty, especially during rainy seasons. The local people use bicycle transport from the hilltops to the central collection point from where trucks are loaded for Kampala and other prospective distant markets.

### **Current local marketing system of agricultural commodities**

Local producers transport their small quantities individually to a nearby town mainly by bicycle. Some of them move their wares (mainly Irish potatoes, bananas and pineapples) over 20 km through very hilly terrain and may carry up to 200 kg of produce. In the small towns, traders (middle men) buy the produce and pack them in trucks destined for bigger urban centres such as Kampala. Sometimes, farmers sell their produce directly to consumers or retail shops. Large supermarkets prefer direct procurement from farmers in order to meet customer needs of consistent supply and quality. It is essential to build on this existing channel. Organized farmers could do it even better by bringing their apples to a collection point where grading and weighing is done and the consignment sold in bulk to an agreed buyer.

### **Collective production and marketing**

It will be necessary for farmers to work closely together through collective production and marketing to ensure that the right quantities are attained. Policing each other would also ensure the right quality. When large quantities are attained, there may be need for cold storage facilities and organized farmers can contribute towards their establishment. This would ensure that fruits are bought during peak supply season and kept through periods of scarcity, thus, ensuring steady supply to established market outlets. Community or privately managed nurseries would also provide easy and cheap access to seedlings. In addition, input costs will decline due to bulk purchase of inputs.

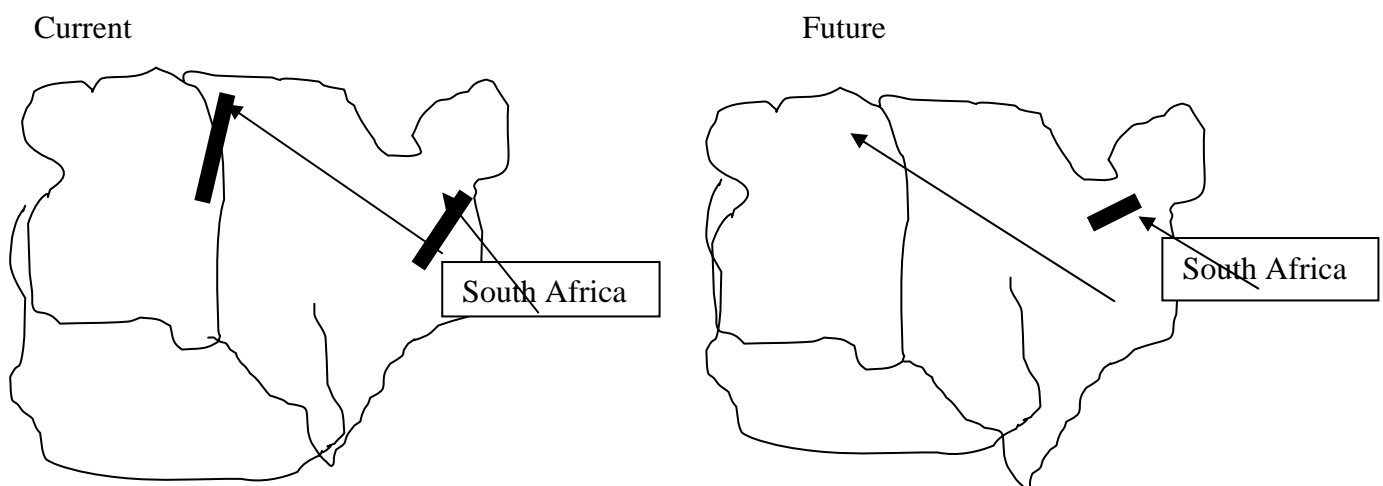
### **National and regional import and export controls**

Information obtained from the markets indicated that costs are halved when apples are received directly from South Africa as compared to when they are re-imported through Kenya. This is because apples imported via Kenya attract a 25% duty into Kenya and another 25% into Uganda. It is assumed that locally grown apples would be cheaper because they

would not attract sea-freight charges and handling costs would be much lower, making them affordable to most customers. This will be true especially if production costs in Uganda can match those in South Africa and the other exporting countries. In that case, local apples will have a low cost-benefit ratio over imports.

The East African Customs Union (EACU) has been formed with a major implication on tariffs levied on exchange of goods and services between the East African countries. With effect from January 2005, tariffs on goods across borders are zero-rated for Tanzania and Uganda. The apples from Kenya will continue to attract 25% import duty to Uganda but this will end in 5 years. This means that the Kabale apples will, in future, compete with zero-rated imports from Kenya and Tanzania. Kenya is already a competitor and may flood the Ugandan market with its own and South African re-exports in 5 years. However, Kabale apples may have a comparative advantage for the apple markets in Rwanda and the Democratic Republic of Congo (DRC) due to proximity to them. Figure 7 depicts this regional trade.

**Figure 7: Current and future import tariffs in East Africa**



The thick lines represent the import tariffs.

### **Potential for processing**

The option of producing apples for commercial juice production looks unpromising in the short run because of the sheer lack of enough fruits to process. Moreover, the capital investment for equipment for pasteurizing and sterile packaging is quite heavy (Pedersen, 2004). According to Britania Allied Company, the main source of apple juice in Uganda, importation of apple concentrate is the cheapest option for processing apple fruit juice and does not require equipment for peeling and juicing the fruits. Therefore, it is not feasible for a large fruit processor like Britania Allied Company to buy locally produced apples unless the quantity is high enough (about 400 tons per year) and the price extremely low (Ush 100 per kilogram). In addition to Britania juice, high quality apple juice is produced in Kenya and sold in Uganda at a competitive price. The following is the situation at Britania Allied Company:

- The plant produces 150 tons of juice per year.
- The price of a ton of imported concentrate is 1000 dollars.
- The plant would require 400 tons of fresh apples per year to produce its normal volume of 150 tons of apple juice.
- 40-45 % of every apple is juice and the rest is fibre.

- 17 tons of fresh fruits make 1 ton of concentrate
- 1 ton of concentrate makes 7 tons of juice.

Currently, their line does not crush fresh apples and specialized equipment would need to be installed if sufficient apple quantities were available at the above quoted buying price.

The opportunity for production of beverages at cottage industry and small-scale enterprise can be exploited and it would mostly likely be in juice concentrates and wines which can be produced with low-technological equipment. This may be significant in the near future where excess and low quality apples could be used for processing. Solar dried fruits especially apple banana and pineapples have been tried in Uganda with positive results. The question is whether solar dried apples have a market niche in this country and whether the Kabale weather favors solar drying of apples? Insufficient hours of sunshine as a result of dense cloud cover would compromise the quality of dried fruits.

#### 4.3.3 Profitability of apple production at farm level

The period for this study work very short and, therefore, first hand information on actual apple production costs and benefits could not be obtained. However, some secondary data was found useful in illustrating some important economic aspects to take into consideration in the enterprise. Table 9 shows a detailed general budget for the initial investment period (4 years) of apple production.

**Table 9: Detailed initial investment budget for a 1 Ha apple farm**

<i>Item</i>	<i>Unit</i>	<i>Quantity</i>	<i>Cost/unit</i>	<i>Amount (Ush)</i>
Cost of land	Ha	1	6,280,000	6,280,000
Land preparation	Days	45	2,000	90,000
Cost of seedlings	Seedling	833	4,000	3,332,000
Labour of planting	Days	104	2,000	208,000
Cost of manure	Kg	33,320	50	1,666,000
Weeding	Days	160	2,000	320,000
Shovels	Sets	5	5,000	25,000
Spades	Sets	5	5,000	25,000
Pangas	Sets	10	3,000	30,000
Hand hoes	Sets	20	3,500	70,000
Labour of training	Days	78	2,000	156,000
Cost of ropes	Rolls	57	2,500	142,000
Cost of pegs	Pegs	12,495	30	374,850
Labour of pruning	Days	156	2,000	312,000
Knapsack sprayers (16 litre)	Sets	2	110,000	220,000
Scissors	Sets	4	9,000	36,000
Labour of defoliation	Days	51	2,000	102,000
Labour of application	Days	12	2,000	24,000
Cost of pesticide (Agrothoate)	Applications	6	9,600	57,600
Cost of fungicide (Dithane M45)	Applications	6	16,000	96,000
Labour of fruit thinning	Days	52	2,000	104,000
Wheelbarrows	Sets	4	50,000	200,000
Labour for harvesting	Days	52	2,000	104,000
<b>Total cost</b>				<b>13,974,950</b>

Adapted from Mbuga, 2004.

**Table 10: Summary of investment costs for the first 4 years**

<i>Item</i>	<i>Amount (Ush)</i>
Land	6,280,00
Farm inputs	6,274,950
Labour	1,420,000
<b>Total</b>	<b>13,974,950</b>

Adapted from Mbuga, 2004.

Intercropping of apples with other crops was observed in farmers' fields. The intercrops provide ground cover and encourage weeding of apple orchards. The crops intercropped with apples include beans, Irish potatoes, Cape gooseberries (*Physalis edulis*) and even Napier grass.

Table 11 demonstrates the costs that will be incurred in each subsequent year after realizing the initial investment. The feeding of the fruit trees becomes the main cost item (fertilizer and/or manure application) representing about 31% of the total annual cost.

**Table 11: Summary of general annual investment costs from year 5 onwards**

<i>Item</i>	<i>Amount (Ush)</i>
Farm inputs	747,670
Labour	566,000
<b>Total</b>	<b>1,313,670</b>

Adapted from Mbuga, 2004.

Table 12 indicates financial cash flow using three price scenarios namely Ush 300, 200 and 100 per fruit. It is assumed that investment capital is borrowed from a commercial bank at 21% interest rate.

**Table 12: Financial evaluation**

<i>Price scenario (Ush)</i>	<i>Financial index</i>	
	<i>NPV (Ush/Ha)</i>	<i>IRR</i>
First price (300)	71,506,253	48%
Second price (200)	22,271,905	31%
Third price (100)	-2,573,678	19%
<b>*Local farmer</b>	<b>19,071,657</b>	<b>48%</b>

Adapted from Mbuga, 2004.

NPV= Net Present Value (equivalent to net profit)

IRR=Internal Rate of Return (The return to investment)

\* The local farmer scenario does not incur land interest costs

The data given in Table 12 shows that apple production would only be economically feasible if the sale price is 200 Ush per fruit or higher. The NPV above zero means that the cost of production is covered. Assuming interest rates are equivalent to 21%, an IRR in excess of this

is needed to justify the investment in apples. IRR values lower than the bank interest rate means that it is more prudent to keep the money in the bank than to invest it in apple production.

### **Investment capacity**

Table 10 above shows that apple production requires capital investment to the tune of Ush 13 million per hectare for the initial investment period of 4 years. Apples require intensive management and labour costs may become significant in future. Currently, grafted apple seedlings are worth Ush 4,000 and have been rated very costly by farmers, indicating the need for credit. Most farmers have no collateral assets such as title deeds and farming is dependent on rain which may fail, thereby causing crop failure. Financial institutions are reluctant to lend money to farming communities because the farming cycle is long term (more than half year). Long term (more than 4 years) lending is necessary for the apple business and lending institutions that can provide this need to be developed. It may be necessary to investigate options for developing savings schemes or accessing loans or grants.

The majority of seedlings was given free of charge but some few were purchased by individual enthusiastic farmers. Development agencies have for some time now discouraged free handouts of whatever nature since this often results to lack of proper ownership by recipients who do not take good care of the handouts.

### **Future Kabale District production projections**

From the Kabale District proposal to the Ministry of Finance, more than 800,000 apple trees are planned to be planted within the next five years targeting 200 farmers. Out of the Ush 3 billion pledged by the government, already Ush 65.5 million has been released for seedling propagation and dissemination to farmers. The projected fruit production in the next five years for the district far outstrips the current national consumption of apples estimated at 190 metric tons per annum (Ssemwanga, 2003). If this plan succeeds, then there is going to be plenty of apples, as shown in the calculation below, and markets need to be established in advance.

- District target number of apple trees: 800,000
- 800,000 trees require 1000 Ha of land on normal farmer management (assuming 800 trees per Ha) or 1600 Ha if trees are left to grow big (i.e. 500 trees per Ha)
- Assuming that 80 marketable fruits are produced per tree per year (only if all conditions are optimal, i.e. appropriate and good quality rootstocks, nutrients, management, control of pests and diseases) the total number of marketable fruits per year is 64,000,000
- Assuming that 8 fruits make one kg, the total projected weight of apples is 8000 tons

The 8000 tons projected far outstrips the current sales by over 7000 tons (the present apple consumption is 190 metric tons). There is, therefore, need to plan for the surplus.

## 4.4 Social Organizations

### 4.4.1 Household gender analysis

#### **Who owns and controls what resources?**

Gender refers to the social roles that a society assigns to male and female members in the community. The roles are dynamic and vary from one community to another. Among the farmers in south western highlands of Uganda, the lineage is patrilineal. Hence, most household heads are men who own and control land. They also own and control most of the cash generating enterprises on the farm including livestock. Therefore, they make most of the decisions on land use allocation, acquisition of family assets, allocation of family funds to different uses and payment of school fees for the children.

#### **Who has access to what resources?**

All members (men, women and children) have access to land and household assets as well as the accruing benefits. However, little can be said on equitable distribution of the resources at this juncture. Despite the fact that men own land and the cash generating enterprises, it is women who perform most of the farm activities assisted by hired labourers and older children who are not in school. Children attending school help on the weekends and sometimes during the evenings on school days.

Currently, the bulk of the responsibility of the apple labour rests on women. Indeed, apple seedlings are disseminated only through farmers' groups and most of these groups are comprised of women (Bizimana, 2005, Pers. Comm.). Therefore, apples enter the household through the woman who is expected to perform most of the apple production activities from digging the hole, to planting, staking, watering, pruning, defoliating, spraying, harvesting and marketing with some assistance from hired labour.

It's also worthy mentioning that besides doing most of the farm activities; women perform most of the reproductive work such as rearing the children, taking care of the sick and household chores while men are away from home doing off-farm employment – formal employment, casual labour, craft making, charcoal burning, brick making, etc.

Key questions arising from the aforementioned issues include:

- Do apples fit into the already existing farming systems in terms of labour?
- Is the amount of labour required for apples going to interfere with the other farm enterprises?
- Are apples going to compete over land with the other enterprises? And lastly,
- Do apples have a comparative advantage over other cash generating enterprises like Irish potatoes in terms of livelihood income?

If the answer to most of the above questions is in the affirmative, then there are some implications on gender division of labour. Documented literature indicates that apple is a labour-intensive enterprise with one hectare requiring about 250 man days of labour per year (Mbuga, 2004). If women were to continue doing most of the apple activities, this translates into more workload for them, leading to a reduction of time on the other household activities. Alternatively, women may not have much extra time for apples, leading to less interest on the adoption of apples than expected. The other likely scenario is that those men who presently

have limited roles in the household and off-farm employment might start performing some apple activities.

#### 4.4.2 *Farmer Organisation*

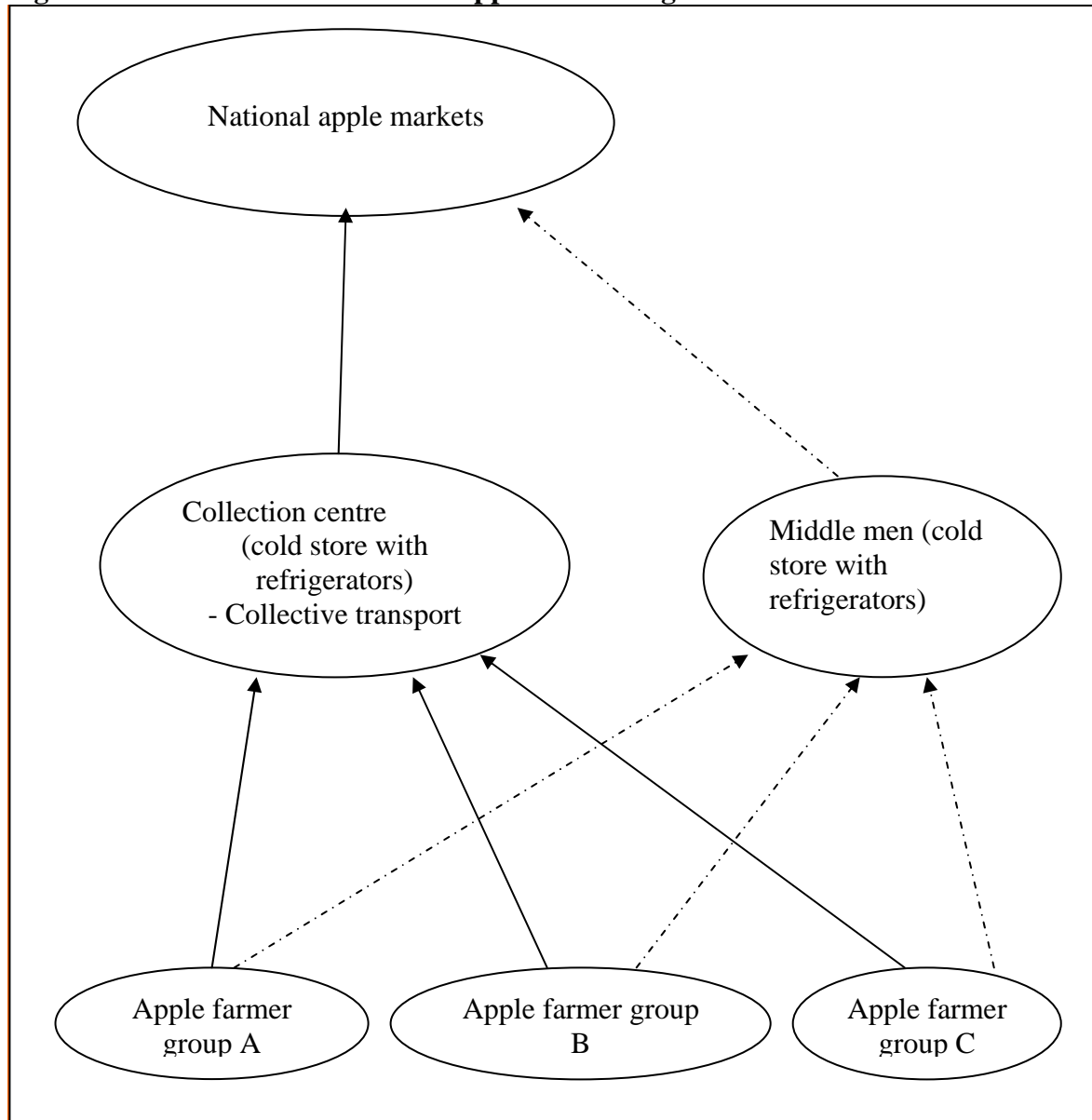
##### **What are the required forms of farmer organizations?**

For farmers to succeed in making apples a profitable and viable enterprise, they need to be organized into strong and robust collective groups/cooperative systems to enable collective production and marketing of their produce/products. Presently, farmers' groups do exist but only at the local level. Individual farmers access apple seedlings through these groups. An example of such a group is Karambo Tukole farmers' group (KTFG) that specializes in growing apples and is registered with NAADS. Such farmers' groups do not exist at the district or regional level. It is strongly felt that local groups alone without corresponding organization at the district cannot really do much if the apple enterprise is to be profitable and viable in the region.

What is required and is actually envisaged is an organized, collective action from production to post harvest handling and a coherent marketing system from the village level to the district and possibly to the national level. Infrastructure such as cold storage facilities may be availed in central collection centres to store the apples so as to even out supply and demand throughout the year. Figure 8 shows a potential future model of farmers' groups at the local level bringing their produce collectively into the district's central collection centre that is under a district apple farmers association. This envisioned chain is expected to enhance the farmers' bargaining power. Moreover, the mode will move the farmers from their present state of less organized to a state of more organized, leading to enhanced profit margins. Profit margins will go up owing to, among other reasons, pooled use of resources, bulk purchase of farm inputs, ability to possibly add value, collective storage and transport to district markets and collective bargaining with powerful retailers. The activities of the associations will not be divorced from politics as they might start lobbying and negotiating for farmers' interests within the micro and macro environments, as well as establishing and defending the Kabale brand of apples.

Although the study is advocating for collective action, many farmers in East Africa have misconceptions about any form of collective activity. They are suspicious of hierarchical systems and Kabale farmers may think that collaborative activity of this kind will be run by a small clique of people over whom they have no control and with whom they may have conflicting interests. Many efforts made to bring farmers together in the past have failed mostly due to corruption and inefficient management. It is important, therefore, from the onset to establish an appropriate democratic constitution governing the activities of the groups. Such a constitution should make sure that the groups have no control over assets of individual farmers nor should any farmer be prevented from leaving the group if they so wish. Besides collective action, apples could be marketed through middle men since they have the capital needed in terms of knowledge, cold storage and truck to transport apples from the farmers' groups to the national markets. The only problem here is that they will plough in some profits that could possibly have gone into the farmers' pockets.

**Figure 8: Possible future model for apple farmer organizations**



#### 4.4.3 Stakeholder Linkages

- Which stakeholders have a role in the apple enterprise and how are they linked?
- What are the future desired stakeholder linkages?

Various stakeholders are already interested in making apple production and marketing a viable and profitability enterprise. They include stakeholders in research and development (R&D) and production and marketing (P&M) subsystems. Strong linkages among these stakeholders in terms of partnership, collaboration and sharing of resources, knowledge, information, space, etc, is vital for the success of the apple enterprise. Continuous participatory planning, monitoring and evaluation involving these stakeholders are imperative to gauge whether the enterprise is on course.

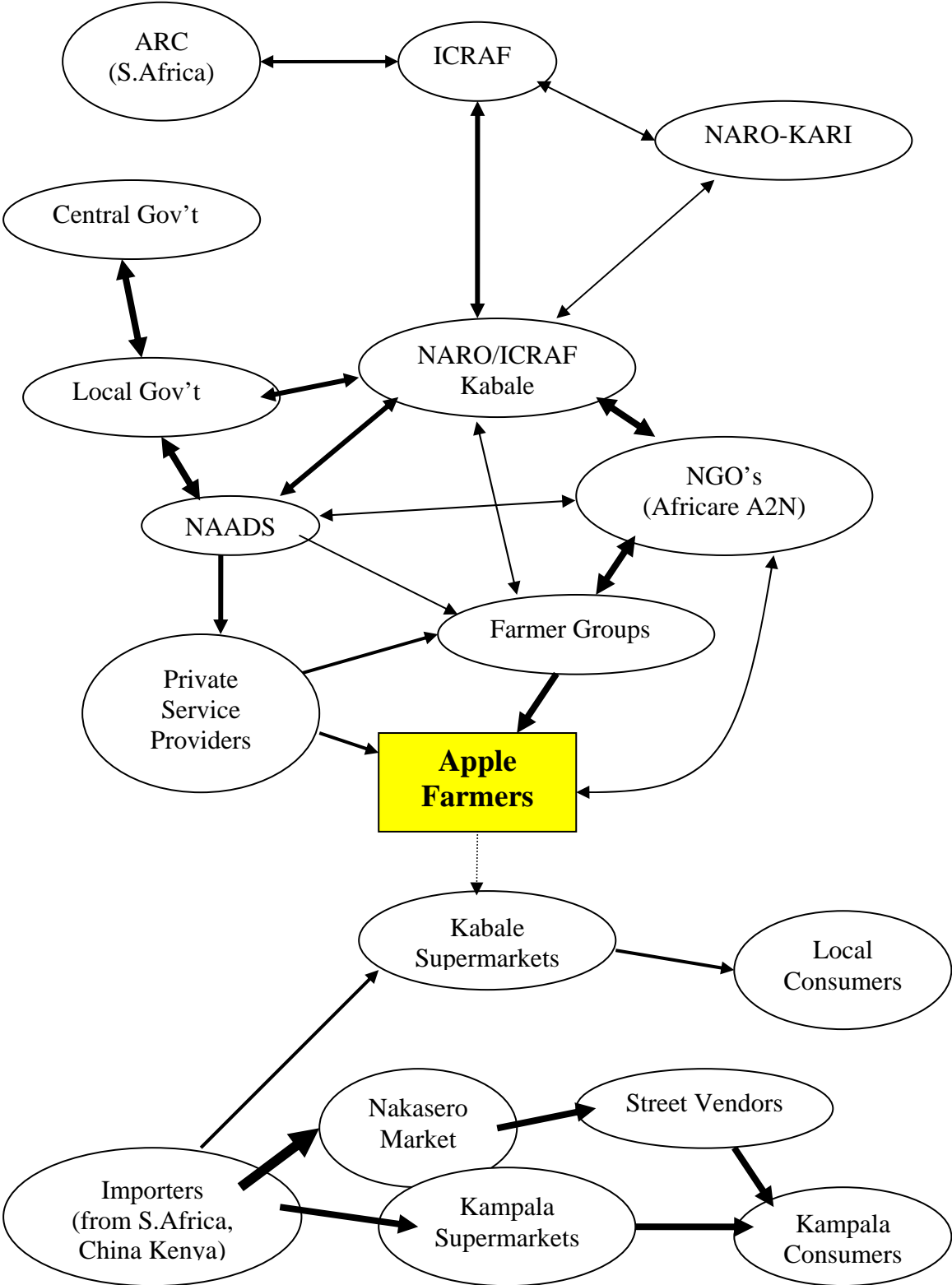
Currently, the linkages between and among the different stakeholders are as demonstrated in Figure 9. The figure shows linkages of different strengths as depicted by the thickness of the

line. Accordingly, there exists strong linkage between NARO/ICRAF scientists in Bungogi and NAADS, NGO's, farmers, local and central government, between NAADS and farmers groups, NGO's, and private extension service providers. These linkages are invaluable. For instance, there is no way farmers will succeed in growing a profitable apple without the inputs of the research scientists whose role is to conduct research on variety selection and development, production technologies, post harvest practices and possibly marketing.

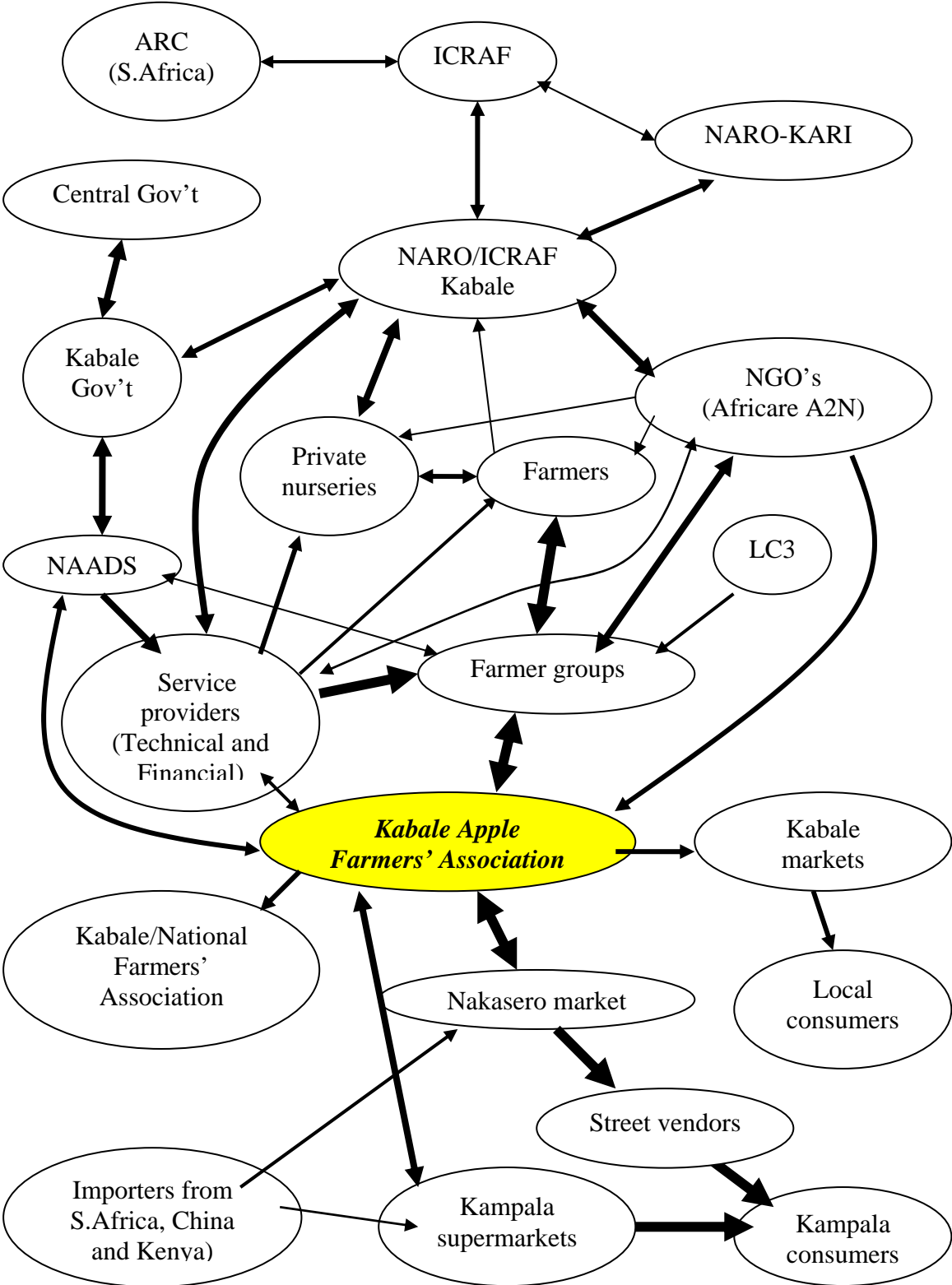
The linkages with NAADs NGO's, private extension service providers and farmers' groups is also necessary because the former three are involved in training and disseminating the apple technologies to the latter, a service that is useful if apples are to play a major role in the economy by reducing the country's reliance on imported apples, ensuring adequate fruit supply and ultimately alleviating poverty. The linkage with the local and central government is also indispensable because if any enterprise was to succeed, the political will and might needs to be behind it. However, there are weak linkages that need to be strengthened. Moreover, some potential actors need to be introduced into the field, for example, Kabale apple farmers' association which is expected to link farmers' groups with major markets in Kampala such as Nakasero open market, street vendors and supermarkets. Once these linkages are forged and boosted, farmers will be able to profitably produce and deliver apples to the market. Figure 10 depicts the envisioned and desired linkages that include (R&D) and (P&M) subsystems.

This scenario might change in future when apple develops into a major cash generating enterprise, subsequently transforming it into a man's crop. In this way, it is envisioned that gender division of labour may possibly change to some extent. It is of paramount importance that the apple enterprise be considered in the light of the region's farming system analysis.

**Figure 9: Current stakeholder linkages**



**Figure 10: Desirable future stakeholder linkages**





## 5 APPLE DEVELOPMENT STRATEGIES

### 5.1 Introduction

Three scenarios are envisaged for the future of the apple enterprise in south western highlands of Uganda as spelt out in chapter three. In scenario 1, the apples become a significant cash crop that is commercially produced by farmers as is the case with Irish potatoes. In scenario 2, apples become a mainly subsistence crop with farmers planting a few apples in the homestead as is the case with avocados. In Scenario3, the momentous interest in apple production wanes and the enterprise fizzles out as happened with pyrethrum and tobacco.

The present study bets on the favourable scenario 1 that apples will be commercially produced and become a significant cash earner for farmers in south-western Uganda. This optimistic view hinges on sustained political interest at the local and national level, continued pursuit of the Programme for Modernization of Agriculture (PMA), improvement in generation of apple technologies and enthusiastic support by farmers and development institutions. It is worth noting, however, that these favourable conditions cannot on their own guarantee an “apple boom”. Several strategies related to marketing, technical services, credit and financial services and organization of farmers and stakeholders need to be implemented for the success of the apple enterprise.

### 5.2 Market strategy

Based on the economic analysis in chapter four, the following points can be noted:

- All apples sold in major market outlets in Kampala and other major towns in Uganda are imported
- There is a ready local market for Kabale apples but quantities available are too small and their supply and quality are not consistent

For successful development of the apple enterprise information on what market outlets are available and what markets require is critical. Also critical is how to respond to market demands.

#### 5.2.1 Market outlets

Major supermarkets (Uchumi and Shoprite), Nakasero open market and street vendors are the main outlets for apples in Kampala. The most effective entry for Kabale apples into the Kampala market is the Nakasero open market, street vendors and small supermarkets because these market outlets command a large local consumer base for fruits.

The best markets to target for Kabale apples in the foreseeable future are the local and national markets and to some limited extent Rwanda and DRC Congo markets. The export market will remain largely out of reach of Kabale apples until they can compete effectively with imports locally and nationally.

Promotion of apples for both home consumption and income generation will help develop the local market. Kabale apples could be promoted as fresh, tasty, crispy, home-grown and fresh “Kabale apples” unlike some of the imported apples. The young generation, especially in boarding schools and colleges, form the major potential reservoir market for Kabale apples.

The prospects for selling Kabale apples to large juice processors in Kampala are not promising because of very cheap apple juice concentrate imports. The focus therefore should be on the fresh apple market. In the long-term, a potential for juice making and apple preserves at cottage level may exist to cater for excess apples not absorbed in the fresh market. However, the feasibility of establishing a viable and profitable apple cottage industry will need to be studied in detail, based on a more in-depth research into available technologies than was possible in this study.

### *5.2.2 Market info needs*

For Kabale apples to be competitive against imported apples, information on consumer-desired variety characteristics, quality aspects, niche markets and market prices must be relayed to farmers. Direct linkage between farmers and market outlets will enable farmers to respond to consumer needs and preferences. NGOs and NAADS can help develop market information channels for apple farmers. Internet, mobiles and radio are potential tools for relaying market intelligence information to farmers.

## **5.3 Technical services**

There is no doubt that to exploit the market opportunities available for apples, Kabale farmers must produce and supply consistently large volumes of apples of the right quality at the right time. For this to happen, special attention should be focused on seedling production and distribution, development of technical capacity on apple orchard management for farmers and service providers, and apple research.

### *5.3.1 Seedling production and distribution*

NARO/ICRAF grows apple seedlings and distributes them to groups of farmers through NAADS and NGOs. Most farmers have received seedlings for free. In a bid to speed up apple seedling dissemination, farmers have been receiving and planting apple rootstocks which are later grafted with scions of appropriate apple varieties on-farm by mobile trained grafters or nurserymen at the village level. Despite the potential benefits of this approach, grafting by mobile community is likely to compromise the quality of the scions used in grafting, especially with respect to pests and diseases. Farmers receive rootstock seedlings from different sources and in different quality conditions. There are also logistical problems of knowing which farmers have planted rootstocks and/or received grafting service. This calls for better coordination among the players involved in rootstock distribution. Documentation of rootstocks distributed and grafted in the field is necessary. In the long-term, grafting on farm should be discontinued.

Development and promotion of private nurseries at sub-county level is a good strategy for effective and sustainable seedling production and distribution should be supported logistically and financially. Intensive training of private nursery operators on grafting and seedling establishment is critical for this to succeed. The practice of giving farmers free seedlings should be discontinued to allow the private sector to thrive. Quality assurance system needs to be put in place for these private nurseries to play their role effectively. NARO-ICRAF has to approve operation of private nurseries by giving phyto-sanitary certificates.

Apple variety development deserves special attention because the range of low chill apples for subtropical areas is limited. Currently only two varieties (“Anna” and Golden dorsett) have shown good promise and are being promoted for cultivation in Kabale. Quality for the fresh market should be one of the criteria for screening scion varieties. It is advisable to screen and preserve elite germplasm from tropical producing countries (e.g. South Africa). Screening of more rootstock varieties is recommended, the tree types with appropriate architecture and disease resistance.

### 5.3.2 *Capacity development*

#### **Farmers**

Apple trees require intensive management to produce high quality fruits, especially in subtropical conditions prevailing in Kabale. Technical skills are required in such management practices as grafting, tree training, staking, defoliation, pruning, flower and fruit thinning, chemical spraying and nutrient management. Apple trees in farmers’ fields are not well managed compared to those at Bugongi and Kalyengere research stations, partly due to limited technical advisory services. Formation of an apple producers association should increase the capacity of farmers to demand specialized services for their enterprise. Concentration of farmers in selected high potential areas will also go a long way to improve farmers’ access to extension services.

#### **Service providers**

Technical services on apple production are provided by private extension agents who are engaged by farmers through NAADS. Being a new enterprise in Kabale, organizations providing extension services to farmers are limited in terms of apple production technologies. Extension agents should be adequately trained in apple management in order to offer competent technical services to farmers. The NARO-ICRAF Project and NAADS are well-placed to carry out the training. However, for these organizations to do the job effectively, additional apple production technologies must be generated through research. Fruit specialists from NARO should take the lead in this research front.

### 5.3.3 *Research*

#### **Variety quality and size**

The apples produced so far in Kabale have been described as small to medium in size compared to imported apples. For Kabale apples to compete well in the market with imported apples, they must be tasty, crispy and of good size to appeal to the buyers. Research related to synchronization of fruiting, plant nutrition, plant physiology, varietal screening, pruning and root stock characteristics may lead to improvement in quality and size of apples.

#### **Synchrony in flowering and fruiting**

Synchronization of flowering and fruiting is a major challenge to commercial production of apples. Prolonged tree flowering/fruiting period has a negative effect on fruit quality and fruit development. Flower abortion and premature fruit abscission are also a problem. Research to tackle these constraints is imperative if Kabale apples are to fair well in the market. Research areas that may provide a solution to these problems include determining the best time to defoliate, the optimum defoliation intensity, potential use of chemical defoliators, plant nutrition studies and varietal screening. KARI scientists could backstop Kachwekano ARDC staff in designing these experiments.

### **Plant nutrition**

Most farmers in Kabale have small plots that are deficient in plant nutrients because they are continuously cultivated without external nutrient replenishment and because they are susceptible to soil erosion. Soil nutrient amendments are therefore necessary for commercial production, but no research on apple tree nutrition has been carried out in Uganda. To develop apple tree nutrition technologies, research should be done on the effect of varying rates of inorganic fertilizers, organic manures and micronutrients.

### **Pests and diseases**

Pests and diseases have the potential to drastically reduce the yield and quality of apples and therefore have to be effectively controlled. Aphids, caterpillars, and birds are the main pests affecting apples on Kabale farms whereas the main diseases reported are fungal leaf spot and scab. The incidence and severity of these diseases and pests is likely to increase in future. New strains of diseases and pests are also likely to surface as more land is brought under apple cultivation. Research needs to focus on:

- Identifying pests and diseases affecting apples in Kabale
- Determining incidence, severity and spread of pests and diseases of apples in Kabale
- Developing control options for the pests and diseases affecting apples in Kabale including biological control measures

The success of this research will depend largely on the effort of competent crop protection specialists specifically plant pathologists and entomologists. In this case, the services of KARI scientists are critical because Kachwekano ARDC has limited technical expertise in crop protection.

### **Post-harvest handling and processing**

Apples are perishable fruits and therefore prolonging their shelf-life after harvest is necessary to guarantee the quality demanded by the market. This requires the establishment of a post harvest management system that ensures optimal handling, storage and transport of the fruits. The apple enterprise is at its infancy in Kabale and the first apple crops are starting to bear fruits and are yet to reach the market. Post-harvest handling and processing is not a serious issue for now, but it will be in the future as apple production is scaled up and fruits become available for the market. Research issues to be considered include storage characteristics of varieties, packaging materials, refrigeration, appropriate time of harvesting and post-harvest diseases and pests. Development of protocols for processing apples into various products will be useful in the future in case of excess apples that can not be absorbed by the fresh market.

## **5.4 Credit and financial services**

Development of the apple enterprise will require investment by various players in the chain. These players include:

- Individual farmers who need long-term credit (4 year and above) to meet costs related to acquisition of apple seedlings, agro-chemicals, fertilizers and labour among others. It would be very useful if the farmers were to obtain subsidized or low interest credit.
- Private nursery operators who need credit to establish apple seedling nurseries
- Extension service providers who need credit for training and business development
- Farmers' groups and organizations to put up collection, storage, transportation, and packaging facilities.

NGOs, microfinance institutions and banks will need to play a critical role in these.

For farmers to access credit or loans they must be organized for collective production and marketing action. They must have business plans indicating production capacity of the enterprise, costs of production (fixed and variable costs) and potential internal rates of return to investment. Credit institutions can only lend to customers with the potential to pay back.

## **5.5 Organization**

### *5.5.1 Farmer organization*

Most farmers in south-western Highlands of Uganda (Kabale) own small pieces of land and have limited financial resources and therefore can not individually produce large volumes of apples for sale.

The strategy here should promote block farming by concentrating apple production in selected high potential villages (where apple trees so far showed good potential) in order to effectively organize small scale farmers to produce and market their apples collectively. This strategy has the potential to improve the farmers' incomes from the apple enterprise in the following ways:

- Ensuring the right quantity, quality and consistent supply demanded in the fresh market.
- Improving access to larger scale traders/markets
- Providing the incentive for farmers to bring more land under apple production
- Improving access to credit from banks that require large collaterals before lending money and microfinance institutions that lend money to groups of farmers
- Improving access to effective and efficient technical and business development services from the government and development agencies
- Bulk buying of inputs will improve bargaining power of farmers with input suppliers
- Improve access to market information
- Encourage a development of private collection and processing centre in which apple farmers have shares

Figure 8 in Chapter 4 is an illustration of a potential model for farmer organization for collective production and marketing action for apples from the village to the district level then to the national level. Farmer groups from different apple growing blocks cluster supply at a village level, sort it out, and then deliver it to a common collection centre operated by a district farmers' association where it is stored in cold rooms and then transported to the national markets. This will need investment in cold storage facilities and refrigerated transport trucks for accessing Kampala markets and other national market. Non-governmental organizations (NGOs), community based organizations (CBOs) and NAADS could spearhead the effort of organizing farmers for collective production and marketing action.

### *5.5.2 Stakeholder coordination (linkages and partnerships)*

The strategy here should be to put in place a structure for effective coordination among the key local stakeholders involved in apple enterprise development. Joint implementation of activities will ensure efficient use of resources, sense of mutual ownership, and effective monitoring and evaluation of progress. The Monitoring Group formed to backstop the ICRA team during the field study could transform itself into apple enterprise steering committee to oversee the implementation of the strategies outlined in the previous sections. Each stakeholder should be allocated clear responsibilities for effective implementation of the

strategies covered in previous sections. Table 13 outlines the suggested future roles of stakeholders in the development of the apple enterprise.

**Table 13: Future stakeholder roles**

<b>Stakeholder(s)</b>	<b>Future Role(s)</b>
NARO	<ul style="list-style-type: none"> <li>• Develop high yielding, consumer-preferred apple varieties and appropriate apple tree management technologies.</li> <li>• KARI to provide a fruit specialist to work closely with NARO-ICRAF Bugongi staff</li> <li>• Kachwekano ARDC to equip NAADS with technical skills and undertake quality assurance in seedling production and distribution</li> </ul>
Kachwekano ARDC	<ul style="list-style-type: none"> <li>• Seedling development and distribution, business plans development and linkages with international research</li> </ul>
ICRAF	<ul style="list-style-type: none"> <li>• Technical backstopping</li> </ul>
NAADS	<ul style="list-style-type: none"> <li>• Ensure farmers receive relevant, efficient and high quality technical services by effective supervision and backstopping of private extension service; and</li> <li>• identify service providers that can offer business development plans</li> </ul>
Farmer groups (village)	<ul style="list-style-type: none"> <li>• Cluster supply, channel services, channel market information</li> </ul>
Farmer Association (district )	<ul style="list-style-type: none"> <li>• Develop contracts with markets, establish brand name, channel market information and organize central storage, packaging and transportation</li> </ul>
Central and local government	<ul style="list-style-type: none"> <li>• Develop infrastructure and provide technical and financial services, create favourable policies and/or subsidies for the apple enterprise</li> </ul>
Credit providers (microfinance institutions and banks)	<ul style="list-style-type: none"> <li>• Lend credit for apple development, especially long term credit for orchard establishment and also for storage and packaging facilities</li> </ul>
NGO's	<ul style="list-style-type: none"> <li>• Train farmers on developing business plans, develop marketing channels, help in organization of farmers;</li> <li>• provide extension service on apple technologies;</li> <li>• help acquire credit for the farmers</li> </ul>

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## ANNEX 1

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