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Currency equivalent

1 US\$ = 455 Rwandan Francs (Frw)

Acronyms and abbreviations

ASSR	Appui au Secteur Semencier du Rwanda
CIP	Centro International de la Papa (International Potato Center)
CPI	consumer price index
DRC	Democratic Republic of Congo
DS/MINECOFIN	Statistical Department, Ministry of Economy and Finance
FAO	United Nations Food and Agriculture Organisation
FOR	Forum des Organisations Rurales
FSRP	Food Security Research Programme
Frw	Rwandan francs
Ha	hectare
HLCS/EICV	Household Living Condition Survey/Enquête Intégrale sur les conditions de vie des ménages
kg	kilogramme
MINAGRI	Ministry of Agriculture, Livestock and Forestry
MINIPLAN	Planning section of MINECOFIN
MT	metric ton
PASAR	Projet d'Appui à la Sécurité Alimentaire au Rwanda (Food Security Support Project to Rwanda)
PNAP	Programme National d'Appui à la Pomme de Terre
PRAPACE	Programme régional de l'amélioration de la culture de la Pomme de terre et de la patate douce en Afrique Centrale et de l'Est (Regional Improvement Program for the cultivation of potato and sweet potato in Central and Eastern Africa)
Q	quarter
Tsh	Tanzanian shilling
Ush	Ugandan shilling
US\$	United States dollar

POTATO MARKETING IN RWANDA¹

Executive summary

by

Dr Frans Goossens

1. Consumer demand

Volume of demand

The role of Irish potato as a staple food in Rwanda has increased since the mid-1960s. Annual per capita consumption rose from 8 kg in 1965 to 40 kg in 1985/86, and to 76 kg in 2000. In rural areas, the average per capita consumption amounts to 68 kg per annum, but ranges between 20 kg and 216 kg. Consumption variation reflects the distribution of production. Urban demand is 141 kg per year, which is unusually high compared to other urban centres in Sub-Saharan Africa. Over the period 1985-2000, urban consumption of Irish potato, bread and rice rose sharply, while that of traditional food staples (sweet potatoes, beans, cassava, maize and sorghum) decreased.

Over the next 20 years, demand for Irish potatoes will increase faster than total demand for food. Demand is expected to rise by at least +200-250% by 2020, or from 603,000 tonnes in 2000 to 1.8 million – 2.1 million tonnes of ware potatoes (i.e. a demand for ware + seed potato of 2.2 – 2.6 million tonnes) in 2020. Given the high income-elasticity of demand for potato (1.43), this projection is conservative. The following factors will contribute to this sharply increased demand:

- a) total population is expected to double by 2020 (from 8.3 million in 2000 to 16.7 million by 2020)
- b) the Rwandan urbanisation rate is still low, but urban population is expected to grow more rapidly than total population; an urbanisation rate of 30% in 2020, compared to 10% in 2000, will lead to a demand increase for Irish potato of 18% (national average consumption of 90 kg/capita in 2020, compared to 76 kg/capita in 2000);
- c) income growth leads to higher potato consumption, both in rural and urban areas (short-term income elasticity of demand: rural 1.45 and urban 1.25); Government's two main long-term growth targets in *Vision 2020* are : a) increasing GDP per capita to US\$960 (currently US\$260); b) reducing the percentage of the population who live below the poverty line to 25% (currently 64%). Three percent income growth will lead to 4.3% growth of potato consumption;
- d) urban consumption is low because of high consumer prices;
- e) Northwest Rwanda has a comparative advantage for potato production in the Great Lakes region, which will lead to higher export demand to neighbouring countries. At the moment, approximately 8,000 tonnes are exported annually. Exports of 100,000 tonnes in 2010 are realistic.

¹ This version includes the amendments of MINAGRI's Potato-Sector Policy Committee at the meeting on 23rd April 2002 during which it endorsed the report as the basis for a potato-sector action plan.

Demand for quality

There is a potential for shifting the demand schedule with higher-quality potatoes. At the moment, only an average standard potato (selling at 40-45 Frw/kg) is available in the Kigali retail market. Some very minor tendencies to grade exist. Clear indications exist that consumers are satisfied with neither present quality grades nor the commercial quality (variety, storability and dry-matter content) of the ware potato. There is potential to develop the more consumer-oriented market segments. Table 0.1 presents current, as well as potential, market segments that could be developed in the near future given the present context: export-quality, premier-quality, average quality (large and medium-size tubers), and small tubers.

The premier-quality potato responds to the urban consumer's requirements:

1. a commercial variety (*Victoria, Sangema, Maryline*, etc.) with good storability and high dry-matter content
2. oblong shape, red skin;
3. a homogeneous bulk product that can be marketed via existing marketing channels;
4. using adapted packaging material (jute)
5. with well-dried potatoes, large and medium size tubers.

Production is justified if a premier-quality potato at the farm gate gets 7-10 Frw/kg (i.e. +30%) more than an average-quality potato. The higher price should compensate farmers for the increased costs of: a) the use of commercial varieties and quality seed potatoes; b) improved crop husbandry (including fertiliser, pesticides; and dehalming, which gives slightly lower yields). The market segment of export-quality is being developed by Volcano Potato Inc. in close collaboration with the business development project, ADAR. Potential clients are supermarkets, hotels, restaurants, export markets. Bamboo packaging material will be used because of its local availability.

Table 0.1: Current and potential market segments

Current market segments			Potential market segments		
Market share	Quality category	Retail price Frw/kg	Market share	Quality category	Retail price (Frw/kg)
>1%	Masisi potato	50	1%	Export quality	80-100
92-94%	Average	(Kigali's central market) 45 (other markets) 40	5-10%	Premier quality	50-65
5-7%	Small tubers	30-35	80%	Standard Quality (large and medium size)	40-45
			10%	Medium and small-size tubers	35
Weighted average		40.5	Weighted average		43

2. Potato supply and rural marketing

During the period 1964-1992, Irish potato production rose steadily from 34,000 tonnes to 347,000 tonnes. Between 1992 and 1999, the upward trend was interrupted because of civil unrest and war. Since 1999, cultivated acreage has been expanding rapidly. Production estimates for 2000 differ wildly, between 350,000 tonnes and 950,000

tonnes. Acreage attributed to potato is approximately 80,000 hectares, with yield at between 7 and 8 tonnes per hectare. Approximately 60-65% of production comes from the volcanic soils in Northwest Rwanda, 15-20% from the highlands of the Congo/Nile Divide, 10% from Byumba province, and 15% from the other provinces. The Congo/Nile Divide and Byumba province are losing market share because of the production limitations of their depleted soils. These acidic soils can only be used to cultivate the variety *Cruza*, which urban consumers do not accept, and which is not a cash crop. In the eastern lowlands, potato has a growing role as food-security crop.

During the period 1966-1990, output growth was attributable to an expansion of cultivated area and to a yield increase from 4.5 tonnes per hectare to 7 tonnes due to the introduction of improved varieties. During the period 1990-2000, growth was mainly due to area expansion (+100%): deforestation of Gishwati, lowland cultivation, and the growing role of potato in crop rotation and even a tendency towards mono-cropping in Ruhengeri and Gisenyi. Yields increased only by 11% because production technology stagnated. Average yields are still amongst the lowest in the world.

Table 0.2: Sources of potato output growth

Period	Area	Yield	Total output
1966/68 – 1988/90	+151%	+40%	+251%
1988/90 – 2000	+100%	+11%	+122%

Source: own calculations

Growing pressure on the average farm size and its financial viability as an economic unit has consequences for the peasant farmer's strategy in Northwest Rwanda. Potato production –and harvesting are dominated by the peasant farmer's food-security strategy, while preferences of urban consumers are not taken into consideration. Farmers prefer short-dormancy, early-maturing varieties, resistance to late blight and tolerance to bacterial wilt, and premature harvesting as a function of cash needs. They prefer to sell potatoes with a high water content because they are heavier, although a high dry-matter content is a basic indicator for a commercial potato (for reasons of marketability and storability). Since 1994, farmers have lost varieties with good marketability characteristics.

3. Ware-potato marketing

National markets

The provinces of Ruhengeri, Gisenyi and Byumba are net exporters of potato to other parts of Rwanda. Local production equals local demand in the provinces of Gikongoro and Kibuye. Eastern Rwanda and the Province of Kigali Rural are supplied via the Kigali wholesale market. Kigali City accounts for approximately 80% of total urban demand.

Within producing areas, rural traders take charge of purchasing, packing and weighing potatoes, assembling 10 to 35 120-kg sacks in their premises and storing for 1-3 days. Their gross margin is 10-15% of the rural market price. Interregional traders handle the transfer of produce between producing areas and urban centres by lorry. The sector has an atomised structure, with approximately 25 15-tonne lorries and 60 3.5- tonne trucks serving the market. The small trucks also cater to smaller village and urban markets in

various parts of the country. Kigali has two informal wholesale markets both created spontaneously by traders: Nyabugogo and Giticyinyoni. The Nyabugogo market is organised by three associations representing approximately 130 vendors. They sell at the roadside, as no market infrastructure exists. The market has a daily turnover of approximately 70 tonnes. This market, the price-leader in Kigali, is characterised by perfect collusion. Social barriers of entry are high. In Giticyinyoni, approximately 20 transporters with 3.5 tonne trucks organise an informal wholesale market each morning between 5h00 and 7h00. Their clients are retailers. The Giticyinyoni market has a throughput of approximately 60 tonnes. Transporters in this market are price-takers. Urban retail trade is through retail markets, either open-air or with stalls. Within each urban retail market, traders all sell the same average quality and use the same sales price, which is determined by the group. Prices are calculated in function of the price in the Nyabugogo wholesale market. Wholesale and retail trade in small urban centres is characterized by collusion, oligopolies or monopolies, so that gross margins are high. Market information is good, except at farm and consumer level. Price transmission is good, but does not lead to strong price competition. Potato storage for speculative purposes is not known to take place. The seasonal price component is unstable.

Another fundamental constraint to potato marketing is that the Rwandan potato is highly perishable and has to be marketed just like a fresh vegetable. Conservation without quality loss is difficult because of inappropriate harvesting (no dehalming, premature harvesting, inappropriate packaging material).

Interventions in marketing should focus on following issues:

- a) promoting a commercial potato (i.e. marketable and storable) that responds to urban consumer demand in order to reach an immediate potential market share of 5%; this potato could also strengthen the position of Rwanda in the export market. Developing such a potato requires also interventions at farm level.
- b) promoting competition in order to change market structure and conduct, and thus efficiency.

Export markets

In Uganda and Tanzania, urban demand for crisps and chips is growing rapidly. Specific potato varieties and quality (high dry-matter content) are required for this segment: *Victoria*, *Kerr's Pink*, *Sangema*, etc. Rwanda is not producing potatoes for this segment in sufficient quantities to develop high value-added export channels. Cooperatives (e.g. COODAF) could take the initiative to produce these quantities, using outgrowers. A second requirement is to establish networks of brokers and wholesalers in these export markets.

Burundi is an important growth market for Rwandan exporters as there are no competitors. The market could expand from 6,000 tonnes in 2000 to at least 30,000 tonnes in 2020. Between the border towns Goma and Gisenyi, seasonal exchanges take place in function of local shortages. Other potential niche-markets, where Rwandan traders can compete with DRC-traders, are the Congolese cities of Bukavu, Kinshasa and Mbuyi-Mayi. For these markets a more commercial potato is required. Most of these supply chains can only be developed under conditions of civil calm. .

4. Seed sector

The Rwandan national seed program focused in the past on: a) the selection and multiplication of varieties resistant to late blight and bacterial wilt; b) the production and diffusion of healthy pre-base seed of improved varieties in good pre-sprouted condition. Government did not aim to establish a sophisticated seed certification program. The strategy was successful in the past, as average yields rose from 4 tonnes per ha in the 1960s to 7 tonnes per ha in the 1980s. Since the 1980s, yields have stagnated. New varieties alone will not again result in a yield increment without accompanying measures (fertiliser, pesticides). A more comprehensive strategy will be required in the future.

The Rwandan seed programme shares following constraints common to other developing countries: low agricultural research budgets, low staff pay, research budgets skewed towards salaries. Since 1972, ISAR has had a mandate and monopoly to screen imported clonal material, to select varieties, and to produce pre-basic seed potatoes. Since 1979, PNAP (National Program for Potato Improvement), a section of ISAR, has been responsible for the potato sector. During the period 1994-2000, PNAP (was not able to produce any significant quantity of pre-basic seed potatoes.

Since 1998, ASSR (*Intervention d'Appui au Secteur Semencier du Rwanda*) has been responsible for the production of basic seed. In 2000, ASSR distributed approximately 900 tonnes of basic seed potatoes , of which approximately 30% was used as pre-basic seed. Directly or indirectly, Government or donors financed approximately 65% of effective demand, via MINAGRI, development projects, NGOs etc. The private sector was buying approximately 7%. Farmers are very interested in new seed, but commercial demand is limited to donor financing due to a lack of purchasing power. Effective demand from farmers on a cash basis is very limited. ASSR is using a network of farmers' associations and cooperatives for its commercial seed multiplication. These organisations buy basic seed potatoes from ASSR and, after multiplication, distribute commercial seed to farmers on credit.

Rwanda has a regional comparative advantage in the production of seed potato. Rapid multiplication in order to reduce the number of field-based generations is required.

5. Growth path: 3 phases

The main conclusion of the above analysis is that Rwanda has a long-term comparative advantage in eating-potato and seed-potato production. However, the potato sector has several fundamental constraints :

1. The quality (variety, standardized product, dry-matter content, marketability) of Irish potatoes in Rwanda does not correspond to minimal commercial requirements for a premium-market segment or for formal exports;
2. Market collusion at wholesale and retail level results in high consumer prices and relatively low consumption;
3. Urban consumers are not familiar with grading on the basis of quality.

An action plan, consisting of three phases is proposed. Targets and timing are summarized in table 0.3. Output growth rates are: 11% during phase I, 16% during phase II, and 5% during phase III. Expansion of area is 3% per annum during the period 2002-2020. Yields rise from 6.9-7.9 tonnes per ha in 2002 to 15.7-18.7 tonnes per ha in 2020.

PHASE I (2002-2004): During the first two years, the components of the strategy are put into place. The strategy gains momentum with a growth rate of 11% per year in 2003-2004. Crucial measures are the following:

- At farm level, productivity (tonne/ha) should increase with demonstrations of fertiliser, seed potato, pesticides and lime, combined with seasonal credit. A yield increase up to about 8.0-9.2 tonnes/ha in 2004 should be targeted. The interventions should first target the volcanic soils of the northwest, and then expand further to Byumba, Gishwati Forest and the Congo/Nile Divide.
- A market segment of more commercial potato varieties (in terms of storability and marketability) should be developed and strengthened, step-by-step. First, extension of harvest and post-harvest technology is required. Cooperatives should establish outgrowers schemes. Tenders with public funds (hospitals, army, university) could contribute to developing this market channel (by requiring specific varieties and quality) (details: section 6.3). The export-quality segment can be developed independently from the premier-quality segment. Publicity and advertisements are required to improve visibility of “premier-quality” potato.
- The seed-potato sector should produce sufficient seed tubers of commercial varieties, as well as “food-security” varieties for rural consumption.
- Donors, cooperatives and government should establish partnerships to implement the strategy.
- Government should oversee:
 - interventions to enhance competition in Rwandan potato markets;
 - the preparation of investments in a national potato wholesale market in Kigali.
 - pilot projects in export markets (Burundi, Tanzania, Uganda).
- At the policy level, government should undertake strategic planning for the ware- and seed-potato sectors, including systematic analysis of comparative advantage, and take steps to ensure the future of Gishwati forest.

PHASE II (2005-2008): A very high growth rate is assumed (16%) during a 4-year period. The interventions, started during phase I, would now have their full impact and are reinforced:

- Expansion of intensification efforts at farm level to medium-potential areas. In areas with acid soils, higher yields will require a massive use of lime or travertine. Government should consider subsidies on the production and transport of these alkaline inputs as part of anti-poverty measures. Expansion to lowlands might be worthwhile but requires further analysis.
- New wholesale markets should become operational.
- Strong growth in export markets of ware and seed potato.
- Potato processing: the private sector plays a leading role in investment. Donor subsidies may be necessary. Government would complement private-sector activity to ensure rapid growth (tax holidays, etc.).

PHASE III (2009-2020): Consolidation of the previous interventions. A slower growth rate (5%), but still higher than the population growth rate is expected.

Table 0.3: Growth path for the Rwandan potato sector (2002-2020)

Period	Minimum			Maximum		
	Production (tonnes)	Acreage (hectares)	Yield (t/ha)	Production (tonnes)	Acreage (hectares)	Yield (t/ha)
2002	550,000	80,000	6.9	730,000	92,000	7.9
2008	1,226,989	95,524	12.9	1,628,549	109,853	14.8
2020	2,203,496	136,195	15.7	2,924,640	156,624	18.7
2020 ware-potato	1,762,797			2,339,712		
<u>Growth rate</u> <u>2002-2020</u>	+201%	+70%	+135%	+201%	+70%	+135%
<u>Annual growth</u> <u>rates</u>						
2003-2004	11%	3%	7.8%	11%	3%	7.8%
2005-2008	16%	3%	11.7%	16%	3%	11.7%
2009-2020	5%	3%	1.0%	5%	3%	1.0%

INTRODUCTION

Rwanda is the most densely populated country in sub-Saharan Africa and has one of the fastest population growth rates in the world. Yet, its economy is mainly based on peasant farming, with an average farm size of approximately 0.71 hectares. Only 10% of the population lives in urban areas, an extremely low level by African standards. Exports of tea and coffee are the main sources of the country's modest foreign exchange earnings. Gross National Product is currently estimated at US\$ 260 per capita. Poverty, which is mainly a rural phenomenon, is widespread. During the next few decades, Rwandan agriculture must grow substantially faster than population to have significant positive effects on rural poverty. For Rwanda, that means emphasis on coffee and tea, on Irish potato and on horticulture.

Irish potato production can grow quickly because the response to fertilizer is startlingly high and some farmers already have knowledge of fertilizer (Mellor, 2001a). The requirements for such rapid growth are: (i) technological change that increases yields of crops; (ii) exports that will allow production to grow faster than domestic demand; (iii) low transaction costs and efficient domestic markets. Increased production without increased marketing and transformation will allow prices to slump. The goals of this study are indicate how Rwanda may improve the performance of existing markets, find new markets, reduce losses in storage and transport, explore the possibilities for profitable processing, and develop public policy to facilitate the realisation of these market improvements.

The study looks at potato consumption, production and marketing (chapters 1, 2 & 3). A brief review is made of production issues that are relevant to marketing. The poor economic performance in marketing is partially caused by the structure of potato production. Chapter 4 analyses the seed-potato sector. Recommendations for private sector and public-sector policies and strategies are presented in chapter 5.

In parallel with the research in Rwanda, a FOODNET² team (Obokoi Geoffrey, Phemba Phizo) researched potato production and marketing in Uganda, Kenya, Tanzania, Congo and Burundi. These market studies – first presented at a MINAGRI workshop held in Kigali on 2nd November 2001 where the findings of the current study were also presented for the first time – were used to evaluate Rwanda's export possibilities for Irish potato.

During the field research in Rwanda, the author gratefully received assistance from ISAR/PNAP researchers, Senkesha Ntizo, Eugène Gashabuka and Jacqueline Tuyisenge, and from staff members of MINAGRI's Department of Extension and Marketing, particularly Octave Semwaga and Damien Byandagara.

² FOODNET is a regional research organisation based in Kampala, Uganda, focussing on post-harvest value added to agricultural commodities. The current study and those conducted by FOODNET researchers in other countries in the region had their origin in collaborative planning between FOODNET and Abt Associates Inc., which both receive finance from the US Agency for International Development.

CHAPTER I: CONSUMER DEMAND

1.1 Potato demand

During the period 1985/86 – 2000, Irish potato consumption in Rwanda increased from 241,000 tonnes to 603,000 tonnes³: consumption per person rose +90%, while Rwanda's population rose +38% to 8.34 million (DS/MINECOFIN, 2001). In 2000, approximately 20% of production was consumed in urban centres, compared to 28% in 1985/86. In the past, potato growers mainly considered potatoes a cash crop to earn money to buy preferred foods and manufactured goods. During the last decades, home-consumption in rural areas has increased in relative terms, indicating a growing role as food-security crop.

Annual per capita consumption of Irish potatoes increased sharply from 40 kg in 1985/86 to 76 kg in 2000 (DS/MINECOFIN, 2001). In 1978, per capita consumption⁴ was estimated at 35 kg⁵ per year in 1978, compared to 45 kg⁶ in 1983. Scott's (1988) "best estimate" was an average per capita consumption levels were between 50 kg and 60 kg in 1987. These national averages are rough estimates and mask highly differentiated regional consumption patterns.

In calorie terms, the Rwandan diet⁷ consists of beans (22.3%), sweet potatoes (21.6%), manioc (14.2%), bananas (14.1%), Irish potato (11.9%) and maize (8.6%) (PASAR, 2001). Secondary calorie sources include sorghum, peas, yams, rice and vegetables. The consumption varies by region and season.

Table 1.1: Urban and rural potato consumption trends (1985-2000)

	Kg/person		thousand tonnes	
	1985/86	2000	1985/86	2000
Urban	113	141	68	118
Rural	32	68	173	484
Total	40	76	241	603

Source: DS/MINECOFIN (1988; HLCS/EICV 2000: preliminary data)

³ HLCS/EICV, 2000; preliminary results

⁴ Food Balance Sheet method: national production minus 20% for seed and marketing losses, divided by the population.

⁵ Dürr (1983)

⁶ FAO (1979)

⁷ 100% = total food crop production

1.2 Rural potato consumption

Rural potato consumption reflects the distribution of production. The population can be classified in three groups, by zone. In the first group, located in northwest Rwanda, potatoes are planted and harvested on a nearly continuous basis and therefore potatoes assume the role of a basic staple (Table 1.2). Average per capita consumption in the provinces of Ruhengeri and Gisenyi is respectively 136 kg and 216 kg (DS/MINECOFIN, 2001). Estimates for producing households are even higher: 174 kg in the Kigombe District in Ruhengeri and 429 kg for the Giciye Commune of Gisenyi (CIP, 2001). Potato consumption of non-producing households in the volcanic region is higher than that of growers in other regions (Scott, 1988) because the rural potato trade between producing and non-producing households in northwest Rwanda is dynamic.

In the second group, more potatoes are eaten during and after the main harvest because of the bimodal production pattern and the inability of most growers to store potatoes for extended periods of time (Scott, 1988). In Byumba, Gikongoro and Kibuye Provinces, Irish potatoes have a prominent role in the diet together with maize, sweet potato and beans. Average per capita consumption varies between 65 kg and 94 kg.

In the third group, in the non-producing areas (Butare, Cyangugu, Kibungo, Umutara and Gitarama), high market prices discourage rural consumers from buying significant quantities of potatoes. Per capita potato-consumption is about 25 kg per year on average, except for Gitarama (45 kg/year) where prices are lower.

Income elasticity of Irish potato is 1.45 in rural areas (Table 1.6). Three per cent rural income growth will lead to 4.5% increase of potato consumption. Future demand potential is high as 90% of all households still live in rural areas.

Table 1.2: Rural potato consumption in 2000 (kg/person)

Province	Kg/person/year	Province	Kg/person/year
Gisenyi	216,2	Gitarama	45,0
Ruhengeri	136,1	Umutara	30,0
Kibuye	94,3	Butare	24,6
Byumba	79,3	Cyangugu	21,3
Gikongoro	65,6	Kibungo	20,0
Kigali Rural	46,2		

Source: DS/MINECOFIN; HLCS/EICV, preliminary data, 2001

1.3 Urban potato consumption

Capacity of urban demand

In urban centres, consumption of Irish potato is unusually high compared to other urban centres in Sub-Saharan Africa. Urban consumption can be estimated at approximately 118,000 tonnes per year in 2000 (HLCS-survey), compared to 68,000 tonnes in 1985/86: per capita consumption rose +25%, while urban population rose approximately +38% during this period. Urban consumption is highest in population centres situated in the major production zones: Ruhengeri town (252 kg/person), Gisenyi town (183 kg/person), Byumba town (171 kg/person), Kibuye urban (169 kg/person). The

most important demand centre is Kigali, with a consumption of 142 kg/person and a total annual demand of 84,000 tonnes per year or 71% of total urban demand. Approximately 15% is consumed in urban centres situated in the major production zones, 14% in urban centres of southern and eastern Rwanda (Table 1.3).

Table 1.3: Urban potato consumption in 2000 (kg/person)

Urban centre	Potato consumption per person (kg/year)	Population	Total urban consumption (tonnes)
Kigali	142	592,473	84,138
Butare	75	35,237	2,630
Byumba	171	12,518	2,141
Cyangugu	51	18,266	931
Gikongoro	89	10,287	918
Gisenyi	183	40,515	7,401
Gitarama	96	24,953	2,393
Kibungo	115	22,394	2,578
Kibuye	169	9,965	1,683
Kigali-Ngali	145	29,726	4,316
Ruhengeri	252	34,161	8,605
Umutara	115	4,778	550
Total	142	835,273	118,284

Source: DS/MINECOFIN (HLCS/EIBC 2000; preliminary results)

Urban consumption trends

Table 1.4 shows urban consumption and price trends. In decreasing order of importance, the urban diet is based on Irish potato, cooking banana, beans, sweet potato, rice and bread.

Over the period 1985-2000, consumption of bread, rice and Irish potato rose sharply. Real prices of Irish potato and rice decreased approximately 33%, and the price of bread by as much as 75%. All three of these food items have an income-elasticity between 1.25 and 1.89 (Table 1.6). This means that, as incomes rise, consumption of these items will rise more quickly. During the 1970s and 1980s, potatoes were considered a high-status food in most urban areas. Income elasticity of Irish potato is 1.25 in urban areas. Three percent income growth leads to 3.75% consumption growth.

Rwandan per capita consumption of “traditional” food staples (sweet potatoes, beans, cassava, maize and sorghum) decreased between 1985 and 2000. Prices of cooking banana, maize and manioc increased in real terms, which contributed to lower demand. Sorghum, beans and sweet potato have an income elasticity of less than unity. They are inferior goods for urban consumers: higher urban income leads to lower consumption.

Table 1.5 looks at consumption per income quintile⁸. Sweet potato, beans and cassava are inferior goods, with decreasing consumption in quintile 5. Irish potato and banana are normal goods.

Table 1.4: Urban consumption and price trends (1985 – 2000)

	Consumption 2000 (kg/person)	Consumption change (1985-2000)	Price change (1985-2000)
Irish potato	141.3	+25%	-34%
Rice	23.9	+152%	-33%
Bread	17.9	+661%	-74%
Cooking banana	37.1	-19%	+14%
Sorghum	6.5	-26%	+12%
Maize	0.8	-86%	+2%
Manioc	4.6	-83%	+23%
Beans	35.9	-17%	-43%
Sweet potato	28.8	-33%	-28%

Source: DS/MINECOFIN (1988; HLCS/EIBC 2000, preliminary results)

Table 1.5: Average consumption per adult-equivalent⁹ (2000, kg/year)

	Irish potato	Sweet potato	Cooking banana	Dry beans
Quintile 1	39	99	7	25
Quintile 2	66	163	19	42
Quintile 3	84	174	35	55
Quintile 4	111	191	55	70
Quintile 5	162	113	75	63
Average	95	149	40	52

Source: DS/MINECOFIN (HLCS/EIBC 2000, preliminary results)

Table 1.6: Income elasticities

	Rural area	Urban area	Rwanda
Irish potato	1.45	1.25	1.43
Rice	1.78	1.64	1.77
Bread	.	1.89	1.89
Banana	0.77	0.70	0.76
Sorghum	0.65	0.40	0.63
Manioc	0.42	0.67	0.45
Beans	0.63	0.40	0.61
Sweet potato	0.14	0.14	0.14

Source: DS/MINECOFIN (1988)

⁸ “Quintile 1” is the 20% of the population with the lowest incomes; “quintile 5” is the 20% of the population with the highest incomes.

⁹ 1 adult-equivalent = 0.9 person

1.4 Consumer preferences

Rural consumers

In potato-producing areas, the dominant mode of consumption is “boiled potato”. Therefore, consumers prefer a potato that is “floury”. “Watery” potatoes are considered as low-quality, because they have a tendency to crack or to decompose in preparation. Small tubers are often used as seed and large tubers are sold to traders, so that medium-size tubers are consumed within the household. Urban consumers are not interested in the variety *Cruza*, because of its poor cooking qualities and a purple ring in the flesh. Consequently, the variety is only sold in local rural markets and only consumed in production zones.

In non-producing rural areas, large and floury tubers are preferred (Table 1.7). *Gahinga* and *Sangema* are popular varieties.

Chips (i.e. French fries) are less popular in rural areas as their preparation is more expensive because cooking oil is required. Crisps are not available.

Urban consumers

Urban consumers do not have rigid tuber-quality preferences, except tuber size and eye depth, because consumption of chips is relatively important. Rwandan potatoes are generally not very suitable for deep-frying because of their low dry-matter content. Unfortunately, a high dry-matter content is not a visible characteristic, except when the skin is damaged. A damaged skin is very frequent in urban markets, but appears not to be perceived as a quality criterion.

Most urban consumers have had bad experiences with storing Irish potatoes, but do not know where to find a better-quality potato. The average potato cannot be stored more than 1 week without noticeable quality loss.

Round, oblong and oval shaped potatoes are equally acceptable by most urban consumers. Hotels and restaurants prefer oblong tubers (Munyemana et al., 1999), for example the varieties *Sangema* and *Gahinga*. According to Scott (1988), skin color and shape were of minor importance to most urban consumers. Consequently, there were no price differentials between red-skinned versus white-skinned potatoes. However, today, red potatoes (often referred to as “*Sangema*”) are preferred.

The market for crisps and snacks on the basis of potato (HQS, 2001) is not very developed in Rwanda, though in most African cities, this market segment is rapidly growing.

Grading

Only a rudimentary grading exists in Rwandan urban centres. In October 2001, potatoes were sold for 40 Frw/kg in all retail markets. The client did not have a choice: only the average standard potato was available. The only exception was the central market of Kigali City where large-size tubers were sold at a premium price of 45 Frw/kg. Retailers in the central market buy potatoes in the Nyabugogo wholesale market and organise minimal grading. Only tuber size is a criterion, not skin damage. In other retail markets no grading whatsoever is done. Sometime, consumers refuse to accept small potatoes. They are sold afterwards at a lower price (35 Frw/kg, the

purchase price). Supermarkets and stores in Kigali generally do not sell potatoes. Only the FRULEX store is selling large potatoes (for 65 Frw/kg), after doing its own grading.

In the central market, *Sangema* potatoes from Masisi (DRC) with a high dry-mass content are sold at a price of 45 Frw/kg, compared to 40 Frw/kg for Rwandan potatoes. In Gisenyi, Masisi potatoes are also considered as premium potatoes and sell at a higher price. Farmers in Masisi can only sell potatoes with a high dry-matter content because of the bad transport conditions: “watery” potatoes would have rotted before arriving in Rwanda.

Table 1.7: Factors determining consumers’ preferences

Characteristics	Urban consumers	Consumers in production areas	Consumers in regions that do not produce	Varieties
Tuber size	43%	20%	65%	<i>Gahinga, Sangema</i>
“Floury” tuber	9%	40%	15%	<i>Montsama, Bufumbira, Sangema, Cruza</i>
Cooking quality (boiling)	12%	21%	9%	<i>Sangema, Montsama, Petero</i>
Oblong shape	7%	2%	0%	<i>Gahinga, Gasore, Sangema</i>
Skin colour	3%	15%	8%	<i>Cruza, Montsama</i>
Modest-sized eye	20%	2%	3%	<i>Kinigi</i>
Total	100%	100%	100%	

Source: Munyemana and von Oppen (1999)

1.5 Future demand and opportunities

Volume of demand

Table 1.8 shows key elements of future demand. Demand for Rwandan eating-potatoes during the next decades will grow, because:

- f) total population is expected to double by 2020 (from 8.3 million in 2000 to 16.7 million by 2020);
- g) the urbanisation rate is still low, but urban population is expected to grow more rapidly than total population and, as shown above, urban potato consumption is higher than rural consumption; an urbanisation rate of 30% in 2020, compared to 10% in 2000, will lead to a demand increase of 18%;
- h) income growth leads to higher potato consumption, both in rural and urban areas (short-term income elasticity: rural 1.45 and urban 1.25); Government’s two main growth targets (Vision 2000) are: a) increasing GDP per capita to US\$960 (currently US\$260); b) reducing the percentage of the population who live below the poverty line to 25% (currently 64%). Three percent income growth will lead to 4.3% growth of potato consumption;
- i) Northwest Rwanda has a comparative advantage for potato production in the region, which will lead to higher export demand (see: chapter III).

Demand for Irish potatoes will therefore increase much faster than total food demand during the next 20 years: at least by +200-250% by 2020, or from 603,000 tonnes to 1.8 million – 2.1 million tonnes of ware potatoes (ware + seed: between 2.2 million and 2.6 million tonnes). Given the high income-elasticity, future growth could even be higher if Government growth targets are achieved.

Table 1.8: Future demand for Rwandan potatoes

	2000	2020	Growth as percent of present consumption
<u>Population effect</u>			
Population	8.3 million	16.7 million	+100%
<u>Urbanisation effect</u>			
Urbanisation rate	10%	30%	
Average national per capita consumption	76 kg/capita	90 kg/capita	+18%
<u>Total population and urbanisation effect</u>			+137%
<u>Income effect</u>			
GDP per capita	260 US\$	960 US\$	1% income growth leads to 1.43% demand growth (short-term income elasticity)
Export markets	6,000 tonnes	100,000 tonnes	(Conservative estimation) +17%
<u>Total demand growth</u>			At least: +200-250%

Source: own calculations

Demand for quality

At the moment, only an average standard potato (40-45 Frw/kg) is available in the Kigali market, and there are some very minor tendencies to grade. Clear indications exist that some consumers are not satisfied with present quality differentiation, or with quality (commercial varieties, storability and dry-matter content) of the ware potato. There exists a market potential for a more commercial potato that responds to consumer demand. According to most elderly traders, this market segment existed in the past and is still often referred to by retailers as “*Sangema*” or “quality potato”. There is a potential to redevelop this market segment, which will be referred to as “premier-quality” potato in this document (details: see chapter V).

There is a potential for shifting the demand schedule with higher quality potatoes. Table 1.9 presents current, as well as four potential, market segments that could be developed in the near future given the present context: export-quality, premier-quality, average quality (large and medium-size tubers), and small tubers.

The market segment of export-quality is being developed by Volcano Potato Inc. in close collaboration with the business development project, ADAR. Potential clients are supermarkets, hotels, restaurants, export markets. Improved bamboo packaging material will be used (see also chapter V).

Table 1.9: Current and potential market segments

Current market segments			Potential market segments		
Market share	Quality category	Retail price Frw/kg	Market share	Quality category	Retail price (Frw/kg)
>1%	Masisi potato	50	1%	Export quality	80-100
92-94%	Average	(Central Market) 45 (other markets) 40	5-10%	Premier quality	50-65
			80%	Standard Quality	40-45
5-7%	Small tubers	30-35	10%	Small-size tubers	35
Weighted average		40.5	Weighted average		43

CHAPTER II: DETERMINANTS OF POTATO SUPPLY

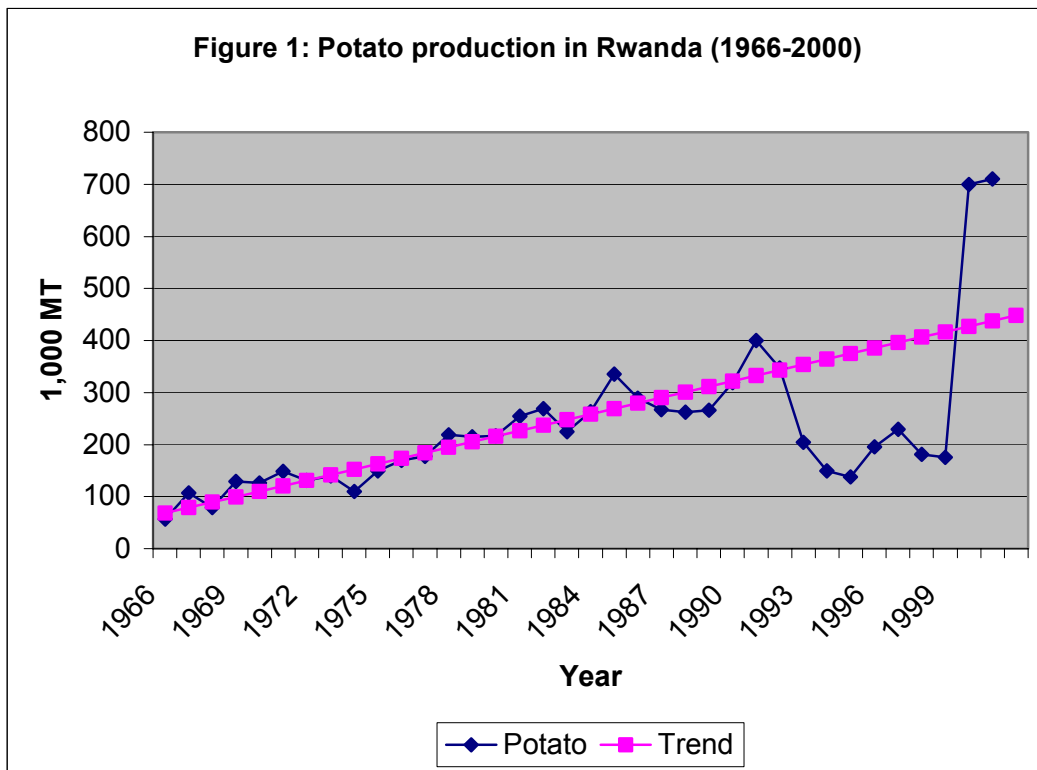
2.1 Production, yields, area

Potato production trends

During the period 1964-1992, Irish potato production rose steadily from 34,000 tonnes to 347,000 tonnes (Figure 1), and potato became a staple food in Rwanda. The average production growth rate during this period was 5.2% per year, or almost twice the population growth rate. Between 1992 and 1999, the upward trend was interrupted because of civil unrest and war. Potato production dropped to approximately 150,000 tonnes in 1994-1995 and picked up slightly in 1996 and 1997. In 1998/99, civil unrest (“*les infiltrés*”) in north-western provinces again affected potato production heavily. Farmers stopped cultivating fields and lost their stocks of seed potatoes. Since 1999, cultivated acreage has again been expanding rapidly and new record harvests have been obtained.

There are wildly differing estimates of production for 2000 (appendix I):

- 954,000 tonnes (MINAGRI/PASAR, pre-harvest crop assessments);
- 320,149 tonnes (MINAGRI/FSRP), survey with a sample of 1,584 households);
- On the basis of preliminary results from the HLCS/EICU survey (6,000 households) (DS/MINECOFIN) Rwandan potato production was estimated at 730,000 tonnes of which 130,000 tonnes of seed potatoes and 603,000 tonnes of ware-potatoes (figure 1; data in appendix VI).



The following factors contributed to the strong recovery in 2000:

- (i) an expansion of acreage sown to Irish potato as a reaction to record market prices in 1998-1999 (see: appendices 1 & 6);
- (ii) Irish potato is the most profitable cash crop in the volcanic highlands of north-western Rwanda; all alternative cash crops, including coffee, face historically low market prices; the wheat market collapsed and the pyrethrum factory was closed down (but reopened recently);
- (iii) favourable meteorological conditions (good rains);
- (iv) renewed distribution of seed potatoes by development and aid programs during the post-war phase;
- (v) privatisation of fertiliser markets in 2000;
- (vi) 10,000 hectares of Gishwati Forest were deforested and allocated to potato cultivation, leading to an additional output estimated at 160,000 tonnes (2 harvests annually);
- (vii) expansion of potato cultivation in non-traditional zones.

The sharp expansion of output in 2000-2001 caused depressed market prices. Farmers might react by reducing plantings in 2002 if these low prices persist and other crops (i.e. pyrethrum, beans, coffee) become relatively more profitable. Low prices for alternative crops still favour of potato cultivation, except for pyrethrum in Ruhengeri, where the pyrethrum factory has been privatised. Pyrethrum and Irish potato are substitutes in farming systems of northwest Rwanda. In 2001, acreage attributed to pyrethrum is again expanding again in Ruhengeri Province.

Location of production zones

Approximately 85-90% of Rwandan potato production is traditionally concentrated in three zones: 60-65% on the volcanic soils in North-western Rwanda (the provinces of Ruhengeri and Gisenyi); 15-20% in the highlands of the Congo/Nile Divide (Kibuye, Gikongoro); 10% in Byumba province. The provinces of Kibungo and Kigali-Rural each contribute 3-4%, Butare 2%, Umutara 1%, Gitarama and Cyangugu less than 1% (Table 2.1).

The provinces Ruhengeri and Gisenyi are particularly favourable for potato cultivation due to deep volcanic soils, abundant rainfall, high altitudes, mild temperatures and low pressure from diseases. Precipitation occurs throughout the year allowing continuous cultivation. In Ruhengeri, potato production is mainly situated in the northern districts of Bukamba, Kinigi, Buhoma, and Mutobo. In the Buberka Highlands (Western Ruhengeri) and Southern Ruhengeri, potato cultivation is less important. In Gisenyi province, potato production is mainly situated in the volcanic northern communities and Gishwati Forest. In these areas potatoes are found on nearly every farm. They are the most important food and cash crop.

In Kibuye and Gikongoro provinces, potato production is concentrated at higher altitudes. The Congo/Nile Divide is dominated by acidic, degraded soils allowing cultivation of the variety *Cruza* for home-consumption and local markets, but not for marketing to urban centres. Without massive use of fertilizer, lime and more market-oriented potato varieties, potato growth potential is limited to that required by local demand. Previous efforts to select and introduce new varieties on these soils have failed. The Congo/Nile Divide was more important as a potato producing and exporting area in the 1970s and

early 1980s. Gikongoro is the only province where potato area has decreased during the period 1979-2000.

Potato production has recently been increasing in the mid-altitude zones, particularly in marginal areas in the south and east (Kigali Rural, Kibungo, Umutara) as a poverty-reduction strategy for households. Potatoes are mainly produced for home consumption. Small harvest surpluses are sold in local markets, as prices are high in non-traditional production areas.

Table 2.1: Cultivated area for potato, by province, in 1979 and 2000

Year	1979	2000	2000	2000	2000
	Cultivated area for potato (ha)	Cultivated area for potato (ha)	Total areas under cultivation (ha)	Area for potato per province as % of total cultivated lands	Share of potato in total cultivated lands per province (%)
Ruhengeri	10,100	25,233	149,348	31.5	16.9
Gisenyi	7,600	24,290	152,380	30.3	15.9
Kibuye	2,900	9,200	105,662	11.5	8.7
Byumba	4,400	8,161	171,736	10.2	4.7
Gikongoro	5,400	4,440	160,222	5.5	2.8
Kigali Rural	1,900	3,169	242,684	4.0	1.3
Umutara		866	66,613	1.1	1.3
Butare	300	1,563	152,473	1.9	1.0
Kibungo	1,200	3,045	377,402	3.8	0.8
Cyangugu	500	58	75,194	0.1	0.1
Gitarama	500	72	237,296	0.1	0.0
Total	34,800	80,097	1,151,662	100.0	6.9

Source: DSA/MINAGRI, 2001

Area

The potato output growth from 1966 to 1980 was partly attributable to an expansion of acreage from 18,000 ha to 40,000 ha. During the 1980s, the area stagnated at around 40,000 ha. By the early 1990s, nearly 50,000 ha were being cultivated. During the war in 1997-98, the area dropped to approximately 30,000 ha, as potato-producing areas were affected by civil unrest and war, and farmers temporarily abandoned their fields. In 2000, approximately 90,000 ha (2 harvests annually) were cultivated, with an average yield of 7.9 tonnes per hectare. Estimates differ wildly¹⁰, but they all assume a significant expansion. The strong area expansion in 2000 is based on:

- an expansion in non-traditional production areas;
- new forest land (Gishwati forest) taken into production (10,000 ha, 2 harvests annually);
- a lack of respect for crop rotation and even an evolution towards monocropping, as potatoes replace other crops in the north-western production zones.

There is some evidence that the 2000-2001 expansion is a cyclical peak.

¹⁰ Estimate on the basis of a production of 730,000 tonnes (derived from HLCS-survey). PASAR assumes an average yield of 8 tonnes per hectare and 108,000 hectares (over two seasons + dry season cultivation) in 2000. FSRP assumes 79,130 hectares and an average yield of 4 tonnes per hectare in 2000.

Yields

Average yields rose from 4 tonnes/ha in the 1960s to 7 tonnes/ha in the 1970s, as improved varieties were successfully introduced. The average yield fell back in the late 1970s and early 1980s because of the expansion of potato production to marginal areas (Munyemana and von Oppen, 1999). They rose again in the late 1980s to nearly 8 tonnes/ha as results of public investments in the sector. The activities of PNAP¹¹ resulted in an increasing number of farmers with access to improved seed to replace old, degenerated varieties. During the war and civil unrest, national average yields dropped as areas with the highest yields were negatively affected. However, they have recovered rapidly since 2000. Yields are estimated to be approximately 8 tonnes per hectare, because recent area expansion took place on volcanic soils and deforested land. (The reader should bear in mind that average yield estimates are very rough estimates.)

Average Rwandan potato yields still remain amongst the lowest in the world. On-farm yields range between 5 to 20 tonnes per hectare. Most varieties have a potential yield of 20-30 tonnes per hectare under good crop-husbandry conditions. Without the use of external inputs, factors determining yield are mainly natural soil fertility and climatic conditions. Highest yields are obtained in Gisenyi and Ruhengeri Provinces (8-15 tonnes per hectare). On acidic soils in Gikongoro, Kibuye, Byumba, and in the lowlands, yields of 5-6 tonnes are obtained without lime and fertiliser application.

The sub-optimal yields are caused by:

- late blight and bacterial wilt;
- low use of pesticides and fertilizer;
- seed degeneration by viruses and micoplasmas;
- inadequately sprouted seed tubers at planting; traditional seed-storage technology is abandoned;
- lack of knowledge about good cultural practices and inadequate extension programmes.

Sources of growth

The 251% growth in potato output during the period 1966-1990 is mainly attributable to an expansion of cultivated area (+151%) (Table 2.2). Government extension efforts to introduce Irish potato into farming systems were successful. A yield increase from 4-5 tonnes per hectare in the 1960s to 7 tons in the 1980s (+40%) is mainly based on a renewal of varieties (Monares, 1984). A limited use of fertilisers and pesticides also contributed to this increase. The use of the fungicide *dithane* against late blight was a partial success. Other pesticides are not used.

During the 1990s, output growth (+122%) was mostly based on expansion of acreage cultivated (+100%): the deforestation of Gishwati Forest (10,000 hectares, 2 harvests per year); expansion of lowland cultivation of potatoes; and the tendency towards mono-cropping in Ruhengeri and Gisenyi. Yield increases only contributed to a minor degree (+11%). New varieties and seed potatoes contributed to maintaining prevailing yields but not to further improvements. Average fertiliser use for potato cultivation

¹¹ “Programme National d’Appui à la Pomme de Terre”, established in 1979, as department of ISAR (National Agricultural Research Institute).

increased by only 2,000 tonnes between 1992 and 2000. The incremental yield due to fertilizer amounts approximately to 30,000 tonnes of potatoes (+11%).

The acreage expansion since 1990 is not fully sustainable for three reasons. Firstly, at low altitudes, yields are at an acceptable level during the first years of potato cultivation, but may drop after 3-4 years because of soil contamination with bacterial wilt and degraded seed as farmers recycle. Lowland farmers do not have access to healthy seed tubers or pesticides, as specific input channels are not developed in these regions. Secondly, after deforestation, soil fertility decreases rapidly without appropriate measures (fertiliser, compost, manure, lime). Thirdly, abandoning rotation can result in a rapid decrease of soil fertility, erosion and bacterial wilt. The strong expansion in 2000 and 2001 could be a cyclical peak.

Table 2.2: Sources of potato output growth

Period	Area	Yield	Total output
1966/68 – 1988/90	+151%	+40%	+251%
1988/90 – 2000	+100%	+11%	+122%

Source: own calculations (data in appendix VI)

Growing seasons and rainfall dependence

Production seasons show slight differences between provinces, due to climatic particularities. Potatoes are planted throughout the year in two major and two minor crop seasons. Season A runs from September to January/February and Season B extends from March to August. Season A potatoes are harvested in December-January and those for season B are harvested in June-July. A dry-season production (Season C) is harvested in September-October. The most important crop is cultivated in the dry season from May to September. A second major crop is grown from September to January. However, most small farmers in the volcanic regions are planting and harvesting potatoes throughout the year because of a shortage of land. Production is relatively low in January-February and May-June.

2.2 Production technology and crop husbandry

Farm characteristics

The average Rwandan farm size decreased from 1.0 ha in 1985 to 0.7 ha in 2000. In Ruhengeri and Gisenyi, current average farm sizes are 0.49 ha and 0.53 ha, respectively. The average potato plot is only 0.04 hectares, with provincial averages of 0.07 ha for Ruhengeri, 0.10 ha for Gisenyi and 0.05 ha for Kibuye. (MINAGRI, 2001)

Table 2.3: Farm characteristics in 2000, by province

Province	Percentage of rural households cultivating potatoes	Average farm size (ares)	Potato area per household (ares)		
			Season A	Season B	Average
Ruhengeri	48%	49	6	8	7
Gisenyi	55%	53	5	10	??8
Kibuye	40%	73	3	7	5
Byumba	45%	65	3	3	3
Gikongoro	32%	108	2	3	3
Kigali Rural	6%	77	1	1	1
Umutara	41%	59	1	1	1
Butare	20%	59	.	1	1
Kibungo	26%	110	1	1	1
Cyangugu	8%	37	.	0	0
Gitarama	5%	90	.	0	0
Total	31%	71	4	3	4

Source: FSRP, 2001

Table 2.4 looks at crop budgets for improved and traditional crop husbandry. Factors that influence the choice of production technology are: (i) meager financial resources; (ii) farmers' perception of modern inputs as prohibitively expensive.

The main inputs in traditional potato production are seed tubers and family labour. Use of purchased inputs, such as chemical fertilizers and pesticides is limited. However, the use of the fungicide dithane against late blight is more frequent than use of fertilizer. Gross revenue amounts to 180,000 Frw per hectare under traditional crop husbandry, compared to 400,000 Frw for improved cultivation. Cash expenditures vary between 40,000 Frw (traditional crop husbandry, own seed, own land) and 365,200 Frw (rented land, certified seed, hired labour). Most farmers produce their own seed and use their own land. It is evident that cash is a major constraint. Extension of innovative technology in the sector has to be combined with seasonal credit. Seeding rates are estimated at 1 to 2 tonnes per hectare, compared to an optimal rate of 2.5 tonnes. Certified or commercial seed is only used when it is combined with seasonal credit, provided by cooperatives or development projects. Farmers expect Government or development projects to provide them with inputs.

In the volcanic production zones, two categories of potato producers exist. First, progressive farmers, who rent land, cultivate one hectare or more of potatoes. They use fertilizer and dithane (against late blight) and produce for the market. Secondly, small farmers typically cultivate 50-70 ares, of which 15-35 ares of potatoes, and produce mainly for home-consumption but occasionally sell small surpluses. The acid soils of the Congo/Nile Divide are depleted. Farmers use small quantities of fertiliser and lime as they face a cash constraint. In Gikongoro, Byumba and Kibuye, 86% of all potato fields are planted with the variety *Cruza* for home-consumption. In the marginal potato areas (Kibungo, Kigali Rural), farmers generally plant 10-50 kg (1-3 ares) of seed potatoes. Fertilizers are not used. Late blight and bacterial wilt are widespread. Those who produce tomatoes sometimes use dithane against late blight. They retain their own seed tubers or buy ware potatoes in the market and use them as seed potatoes. Certified seeds are not available in the market. Yields vary widely but are low.

Table 2.4: Crop budget, improved and traditional crop husbandry (Ruhengeri Province)(2001 prices)

	Quantity	Price (Frw)	Value (Frw)
<u>A. Improved crop husbandry</u> (rented land, certified seed)			
Gross revenues	20,000 kg	20	400,000
Seed potatoes	2,000 kg	67	134,000
Rent land	1 ha	50,000	50,000
Labour		80,000	80,000
Fertiliser	300 kg	220	66,000
Pesticides (dithane)	20 kg	1,760	35,200
Total cash expenditures			365,200
Net margin			34,800
Net margin (own seed)			168,800
<u>B. Improved crop husbandry</u>			
Gross revenues	18,000 kg	20	360,000
Rent land	1 ha	50,000	50,000
Seed potatoes	2,000 kg	30	60,000
Labour		80,000	80,000
Fertiliser	300 kg	220	66,000
Pesticides (dithane)	20 kg	1,760	35,200
Total cash expenditures			291,200
Net margin			68,800
Net margin (own seed)			128,800
Net margin (own land, own seed)			178,800
<u>C. Traditional crop husbandry</u>			
Gross revenues	9,000 kg	20	180,000
Rent land	1 ha	50,000	50,000
Seed potatoes	2,000	30	60,000
Family labour			0
Fertiliser	100 kg	220	22,000
Pesticides	10 kg	1760	17,600
Total cash expenditures	Purchased seed		149,600
Net margin			30,400
Net margin (own seed)			90,400
Net margin (own land, own seed)			140,400

Source: Own calculations

Availability and use of fertilisers

Potato cultivation in Rwanda had a tradition of accompanying purchased-input use (Sperling, 1997) in the 1970s, 1980s and early 1990s, as inputs were subsidized and distributed by government and development programmes. Nevertheless, the total quantity of fertiliser used was never important. In November 1999, MINAGRI passed a Ministerial Decree banning the distribution of free or subsidized farm input. In April 2000, import duties and sales tax on fertilizer were eliminated.

Table 2.5 presents the relation between fertiliser imports and the incremental potato yield. Only after the liberalization of the fertilizer market, fertilizer use seems to be on the rise. Non-tea/coffee imports are estimated at 3,100 tonnes in 2000 and 12,104 tonnes in 2001. Assuming that 60% is used for potato production, the incremental potato yield is 27,000 tonnes in 2000 and 108,000 tonnes in 2001. The fertilizer price at farm level in Gisenyi and Ruhengeri is approximately 220 Frw per kg for NPK 17:17:17 and urea. A survey organised in the provinces of Gisenyi and Ruhengeri (Rucakibungo, 2001) indicates that the price of fertiliser is perceived as the main constraint. Availability is only a secondary constraint.

Table 2.5: Fertilizer imports and incremental potato yield (1995-2001)

	Imports (tonnes)	Fertiliser on potato (tonnes)	Incremental potato yield (tonnes)
1995	2,423		
1996	1,913		
1997	4,326		
1998	3,777		
1999	6,064		
2000	8,500	1,860	27,000
2001 (9 months)	8,400		
2001 (12 months: estimate)	16,919	7,262	108,000

Source: Cook (2001); Rucakibungo (2001)

Prevalence of disease and use of pesticides

The most devastating disease to Rwandan potato production is late blight (*Phytophthora Infestans*). Late blight is particularly disastrous during the rainy season. The use of *dithane* to counter this disease is widespread in the main production areas. Farmers recognize the need to use fungicides, but either cannot afford to do so or try to save money by spraying less often than recommended. Most farmers only use *dithane* when symptoms of the disease are visible, rather than spraying before the symptoms are visible.

The second most deadly disease is bacterial wilt (*Pseudomonas solanacearum*). Surveys done by CIP show that the incidence and severity of outbreaks are correlated with altitude. At altitudes of 1,500 to 2,100 m, bacterial wilt is most damaging. Above 2,100 m it becomes less severe and at 2,400 m it disappears. Major factors determining occurrence of bacterial wilt are climatic, particularly soil moisture and temperature, assuming clean seed is used. Clean seed and crop rotation are preventive measures for bacterial wilt. Crop rotation must be conducted over longer periods in areas with a

greater wilt risk. Bacterial wilt is the main constraint to potato cultivation in lower-altitude areas of Rwanda. Because conditions in these zones promote the spread of bacterial potato diseases, potato development programmes must include a component to combat disease (Kelly, 2001).

2.3 Farmers' versus urban consumers' criteria

Growing pressure on the average farm size and its financial viability as an economic unit has consequences for the peasant farmer's strategy. The present potato production-and-harvesting strategy is dominated by farmers' food-security constraints, while preferences of urban consumers do not play a role. Farmers plant potatoes twice or even three times a year and need sprouted seed as soon as possible after harvesting. Therefore short dormancy is required. Cash expenditures for pesticides and fertilizer are minimized, so that varietal resistance to late blight and tolerance to bacterial wilt is important. Harvesting takes place as a function of cash needs, not as a function of crop maturity. Premature harvesting is frequent and early maturing varieties are popular. The use of weighing scales for transactions with traders is widespread, so that farmers prefer to sell potatoes with high water content because they are heavier. However, a high dry-matter content is a basic quality indicator for a commercial potato and necessity to improve storability. The most popular varieties respond to farmers' requirements: a short dormancy period, resistance to late blight, tolerant to bacterial wilt. The dominant varieties at national level are: *Kirundo*, *Gasore* and *Mabondo*. *Cruza* is preferred on acid soils.

During the 1980s, market share of varieties with a commercial potential (*Sangema*, *Victoria*) was more widespread than in 2000. Since 1993, PNAP has introduced no new varieties. Farmers have lost good seed of varieties with good marketability characteristics such as *Sangema*. All efforts to supply farmers with seed tubers after the war were organised from a food-security viewpoint, rather than a commercial perspective.

At the moment, a response to the criteria of urban consumers, traders and exporters is totally absent at farm level. As a result of the present strategy, a potato of only average quality is produced, which cannot be stored nor exported. The marketing chain of Irish potatoes is in a vicious circle, with low-quality potatoes produced by farmers and sold by traders because "urban demand for quality does not exist" and consumers who "do not know where to find or how to recognize a quality (i.e. high dry-matter content) potato".

Table 2.6: Farmers' versus consumer criteria

<p>Current farmer-driven criteria</p> <ul style="list-style-type: none"> • High water content (weight) • Short seed dormancy • Continuous cultivation • Harvesting as a function of cash needs (premature) • Early-maturing varieties 	<p>Future needs of exporters, processors and urban consumers</p> <ul style="list-style-type: none"> • High dry-matter content • Storability • Long dormancy • Quality differentiation • Good preparation, cooking and taste qualities <p>Other market needs that are not met:</p> <ul style="list-style-type: none"> • Sufficiently firm to withstand handling • Marketability (including colour)
<p><u>Conclusion:</u></p> <ul style="list-style-type: none"> • No stimulus for farmers to improve quality • Food-security strategy has negative quality implications 	<p><u>Conclusion:</u></p> <ul style="list-style-type: none"> • Demand of urban consumers and exporters is not met

Some potato varieties

Kirundo has a good yield. Traders complain that quality decreases significantly even only one week after harvest and they avoid this variety.

Sangema has proven particularly popular because of its resistance to late blight and its large tubers, but is not resistant to late blight. Storability is good. Retailers and consumers know the name of the variety, as it was an important commercial variety before the war. At the moment, *Sangema* is also imported from Masisi (DRC). In Rwanda, the variety is mainly produced in Ruhengeri and Gisenyi but, according to farmers, seed tubers have degenerated. ASSR is not distributing *Sangema* because of its relatively low yield, so that its relative share has fallen. *Sangema* is considered as an old variety by ASSR.

Mahondo has good yields, a seed dormancy of 7-8 weeks, is resistant to late blight and tolerates bacterial wilt. These characteristics match perfectly with farmers' requirements. Storability is good, but not under traditional circumstances. ASSR abandoned the variety. It is, however, popular amongst producers for own-consumption and therefore widespread in the volcanic region.

Cruza is an early and high-yielding variety with poor cooking qualities (boiling and chips). It has a purple ring in the flesh with is unacceptable to the urban consumer. It is resistant to bacterial wilt and late blight and has a short dormancy period. The variety is preferred for home consumption in rural areas and is popular in rural markets where it is traded during periods of low sweet-potato availability. *Cruza* can be considered as a food-security crop and drops out of the privatised seed system. It has no storage problems. Traders are not interested in the variety as it is not popular in urban centres. It is preferred for home consumption and considered as the potato of the poor farmer.

The variety is popular in Gikongoro and Kibuye where bacterial wilt is problematic and soils are acid.

At the moment, *Victoria* a successful Ugandan breed is the most requested variety. It is high yielding, resistant to late blight and bacterial wilt, has a short production cycle, and a long dormancy period. It has the potential to replace *Sangema*. The variety has potential in improved marketing channels and even industrial processing. However, it is not yet widespread amongst farmers.

2.4 Harvesting and post-harvest

Potato harvest takes place about four months after planting. All harvesting is done by hand. When lifted, tubers are graded roughly by size. Normally small ones are kept aside for seed and damaged ones are kept for immediate home consumption. Growers generally start harvesting potato tubers prematurely because of their cash and food constraints. Premature harvesting causes potato skins to peel and consequently eliminating the possibility of storage (Scott, 1988). Dehalming (i.e. removing stems and leaves two weeks before harvest) is not done, except for seed potato production. Dehalming contributes to a higher dry-matter content and a better storability and marketability, but also implies a lower yield (10-20% lower). It is therefore not popular amongst farmers.

On-farm storage over a longer period is exceptional, as the water content of current varieties is too high. Traditional storage techniques (of ware and seed) are abandoned in northwest Rwanda. Instead, potatoes are stored uncovered on the ground in a heap.

Conservation without quality loss is difficult because:

- latent bacterial wilt leads to losses during transport and (lowland) urban storage;
- inappropriate harvesting (no dehalming; often premature harvesting) leads to weak, damaged skin and high water content;
- traders use inappropriate packaging material (polypropylene sacks instead of jute).

The fundamental constraint to potato marketing is that the Rwandan eating potato is highly perishable and has to be marketed just like a fresh vegetable. This has consequences for each stage of the marketing chain.

- Farmers have weak market power because of rapid quality deterioration; therefore, farm-gate prices are low and volatile; because of price volatility, market transparency and quality of market information at farm level are often low;
- Most farmers only sell surpluses and harvest when they need cash, which results in small transactions;
- Each transaction requires visual quality control because of rapid quality deterioration, which contributes to inefficient rural assembly;
- Rural-urban price differentials are high to cover high transaction cost;.

- Price differentials between the farm gate and main roads are high because of small transactions at farm-gate. Rural assembly points are organized to bulk production.
- Gross margins of all marketing intermediaries are high because of risks involved;
- Formal traders, who dominated urban wholesale marketing in the past, have abandoned potato marketing since 1994. Other crops (cereals) are less risky and allow larger transactions.
- Urban consumers face storage losses and rapid deterioration of quality because of high water-content.

At the moment, Rwanda hardly produces any potatoes that can be used to develop formal (i.e. large scale) marketing channels, exports, or industrial processing. In order to improve efficiency of the prevailing marketing channel, it is important to increase storability and marketability and to standardize the product. This will have a dynamic impact on the whole marketing chain.

CHAPTER III: WARE-POTATO MARKETING

3.1 Trade flows

Domestic trade flows

The provinces of Ruhengeri, Gisenyi and Byumba account for approximately 80% of national Irish potato production and are net exporters to other parts of the country. Local trade, both rural-rural and rural-urban, in these provinces are important, as Rwandan potato consumption is high and widespread. The towns of Ruhengeri and Gisenyi, respectively the second and third urban consumption centres for potatoes, are in or at the periphery of producing areas and are supplied directly.

Local production more or less equals local demand in the provinces of Gikongoro and Kibuye. The dominant variety, *Cruza*, is only sold in village markets, as interregional traders are not interested in the variety. In Gikongoro town, interregional traders are selling potatoes imported from outside the province (from northwest Rwanda). The southern part of the Congo/Nile Divide has lost its role as a potato-exporting area because of soil degradation. More commercial varieties are hardly cultivated in this area.

The provinces of Butare, Kigali Rural, Gitarama, Umutara, Kibungo and Cyangugu are net importers of potatoes. Local production in these provinces is mainly for home consumption. The urban centres of Kigali, Butare, Gitarama and Kibungo are outside major producing areas and are supplied through interregional trade. Most market potatoes move along the Gisenyi-Ruhengeri-Kigali route. Eastern Rwanda and Kigali Rural are supplied via the Kigali wholesale market. Cyangugu province is supplied by boat from Gisenyi. Traders from Butare and Gitarama buy directly in Gisenyi and Ruhengeri.

In 2000, interprovincial trade is estimated at 136,000 tonnes of potatoes or 23% of national production. Including intra-regional trade, 30-35% of total production is sold. The percentage of total production marketed has remained roughly between 30 and 40% during the last few decades. Dürr (1983) and Scott (1988) estimate that between 35% and 50% of Rwanda's potatoes are marketed. MINAGRI assumes that on average 40% of production is sold. In 1990, potato production was estimated at 285,000 tonnes of which 51,100 tonnes or 18% were exported to urban centres and 234,000 tonnes available in rural areas (Loveridge, 1990).

The percentage of production marketed varies by region. Rural to urban marketing is stronger in the volcanic provinces, Ruhengeri and Gisenyi. A much smaller percentage of production is sold along other parts of the Congo/Nile Divide and in the marginal growing areas in the eastern part of the country.

Foreign trade

Foreign marketing channels consist of: a) long-distance shipment to Burundi; b) small-scale informal border exchanges with Congo and Uganda. At a national level, Rwanda is a net potato exporter to Burundi and Tanzania and net importer from RDC. Total net exports are lower than 10,000 tonnes per year (rough estimate). Official potato export

statistics are only available since May 2001, but only shipments in large lorries are registered. Customs admit that details of cargoes in small trucks are not registered, so that these statistics underestimate real exports.

In the early 1980s, annual shipments from Rwanda to Burundi averaged about 2,000 tonnes (Scott, 1988). In 2001, exports to Burundi are estimated at 4,000-6,000 tonnes per year. The Burundi market is attractive with its relatively high prices. Because of the unstable security situation in Burundi, Rwandan traders have abandoned this channel and Burundian traders have taken over. Burundian traders purchase potatoes directly in the Ruhengeri region. In the past Burundian traders bought potatoes in Butare. Official exports were 400 tonnes in the period May-August 2001.

Limited formal and informal trade takes place along the Uganda-Rwanda border during the months of September to November when there is a potato supply shortage in Uganda (Okoboi, 2001a). Rwanda is a net exporter of potatoes to Uganda.

Rwanda is a net importer of potatoes from the Masisi zone in the North-Kivu Province of DRC. Imports are estimated at 280 tonnes per month during the period July-August 2001 and 120 tonnes in October (MINAGRI, Gisenyi). Annual imports are roughly estimated at 2,000 tonnes per year. These potatoes are mainly sold in urban markets of Rwanda.

Exports to Tanzania mainly consist of small backhaul quantities that are transported by truck-drivers plying the Kigali-Isaka route. They often buy in the Nyabugogo market (Kigali). Total exports are lower than 2,000 tonnes per year.

3.2 Market structure and conduct

Rural traders

Within producing areas, rural assemblers take charge of purchasing potatoes from the farmer, packing and weighing them, assembling 10 to 35 120-kg sacks in their premises for transport and storing for 1-3 days. Their gross margin is 10-15% of the rural market price (2-3 Frw/kg). The primary service these rural traders provide growers is prompt payment in cash (Scott, 1988). The service they provide traders is assembly of complete truckloads. Rural assemblers are a necessity given the fragmented structure of potato production. Their inputs are their own labour and working capital (at least 100,000 Frw, the value of a lorryload). Most rural assemblers buy potatoes in the morning and afternoon and sell in the late afternoon to interprovincial traders. In rural areas, prices are negotiated at the time and place of sale on the basis of bargaining between buyers and sellers. Farmers generally have limited market power as, lacking credit, they often sell when they need cash and their bargaining position is weak. Most rural assemblers have good contacts with transporters, but sell to whomever is interested. Rural traders are reluctant to tie themselves to a specific trader/trucker (Scott, 1988). They are not stringent on grading or varieties.

Rural assemblers

Transport of sacks to collection points or to rural traders is organised by farmers or assemblers. Only farmers who live near the main road, have good market information. The assemblers often buy in the field and transport sacks on their heads or using

wooden bicycles that were introduced in the late 1990s from DRC. The profit margin of these local transporters varies between 10% and 35% per load, depending on distance and road quality, and is negotiated. They also sell in weekly rural markets at greater profit, but turnover per trader is limited. Their volume is seldom more than 2 sacks (240 kg).

Cooperatives and associations

Cooperatives and associations lost their importance in marketing ware potatoes when Government decide to liberalize the agricultural sector and to abolish most subsidies. Most rural cooperatives and associations are not involved in the trade of ware potatoes. Only one cooperative in Ruhengeri (COODAF) is organised in rural assembly and transport to urban consumption centres of ware and seed potatoes. They buy the harvest of their multipliers of seed potato. Small and medium-size tubers are redistributed as seed, large tubers are sold as ware potato.

Interprovincial traders

Interregional traders handle the transfer of produce between producing areas and urban centres by lorry. A first type of interregional trader hauls potatoes for urban merchants on a per kilo basis. A second type is full-time potato trader who owns a vehicle. Two categories of trucker exist: a few using 15-tonne lorries and a majority with 3.5-tonne trucks. Approximately 25 to 30 traders, each owning a 13-15 tonne lorry, are involved in potato transport and trade. These trucks dominate transport from Gisenyi and Ruhengeri to Butare and to the important Nyabugogo wholesale market in Kigali. They have a 50% share in the Kigali market. For transport to Bujumbura, 25-tonne lorries owned by Burundian traders are used. Approximately 50 - 65 3.5-tonne Daihatsu trucks are involved in trade from northwest Rwanda to the Giticyinyoni wholesale market and to other retail markets in Kigali. The Daihatsus are also very flexible in catering to smaller village and urban markets in various parts of the country.

Eight traders, each owning a 15-tonne lorry, dominate the Butare potato-market. They buy in Gisenyi and Ruhengeri and they each sell one truckload per week (total: 125 tonnes per week). Their clients are retailers and consumers from Butare, as well as traders on bicycles who cater to village markets in Butare Province. The eight traders all park their lorry in front of their premises, situated in the commercial centre of Butare. They do not offload potatoes before selling them. In this way, clients cannot visually inspect the quality and size of the tubers, and cannot select the large tubers. They receive sacks and baskets with a mixture of small and large tubers. The disadvantage of this strategy is the fact that the lorry is immobilized during the whole week. Clients are not satisfied as they are interested in a product graded according to size. The traders are all using exactly the same sales price in Butare and also calculate their sales price in the same way: purchase price in the north plus 15 Frw to cover costs. They all assume their transport cost is 12 Frw, which is unlikely to be the case.

In small rural centres of Gitarama, the northern part of Kigali Rural and Byumba, local trader-retailers owning a small truck sell approximately one Daihatsu truckload or 3-4 tonnes per week in their premises or in the weekly village market. These retailers have local monopolies, leading to relatively high prices and profit margins in these rural centres. Prices in these rural centres are often higher than in Kigali.

Urban wholesale markets

Kigali has two informal wholesale markets both created spontaneously by traders since 1994: Nyabugogo and Giticyinyoni. The Nyabugogo market is organised by three associations representing approximately 130 vendors. Most vendors are women, often widows. These vendors communally hire 15-tonne lorries, buy potatoes in northwest Rwanda, and organise wholesale and retail trade in Kigali. Their clients are retailers, urban consumers and transporters who sell in eastern Rwanda. They sell on the edge of the road, as no market infrastructure whatsoever exists. The daily market turnover of the Nyabugogo market is approximately 70 tonnes. All traders in Nyabugogo market are members of one of the three associations. They hire their family members as labourers. The market is characterised by perfect collusion. The three associations agree on their gross margin and have created a cartel. The three associations calculate their price in the same way: purchase price +15 Frw. Social barriers of entry in the market are high: it is difficult for individual traders to start selling in this market, without being member of one of the three associations. The associations themselves choose new members.

In Giticyinyoni, near the junction of the Butare-Kigali and Kigali-Ruhengeri roads, approximately 20 transporters with 3.5-tonne trucks organise an informal wholesale market each morning between 5h00 and 7h00. Their clients are urban retailers. The Nyabugogo traders make use of large lorries (13-15 tonnes) that have a lower per unit cost than small trucks (3-4 tonnes) used by the Giticyinyoni transporters. Transporters in Giticyinyoni are price-takers. Their profit margin is extremely volatile because their sales price is a function of the Nyabugogo price and not of their own purchase price. Barriers of entry in this market are low. They are not organised. No fees or taxes are paid.

Other urban wholesalers at the Central Market

In Kigali, only one wholesaler/stockist/retailer ("*demi-grossiste*") is selling potato near the central market, compared to about 10 wholesalers in 1987 (Scott, 1988). He has no own transport, but buys in the Nyabugogo wholesale market. He complains that his fixed costs (rent, taxes) are too high, compared to those of urban market retailers. The present quality of potatoes does not allow storing large quantities, so that a few times per year his storage losses are high in case of temporarily low demand. This category of trader largely disappeared after 1994. The services of urban wholesalers, namely physical urban storage and financing of seasonal storage, are not needed in the present market chain. The potato marketing chain has shifted to the informal sector in relative terms because of the diminished quality of the Rwandan potato.

Retail

Distribution in urban areas is through retail markets, either open-air or with stalls. Within each urban retail market, perfect collusion between potato traders exists: they all sell the same average quality and use the same sales price, which is determined by the group. In most retail markets, all potato traders are even organised in formal or informal associations. In the Central Market, only five stalls are available for potato trade. The eleven potato retailers are member of one association, and operate in five groups of 2-3 retailers: one group per stall. All retailers in Kigali buy potatoes from transporters and wholesalers and add 5 Frw, as marketing margin. They all calculate their price in function of the price in Nyabugogo. Therefore, prices in different markets vary directly with each other. There is no competition within the market, but between

retail markets. Because of the high transport cost to other markets, consumers accept to pay a relatively high price and retailers are able to maintain a high gross and net profit margin (see also below).

Competition in the urban centre of Kibungo (eastern Rwanda) is comparable to that in most small urban centres of Rwanda. In Kibungo, twelve potato traders are organised in an association that behaves as a cartel. They buy 8 tonnes of potatoes per week in the Kigali wholesale market, and sell in the Kibungo retail market. Their gross margin is 40%, the net profit margin is 20% of their sales price, but turnover per trader is low. Social barriers of entry are high: the group does not tolerate undercutting of prices by individuals and new entrants. Small quantities are also sold in urban stores of Kibungo. They complain that losses (due to quality deterioration) are high because of thin and irregular demand. Some of them have stopped selling potatoes because of these losses. The retail market is the price-leader.

Market information

Market information is relatively good, except at farm and consumer level. Traders at all levels of the marketing chain have access to recent price information, with a time lag of one day or less, thanks to the large number of operators, relatively short distances between producer and consumer markets (50 – 200 km) and daily travelling. Traders buy in the late afternoon and sell the next morning. Their main problem is short-term demand-side volatility in the market. In the afternoon they have no idea about their sales price the next morning. Price shocks are mainly absorbed by interregional traders. Traders in the Nyabugogo market are selling both Irish potatoes and cooking bananas. According to some of them, there exists substitution between the banana (from Uganda) and potato. An oversupply of banana causes lower demand for potato.

Storage

Potatoes in Rwanda are harvested, transported and sold to retailers within one to five days. Potato storage for speculative purposes is not known to take place. Traders store potatoes to assemble quantities large enough to fill a lorry. This storage is done in heaps on the ground or in sacks in ordinary concrete buildings at market places, where the produce is kept for a few days.

Credit

Traders do not have access to credit, and do not give credit to buyers. No credit or advances are given to growers or other traders.

3.3 Prices and market performance

Price trends

Figure 2 presents real¹² market prices of potato in Ruhengeri during the period 1980-2001. Two important factors emerge:

- a) the price-series has a strong cyclical component, with price troughs in 1981, 1985, 1991-1992, 1995 and 2000-2001; higher prices could again be expected in 2002-2003;
- b) an almost stationary trend; the long-term average deflated price is 48 Frw/kg (in 2000 prices); in an historic perspective, the present price is rather low;
- c) in the late 1980s, real prices were very high, because: a) production was characterised by a cyclical bottom (see figure 1); b) consumer markets were not disturbed as was the case during the 1998-99 price peak.

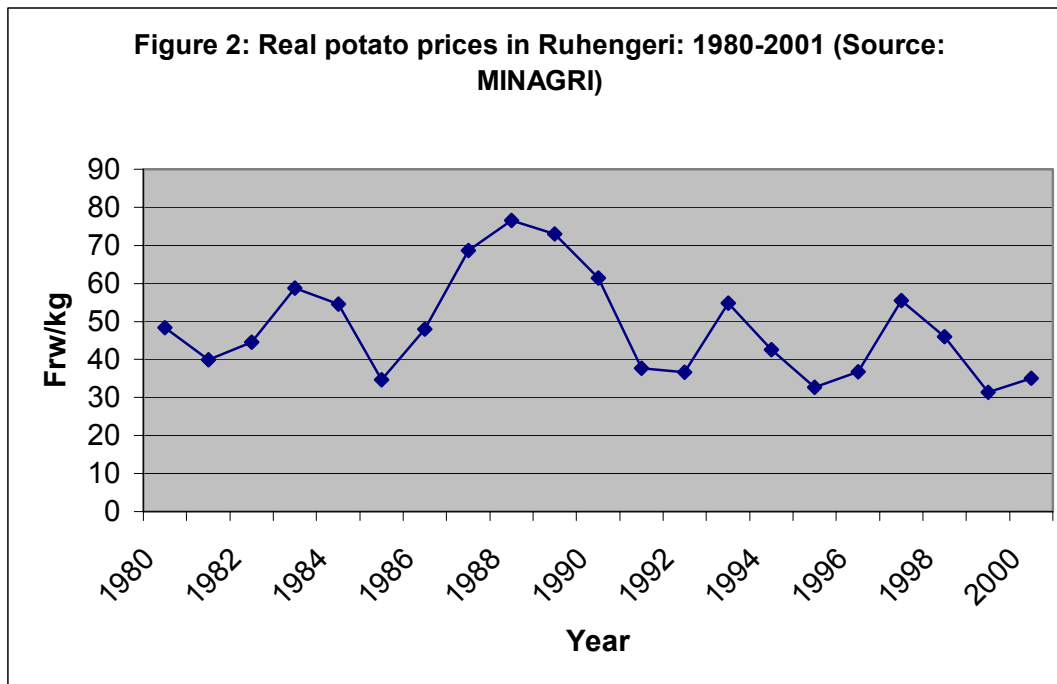
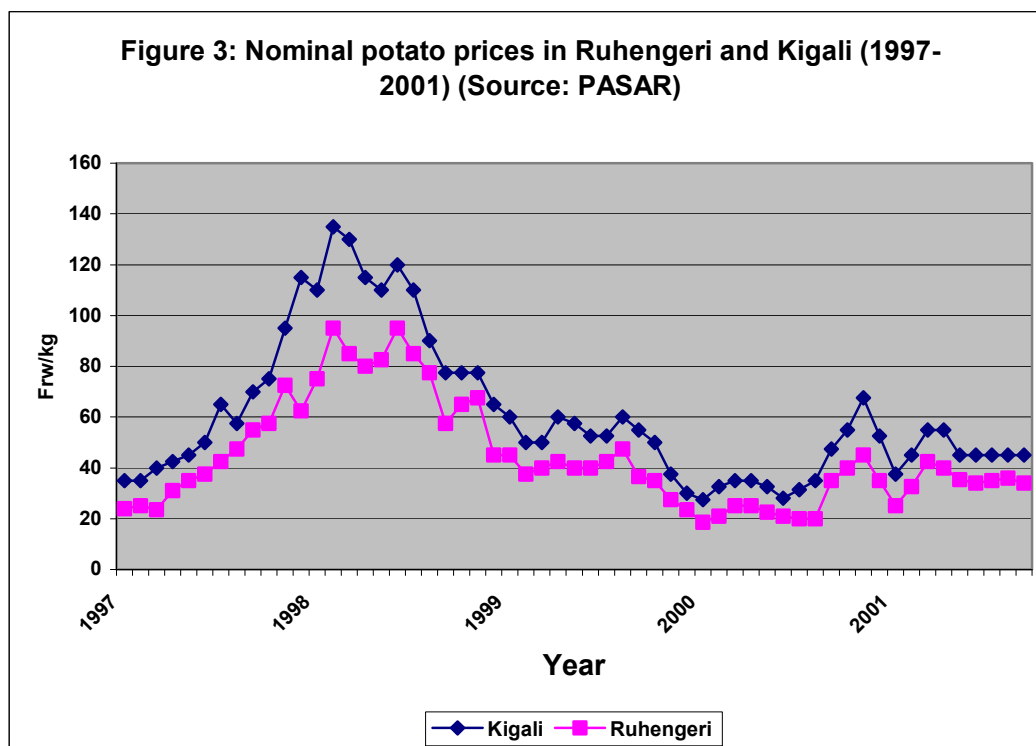


Figure 3 displays the nominal price trend during the period 1997-2001. Prices in 1998 and the first half of 1999 were extremely high because production in Gisenyi and Ruhengeri was negatively affected by war and so farmers' production dropped. Because of the incentive of these high prices, potato cultivation recovered rapidly (see: figure 1) when farmers returned. The expansion of production led to low prices during the first half of 2000. During the second half, prices recovered again and have stagnated since beginning 2001.

¹² "Real prices" take account of price inflation to express prices in different years in terms of a price at one moment in time, in this case 2000.



Prices and margins

Table 3.1 compares the price structures for 1983 and 2001. In 1983, a potato-grower in Ruhengeri received 42% of the urban retail price, compared to 45% in 2001. The rural trader’s margin dropped from 7% to 5%. The margin of transporters and wholesalers dropped from 40% to 37.5%. The improvement of the road infrastructure might explain the relatively higher farm-gate price and the narrower margin of rural traders and transporters/wholesalers. The quality of the main rural roads in northwest Rwanda has improved since 1983.

Table 3.1: Prices and margins for potatoes (1983 – 2001)

	1983		2001	
	Selling price (Frw/kg)	Marketing Margin (%)	Selling price (Frw/kg)	Marketing Margin (%)
Grower near Ruhengeri	6.0	42%	18	45%
Local rural trader near Ruhengeri	7.0	7%	20	5%
Trucker/trader	11.0	29%		
Wholesaler in Kigali	12.5	11%	35	37%
Retailer in Kigali	14.0	11%	40	13%
		100%		100%

Source: Scott (1988) and own research

Table 3.2 shows the price structure of potatoes sold in a Kigali retail market. The gross margin covers transportation, processing, packaging, losses during transport, storage and taxes, as well as net profit and the return to capital and labour. The main conclusions are as follows:

- Taxation is relatively modest at all stages of the marketing chain. Total taxation is lower than 5% of the urban retail price. In the production zones, a community tax of 1 Frw per kg is paid to the local community. Urban retailers pay a tax of 5,000 Frw per month in the Central Market and 2,500 Frw in other markets. This contribution includes usage of the retail market infrastructure as well as taxation of retail trade, and is very reasonable. This is one of the reasons why formal stockists-retailers with sales outlets (stores) around the markets, who are paying a high rent and income taxes, are not able to compete.
- Rural traders have a net profit margin of 5-7% of the urban retail price, which is very high given the limited services they provide. This excessive profit margin reflects the weak market position of peasant farmers, who are always in need of cash.
- Transporter/wholesalers have a net profit margin of nearly 7%, which is relatively high because no storage is involved. Potatoes are bought in the afternoon in Ruhengeri and sold the next morning in Kigali. The profit margin is comparable to those typically realized in the fresh vegetable trade, not in the trade of tubers.
- Urban retailers also have a net profit margin of about 7%. Individual traders in potato retail trade obtain monthly profits of 50,000 Frw, which is high, given the local context. In urban centres of eastern Rwanda, net profit margins of even 20% are obtained, but the turnover per trader is lower. Retailers have a strong tendency to collude, not to compete.

In general, net profit margins realized in potato trade are high, and reflect: a) risks involved in trade because of the perishable character of the crop; b) collusion between traders in cartels in urban wholesale and retail trade; c) low turnover per trader. Government intervention measures should focus on issues of:

- a) the commercial quality (marketability and storability) of the potato; it is not realistic to assume that the quality of total supply can be improved in the short and medium term; however, given characteristics of urban demand, there is a potential to develop a specific higher-quality market segment of 10% of urban demand (premier-quality potato) and a top-quality segment of 1% (export-quality);
- b) market structure and conduct, in order to enhance competition in the market so that gross profit margins decrease and potatoes become cheaper in urban markets. In small urban centres, consumers pay excessive prices. The potential to boost demand is considerable.

Table 3.2: Potato Marketing Cost and Margins

	Frw/kg	Frw/bag (130 kg)	Percentage of retail price	Frw per 4-tonne truck
<u>A. Farmer in Ruhengeri</u>				
Farm-gate	18.0	2,340	45.0%	
<u>B. Rural assembler</u>				
Purchase price	18.0	2,340	45.0%	truck load 81,900
Selling price	20.0	2,600	50.0%	91,000
Gross margin/net margin	2.0	260	5.0%	9,100
<u>B. Transporter- Wholesaler</u>				
Purchase price	20.0	2,600	50.0%	4-tonne truck 91,000
Selling price	35.0	4,550	87.5%	159,250
Gross margin	15.0	1,950	37.5%	68,250
Fuel	3.0	390	7.5%	13,650
Rent vehicle	5.0	650	12.5%	22,750
Loading	1.0	130	2.5%	4,550
Community tax Ruhengeri	1.0	130	2.5%	4,550
Offloading	1.0	130	2.5%	4,550
Taxes	0.3	39	0.7%	1,365
Sacks	0.4	52	1.0%	1,820
Security	0.2	26	0.5%	910
Losses	3%	59	1.1%	2,048
Total costs	11.9	1,606	30.9%	56,193
Net margin	3.1	345	6.6%	12,058
<u>C. Retailer – Kigali</u>				
Purchase price	35.0	4,550	87.5%	daily sales 31,850
Selling price	40.0	5,200	100.0%	36,400
Gross margin	5.0	650	12.5%	4,550
Urban tax	0.4	50	1.0%	350
Labour	0.8	100	1.9%	700
Losses	0.8	100	1.9%	700
Security	0.2	20	0.4%	140
Total costs	2.3	270	5.2%	1,890
Net margin	2.9	380	7.3%	2,660
<u>D. Urban consumer</u>	40.0	5,200	100.0%	

Source: own survey

Spatial market integration

Geographic price fluctuations refer to variations in price differences between two geographically separate markets during the same period. Price correlations are used as an indicator of market integration. Correlation coefficients, calculated between market pairs, are all higher than 90%, indicating the Rwandan potato market is geographically integrated. The high correlation coefficients are realistic because of the following factors:

- a) the structure of trade flows: all potatoes are transported from relatively small production zones in northwest Rwanda to rural and urban centres all over the country. They all set prices as a function of the Gisenyi or Ruhengeri price; and the time-lags are only 1-4 days;
- b) the relatively short distance from Gisenyi and Ruhengeri to Kigali (179 km and 116 km);
- c) a large number of traders (about 50 inter-provincial traders) who buy and sell each day in northwest Rwanda;
- d) the widespread use of mobile telephones;
- e) the availability of vehicles and fuel ;
- f) good major roads ;
- g) widespread collusion and cartels.

Unfortunately, the nearly perfect price transmission reflects collusion and cartels. All retailers in Kigali add 5 Frw to their purchase price as gross margin. All wholesalers in Nyabugogo are using the same gross margin. All wholesalers in Butare are using a gross margin of 15 Frw/kg. All retailers in Kibungo are using the same sales price that is calculated on the basis of the Kigali price. The former Gishwati forest is less integrated in this regional network because of the absence of good roads. At farm level, information about prices is of a lower quality. Remote farms are not well integrated into the marketing chain.

Loveridge (1989) found that 65% of all market pairs had a low price correlation (0% - 69%), and 35% an average correlation (60% - 79%) in 1988. Spatial integration of markets has thus improved significantly because of the factors already enumerated. The number of traders (with 4-tonne trucks) has increased significantly; mobile telephones were introduced; the main rural roads were improved.

Table 3.3 presents annual prices in the provinces. The lowest prices are found in Gisenyi, followed by Ruhengeri where prices are 2-3 Frw/kg higher. All prices in eastern and southern Rwanda are higher than those in urban Kigali. Prices in Gikongoro and Byumba, important traditional potato surplus zones in the past, are relatively high. Dürr (1983) mentions that 10% of the interregional trade came from Gikongoro and 20% from Byumba in the late 1970s. Most observers agree that Gikongoro is no longer a potato-exporting province. Its urban centre even imports potatoes. The market share of Byumba in interregional trade has dropped from 20% to approximately 8%. Decreasing soil fertility and depleted soils have caused these changes in both cases.

Table 3.3: Average nominal potato prices at retail level, per province, 1997-2001 (Frw/kg)

	1997	1998	1999	2000	2001*
Ruhengeri	43	73	38	27	35
Gisenyi	39	69	35	24	33
Kibuye	65	78	39	31	37
Byumba	58	84	46	34	41
Gikongoro	64	96	47	37	43
Kigali Rural	64	100	54	39	49
Kigali Urban	58	98	51	38	48
Umutara	68	83	58	44	52
Butare	66	102	59	43	53
Kibungo	75	103	60	42	53
Cyangugu	71	102	50	44	49
Gitarama	63	97	54	38	48
Average	61	91	49	37	45

* January-June 2001

Source: PASAR

Seasonality

During the 1970s and 1980s potatoes were grown nearly all year, with relative shortages in July-August and December-January. The within-year price fluctuations largely corresponded to recognized growing seasons for potatoes. From April to June/July prices increased sharply to a level twice as high as the lowest prices in November-December (harvest time). This price increase reflected the poor harvest after the main season, caused by erratic rainfall and late blight attacks (related to rainfall). The January peak was significantly lower than the June-July peak. During other periods, price fluctuations were fairly moderate and the price level remained relatively stable (Dürr, 1983)

The seasonality in the period 1997-2001 has a different pattern, with low prices from December to February. The price peak in July-August does not exist anymore, as dry-season production is nowadays more important. During the rest of the year, the seasonal component is unstable. Storage for speculative purposes is a highly risky undertaking because: a) price increases during the period September-February are not reliable; b) the storability of potatoes harvested is poor.

3.4 Transformation of ware potatoes

Industrial processing of ware-potatoes does not exist in Rwanda. However, two groups in the Great Lakes region are preparing investments: *House of Quality Spices Ltd.* in Kampala and *Potato Enterprise s.a.r.l.* in Ruhengeri. Both have prepared feasibility studies (HQS, 2001); (Potato Enterprise, 2001).

House of Quality Spices (HQS) in Kampala is preparing an investment in the sector of crisp-type snacks, prepared on the basis of starchy staples (potato, banana, cassava, etc.). The objective is to enter the market at a modest level and to process 100 tonnes of

potatoes per year. HQS is seeking technical and financial support from FOODNET and Uganda's National Agricultural Research Organization (NARO) to test the snack food markets in Uganda, Rwanda, Western Kenya, DRC and Tanzania. The total project cost is US\$100,000 (1 US\$/kg of raw material). The company has already penetrated the Kampala consumer market with a line of basic spice products, with approximately 40 products on the market, including ginger powder, curry powder and tea massala. HQS would like to expand into the snack market as it can flavour crisps with spices, and thus increase its core business. HQS has an operational distribution channel and knowledge of the Kampala market.

Potatoe Enterprise s.a.r.l.

Potato Enterprise s.a.r.l. is a new company that has prepared a business-plan for a potato processing plant in Ruhengeri. The goal is to process 4,800 tonnes of chips during its first year of operation and 14,400 tonnes after 10 years. Approximately 25% of the final product will be sold in Rwanda; the rest will be exported to the region (Uganda, Tanzania, Eastern Congo, Burundi). The investment is estimated at US\$ 1,500,000. Potato Enterprise is working together with the cooperative COODAF and is looking for investors. COODAF will play a role in raw-material supply.

Comments

The market for this type of snacks exists in all urban centres of eastern and southern Africa, and is still expanding because of a changing lifestyle of young people. Total demand in this market is an unknown factor.

The risk profile of *HQS*'s investment is limited because:

- *HQS* is planning a gradual expansion of its current activities; management and distribution structures are functioning.
- Its total supply is modest and can easily be absorbed step-by-step by urban markets; in a first phase, the home-market will be targeted.
- The volume of raw material (potatoes) is modest, so that raw-material supply will be not difficult to organise (15-20 hectares); only contracts with a limited number of outgrowers are needed; other starchy staples can also be used.

The risk profile of *Potato Enterprise*, but also the potential impact, is much higher. Some points of attention are as follows:

- In case the product is not an immediate success, the company might have a negative cash-flow during the start-up phase;
- Raw-material supply, as 4,800 tonnes of a standardized and stable quality are not currently available; 6,000-8,000 hectares of Irish potato are needed; planning a stable seasonal supply will also be a challenge as more than 5,000 farmers will be involved;
- The Rwandan home-market is limited, so that export channels need to be developed at a very early stage. An East African distribution network for important volumes is required, as well as expensive publicity campaigns.

The success of *Potato Enterprise* depends completely on consumer response, quality of management, control of operating costs and of the cost of an international distribution channel. Government's role should be limited to the creation of an conducive investment environment (tax holidays and tax-free imports of packaging material and

equipment and tax-free export of the final product) and to raw-material supply (extension, seed production).

Catering for institutions

The restaurant of the University of Butare is buying 1,500 tonnes of potatoes per year (2001), compared to 200 tons in 1978. Meals in the university restaurant are 75% subsidized. The University has a contract with the cooperative COODAF, the only supplier that is able to deliver the required volume. It is paying 55 Frw/kg compared to a wholesale price of 35 Frw in Butare town. This price is high because no specific requirements are imposed concerning variety, storability, dry-matter content. A tender procedure with several smaller lots would be more in line with the market structure at wholesale level.

Most secondary schools are buying lower proportions of Irish potatoes than the University of Butare and relatively more sweet potatoes and beans, as their meals are not subsidised. They often buy potatoes at farm level in Ruhengeri and organise their own transport.

Prisons and the army are also important clients for potato.

3.5 Export opportunities

FOODNET has organised studies of markets in surrounding countries: Congo, Uganda, Kenya and Tanzania. A summary of the conclusions in relation to the Rwanda market will be presented here.

Congo¹³

Potato producers in Congo are small, resource-poor farmers practicing shifting cultivation. These farmers use no fertilizers, pesticides or machinery, as farm-gate prices are low (14 Frw/kg). Their main constraint is market access because of the bad roads. Transport costs are high. In the Masisi valley, potatoes of commercial varieties are produced. In Southern Kivu, the variety *Cruza* is cultivated and marketing faces problems comparable to those in the Gikongoro highlands.

At the moment, Congo (North Kivu) is exporting small quantities of potatoes to Rwanda via Gisenyi. Rwanda is having problems competing with these prices. The border towns of Gisenyi and Goma are supplied by both Congolese and Rwandese traders. Trader flows depend on local surpluses and prices.

The Bukavu market (South Kivu) holds potential for Rwandan traders by boat from Gisenyi. Also the market of Mbuyi-Mayi and Kinshasa could have potential (by airplane). Northwest Rwanda has lower transport costs than the Masisi Valley in these markets, because of a good market access (road-air or road-boat). A more commercial potato with good storability is required to further develop these export flows. Rwanda can sell more potatoes to urban centres of DRC by planting good varieties for chips. To

¹³ Case-study prepared by Phemba Phezo (October 2001) and presented at the November 2001 MINAGRI workshop on potato marketing

encourage cross-border trade, border taxes imposed by DRC and Rwanda on both seed and ware potatoes should be reduced.

Congo could be a client for Rwandan seed tubers. Demand for seed in Congo is a profitable market niche, but risky because sales are not assured. More than 90% of the clients for seed potato are NGOs and UN agencies. Seed potato is needed in September-October and February-March.

Burundi

Burundian traders buy ware-potatoes in Rwanda, as Burundian potatoes are of a very mediocre quality (late blight, bacterial wilt, viruses, etc.). Consumer preferences in Burundi are comparable to those in Rwanda. At the moment, Rwanda is exporting 6,000 tonnes per year to Burundi. In the future, Burundi will remain a growth market for Rwandan exports, as there are no immediate competitors. The Burundian consumer is comparable to the consumer in Butare and Kibungo: high income-elasticity, growing consumption of chips and crisps, but still a low present consumption of potatoes. The market structure in Bujumbura is also comparable to that of Butare: collusion, very high consumer prices and gross margins. Therefore the Burundian market has potential to grow faster than the Rwandan market. Enhanced competition should lead to significantly lower consumer prices and higher consumption. In 2020, Rwanda should be able to export 20,000 – 30,000 tonnes of potatoes per year to Burundi.

Burundi (NGOs, UN agencies, donors) could be an important client for seed potatoes. It does not have the capacity to produce its own potato seed, and due to bacterial wilt, its seed potatoes need to be renewed regularly.

Uganda¹⁴

During the months of September to November, there is a potato-supply shortage in Uganda and off-lorry prices are relatively high in Owino Market in Kampala. Informal cross-border trade between Uganda and Rwanda exists during this period, but is mainly organised by Ugandan traders. In urban areas, over 50% of potatoes are consumed as chips. The urban fast-food market (potato-chips outlets) is growing rapidly, but requires commercial potatoes, in terms of marketability, storability and dry-matter content. *Victoria* is the most common commercial variety in Uganda. Its production is still too low in Rwanda. The Kampala ware-potato market has potential, as Rwandan and Ugandan farmers face more or less the same transport costs. The presence in Rwanda of many people with a Ugandan background is an additional opportunity. Combined efforts by Rwandan traders and cooperatives are needed to develop supply chains in Ugandan urban centres. A network of local brokers and wholesalers should be established in order to enhance market power of exporters. The present quality of the Rwandan potato is only good enough for small-scale informal cross-border trade.

Seed-potato production and marketing in Uganda is monopolised by the 25 members of Uganda National Seed Potato Producers' Association. Seed potatoes are sold at five times the price of ware-potato. Rwanda has an opportunity to provide the Uganda market with basic-seed potatoes and commercial-seed potatoes.

¹⁴ Case-studies in Uganda, Kenya and Burundi were prepared by Okoboi Geoffrey (August – October 2001) and presented in November 2001 at the MINAGRI potato-marketing workshop

Kenya

Chips and crisps are the principal products from potatoes that are prized in Kenya's urban areas. Kenya imports potatoes from Tanzania (Arusha) to supplement local production. Kenya does not import potatoes from Uganda. Potential for Rwandan traders to export to Kenya is limited, unless well-structured supply chains are organised for quality potatoes. There might be potential for a niche-market of "export-quality" potatoes. Kenyan urban markets are competitive.

Kenyan growers of Kerr's Pink and Dutch Robyn receive a premium price from processors for the rapidly growing crisps market (Okoboi, 2001c). In Meru District, the main commercial potato producing area in Kenya, one single variety, Kerr's Pink, has remained most popular for more than four decades (Crissman et al., 1993). At the moment, Rwanda does not have the required commercial-quality potato to be competitive in Kenya. Rwandan traders should first develop the Rwandan and Ugandan market before doing efforts to develop the Kenyan market.

Yields are low in Kenya because of the low use of inputs and the absence of clean seed.

Tanzania

Traders from Mwanza buy potatoes from Kenyan farmers in Meru district through a broker (Okoboi, 2001b). Meru District is well known for high-quality red potatoes (Kerr's Pink). This is a second Kenya-Tanzania trade route, but in the opposite direction from the one mentioned in the Kenya section. Both flows in opposite directions co-exist. The major reasons cited by Mwanza traders for not buying potatoes from Arusha (Northern Tanzania) or Mbeya (Southern Tanzania) are transport costs and quality of potatoes. Quality is understood as the high dry-matter content of potatoes because it directly affects storage period and quality of chips. Rwandan potatoes are not popular because of their high water content.

Rwandan potatoes may not be competitive on the Mwanza market when compared to Kenyan potatoes between November and June, when Kenyan traders are catering the market. Rwandan potatoes can be competitive in Mwanza between July and October. Furthermore, there are opportunities for potato as a backhaul cargo from some Rwandan provenances to Isaka.

The off-lorry price of potatoes on Mwanza market does not exceed 80 Frw/kg and in Dar Es Salaam does not exceed 75 Frw/kg. A well-organised supply chain is required based on a network of local brokers and wholesalers.

3.6 Conclusions

Local markets

Gross margins in Rwandan interregional and retail potato trade are high because of:

1. high risks and transaction costs, as the Rwandan potato is highly perishable;
2. weak market power of farmers;
3. collusion and cartels at all levels of urban wholesale and retail markets.

More competition at wholesale and retail level should lead to lower urban prices, higher farm prices and a shift of demand (resulting in higher consumption). The potential is

significant in small urban centres of Rwanda. Grading would lead to more consumer satisfaction.

Interventions in marketing should focus on these issues:

- Promoting the growing of varieties that respond to urban consumer demand in order to reach an immediate potential market share of 10%; this potato could also strengthen the position of Rwanda in the export market.
- Promoting competition in order to change market structure and conduct.
- Encourage farmers to play a more active role in rural assembly.

Export markets

Burundi is currently the main growth market for Rwandan exporters as there are no competitors. Bukavu (DRC) is a market with growth potential. However, supply chains can only be further developed under conditions of peace and civil calm. Other potential Congolese niche-markets where Rwandan traders can compete with DRC-traders are Kinshasa and Mbuyi-Mayi.

In Uganda and Tanzania, urban demand for crisps and chips is growing rapidly. Specific potato varieties and quality (high dry-matter content) are required: *Victoria*, *Kerr's Pink*, etc. Rwanda is not producing potatoes of this quality in sufficient quantities to develop reliable supply lines. Cooperatives (e.g. COODAF) could take the initiative to produce this commercial quality, using a network of outgrowers. Exporting potatoes without a network of brokers and wholesalers is extremely risky as it weakens bargaining power in export markets.

CHAPTER IV: SEED POTATOES

4.1 The Rwandan seed potato strategy

The central objective of Rwandan Government has been to supply farmers with improved-quality seed potatoes. The national program focused on:

- (i) the selection and multiplication of varieties resistant to late blight and bacterial wilt;
- (ii) the production and diffusion of healthy pre-base seed of improved varieties of acceptable size, and in good pre-sprouted condition. (Monares, 1984)

Government did not aim to establish a sophisticated seed certification program or to produce large quantities of certified seed¹⁵. Rwanda could not afford sophisticated research facilities, such as a virology laboratory for post-harvest virus testing. In addition, the concept of certified seed had little relevance in a country where most potato growers are peasant farmers producing mainly for home-consumption.

Government strategy was successful with a significant impact in the past. The internal rate of return was 40% during the seventies and early nineties (Monares, 1984). Reasons for this success are as follows:

1. Introduced varieties respond to farmers' demand (and not necessarily to commercial or consumer considerations).
2. Potatoes are grown at elevations above 1,800 metres where virus diseases are secondary in importance and where farmers' seed degeneration is slow. The slow degeneration rate means that the multiplier effect of a small stock of basic seed is great.
3. The majority of farmers do not use pesticides and chemical fertilisers that are required for most certified seed.
4. Farmers' demand for new, late-blight-resistant varieties is high.
5. Potatoes are more profitable than most food crops.
6. Farmers are interested in new varieties. According to Crissman (1990), farmers assume yield declines are due to varietal degeneration not seed degeneration. Thus varieties are often changed when seed is renewed. Farmers often voluntarily reject the older varieties when newer varieties become available.

Reasons for this success are still valid, but the strategy will not again result in a significant yield increment without accompanying measures (fertilizers, pesticides). The genetic potential to obtain high yields is already available at present. The high yields are not obtained because of low-quality crop husbandry. In addition, the present strategy does not support a more commercial orientation of the sector.

¹⁵ The fundamental objective of a certified seed scheme is to produce seed guaranteed to be of the advertised variety and, within established tolerance levels, free of certain diseases and pests (Crissman, 1990).

4.2 Demand for and availability of seed potatoes

On the basis of average seeding rates, total annual seed-potato requirements in Rwanda amount to 100,000 tonnes (i.e. 1/7 of annual production). Sources of seed potatoes in Rwanda are:

1. Farmers retaining sufficient small tubers from their own potato crop to be used the next season. They usually keep the small-sized tubers, which are more difficult to sell. Storage of seed indoors in heaps on the ground is the most common method. This system provides the vast majority of seed used (85-90%).
2. Farmers who sell sprouted small-size ware-potatoes as seed potatoes in local markets (5-10%). When farmers do not have enough of their own seed, they usually purchase new seed in village markets. Prices of sprouted seed tubers are 5 to 10 Frw higher than those of ware potatoes. Quality is often low because: a) mixtures of varieties are sold; b) on-farm seed-storage is of poor quality; c) farmers have limited know-how about and control of diseases.
3. The official seed programme meets 3-4% of demand. Members of cooperatives and farmers' associations multiply annually 600 tonnes of basic seed potatoes, made available by ASSR. In this way, approximately 3,000 tonnes of seed potatoes are distributed each year. So far, only 1 or 2 commercial farmers are involved in commercial seed multiplication. Only a very small fraction has ever bought certified seed. Reasons for the unpopularity of improved seed are its high cost (75 Frw for basic seed versus 30 Frw for local seed), the lack of an established seed potato market and, in many cases, lack of know-how.

The degeneration rate for seed potatoes was traditionally low in the main potato producing areas, permitting farmers to replant tubers harvested from their own fields for 3 to 10 years before virus infection substantially reduced yields (Haverkort, 1983). After the genocide in 1994, the degeneration rate accelerated because: (i) traditional storage methods of seed tubers were abandoned because of more frequent theft; (ii) crop rotation is less respected, and even mono-cropping becomes frequent. Seed degeneration is high in low-altitude producing areas, forcing farmers to renew their seed stock regularly. These farmers often buy small ware-potatoes from the highlands in village markets as planting material.

During the 1970s seed potatoes were hardly available. Since the 1980s, farmers have become heavily dependent on development projects and the government for clean seed and for the few new varieties, introduced at subsidized prices. Since 1998, ASSR has been multiplying and distributing basic seed. As mentioned above, ASSR produced 600 tonnes of basic seed tubers for multiplication in 2000. The present target is 2,000 tonnes per year. Production of seeds is still significantly lower than farmer demand for seed at current prices because of a capacity constraint at the level of ASSR (availability of pre-basic seed, clean land for multiplication). Certified seed potato being an expensive input, NGOs, MINAGRI and donor organisations have been the major buyers of seed potato from ASSR for onward distribution to farmers. This distribution is always based on credit. Members of farmers' organisations receive seed-potatoes and inputs on credit and repay after harvest in kind. Without credit, effective demand for seed would be very limited.

The objective of seed programmes is to produce seed of varieties with characteristics suitable to the needs of farmers, processors and consumers (Crissman, 1990). At present, farmers' food-security strategy is dominating demand in Rwanda. The programme is mainly farmer-driven, while urban consumers and farmers have different variety requirements (see table 4.1). Because of the war period and haphazard renewal of seed tubers, and growing population pressure, a shift towards varieties that respond to food-security objectives (i.e. consumption on-farm or very locally) took place during the 1990s and was accelerated during the post-war phase. The traditional commercial variety *Sangema* is still popular, but farmers complain that the variety has degenerated. Its market share has dropped drastically since 1994. According to ASSR, the potential yield of *Sangema* is too low. Meanwhile, other more commercial varieties (*Victoria*) have a very limited market share. PNAP and ASSR are screening some more commercially-oriented varieties, with the possibility of multiplying them for farmer use during the coming years. A continuous introduction of new varieties is a necessity for the Rwandan potato sector to remain competitive.

Table 4.1: Conflicting variety requirements

Farmers in volcanic zones want:	<ul style="list-style-type: none"> • Short seed dormancy • Short vegetative cycle • Resistance to late blight • Tolerance to bacterial wilt • Large tubers • Sufficient quantities of seed • Short cooking times • Marketability 	<i>Mahondo, Kirundo, Mizero, etc.</i>
Farmers with acid soils want:	<ul style="list-style-type: none"> • Tolerance to bacterial wilt • High yields on acid soil 	<i>Cruza</i>
Exporters, processors and urban consumers want:	<ul style="list-style-type: none"> • Long seed dormancy • Good storability • Good cooking and taste qualities • Good crisping quality • High dry matter content • Red or pink skin • Moderate eye depth • Oblong tuber shape 	<i>Sangema, Victoria, Maryline, etc..</i>

Source: Own research

4.3 The Rwandan seed programme

The Rwandan seed programme shares the following constraints common to other developing countries (Crissman, 1990): low agricultural research budgets, low staff pay, station budgets skewed towards salaries. The Government seed scheme has always been supported by development projects with externally-funded technical assistance. In 1994, potato seed research and production collapsed as foreign aid was temporarily interrupted, facilities were destroyed and staff disappeared. Since 1994, new projects have mainly been targeting multiplication and distribution of seed potatoes of existing varieties, while research received less attention and no new varieties were introduced.

Pre-basic seed potato production

Since 1972, ISAR has had a mandate and monopoly to screen imported clonal material, to select varieties, and to produce pre-basic seed for food and export crops, including Irish potatoes. The National Program for Potato Improvement (PNAP) was established in 1979 as a section of ISAR, the national agricultural research organisation, in cooperation with the International Potato Center (CIP). PNAP's potato research is concentrated at the Rwerere and Tamira Stations, in Ruhengeri and Gisenyi provinces. Since 1979, PNAP has always concentrated on the farmer and his problems. This focused selection on the most limiting production factors: the lack of varieties resistant to late blight and bacterial wilt (Monares, 1984). Before 1992, the dissemination of improved varieties on a large scale was rapid. However, during the period 1994-2000, PNAP was not able to produce any significant quantity of pre-basic seed potatoes. Most of the infrastructure and equipment was destroyed twice during this period. Human capacity was lost. Recently, the tissue-culture laboratory has been fully renovated and has been operational since June 15, 2001. The lab will be used to regenerate disease-free improved planting material. In Season B 2001, 53,000 mini-tubers were produced. Belgium provided significant financial support to PNAP.

The effectiveness of PNAP's research has been limited by the lack of trained personnel and the scarcity of physical facilities. Production of pre-basic seeds has always been insufficient in quality and quantity. Weak points are: a) insufficient institutional capacity; b) limited operational budget; c) very motivated but relatively inexperienced staff. Strong points are: a) land for seed multiplication is available; b) the tissue-culture laboratory is now operational.

During the last three decades, new varieties were introduced into Rwanda by development projects, in collaboration with PNAP/ISAR. *Bufumbira*, *Muhabura* and *Malirahinda* were imported from Uganda in the 1970s. *Condea*, *Montsama* and *Sangema* were introduced by ISAR in 1972. Since the 1980s, most traditional varieties have been replaced by these new varieties, as old varieties were not multiplied. Before the creation of PNAP, these six varieties were cultivated by more than 80% of all potato producers (Monares, 1984). PNAP released *Gahinga*, *Petrero*, *Nseko*, *Gasore*, *Kinigi* and *Cruza* between 1982 and 1986, and *Mabondo* in 1989. Since 1992, following varieties have been promoted: *Gikungu*, *Nderera*, *Ngunda*, *Kigega*, *Mugogo* and *Mizero*. *Victoria* was introduced from Uganda in 1995. *IPPC62*, *IPPC281*, *IPPC200*, and *Maryline* are promising new varieties, but are still in a screening phase and not widespread yet.

Basic seed production

Since 1998, ASSR (*Intervention d'Appui au Secteur Semencier du Rwanda*), a joint project of the Belgian and Rwandan Governments, has supported the production of foundation, pre-basic and basic seed, and coordination of the seed scheme, as well as seed quality control and certification. Its main activity is the production of basic seed. The Belgian support to ASSR will end in August 2002.

In Rwanda, as well as in Congo and Burundi, demand for seed potatoes is often financed directly or indirectly by donors. Table 4.2 shows ASSR's clients. In principle, ASSR obtains its pre-basic seed from ISAR and distributes basic seed to various

projects, farmers' organisations and the private sector. As ISAR has not been able to deliver sufficient quantities of pre-basic seed in the past, ASSR has used approximately 30% of its basic seed-potato production as pre-basic seed. Approximately 65% of effective demand was directly or indirectly financed by government or donors via MINAGRI, development projects, NGOs, etc. The private sector was buying approximately 7%. Farmers are very interested in seed potato, but commercial demand is limited due to a lack of purchasing power.

A second constraint, faced by ASSR, is availability of land to multiply seed and respect crop rotations. Because of unorganised and uncontrolled multiplication during the post-war phase, most land is contaminated with bacterial wilt and viruses. Nevertheless, it is used to multiply seed.

Table 4.2: Destinations of seed potatoes distributed by ASSR (Season 2001B: March – June 2001)

	Basic seed potatoes (kg)	Basic seed potatoes (%)
ASSR	130,270	29%
FAO	79,250	17%
Cooperatives	75,118	16%
ONG	75,065	16%
Projects	39,867	9%
Private sector	30,265	7%
MINAGRI	24,875	6%
TOTAL	454,710	100%

Source: ASSR

Table 4.3 looks at the production cost of basic seed in Rwanda. The cost of multiplying the variety *Kirundo* is 34 Frw/kg. It is assumed that only 54% of the harvest is used as seed potato (small and medium size tubers) and that 46% is sold as ware-potato (large tubers). Land rent is not included. Including land rent, the cost will be approximately 42 Frw/kg. The yield is 29 tonnes/ha under optimal circumstances. For other varieties, the cost is also varying between 40 and 50 Frw/kg. ASSR is selling at a price of 65 Frw/kg.

Table 4.3: Cost of production for basic seed potatoes: variety Kirundo (Frw/ha)(2001)

Yield (tonnes/ha)	29.22
% seed potatoes	54%
% ware potatoes	46%
Seed potatoes	13,980 kg/ha
Ware potatoes	13,420 kg/ha
Total cost	736,936 Frw
Labour	381,763 Frw
Seed potatoes	272,257 Frw
Pesticides	43,917 Frw
Fertiliser	39,000 Frw
Revenue ware potatoes	268,400 Frw
Cost seed potatoes	468,536 Frw
Cost seed potatoes (Frw/kg)	33.51 Frw/kg

Source: ASSR

Commercial seed potato multiplication by farmers' organisations

Certified seed production consists of field-based clonal multiplication and the accompanying quality-control measures. In Rwanda, the policy is to stimulate the formation of seed-grower associations of peasant farmers, which can serve as seed-multiplication agents. Basic seed potatoes are sold to a large number of growers for multiplication.

In other countries, this approach has failed because of farmers' demands for cash during the year, which restrict their ability to hold tubers as seed (Crissman, 1990). In Rwanda, farmers need seed tubers 3-4 times per year so that this risk is smaller. In order to control the seed flows, ASSR is using a network of associations: COODAF, FOR and farmers' syndicate IMBARAGA in Ruhengeri province; BAIR and COODAF in Gisenyi province; World Vision in Gikongoro and Kibuye; etc. These organisations buy basic seed potatoes from ASSR and distribute them to farmers on credit. Farmers reimburse after the harvest in kind. The cooperatives organise storage in their warehouses and again deliver these seed tubers to other groups, and so on. Distribution takes place via existing informal seed flows.

The large number of seed multipliers eliminates the possibility of certification or further testing. With each multiplication, the seed becomes increasingly infected with diseases, reducing its quality as planting material. Three field multiplications (F6, F7, F8) at farm level are not realistic under current Rwandan conditions. A further shift to rapid laboratory multiplication in order to reduce the virus content of certified seed is required. Rapid laboratory multiplication reduces the number of field-based generations necessary to reach a given quantity of seed by improving the efficiency of the first multiplication of seed from its source material (Crissman, 1990).

Effective demand for basic seed potatoes from peasant farmers on a cash basis is very limited. All cooperatives and associations involved in seed production distribute basic seed on credit to their members and these members repay in kind. After the harvest, the associations buy seed potatoes produced, which are stored in the cooperative ware-

house. Since 1997, warehouses for seed tubers have been constructed with financial donor support. These warehouses improved storage quality of seed significantly. As complementary measures, proper crop-husbandry, post-harvest handling and storage should be improved to slow the rate of degeneration.

Weaknesses of the approach are:

- Very small fields and remote locations, which make monitoring and inspection for certification expensive; and a lack of trained inspectors;
- Technical capacity and extension services of farmers' organisations are still weak;
- Dependence on external financing (long-term sustainability in doubt);
- Sub-optimal storage of seed tubers (improvement of management required);
- Farmers' demand is based on the availability of credit (for fertiliser, seed, other inputs).

Table 4.4 shows the cost of on-farm commercial seed multiplication. Approximately 50% of the harvest can be used as seed-potato.

Table 4.4: Cost of on-farm multiplication for basic seed potatoes

	Quantity	Unit cost	Total
Seed	2,000 kg	67 Frw	134,000 Frw
Rent	1 ha	50,000 Frw	50,000 Frw
Labour	233 man-days	300 Frw/day	70,000 Frw
Fertilizer	300 kg	220 Frw	60,000 Frw
Insecticides	2 l Thiodan	8,000 Frw/l	16,000 Frw
Dithane	20 kg	1,760 Frw/kg	35,200 Frw
Total costs			371,200 Frw
Yield	15,000 kg	24.7 Frw/kg	
	20,000 kg	18.7 Frw/kg	

Source: COODAF

4.4 Conclusion

A leading role in the regional ware-potato sector is necessarily based technologically on a strong seed-potato sector. Irish potato is the only segment in the seed sector where Rwanda has long-term comparative advantages to become a major producer in the region. It will take a clear strategic plan and important government (and donor) subsidies in pre-basic seed and basic seed production to achieve this position.

CHAPTER V: SUMMARY OF CONSTRAINTS AND OPPORTUNITIES

The main conclusion of this study is that Rwanda has a long-term comparative advantage in eating-potato and seed-potato production. This section summarizes detailed opportunities and constraints that should be taken into account to generate and maintain this comparative advantage.

5.1 Production strategy and choice of technology for ware potato

Opportunities

- Potato yields are low, but have a significant potential for rapid improvement. Irish potato is the prime candidate for immediate production increases because of its high responsiveness to fertilizer and its geographic concentration, both facilitating a simple demonstration programme (Mellor, 2001a);
- Seasonality: potatoes are produced the whole year long allowing a relatively stable supply of ware and seed potato to markets and processing industries;
- Liberalized input market and profitable opportunities for the private sector in input supply and marketing;
- Farmers easily adopt new potato varieties, while PNAP has a longstanding tradition of introducing new varieties;
- All elements of a production strategy (extension messages, farmers' associations and cooperatives, capacity to produce seed of commercial varieties, urban demand) are available, but coordination is needed to develop: a) a premium-potato market segment (marketability and storability); b) an export quality segment;
- Farmers' associations and cooperatives exist and can be used to organise extension, rural credit, outgrowing, etc. Farmers have a tradition to organise themselves in associations.

Constraints

- Farmers are risk-averse and will not produce a more commercial potato without a guaranteed market;
- Consumers are not used to grading;
- Farmers appear not to have the financial capacity to invest in inputs; innovation in Rwandan agriculture is traditionally introduced by development projects and requires seasonal credit;
- Most peasant farmers are very poor, always in need of cash, and have weak market power;
- No incentives for farmers to improve quality of potatoes; low commercial quality of Irish potatoes because of variety, crop husbandry; perishability, and lack of export quality;
- No market segments for quality potatoes of commercial varieties (except for small quantities imported from DRC);
- Limited area planted in potatoes: expansion of land in the volcanic production zone is physically constrained and compromised by the extension of the area

under pyrethrum; acid soils require adapted (non-commercial) varieties, or the use of 2 tonnes of lime per hectare;

- Farmers typically grow a mixture of varieties; the seed sector is farmer-driven from a food-security perspective, not consumer-driven with commercial perspective, which disappeared after the genocide;
- Poor crop-husbandry, harvesting and post-harvesting technology;
- Widespread bacterial wilt, nematodes and viruses.

5.2 Marketing techniques for ware potato

Opportunities

- Regional market-information dissemination can be developed on the basis of prices provided by national market-information systems in different countries. Evolving technology (internet, email) should be used to make regional spot prices available to traders.
- Presence of ADAR to finance and advise on innovations.

Constraints

- Perishability of the potato. The marketing system for potatoes in Rwanda has characteristics of a typical informal vegetable marketing system: high short-term price volatility, high marketing margins, high profit margins.
- Poor harvesting practices: premature harvesting, no dehalming;
- Poor post-harvest handling;
- Limited farm storage techniques: quality of ware potatoes does not allow storage for longer than 3 days; traditional storage techniques have been abandoned since 1994 because of frequent theft;
- No adapted packaging material (poly-propylene used instead of jute or bamboo);
- General use of 3.5-tonne lorries, which are less cost-effective than larger lorries;
- Widespread scattered production, leading to high rural-collection costs.
- Processing technologies:
 - No industrial processing of potatoes;
 - Organised supply of sufficient quantities of commercial varieties does not exist;
 - Urban demand for processed food and snacks in Rwanda is limited because of the low urbanisation rate and low average income;

5.3 Marketing strategies for ware potato

Opportunities:

- Enhanced competition in Rwandan urban wholesale and retail markets will lead to lower retail prices, higher demand and higher farm-gate prices; significant potential for growth of consumption in urban centres of eastern and southern Rwanda;
- Some demand for a premium potato exists;
- Cooperatives are available as partners to implement marketing strategies;
- Potential export markets are available: Uganda, Tanzania, Burundi.
- Presence of ADAR.

Constraints:

- Atomised structure of traders: too small to innovate marketing;
- Widespread collusion;
- Commercial varieties are not available;
- Food-security orientation of farmers: selling a potato with a high water content is the most lucrative strategy (highest weight).

5.4 Production strategy and choice of technology relative to seed potato

Opportunities

- Rwanda has a long-term comparative advantage in the seed potato sector, but a well-defined government policy is required;
- The size of Rwandan potato output allows development of a seed-potato sector that can be a major player in the regional market;
- Climatic conditions in the volcanic regions permit two crops for selection and multiplication each year;
- Rwandan farmers are receptive to new varieties;
- PNAP/ISAR has enough land for significantly increased multiplication;
- Demand for seed tubers is growing in Rwanda, Congo, Burundi and Uganda;
- Rapid multiplication techniques exist;
- There is high value-added in seed sector (internal rate of return of seed programs in 1970s and 1980s: 40%).

Constraints

- The strategy is not to produce large quantities of certified seeds; only two inspectors are responsible for quality control of seed multiplication;
- PNAP has weak human capacity and a low operational budget, a scarcity of research and extension personnel, and a high dependency on donor financing;
- Project interventions have not led to a sustainable seed programme;
 - long-term viability of farmers' associations depends on external financing;
 - demand for seed potato is directly or indirectly financed by donors.

CHAPTER VI: RECOMMENDATIONS

6.1 Growth path

If agriculture is to play a major role in poverty reduction it must grow more rapidly than population growth (Mellor, 2001a). Rapidly rising farm incomes should provide the purchasing power to drive employment in the rural non-farm sector. The Mellor strategy (2001a) is based on following crops: Irish potato, with a target growth rate of 20%, tea and coffee with 15%, and vegetables and livestock with 8%. Requirements for rapid growth are: a) technological change; b) low transaction costs; c) export commodities to grow faster than domestic demand. Irish potato production can grow quickly because the response to fertilizer is high, farmers already have some knowledge of fertilizer and improved crop husbandry. Mellor (2001a) assumes a basic potato production of 175,000 tonnes in 1999. However, the 1998-1999 production dip was caused by exceptional circumstances (war in Northwest Rwanda). Potato production picked up autonomously in 2000 after the war. Part of the growth has been accomplished in the large (cyclical) increase in 2000. Nevertheless, Irish potato still has to potential to be the basis for a rapid agricultural growth strategy because of its high income elasticity of demand and its widespread consumption in rural and urban areas, as well as its potential in export markets.

Because of the wildly differing estimates of production, acreage and yield (appendix I), a growth path with minimum and maximum range is defined (table 6.1):

- Minimum range is based on the long-term trend of potato production (1966-1994) + area expansion (1999-2000) in Gishwati forest. The basic year (2002) has following characteristics: potato production of 550,000 tonnes; 80,000 ha; 6.9 tonnes/ha;
- Maximum range is based on HLCS survey results (2000). Basic year (2002) has following characteristics: potato production of 730,000 tonnes; 92,000 ha; 7.9 tonnes/ha.

A stagnation of potato production is assumed in 2001-2002, after the explosive growth in 2000. Total production might even fall back (potato cycle) in 2002, because the 2000 expansion partially took place in areas that will face decreasing fertility without fertilizer use (see: chapter II). Furthermore, pyrethrum is expanding again, which traditionally results in a lower potato production.

For the period 2002-2020, a demand growth of at least +200-250% is expected (see: chapter I). A strong GDP-growth might even result in a much stronger growth of demand for potatoes.

The expected potato output growth cannot be based on yield increases alone. An area expansion of 3% per year is assumed. The same annual growth rates for output, yield and acreage are assumed in both scenarios. The area expansion is realistic, as substitution of sweet potato and beans with Irish potato in farming systems will take place in the future. Income growth will lead to a partial substitution of sweet potato and beans in urban and rural diets. In addition, the use of lime on acidic soils will again result in an expansion of potato cultivation.

An action plan, consisting of three phases is proposed. Targets and timing are summarized in table 6.1. Output growth rates are: 11% during phase I, 16% during phase II, and 5% during phase III. Expansion of area is 3% per annum during the period 2002-2020. Yields are assumed to rise from the range of 6.9-7.9 tonnes/ha in 2002 to 15.7-18.7 tonnes/ha in 2020.

PHASE I (2002-2004): During the first two years, the components of the strategy are put into place. During the period 2002-2004, the strategy gains momentum with a growth rate of 11% per year. Crucial measures are the following:

- Productivity (tonne/ha) should increase with demonstrations of fertiliser, seed potato, pesticides and lime, combined with seasonal credit. Yield targets are in the range of 8.0-9.2 tonnes/ha in 2004. The interventions will first target the volcanic soils, and expand further to Byumba, Gishwati Forest and the Congo/Nile Divide (details: see section 6.2).
- A market segment of more commercial potato varieties (in terms of storability and marketability) should be developed and strengthened step-by-step. Publicity and advertisements are required to improve visibility of “premier-quality” potato. Extension of harvest and post-harvest technology. Tenders with public funds (hospitals, army, university) would help develop this market channel (by specifying specific varieties and quality) (details: section 6.3). The export-quality segment can be developed independently from the premier-quality segment.
- The seed potato sector should produce sufficient seed tubers of commercially oriented varieties.
- Partnership (donors, cooperatives, government) to implement the strategy.
- Start of interventions to strengthen market power of peasant farmers.
- Start of interventions to enhance competition in Rwandan wholesale and retail potato markets;
- Preparation investments in a national potato wholesale market in Kigali (details: section 6.3).
- Pilot projects in export markets (Burundi, Tanzania, Uganda).
- Policy level: strategic planning of ware-potato and seed-potato sector + analysis of comparative advantage + future of Gishwati forest (details: section 6.5).

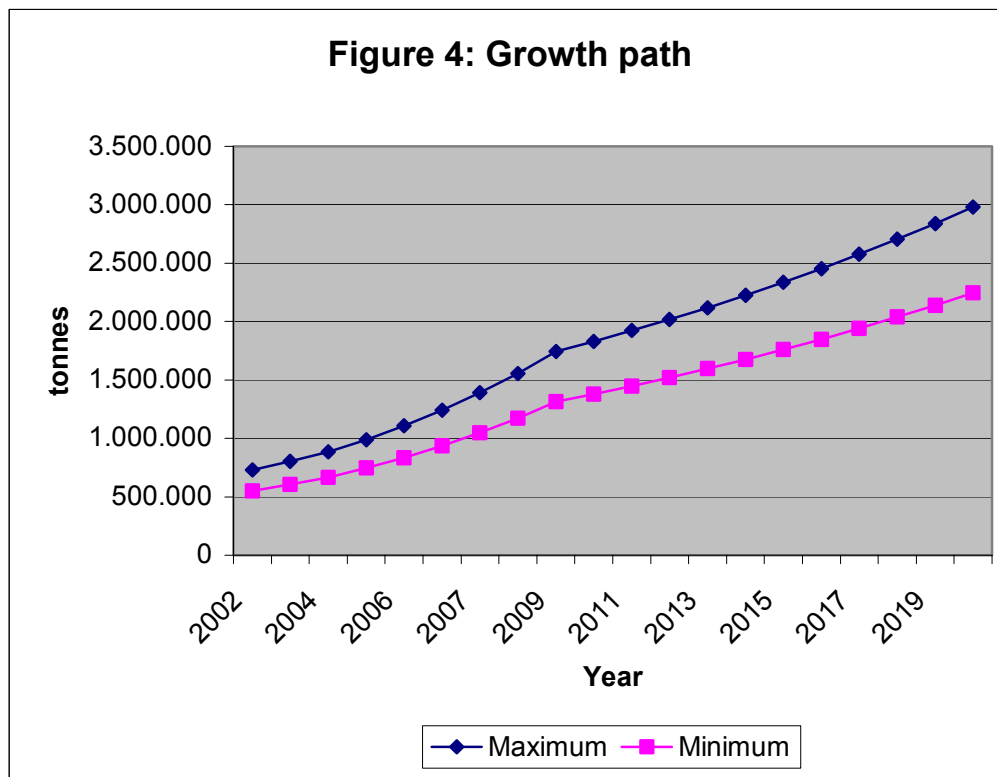
PHASE II (2005-2008): A very high growth rate is assumed (16%) during a 4-year period. The interventions, started during phase I, now have their full impact and are reinforced:

- Expansion of efforts at farm level to medium-potential areas. In areas with acid soils, higher yields will require a massive use of lime. Specific subsidies as part of an anti-poverty measure might be justified. Expansion to lowland would be possible at this stage but requires further analysis.
- New potato wholesale markets should become operational.
- Networks of brokers and wholesalers in export markets of ware and seed potato should become operational.
- Potato processing: the private sector plays a leading role in the investment. Donor subsidies (import subsidies for equipment) provided. Government has to complement the private-sector activity to ensure rapid growth (through tax holidays, etc.).

PHASE III (2009-2020): Consolidation of the interventions. A slower growth rate (5%), but still higher than the population growth rate, is expected for the period 2009-2020.

Table 6.1: Growth path

<u>Potato cultivation</u>	Minimum			Maximum		
	Production (tonnes)	Acreage (hectares)	Yield (t/ha)	Production (tonnes)	Acreage (hectares)	Yield (t/ha)
2002	550,000	80,000	6.9	730,000	92,000	7.9
2008	1,226,989	95,524	12.9	1,628,549	109,853	14.8
2020	2,203,496	136,195	15.7	2,924,640	156,624	18.7
2020 ware-potato	1,762,797			2,339,712		
2020/2000	+201%	+70%	+135%	+201%	+70%	+135%
<u>Growth rates</u>						
2003-2004	11%	3%	7.8%	11%	3%	7.8%
2005-2008	16%	3%	11.7%	16%	3%	11.7%
2009-2020	5%	3%	1.0%	5%	3%	1.0%



6.2 Changes in production to better meet anticipated demand for ware potatoes

1. Higher potato yields (productivity) are required to meet future demand and to improve rural incomes. The following actions are recommended:

- Increase use of inputs (fertiliser, pesticides, seed tubers, lime) supported by appropriate seasonal credit. A fertiliser and pesticide subsidy is not necessary and probably not desirable.
- Organise farmers into associations that are the basis for extension and access to credit.
- Continue distribution of seed tubers and renew varieties in order to minimize seed degeneration and the spread of diseases.
- Increase numbers of demonstration plots; concentration of fertilizer demonstrations in volcanic potato areas; fertilizer-lime demonstrations on acid soils (Gishwati Forest, Congo/Nile Divide, Byumba).
- Lime-subsidies might be an option to recapitalise family farms on the Congo/Nile Divide: a lower soil acidity (higher pH) implies a higher commercial value of agricultural land.
- Strengthen extension services, with more attention to harvesting and post-harvest technology.
- Ensure partner collaboration: Government, donors, ARMDP, PGERB, farmers' associations and cooperatives.

During PHASE I, these measures will focus on the volcanic soils.

2. Regional differences should be taken into account (PHASE II)

- Volcanic soils have the highest agricultural potential: focus on fertilizer, pesticides, healthy seed potatoes, seasonal credit. A lack of respect for rotation leads to pressure from diseases and pests;
- Much the same can be said for acid soils, but they also require specific credit for lime, possibly via promotion of lime extraction as an externally-funded, labour-intensive activity and subsidised transport; 2 tonnes of lime per hectare (60,000 Frw) is recommended;
- For lowland cultivation, use of fertiliser and pesticides is profitable in Gitarama (Kelly et al. 2000); bacterial wilt is a problem and requires frequent renewal of seed;
- Analysis of the comparative advantage of different crops is recommended in order to refine the present Government Strategy to limit potato production to highlands.

3. Environmental protection is important (PHASE I-II-III):

- A lack of respect for crop rotation leads to soil degradation: adequate extension is required;
- Deforestation of Gishwati Forest leads to soil degradation, erosion and increasing soil acidity. Urgent measures are required: Government should take and implement a decision on the future of Gishwati Forest;
- Use of bamboo as a packaging material could have environmental implications. In the case of successful use, bamboo plantations are required.

6.3 Private-sector marketing of untransformed ware potatoes

4. Develop market segments for export and premier quality potatoes. At present, only market segments for average-quality potatoes exist. The following categories could be developed:

- | | |
|---|-----------------------------|
| • Export quality (1% market share) | retail price: 80-100 Frw/kg |
| • Premier-quality (5-10% market share) | retail price: 45-65 Frw/kg |
| • Average quality (80% market share) | retail price: 35-40 Frw/kg |
| • Low quality (small tubers) (15% market share) | retail price: 30-35 Frw/kg |

The premier-quality potato responds to the urban consumer's requirements (PHASE I): a) a commercial variety (*Victoria, Sangema, Maryline*, etc..) with good storability and high dry-matter content; b) oblong shape, red skin; c) a homogeneous bulk product that can be marketed via existing marketing channels; d) using adapted packaging material (jute); e) with well-dried potatoes, large and medium size tubers. Production is justified if a premier quality potato at farm gate gets 7-10 Frw/kg (i.e. +30%) more than an average quality potato. The higher price should compensate farmers for: a) the use of commercial varieties and quality seed potatoes; b) improved crop husbandry (including fertiliser, pesticides; and dehalming, which gives slightly lower yields). In order to develop the premier-quality market segment, a partnership led by cooperatives, with MINAGRI, projects, ADAR and the private sector is required to:

- Increase urban demand – advertising and publicity are required;
- Improve harvesting methods (dehalming) for higher dry-matter content and firm skin, so that storability is improved;
- Import and popularise new packaging material (jute sacks);
- Organise outgrower schemes in order to a) supply farmers with seed tubers; fertiliser, pesticides, extension; b) standardize raw material (differentiation according to size);
- Organise a well-equipped sales outlet in Kigali (preferably in Nyabugogo, near the existing wholesale market, so that the visibility is high during the initial period).

Develop export channel on the basis of the premier-quality market segment (PHASE II).

The export-quality segment is being developed by Volcano Potato, with support from ADAR. Potential clients are: supermarkets, hotels and restaurants, export markets. An excellent vertically-integrated strategy has been developed with following basic elements: a) organisation of production; b) post-harvest handling and conditioning; c) market recognition; d) sustainable financing (PHASE I-II-III).

5. Strengthen market power of peasant farmers in rural assembly markets (PHASE I-II):

- Promote decentralised storage facilities for storage of up to 3 days, in order to bulk produce; farmers' groups, cooperatives, or even traders, should manage these facilities. Farmers' associations should compete with rural traders and bulk their produce themselves in order to receive a price that is 2-3 Frw/kg higher (+ 10-15%).

- Encourage farmers (via extension workers) to organise associations in order to strengthen their market power.
- Investments in transport equipment by small cooperatives should not be encouraged.
- Speculative storage (for longer than 4 days) should not be encouraged, as seasonal price fluctuations are unstable and irregular, and potatoes spoil.
- Government should not act as buyer of last resort for ware potatoes when prices are falling. Storability of potatoes is very low, so that storage losses could be very high.

6. Enhance competition in urban wholesale and retail markets in order to decrease marketing margins and boost potato consumption (PHASE I-II):

- Encourage new entrants (farmers' cooperatives) in Kigali and Butare wholesale markets.
- Improve wholesale-market infrastructure in Kigali (paving & roofing, parking and loading space); investment financed by government & donors, with private-sector contribution. Wholesale trade of potato, the most important starchy staple in Kigali, is currently organised on the edge of the road.
- Offer space to Nyabugogo and Giticyinyoni traders and others in the improved potato-wholesale market.
- Offer annual leases for space in the new market on an auction basis, so that aspiring new entrants do not meet barriers to participation in this area.
- Take similar steps to enhance competition in other urban centres (Butare, Gitarama, Kibungo).

7. Develop export markets (PHASE II-III)

- Develop market segments of premier-quality and export quality potatoes in the home market, which allows Rwanda to be competitive in export markets during a second phase.
- Regional market information should be made accessible to traders. In most neighbouring countries market information systems are operational. Modern communication technology (email, internet) allows organizing accessible and up-to-date price information that might boost regional trade. Key role for: the Rwandan market information system in order to give Rwandan traders a comparative advantage; or for PRAPACE in order to stimulate regional market exchanges (premier-quality and export quality potatoes).
- Outside support in order to organise supply chains during start-up (market studies, advertising, travel costs); ADAR is already playing a key-role in Rwanda (export quality potatoes).
- Required raw-material for export (except for informal border exchanges) to Uganda, Kenya and Tanzania is not available; outgrower schemes should be organised by farmers' organisations to produce formal-sector, high-quality potatoes for export; a partnership between cooperatives - PNAP -private sector – donors (e.g. Volcano Potato).
- Exports to neighbouring countries require local agents in the destination markets. Outside support for cooperatives is required during the start-up phase to identify these agents (premier-quality potatoes).

6.4 Private-sector processing of ware-potato

8. Potato Enterprise s.a.r.l. is preparing an ambitious investment in a chip processing factory with a capacity of 14,400 tonnes of chips per year after ten years. (PHASE II-III)

- Collaboration with cooperatives is required to organise a steady supply of high-quality raw material (via outgrowers); this could be combined with seed-potato multiplication, as only large-size tubers are required for processing.
- Collaboration with PNAP and ASSR (SNS) is required to identify suitable varieties and organise basic seed supply. Renewal of seed tubers.
- Government can assist with training of extension workers, access to seasonal credit, etc.
- Outside support (perhaps via ADAR) during start-up for one-time costs (development of distribution channels). Development of international distribution channels will require major efforts.
- Government measures: tax incentives (corporation tax holidays and exemption of equipment and packaging material from import taxes).

9. Facilitating technology transfer to strengthen processing: for example small-to-intermediate scale processing equipment and expertise (PHASE I-II-III):

- Via COODAF and other cooperatives.

6.5 Public-sector policies and strategies for ware- and seed-potato

10. Develop a sectoral strategy for the potato sector (ware and seed potatoes). The cost of the strategy needs to be integrated into the expenditure programme of MINAGRI. MINAGRI (Department of Extension and Marketing, Department of Planning and Agricultural Statistics) should involve all stakeholders in order to develop an action plan for the Rwandan potato sector. Define the role for government (MINAGRI, and province & district levels) in the sector of ware-potato production. (PHASE I)

11. Develop capacity to play a profitable regional role in basic and commercial seed-potato multiplication, or encourage the private sector to play a regional role in commercial seed-potato multiplication. (PHASE I)

12. Strengthen the Extension and Marketing Department (MINAGRI). A separate Marketing Department should be created. The department would take responsibility for a) a market information system; b) monitoring input markets; c) facilitating development of marketing skills in co-operatives; d) rural credit (PHASE I-II).

13. Government should impose quality requirements (commercial varieties, high dry-matter content) for all public tenders (university, army, etc.) in order to stimulate production of premier-quality potatoes. It should be organised in a progressive way, first focusing on packaging material (jute sacks), commercial varieties and in a second phase on dry-matter content (dehalming). (PHASE II-III)

14. Guarantee the future of a Rwandan market information system (PASAR) and facilitate the creation of a regional market information system for potential export crops, particularly potato (PHASE I)
15. Reassess the comparative advantage of lowland potato cultivation. If lowland cultivation appears competitive, refine current government policy. (PHASE I-II)
16. More research on potato consumption in Rwanda (MINIPLAN). An in-depth analysis of Household Consumption Survey (EICV) data would allow the development of a detailed profile of the Rwandan potato consumer. (PHASE I)
17. Analyse the economic, commercial and financial impact of lime on the Rwandan family farm, and the feasibility of Government (or donor) subsidies for lime. On the Congo/Nile Divide, the use of lime is probably one of the most effective measures to reduce rural poverty.
18. Study the impact of lower import taxes on equipment and packaging materials, and export taxes on processed food items.

6.6 Changes in production to better meet anticipated demand for seed- potato

19. Develop a national seed potato strategy and identify Government objectives. Provide required budgets to PNAP and SNS to implement the strategy. (PHASE I)
20. An export strategy should be developed with the largest cooperatives (e.g. COODAF). Partnership: cooperatives, Government, private sector. (PHASE II)
21. Basic seed multiplication (PHASE I-II):
 - Continue efforts to introduce new varieties on a continuous basis.
 - Increase step-by-step market share of more commercial varieties.
 - Strengthen capacity for rapid multiplication so that less multiplication at farm level is required.
 - Strengthen market share of private-sector multipliers of commercial seed potatoes.
22. Limit the tasks of SNS (certification production and marketing of basic seed, marketing of commercial seed). Give the private sector responsibility for marketing of seed potato (PHASE I).
23. Give SNS access to enough land for seed-potato multiplication (PHASE I-II).
24. Strengthen PNAP (PHASE I-II-III).
 - Develop a long-term strategy to build human capacity.
 - Strengthen the integration of PNAP into regional and international networks.
 - Benefits from sales of pre-basic seed realised by ISAR should be reinvested in PNAP.

6.7 Private-sector marketing of seed potatoes

25. Make cooperatives and associations more effective (PHASE I-II)

- Play facilitating role in basic seed multiplication (bring actors together, info dissemination, training of extension workers);
- Encourage farmers to form farmers groups;
- Supply appropriate seasonal credit.

26. Abolish monopolies for basic seed multiplication, but strengthen certification and quality control. (PHASE I-II)

- Private seed multiplication will be characterized by serious moral hazard problems: cheating on quality. Therefore, quality control should be strengthened.
- Unorganised seed multiplication on small plots with a lack of respect for rotation could lead to contamination of soils with potato viruses and diseases.

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Appendix I: Rwandan potato production statistics: comments

Table 0.1 presents potato production and area data in the post-war era from three statistical sources.

1. Since 1996, PASAR and FEWS have made pre-harvest crop assessments that are used as official agricultural production statistics. PASAR data show a jump of production from 176,000 tonnes in 1999 to 954,000 tonnes in 2000 and area expansion from 29,771 hectares to 108,983 hectares. In 2001 production amounted to 989,021 tonnes (these statistics are presented in the annual report of the Rwandan Central Bank). Personally, I have the impression that the total area allocated to Irish potato is not realistic. The expansion between 1999 and 2000 is not plausible. The average yield per hectare is rather high, but might be realistic. However, a total production of 954,418 tonnes implies a national annual consumption of 100 kg/person. This is not realistic as national average.
2. FSRP organised a national survey in 2000. A sample of 1,584 households was visited and harvested units for different crops were counted. MINAGRI (in collaboration with MSU/FSRP) used the survey methodology in the late 1980s to measure agricultural production on a larger sample of rural households. FSRP mentions a total production of 320,149. The total area allocated to potato is realistic, but an average yield of 4 tonnes per hectare is extremely low; too low according to most observers in the sector. Furthermore, the production gap between production and consumption (MINIPLAN) is significant.
3. Preliminary results of the Household Living Condition Survey (MINIPLAN) indicate a national annual potato consumption of 603,000 tons in 2000. Including seed potatoes, national potato production is estimated at 730,000 tons per year. On the basis of production, area can be estimated somewhere between PASAR and FSRP estimates (92,000 hectares) and yield (7.9 tonnes/ha).

Table 7.1: Annual potato production in 1999-2000

	Methodology	1999	Production 2000	Area 2000	Yield 2000
1. PASAR (MINAGRI)	Crop assessments	175,889	954,418	108,983	7,9
2. FSRP (MINAGRI)	Production survey (1,584 households)		320,149	79,130	4
3. EICV (MINIPLAN)	Household Living Condition Survey (6,000 households)		730,000*	92,000**	7.9**
4. Long-term trend (1966-1996) + expansion in Gishwati forest in 1997-1998-1999			550,000	80,000	6.9

*national potato consumption (603,000 tonnes) + 20% seed tubers

** personal estimate

Appendix II: Market participants by name and firm

Rwandan traders

- Rwandan Private Sector Federation (Pipiani Hakizabera)
- Emballage Rwanda, Kigali (Evase Nsengimana)
- Potatoe Enterprise s.a.r.l., Kigali (Célestin Semuhungu)
- Association DUFATANYE, Nyabugogo market, Kigali (Aloys Mbarara)
- Association TURWANYINZARA, Nyabugogo market, Kigali, Mme Bazirete Zipora)
- Jonas Ngarambe, potato trader, Gisenyi
- Mwiseneza Eugène, potato trader, Butare
- Ndejuru Michel, potato trader, Butare
- Rutabingwa Hormisdas, UNR restaurant manager, Butare

Non-Rwandan traders

- Steven Timarabona, Ugandan Seed Potato Producers' Association
- Ntirandekura Macaire, Burundian trader
- Mutaba Herman, DRC trader

Co-operatives & associations of farmers

- COODAF, Ruhengeri (Théonase Ngwanayo)
- Association IMBARAGA, Ruhengeri, Mme Marie Nyirarwimo
- Association BAIR, Gisenyi (Anselme Nzabonimpa)
- Forum des Organisations Rurales (FOR), Ruhengeri (Faustin Musanganya)
- KAIGA farmers' association, Rwerere
- ATC farmers' association, Gisenyi
- UAKA farmers' association, Kayove

Seed potato sector

- PNAP (Ntizo Senkesha)
- ASSR (Pierre Lepoint)

NGOs

- World Vision, Butare (Thadee Mariro)
- CARE, Kabale, Uganda (Mme Signe Jensen)

Appendix III: Growth path (2002-2020)

Year	Area		Output		Yield		Growth rates		
	Maximum	Minimum	Minimum	Maximum	Minimum	Maximum	Output	Area	Yield
2002	92.000	80.000	550.000	730.000	6,88	7,93			
2003	94.760	82.400	610.500	810.300	7,41	8,55	11%	3%	7,8%
2004	97.603	84.872	677.655	899.433	7,98	9,22	11%	3%	7,8%
2005	100.531	87.418	786.080	1.043.342	8,99	10,38	16%	3%	12,6%
2006	103.547	90.041	911.853	1.210.277	10,13	11,69	16%	3%	12,6%
2007	106.653	92.742	1.057.749	1.403.921	11,41	13,16	16%	3%	12,6%
2008	109.853	95.524	1.226.989	1.628.549	12,84	14,82	16%	3%	12,6%
2009	113.148	98.390	1.288.338	1.709.976	13,09	15,11	5%	3%	1,9%
2010	116.543	101.342	1.352.755	1.795.475	13,35	15,41	5%	3%	1,9%
2011	120.039	104.382	1.420.393	1.885.249	13,61	15,71	5%	3%	1,9%
2012	123.640	107.513	1.491.413	1.979.511	13,87	16,01	5%	3%	1,9%
2013	127.350	110.739	1.565.983	2.078.487	14,14	16,32	5%	3%	1,9%
2014	131.170	114.061	1.644.282	2.182.411	14,42	16,64	5%	3%	1,9%
2015	135.105	117.483	1.726.496	2.291.532	14,70	16,96	5%	3%	1,9%
2016	139.158	121.007	1.812.821	2.406.108	14,98	17,29	5%	3%	1,9%
2017	143.333	124.637	1.903.462	2.526.414	15,27	17,63	5%	3%	1,9%
2018	147.633	128.377	1.998.635	2.652.734	15,57	17,97	5%	3%	1,9%
2019	152.062	132.228	2.098.567	2.785.371	15,87	18,32	5%	3%	1,9%
2020	156.624	136.195	2.203.496	2.924.640	16,18	18,67	5%	3%	1,9%
Growth rate	70%	70%	3014%	301%	135%	135%			

Appendix IV:

Nominal Prices of Potato in Rwandan Francs (FRW/Kg) by Province, Rwanda, 1997-2001.

Year	Trimester ¹	Prefecture												National Average
		Butare	Byumba	Cyangugu	Gikongoro	Gisenyi	Gitarma	Kibungo	Kibuye	Kigali Rurale	Kigali Ville	Ruhengeri	Umutara	
1997	97Trim1	44	33	45	35	22	42	55	39	40	36	23	48	38
	97Trim2	54	50	62	53	30	53	65	59	52	44	35	59	51
	97Trim3	72	70	79	73	43	68	80	75	69	63	48	73	67
	97Trim4	93	78	99	95	62	88	101	86	94	90	68	90	87
1998	98Trim1	104	82	108	107	83	105	109	83	104	109	81	81	98
	98Trim2	127	99	120	122	84	115	125	97	120	115	78	104	108
	98Trim3	104	90	113	100	66	103	103	76	103	96	76	94	93
	98Trim4	79	69	73	59	51	71	79	56	80	74	57	68	68
1999	99Trim1	68	47	48	51	36	58	63	43	63	54	40	58	53
	99Trim2	60	50	56	50	38	55	64	44	55	54	41	59	52
	99Trim3	62	48	54	45	37	59	63	40	58	56	40	60	52
	99Trim4	49	40	44	42	27	42	53	30	40	41	30	54	41
2000	00Trim1	34	29	35	33	19	32	37	25	34	32	21	40	31
	00Trim2	37	27	38	31	20	33	35	26	33	31	21	36	31
	00Trim3	45	37	43	38	25	42	40	31	42	40	27	41	38
	00Trim4	57	46	58	45	33	47	57	40	49	49	37	57	48
2001	01Trim1	51	40	47	40	31	47	53	36	48	46	32	51	44
	01Trim2	55	43	51	46	35	49	53	37	50	48	37	53	46
		Butare	Byumba	Cyangugu	Gikongoro	Gisenyi	Gitarma	Kibungo	Kibuye	Kigali Rurale	Kigali Ville	Ruhengeri	Umutara	National Average
	1997	66	58	71	64	39	63	75	65	64	58	43	68	61
	1998	102	84	102	96	69	97	103	78	100	98	73	83	91
	1999	59	46	50	47	35	54	60	39	54	51	38	58	49
	2000	43	34	44	37	24	38	42	31	39	38	27	44	37
	2001	53	41	49	43	33	48	53	37	49	47	35	52	45
		65	54	64	58	40	60	68	51	61	59	44	59	57

Appendix V: Potato production, area, yields (1966-2000)

Year	Area production (hectares)	tonnes	Yield tonnes/ha
1966	14,000	57,000	4.07
1967	16,500	107,300	6.50
1968	17,200	78,750	4.58
1969	17,200	129,000	7.50
1970	18,000	126,000	7.00
1971	21,170	148,190	7.00
1972	18,776	131,432	7.00
1973	19,286	140,116	7.27
1974	20,111	109,621	5.45
1975	35,867	149,745	4.18
1976	37,000	169,766	4.59
1977	38,000	177,250	4.66
1978	30,000	218,703	7.29
1979	33,500	214,917	6.42
1980	32,040	217,060	6.77
1981	40,668	254,113	6.25
1982	40,332	268,800	6.66
1983	36,625	224,700	6.14
1984	40,465	263,200	6.50
1985	47,112	335,420	7.12
1986	38,096	288,700	7.58
1987	37,809	267,120	7.06
1988	38,000	262,245	6.90
1989	39,456	266,340	6.75
1990	42,055	319,000	7.59
1991	45,500	400,000	8.79
1992	46,700	347,000	7.43
1993	45,500	204,159	4.49
1994	32,398	149,070	4.60
1995	41,567	137,700	3.31
1996	42,385	195,381	4.61
1997	42,000	229,625	5.47
1998	28,264	181,138	6.41
1999	29,770	175,889	5.91
2000	92,000	730,000	7.93