



**IMPACT OF FARMER SUPPORT AND SOCIO-ECONOMIC FACTORS ON  
AGRICULTURAL PRODUCTION IN GIKONGORO PROVINCE, RWANDA**

BY

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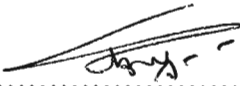
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## DECLARATION

I hereby certify that, unless specifically indicated to the contrary in the text, this dissertation is the result of my own original work, and it has not previously been submitted for a degree in this or any other university.

Signed:  .....

Alfred Runezerwa Bizosa

I hereby certify that the above statement is correct.

Signed:  .....

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## ABSTRACT

Rwanda, in its transition phase since 1994, has had the support of major international development organizations, including the World Bank, the International Monetary Fund (IMF), the United Nations Development Program, the US Agency for International Development (USAID), and other development organizations. The aim of this support is to promote Rwandan agriculture in which 45 percent of the Rwandan GDP and 90 percent of employment share originate. The possible role that farmers can play in this process through their small-scale farmers' associations is well recognized by the Ministry of Agriculture in Rwanda.

Farmers in Gikongoro province, the study area, are constrained by many factors, such as soil infertility, small land areas, and lack of access to modern inputs (e.g., seed, fertilizer and lime) and agricultural credit. In addition, land degradation in the form of soil erosion, soil acidity, and nutrient depletion undermines soil productivity leading to poor crop yields, and keeps farmers dependent on potential support from government and non-governmental projects. Between 2000 and 2004, farmers in Gikongoro province received support from the Development Activity Program (DAP) under the umbrella of World Vision International, Rwanda. The DAP supports farmers mainly in land terracing for soil erosion control, and supported farmers also receive modern inputs (fertilizer, seed and lime), storage facilities, and training.

This study analyzes the impact of agricultural assistance afforded by the DAP and socioeconomic characteristics of households on agricultural production in Gikongoro province. Data for this study were collected from July to August 2004 using a stratified multistage sample of 204 household heads who are members of 24 farmers' associations of which 10 are supported by the DAP in the three districts; Mudasomwa, Kivu, and Nyamagabe. The study compares DAP supported and unsupported farmers in terms of differences in household incomes and crop yields. Descriptive statistics indicate that DAP supported farmers have significantly higher yields, household income, and better access to modern inputs and terraced land than unsupported farmers. These results seem to indicate that DAP support has had a

significant impact on agricultural production and household incomes in Gikongoro province. However, these results are based only on a univariate analysis.

The relationship between socioeconomic characteristics and household potato production in Gikongoro province was also analyzed to identify other factors that affect food production. A recursive system of linear and log-linear equations was estimated to analyze the effects of DAP, cultivated potato area, liquidity, gender of the household head (producer), years of schooling, family size, and age of the producer on farmers' productivity as measured by potato yields. Investment in operating inputs (fertilizer, seed, and lime) was used as a determinant of potato yields. Results indicate that cultivated potato area, liquidity, family size, and age (greater experience and lower transaction costs) of the household head significantly increase the use of operating inputs, which in turn has a significant positive impact on potato yield. The study suggests that DAP may need to be more selective in supporting farmers, focusing more on the farm size, education and family size profile of association members when deciding where to channel support. The study also recommends more research into the efficiency of land rental and credit markets to better understand land and liquidity constraints to improved household production in Gikongoro province. A networking model for supporting farmers' associations is proposed, in which a joint role for the Rwandan government, academic and research institutions, NGOs, and the private sector is expected to lead to sustainable agricultural development in Gikongoro province, Rwanda.

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## INTRODUCTION

Lack of access to agricultural production resources in the right quality and quantity has been a major constraint to the increase of agricultural production in most African countries (Spio, 1996, citing FAO, 1987). Seyoum *et al.* (1998) state that the relatively low level of agricultural production in Africa reflects low levels of technical efficiency and use of outdated technology. After the 1994 Rwandan war and genocide, the priority of the Rwandan government in networking with developmental activity projects was to rebuild the agricultural sector, which employs 90 percent of the Rwandan labour force (MINECOFIN, 2002). After the war, most international NGOs, such as the Agency for Cooperation and Research in Development, Action Aid, Australian Help Program, Care International, Catholic Relief Service and World Vision International, Rwanda were interested in supporting activities that could promote the long-term development of the country. Intervention was mainly in areas such as agriculture, soil protection, food security, input trade, seed multiplication, support of small farmers' associations, education and health, community capacity building, construction and infrastructure rehabilitation (Bingen & Mpyisi, 2001).

In the agricultural sector in Rwanda, most of the developmental projects deal with food security activities such as food distribution, provision of agricultural credit in terms of modern inputs (e.g., fertilizers, improved seeds and lime), construction of storage facilities, and training. However, there are also other organizations in partnership with the Rwandan government, such as the World Bank, International Monetary Fund (IMF), the US Agency for International Development (USAID), and the United Nations Development Program (UNDP), that are not directly involved in small projects. The World Bank and the IMF are assisting the Rwandan government in macroeconomic, structural and social policies aimed at promoting growth and poverty reduction. The USAID deals with various activities in regard to health, agriculture, democracy, and good governance. The UNDP is supporting the Rwandan government in various activities related to good governance, poverty reduction, information and communication technology.

Currently, the Rwandan policy on agricultural development is aimed at expanding agricultural activities and also promoting the development of related sectors of the

economy. Different actions are proposed for the implementation of this agricultural policy, namely: rehabilitation of production support infrastructure (e.g., roads), use of improved agricultural inputs (e.g., improved seeds) to increase yields of food and cash crops, training farm extension agents, legislative reform (such as land tenure reform) to facilitate private investment, and involving farmers' associations in this process (MINECOFIN, 2000). The implementation of this strategy is a long-term process, and to enable this to become a reality requires access by rural households to education, sufficient and quality food, health facilities, and transport and communication infrastructure.

Agricultural production requires access to traditional factors such as land, labour, capital and financial resources (Berkeley & Derek, 1987; Ismail, 1998). The 1994 genocide in Rwanda severely disrupted agricultural production because all production resources were negatively impacted and their accessibility and availability were constrained. Apart from losses in human capital, land ownership became a source of conflict between those who were in the country during the war and other Rwandese who returned after the war from neighbouring countries (mainly Uganda, Burundi, Tanzania, and the DRC).

Rwanda, with a population of about 8.3 million, is stratified into 12 provinces, which are generally mountainous and characterized by low soil fertility and high soil erosion caused by the hilly topography, high rainfall, inappropriate water management, and a lack of soil protection infrastructure. Low soil fertility and high soil erosion are likely to have a significant impact on agricultural production (Battelle Memorial Institute, 1983: 29-37). To improve soil fertility and to control soil erosion, actions from government and non-governmental projects, such as providing fertilizers and irrigation, extension services, and credit facilities have been attempted (Grepperud, 1995). Farmers in Rwanda, as in Ethiopia, are encouraged to maintain erosion control infrastructures once these have been installed by government or non-governmental projects through Food-For-Work incentives (Shiferaw & Holden, 2000).

Food aid agencies such as the World Food Program (WFP) and USAID have extended food aid to the use of food in supporting various development activities. This support is channeled by development projects to various activities where food is paid as wages to the community that has actively participated in development activities. This system of paying workers with food becomes a substitute to, or a complement of, the payment of labour in cash, especially in the agricultural sector. Therefore, two systems of labour payment are currently applied in the labour market in Rwanda, namely Food-For-Work (FFW) and Cash-For-Work (CFW).

Rwanda has applied the FFW system in its agricultural sector through the international NGOs and the Ministry of Agriculture. International agents get involved in terrace construction on behalf of the local population for various reasons. The targeted population is very poor while land terracing is very demanding in terms of labour; hence it is difficult for landowners to pay for this labour (Mkhabela, 2002). Furthermore, there is need in rural areas for technical support of development projects. Food insecurity is also a reason for providing food to those involved in terrace construction.

Gikongoro province in Rwanda, the location of this study, has been characterized by chronic food insecurity before and after the 1994 genocide. Based on the land characteristics (soil acidity, hilly topography) of this province, the level of food production has been and still is constrained by poor soil fertility and soil erosion that leads to low annual average crop yields of staple food (Nyarwaya *et al.*, 2002; Pender *et al.*, 2004). At present the population in Gikongoro province is estimated at 490,607 (MINECOFIN, 2003a). Given that the agricultural sector is the main source of subsistence food and income of this population, a sustainable system of agriculture is one of the priorities of the government. Farmers are supported not only by government projects initiated by the Ministry of Agriculture, but also by international NGOs such as the Development Activity Program (DAP) under the umbrella of World Vision International Rwanda.

The DAP as a Food-For-Work oriented project deals with soil protection (through land terracing), provision of modern inputs (e.g. seed, fertilizer and lime),

construction of storage facilities, and training in supporting farmers' associations and member households to improve their level of agricultural production and incomes. The targeted provinces of the DAP project in Rwanda include Butare and Gikongoro in the south, and Ruhengeri and Byumba in the north. Gikongoro province is generally known as the poorest province in Rwanda, and is the most targeted province with respect to DAP support. Specific objectives of this DAP project are: (a) to increase the average annual yields of potatoes, beans, wheat, and maize; (b) to increase the adoption by target farmers of improved cultivation techniques, including bench or progressive terracing and planting of conservation crops; (c) increased income from sales of key agricultural products; and (d) improved soil fertility (World Vision International Rwanda, 1999).

The overall objective of this study is to analyze the impact of agricultural assistance by the DAP and socio-economic characteristics of households on agricultural production in Gikongoro province. The specific objectives are: (1) to identify the support provided to farmers' associations by the DAP project and its impact on household production; (2) to establish if there is a significant difference in terms of yield and access to operating inputs by the DAP supported farmers compared to those not supported; (3) to identify gaps in developmental assistance through FFW projects and recommend measures for a sustainable system of agricultural assistance; (4) to analyze the relationship between socio-economic characteristics and household potato production in Gikongoro province; and (5) to recommend policy measures towards sustainable agriculture in Gikongoro province.

Appropriate research hypotheses to analyze the impact of DAP support and socio-economic characteristics on household potato production in Gikongoro province are as follows:

*Hypothesis (1): Agricultural assistance through FFW projects allows targeted households and farmers' associations to increase their level of agricultural production.*

*Hypothesis (2): Investment in operating inputs (fertilizer, seed, and lime) depends on the socio-economic characteristics of the household, support by the DAP project, and*



*location. This investment, in turn, influences household potato production in Gikongoro province.*

The achievement and verification of the research objectives and hypotheses are motivated by the following questions: (1) what has the DAP project done to help farmers' associations gain access to agricultural resources for the increase of agricultural production? (2) Is there any significant difference in crop yield of members of DAP supported farmers' associations compared to members of the unsupported farmers' associations? (3) What other factors affect household food production in the study area? and (4) What can be done to promote a sustainable agricultural system in Rwanda?

The first chapter provides some general characteristics and current socio-economic challenges of the Rwandan economy. This sets the background to the study where limitations related to the agricultural sector are highlighted and key reasons for international assistance in Rwanda are explained. Chapter 2 discusses some key concepts related to FFW activities as one of the drivers of food aid from developed countries to developing countries. It describes FFW activities undertaken by the DAP project under World Vision International in Rwanda after 1994. Chapter 3 provides information on the research methodology and household characteristics of the sample households. Chapter 4 focuses on an empirical analysis of the relationship between socio-economic characteristics and investment in modern inputs, and between these inputs and household potato production in Gikongoro province. Chapter 5 presents a networking model that is recommended to coordinate development activities in Rwanda. The study concludes with a discussion on policy recommendations and approaches towards sustainable agriculture in Gikongoro province, Rwanda.

## **CHAPTER 1**

### **GENERAL CHARACTERISTICS AND CHALLENGES OF THE RWANDAN ECONOMY**

This chapter describes general characteristics of Rwanda and the main challenges facing its economy through selected socio-economic indicators, including current agricultural production. Constraints limiting agricultural production are highlighted. A review of developmental assistance in Rwanda after the 1994 genocide is given and there is a brief introduction to the Food-For-Work activities in Gikongoro province, which is the basis of the second chapter of this study.

#### **1.1 General characteristics of the Rwandan economy**

##### **1.1.1 Location**

Rwanda is situated in the central part of Africa, landlocked between Uganda, Burundi, Tanzania and the Democratic Republic of Congo (DRC). It is a mountainous country (1,500m above sea level) with 26,338 Km<sup>2</sup> of land area. Currently, the Rwandan population is estimated at 8.3 million people with an annual growth rate of 2.58 percent. The estimated number of rural inhabitants per hectare of arable land available is about nine (MINECOFIN, 2002). Historically, Rwanda has faced many conflicts since the first event of ethnic conflict in 1959, which ended in the 1994 war and genocide. This has caused socio-economic and political instability with many people being refugees in neighbouring countries, destruction of infrastructure, and a lack of good governance and democracy. Figure 1.1 shows a map of Rwanda and its neighbouring countries Burundi, Tanzania, Uganda and the DRC.



**Figure 1.1 Rwanda and neighbouring countries**

Source: < [http:// travel.yahoo.com](http://travel.yahoo.com) > [Accessed on 29 April 2004]

### **1.1.2 Economic profile of Rwanda**

Economically, Rwanda is characterized by imbalances in economic sectors evidenced by the contribution of each to Gross Domestic Product (GDP) and the employment share per sector. The agricultural sector is the dominant one, with its contribution of 45 percent to GDP being relatively high compared to 20 percent of the industrial sector and 35 percent of the services sector. The estimated employment share in agriculture is 90 percent of the population, 2.8 percent in the industrial sector, and 7.2

percent in the services sector (Butare, 2003). Economic growth in Rwanda is mainly constrained by poor soil productivity, high transport costs due to long distances to the main ports of Mombasa (Kenya) and Dar-es-Salam (Tanzania), public debt (US\$ 1.5 billion) owed to external creditors (mainly the World Bank), and related consequences of the 1994 war and genocide, which the Rwandan government and civil society are yet to cope with (MINECOFIN, 2002). Table 1.1 summarizes the contribution of various economic sectors to the Rwandan economy in terms of GDP and employment.

**Table 1.1: Contribution to GDP and employment share per sector, Rwandan economy, 2003**

Sector	Contribution to GDP (%)	Employment rate (%)
Agriculture	45	90
Industry	20	2.8
Services	35	7.2

Source: Butare (2003)

Data from various Rwandan Ministries' reports show some selected socio-economic indicators related to demography, education, health, the economy and finance. Poverty is widespread with 60.3 percent of the Rwandan population living on less than 1US dollar per person per day. In 2002, the infant mortality rate was estimated at 107 per 1000, and just 52 percent of the population in 2001 had access to safe water. The literacy rate in 2001 was also estimated at 52 percent (MINICOFIN, 2002; MINICOFIN 2003b). Currently, the budget deficit is more than 12 percent of Rwanda's GDP (Kanimba, 2004). This deficit is mostly covered by external aid. The current annual inflation rate is estimated at 10 percent. According to Kanimba (2004), three factors explain this inflation level, namely poor seasons affecting yields resulting in high prices of agricultural products, an increase in the price of oil products (e.g. fuel), and an increase in government expenditure on infrastructure (e.g. road rehabilitation), which leads to higher levels of money supply and thus higher inflation. Table 1.2 summarizes some socio-economic indicators for Rwanda.

**Table 1.2: Summary of socio-economic indicators for Rwanda**

Socio-economic indicators	Value	Year	Socio-economic indicators	Value	Year
Population (million)	8.3	2002	Public debt (billion US dollars)	1.5	2002
Population growth rate (%)	2.58		Inflation rate (%)	10	2004
Life expectancy (years)	51.2	2000-2005			
Population under poverty line (%)	60.3	2002	Enrolment in primary schools (net) (%)	72.6	2001
Access to safe water (%)	52	2001	Enrolment in secondary schools (net) (%)	7.6	2001
GDP (billion Rwandan francs) <sup>1</sup>	85.25	2002	Enrolment in tertiary institutions (net) (%)	1.7	2000

Source: MINICOFIN (2002), MINICOFIN (2003a), Kanimba (2004).

## 1.2 Agricultural production and resources in Rwanda

The agricultural sector in Rwanda is the predominant one in the economy and contributes 45 percent of GDP, 90 percent of employment share and 72 percent of export earnings (Butare, 2003). Small-scale farming is predominant. The challenge for agricultural policy in Rwanda is ensuring food security for households, and improving income earnings (Jose, 2003). The achievement of these is dependent on improving agricultural production through efficient resource use. Agricultural production improved in 2001 and 2002, as reported in Table 1.3, due to favourable weather (MINECOFIN, 2003b). Table 1.3 indicates trends in production of some important crops at national level. Only about one percent of farmers have access to improved seeds, and low use of fertilizers is one of the major problems affecting agricultural production.

<sup>1</sup> 1 USD = 580.7 Rwandan Francs at the time of the study

**Table 1.3: Production of selected agricultural crops in Rwanda (1995-2002)**

(tons)

Crop/Year	Rice	Maize	Soya	Potatoes	Beans	Coffee	Tea
1995	2,001	55,600	0	137,700	126,300	21,952	5,414
1996	6,596	66,595	0	195,381	178,697	15,285	9,057
1997	9,805	83,427	4,279	229,625	141,815	14,830	13,239
1998	7,935	58,618	9,831	181,138	153,917	14,268	14,874
1999	8,921	54,912	4,707	175,889	140,425	18,817	12,669
2000	11,363	62,502	7,034	954,418	215,347	16,098	14,481
2001	17,697	92,129	17,140	988,982	289,983	18,268	17,817
2002	24,539	78,465	19,216	1,097,503	244,623	-	-

Source: MINECOFIN (2003b)

### 1.2.1 Land allocation in Rwandan agriculture

The land tenure system in Rwanda has been characterized by ambiguous policies regarding land rights. This has constrained local authorities to deal with land issues; hence, different systems and norms have been used throughout the country for land distribution (MINITERE, 2001). Musahara and Huggins (2004), the state is still the major actor and player in Rwandan land theatre. Consequently, land holdings are set by traditional land rights; there is no formal land market for purchase and sale (Byiringiro & Reardon, 1996). Currently, the Rwandan government is in the process of implementing a land policy that will help local leaders to cope with land distribution in a more efficient manner. This new land policy aims to promote equal distribution and access to land, provide land tenure security in order to encourage investment in land development, strictly monitor land management systems in order to avoid speculation and abusive exploitation, and encourage participation of the population in the management of the land (OXFAM, 2001).

Land is one of the most important assets in Rwanda affecting the wealth position of farmers (Berkeley & Derek, 1987: 131). Constraints in its management due to soil infertility have a strong relationship with investment levels (MINITERE, 2004). Access to land in Rwanda has been increasingly constrained by population growth and poor management (Byiringiro & Reardon, 1996). The average farm size in 2002

was 0.80 hectares compared to 0.94 hectares in 1990. In 2002, 74 percent of the land was cultivated, 14 percent was under pasture and fallow, 7 percent was under woodlot and 5 percent was classified as other land (Mpyisi *et al.*, 2004). Table 1.4 shows changes in farm size and land distribution over the period 1984 to 2002. In 1984, almost 7 percent of households had less than 0.25 hectares while in 2002, about 17 percent of households had less of 0.25 hectares. High population pressure in Rwanda is the major factor leading to a scarcity of farming land with no alternative for renting due to an inactive land market (Bizimana, 2002). Accordingly, the inheritance law, which divides a family's land between the remaining sons, leads to a decrease of farm size and increased land fragmentation into small plots.

**Table 1.4: Farm size and land distribution in Rwanda (1984-2002)**

Farm size classification by area allocated	Households		Total land allocated	
<i>Hectares</i>	<i>% in 1984</i>	<i>% in 2002</i>	<i>% in 1984</i>	<i>% in 2002</i>
< 0.25	7.4	16.8	1.0	3.3
0.25- 0.50	19.0	26.4	5.9	11.8
0.5-1.0	30.4	29.7	18.4	25.4
1.0-2.0	26.7	19.5	31.8	31.7
> 2.0	16.4	7.6	42.9	27.8
Total	99.9 %	100 %	100 %	100 %
Average farm size (ha per household)			1.2	0.84

Number of rural households in 1984 =1,111,897

Number of rural households in 2002 = 1,442,681

Source: Mpyisi *et al.* (2004).

Apart from limitations of farm size, soil loss and degradation also affect access to land. As highlighted by Clay & Reardon (1994:2), efforts from individual farmers, government and non-governmental projects were made to control land degradation. In many parts of the country, terraces and drainage ditches have been constructed to address the problem. Farmers contribute to these practices through government policy and Food-For-Work incentives provided by NGOs. This indicates why Gikongoro province, which has been severely affected by soil erosion, has been supported by the Development Activity Program (DAP) using food as wage and incentive.

### **1.2.2 Labour force in Rwandan agriculture**

Rwandan agriculture provides considerable opportunities for employment, but the drawback is the low investment in human resources that handicaps activities related to agricultural planning and strategic implementation by farmers. Investment in human capital is positively linked with productivity and with the ability to adapt to new situations (Berkeley & Derek, 1987; Hazell, 1998; Huffman, 2001). Investing in rural education offers opportunities for the adoption of new agricultural technologies by smallholder farmers and an increase in productivity. Welch (1978) states that farm scale and farmer education are natural complements in the sense that increased scale raises the productivity of education. Thus productivity of investment in education will be constrained by small farm sizes. Capacity building in the rural areas, once well conceived and applied, may have a positive impact on agricultural development.

The agricultural labour force in Rwanda, as in Lombok, Indonesia (Meindertsma, 1997:11), is composed of household labour, exchange labour, and hired or contract labour. The first two types are applicable to most farmers because hired or contract labour has cash flow implications, which most farmers cannot afford. Capacity building in agricultural techniques, such as improved cultivation techniques, is one of the priorities for the Rwandan government (MINECOFIN, 2004).

HIV/AIDS is a threat to rural development, affecting the amount and quality of labour. Donovan *et al.* (2003) state that malaria, tuberculosis and dysentery are now complemented by HIV/AIDS (currently at a prevalence rate of 13.5 percent of the population) as health related risks for farm households, affecting prime-age working adults as well as the elderly and children. Developing programmes for the agricultural sector ought to take into consideration the loss of labour occurring as a result of this pandemic.

### **1.2.3 Agricultural capital and technology transfer**

Historically, the agricultural sector in Rwanda has been dominated by manual labour. Kuyvenhoren *et al.* (1998) affirm that labour intensive systems characterize the small



farm households and less diversified production systems in developing countries, as it does in Rwanda. The training of rural labour in agricultural activities is of concern to the Rwandan Ministry of Agriculture. These activities involve the training of farmers to use modern inputs, liberalization of the fertilizer market, promotion of seed multiplication, use of agricultural technologies (terrace construction), facilitation of input imports, and introduction of agribusiness activities using financial support from the World Bank and the US Agency for International Development (USAID).

The introduction of new agricultural technology, as highlighted by Rymon and Or (1996), requires an assessment of socio-cultural elements that may constrain the adoption of new technologies, namely the rights to use factors of production, customary division of labour, responsibility between age, gender and social groups, forms of cooperation within and with families, and sense of ownership. The adoption of recommended technological packages by farming households depends on how they fit in with their preferred labour allocation patterns (Meindertsma, 1997:3). The overall combination of techniques used in production has to consider the characteristics of production factors (e.g., characteristics of land and capacity for technology adoption). If public and private initiatives do not consider these characteristics, production will end up at the same low level. Thus, meeting the growing food requirements of Rwanda will remain an unattainable objective for development agents when proposed technologies are inappropriate.

### **1.3 Current agricultural development strategy for Rwanda**

Rwanda, in its transition phase since 1994, has had the support of major international development organizations including the World Bank, the International Monetary Fund, the United Nations Development Program, the USAID, and other development agencies. This support contributed to the adoption of new policies for agricultural development in Rwanda as highlighted in different documents of the Ministry of Finance and Economic Planning since 1998.

The aim of this collaboration is to transform Rwanda's traditional agriculture to a modern one. According to Seckler (1993), Alene and Hassen (2003) and Chieko *et al.* (2003), agricultural transformation occurs when a substantial number of rural

households have incomes from farm and non-farm activities, operate farms commercially (selling a substantial portion of farm output), specialize in production at the farm level, invest more heavily in the farm, purchase commercial inputs, including hired labour, in significant quantities, and adopt new technologies on a regular basis.

Among the adopted strategies there is recognized a need to establish agro-industries that could link the agricultural sector to other sectors of the economy. Emphasis is placed on land management, labour reform, rural financing schemes and markets, improvement of rural infrastructure, increased use of inputs (improved seeds and fertilizers) and high-yielding pest resistant crops, and environmental control measures to halt the decline in soil fertility (MINECOFIN, 2002). The achievements towards this strategy since its implementation in 2000 have fallen short of expectations. Some problems include a lack of: a sustainable export crop strategy; road infrastructure; agricultural and environmental protection infrastructure; and school and health infrastructure (IMF, 2004).

Objectives under the current agricultural development policy are: expansion of production, efficient use of production resources, and a shift in the number of people engaged in agriculture to off-farm activities. The attractiveness of off-farm activities to farmers depends to what extent the off-farm activities are developed. The achievement of these goals depends, firstly, on how well all agricultural stakeholders (e.g., agricultural projects, farmers, and government) are integrated into the process. Secondly, it requires good management of the partnership for successful strategy implementation; and thirdly, strategies that are suited to farmers' capabilities and which enable them to shape their own lives (Obiora, 1996).

Investment in agricultural research also has to be prioritized. Technical changes in agriculture are the result of research investment, which in turn leads to four critical roles: (1) increase of production from present levels of inputs which thereby contribute to increasing food supply and rural income; (2) reduction in per unit cost of output, leading to lower prices and lower cost to consumers; (3) increased food production can contribute to the increase in off-farm activities such as food processing; and (4) technical change in agriculture has important employment and income linkages with the rural non-farm economy (Ralph & Dana, 1989).

#### **1.4 Development assistance in Rwanda after 1994**

Developing countries such as Mozambique and Ethiopia have various Food-For-Work (FFW) programmes aimed at improving household food security, rehabilitation of production capacities, soil conservation and land protection (Dorosh *et al.*, 1995). The implementation of such activities related to FFW projects involves investment in human and financial resources requiring external support. The support can be in terms of cash or in kind. An example of assistance in kind is Food Aid, the central engine of the current FFW system channeled by the USAID.

Obiora (1996) stresses that the purpose of development projects in agriculture is to sustain the lives of people. This is possible when the project helps people clearly understand their own situation, learn to know how they can change it through their own efforts and with the assistance required. The FFW system's philosophy fits in with this condition of feasibility as highlighted by Obiora (1996), but the implementation has advantages (community support) and disadvantages (creation of dependency) that arise during the project's life.

Local leaders are concerned about the activities of Aid agencies, namely (1) what should Aid agencies do more of and what should they do less of; (2) what can Aid do to relax institutional and other constraints on private investment; and (3) what sustainability issues and resource-environmental policy questions should Aid address in its programmes (Carter *et al.*, 1993:177-178). The Rwandan government in 1995 evaluated NGO activities and this resulted in the review of some agreements and termination of others between international organizations and the Rwandan government. A survey was conducted in the Rwandan agricultural sector in 2001 (Bingen & Mpyisi, 2001) and the results show that 18 NGOs (10 local and 8 international) were involved in extension work, distribution of agricultural inputs, promoting food security, and FFW related activities. The next chapter reviews the main concepts related to FFW projects and the activities undertaken in Rwanda.

## CHAPTER 2

### A REVIEW OF FOOD-FOR-WORK ACTIVITIES IN RWANDA

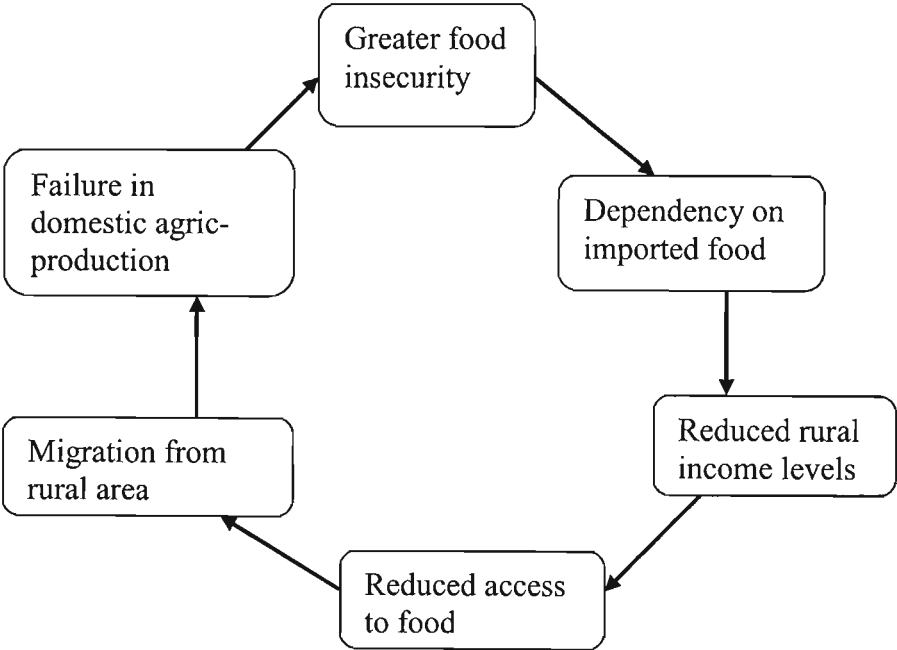
This chapter focuses on Food-For-Work (FFW) activities in Rwanda as a developmental approach. It underlines the basic concepts related to the FFW system as one of the channels for food aid. The application of FFW and activities undertaken by FFW in Rwanda, especially those undertaken by the Development Activity Program (DAP) project of World Vision International, Rwanda form the basis of this chapter.

#### 2.1 FFW in development activities

Food shortages in most developing countries become an opportunity for United Nations agencies, such as the FAO, and other organizations like the USAID to assist those countries. The aim of that assistance is to prevent famine amongst needy people. In 1961 the World Food Program was established in Rome as a joint arm of FAO and the United Nations. Their goals were to make food available to avert famine, and also to pay for labour on projects to improve rural infrastructure and other development activities (Abbott, 1992:4). This opened the channel of thinking about alternatives of using food other than free food distribution. This encourages the creation of projects that can drive food aid to the needy countries as emergency assistance and/or as support for development activities.

Support from food aid donors has two effects on recipient countries: (1) It increases food dependency of the assisted population by affecting negatively the level of production when people keep relying on food aid as the main source of subsistence; and (2) it encourages farm production in the donor country and promotes exports (Ralph & Dana, 1989). Despite these effects, a positive impact is generally experienced by developing countries, especially in terms of support that they receive through development activities such as meeting national and regional nutritional needs, building schools and other public infrastructure (e.g., roads) ( Athanasios *et al*,1994).

The USAID is a vehicle for food aid through FFW activities. This is achieved with the aim of improving food security by addressing temporary household food insecurity while also supporting key construction and rehabilitation of public infrastructure (e.g. schools, roads, drainage systems) that lead to long-term food security results (USAID, 2003). Food insecurity, as defined by the International Food Policy Research Institute (IFPRI) (2002), is characterized by the cycle shown in Figure 2.1.



**Figure 2.1 Food Insecurity Cycle**

Source: International Food Policy Research Institute (IFPRI) (2002).

Supporting the construction or rehabilitation of public infrastructure creates a demand for labour that needs to be paid in kind or in cash. In light of USAID and World Food Program activities, food is used as a wage or incentive. Thus, FFW can be understood as a daily or monthly wage in terms of food, calculated at market prices and paid to those who participated in community development activities under the food aid project.

### **2.1.1 Activities under FFW projects**

An activity to be undertaken under FFW projects depends on which problems the population faces, which could include, for example, soil erosion, floods, and road destruction. Mordecai Ezekiel of the FAO, cited by Abbott (1992:29), wrote an influential paper showing how surplus food could contribute to development. It could be used as wages for people employed in building and maintaining rural roads, irrigation and drainage ditches, and in planting trees. From Ezekiel's statement, activities normally taken under FFW projects are mostly community centered: construction or repair of roads, health clinics, environmental and conservation activities, schools, irrigation systems and other activities related to public needs. In Rwanda, land terracing is the main activity under the FFW projects such as the DAP, which has been using food as wages for people working in the construction of terraces since 2000.

### **2.1.2 Beneficiaries and estimation of FFW rations**

FFW projects can either target individual households or farmers' associations. This forms a link with the activities to be pursued by the project in a given area. Communities facing food shortages due to droughts or soil erosion are mostly targeted by such projects. To address food deficits, projects frequently involve agricultural practices such as irrigation and terracing. Local people in need of food are targeted and paid in terms of food in pursuing such development activities (World Food Program, 2004). Once the target area and people (beneficiaries) have been identified, the next step is to estimate the food rations to be provided by the project as wages.

In estimating food rations, different values are taken into consideration, as stated in the USAID (2003) commodities regulation guide. These are: (1) FFW rations are given as wage payment based on income transfer (monetary); (2) the rations are based either on time worked or output produced; (3) the recipients' transport costs for rations are considered in determining the quantity of FFW to be provided; and (4) local authorities and community leaders may be consulted in determining the ration level.

The consideration of income transfer implies that FFW projects need to compare the cost of a man-day in cash and in kind. This has an impact on labour migration when the payment in food is greater than the payment in cash, all other things being constant. This comparison is undertaken at the design phase of the project. Since changes in the price of hired labour may occur, the projects are also likely to adapt their ration to those changes.

When FFW is based on time or output produced, this will affect the time allocation and output of the selected households as FFW beneficiaries. Participating jointly in the project activities and home activities (e.g. cultivating their own land) causes some imbalance. For example, given that home activities in agriculture are performed in the same period as FFW activities, then home productivity could effectively decrease as more labour is devoted to FFW projects.

Considering recipients' transportation costs in determining the food rations as wage requires estimates of local transportation costs. Recipients normally live in different villages with different distances from home to distribution centres. Considering transportation costs either by public transport or by foot helps more the FFW project to determine the location of distribution centres and does not directly affect the size of food rations.

Accounting for local authorities and community leaders' views when determining the rations is relevant although they do not affect the level of allocated rations much. Consultations with local leaders are made for official implementation of the project; hence local people (beneficiaries) are often not involved in the first phase of the project design. Consequently, beneficiaries do not have bargaining power on the size of rations, since the ration sizes are determined before the implementation of the project.

The implementation of activities related to FFW is very demanding in terms of human and financial resources. These activities include: the transportation of commodities from donors to the beneficiaries' country by different transport companies, salary payments for field staff, warehousing costs, office equipment and materials, transport means, insurances of project vehicles, etc. All these activities influence different

socio-economic indicators, such as the increase of imports, changes of price in different markets (labour market, goods and services market), and a source of conflict between people in the project. The success of the project could be measured not only in terms of the impact on beneficiaries, but also on its value relative to cost. Comparing the output of the project at beneficiaries' level and the total cost of the project should suggest either maintaining the project or finding alternative assistance.

USAID in its food aid policy can either provide Cash-For-Work (CFW) or FFW. The preference between the two systems depends on what is needed by the targeted population and the types of activities undertaken. In the case of Rwanda, the targeted population is food-insecure and this makes them prefer FFW to CFW in the terracing activities. FFW beneficiaries can also sell part of the rations received to obtain some cash income.

### **2.1.3 Access to services and formation of farmers' associations**

Farmers' associations in Rwanda have been, and are being, established because of potential support in terms of agricultural inputs and technical assistance from the Ministry of Agriculture and other agricultural projects (e.g., DAP). Current government policy in agriculture also encourages the formation and membership of farmers' associations, in which farmers may relatively easily gain support (e.g., inputs, advice) in their farming activities rather than being supported individually. These farmers' associations are not only involved in farming activities, but also in non-farm activities such as the marketing of agricultural produce that generates income for some members.

Farmers in Rwanda are constrained by many factors, including soil infertility, small arable land areas, lack of access to credit and markets, and lack of agricultural knowledge. These factors constrain farm growth and keep farmers dependent on support from government and non-governmental projects. Despite these limitations, farmers do have some advantages, such as indigenous knowledge (Rist, 1993), that can be directly or indirectly integrated into the support initiatives of development agencies involved in agriculture. Rwandan farmers generally support the concept of self-sufficiency. However, farmers have to gain access to other resources (e.g.,



modern inputs) needed for their activities (Burkey, 1993). Developing a support policy, such as development networks in which farmers can participate and take control of their own development (Haverkort, 1993), is a key to sustainable agriculture in Rwanda.

## 2.2 FFW activities under the DAP project in Gikongoro province

Land degradation in the form of soil erosion, soil acidity, and nutrient depletion undermines soil productivity in Rwanda, as it does in Ethiopia (Gebremedhin & Swinton, 2003; Goetz, 1997). This leads to relatively low productivity, which is reflected in poor cereal yields (Nyarwaya *et al.*, 2002; Pender *et al.*, 2001), and the motivation of many projects and policy interventions to stimulate technology diffusion (Barrett *et al.*, 2004). DAP support comprises of terrace construction and provision of agricultural inputs to farmers, farmer training, and construction of storage facilities. These inputs are aimed at increasing farmers' productivity in terms of higher crop yields. Table 2.1 reports crop yields in various provinces in Rwanda.

**Table 2.1: Yields (kg/ha) of beans, potatoes, wheat, and maize in various provinces of Rwanda, 2004 (Season B<sup>2</sup>)**

Province/ Crops	Beans	Potatoes	Wheat	Corn
Butare	500	4,000	-	450
Byumba	500	4,500	700	500
Cyangugu	600	4,500	-	800
<b>Gikongoro</b>	<b>450</b>	<b>5,500</b>	<b>900</b>	<b>650</b>
Gisenyi	500	9,000	900	850
Gitarama	400	4,500	-	350
Kibungo	500	4,000	-	400
Kibuye	400	5,500	600	550
Kigali rural	450	4,500	-	500
Ruhengeri	600	8,500	700	700
Umutara	600	5,000	-	400
Rwanda	500	5,409	760	559

Source: MINAGRI (2004)

<sup>2</sup> February – August 2004.

### 2.2.1 Bench terrace construction in Gikongoro province

Food production has been one of the preoccupations of agricultural researchers. In hilly regions with water control problems, terracing has been suggested as an appropriate solution to soil erosion problems (Stockman, 1994:53; Mkhabela, 2002). Even though terracing is encouraged, the construction is highly demanding in terms of labour and equipment. But one of the advantages of terracing is the maintenance of soil fertility.

An individual building terraces may be at a disadvantage compared to collective activities of the community. For example, building one hectare of terraces requires at least 91 people for 22 days, according to World Food Program (WFP) and USAID estimates. This means that resources must be available to ensure that farmers who wish to reduce soil erosion are able to do so (Harold *et al.*, 1982:146). The DAP project has been using food as wage and incentive in supporting terrace construction in Gikongoro province by allowing increased community participation in soil erosion control. Table 2.2 shows that under the DAP project, 1,400 hectares were planned to be terraced within a five-year period (2000-2004) in Gikongoro province compared to 1,107 hectares actually achieved for the period 2000 to July 2004. During the same period 13,300 tons of food comprising maize, beans, and vegetable oil, were also to be distributed compared to about 9,830 tons actually achieved for the period 2000 through July 2004 as labour payment in terracing. The difference in the planned hectares and food was expected to be achieved by the end of 2004.

**Table 2.2: Hectares and FFW estimates in Gikongoro province by DAP project of World Vision International in Rwanda (January 2000- July 2004)**

Years	Food rations planned and distributed in metric tons*						Terraces in hectares	
	Maize		Beans		Oil			
2000	1,136	(165)	682	(99)	82	(11.92)	200	(-)
2001	1,704	(1,341)	1,023	(761)	123	(97.5)	300	(82)
2002	1,704	(2,384)	1,023	(1,192)	123	(176.5)	300	(430)
2003	1,704	(192)	1,023	(904)	123	(142.8)	300	(265)
July 2004	1,704	(1,501)	1,023	(750)	123	(111.1)	300	(330)
Totals	7,952	(5,585)	4,774	(3,708)	574	(539.7)	1,400	(1,107)

\*Figures in parentheses are the achievements for the period 2000 to July 2004

As indicated before, about 91 people are required for 22 days for one hectare of terrace construction. The ration allocated per person per month (22 working days) is a package of maize (50kg), beans (25kg), and vegetable oil (3.6liters). The big challenge for farmers is the maintenance of terraces already constructed after the project ends its activities, even if the food that is distributed motivates people to control soil erosion. Figure 2.2 shows the terrace construction process in Gikongoro province.



**Figure 2.2. Terrace construction in process, Gikongoro province, Rwanda**

### **2.2.2 Provision of agricultural credit**

The use of improved seed, fertilizers, and lime remains an elusive goal for Rwandan agriculture (Clay *et al.*, 2001). Access to these inputs by farmers in rural areas determines the level of agricultural production (Bingen *et al.*, 2003). Agricultural projects have assisted poor farmers in many developing countries to gain access to production resources.

Development institutions (African Development Fund, 2000) attempt to create conditions that encourage high yield production by facilitating the import of necessary inputs. These conditions allow for the production of cash crops that in Rwanda and other developing countries are still constrained by many factors, including the low capacity of farmers to acquire inputs caused by low incomes. Currently, the Rwandan government is encouraging commercial banks to invest in the commercialization of modern inputs through an “easy” allocation of credit to input traders. This should help farmers to gain access to modern agricultural inputs and increase their productivity.

The provision of agricultural inputs is the most common type of agricultural assistance by international NGOs. The DAP project has opted for providing not only food for terrace building for farmers’ associations, but also provision of agricultural credit in terms of fertilizers, seeds and lime. This could positively affect crop yields in the targeted area of the project. The DAP project intended in its plan to distribute agricultural credit to 12,000 beneficiaries in six districts of Gikongoro province. If small farmers can meet the conditions and criteria for accessing this credit (e.g., interest rate), crop yields are likely to increase. But in the case of DAP support, not everybody receives credit. Only those beneficiaries with land terraced by DAP may apply for credit and modern inputs in terms of fertilizers, seeds, and lime.

According to studies on the impact of farm credit in Pakistan and Bangladesh (Shahidur & Faruquee, 2003), the impact on household consumption and other household needs (home assets) was significant. A well functioning market for credit offered by banks, agricultural cooperatives and other credit institutions could positively affect the level of farm production and income level, which might generate other off-farm activities in rural areas. Figure 2.3 shows the completed terraces which are planted by DAP supported farmers. After the harvest, members of supported farmers’ associations can either share crop yields or sell and share the equivalent income. Seeds for reimbursement and for the next agricultural season are retrieved before the sharing or selling of any produce.





**Figure 2.3. Completed terraces in Gikongoro province, Rwanda**

### **2.2.3 Training of farmers**

Investing in education and schooling in rural areas is considered an important driver of agricultural growth (Anderson, 1996). Most farmers in developing countries do not have basic skills that allow them to increase their level of understanding and propose solutions for different issues they face in decision-making. Lack of knowledge is one of the reasons why farmers do not use of fertilizer in Rwanda (MINECOFIN, 2002).

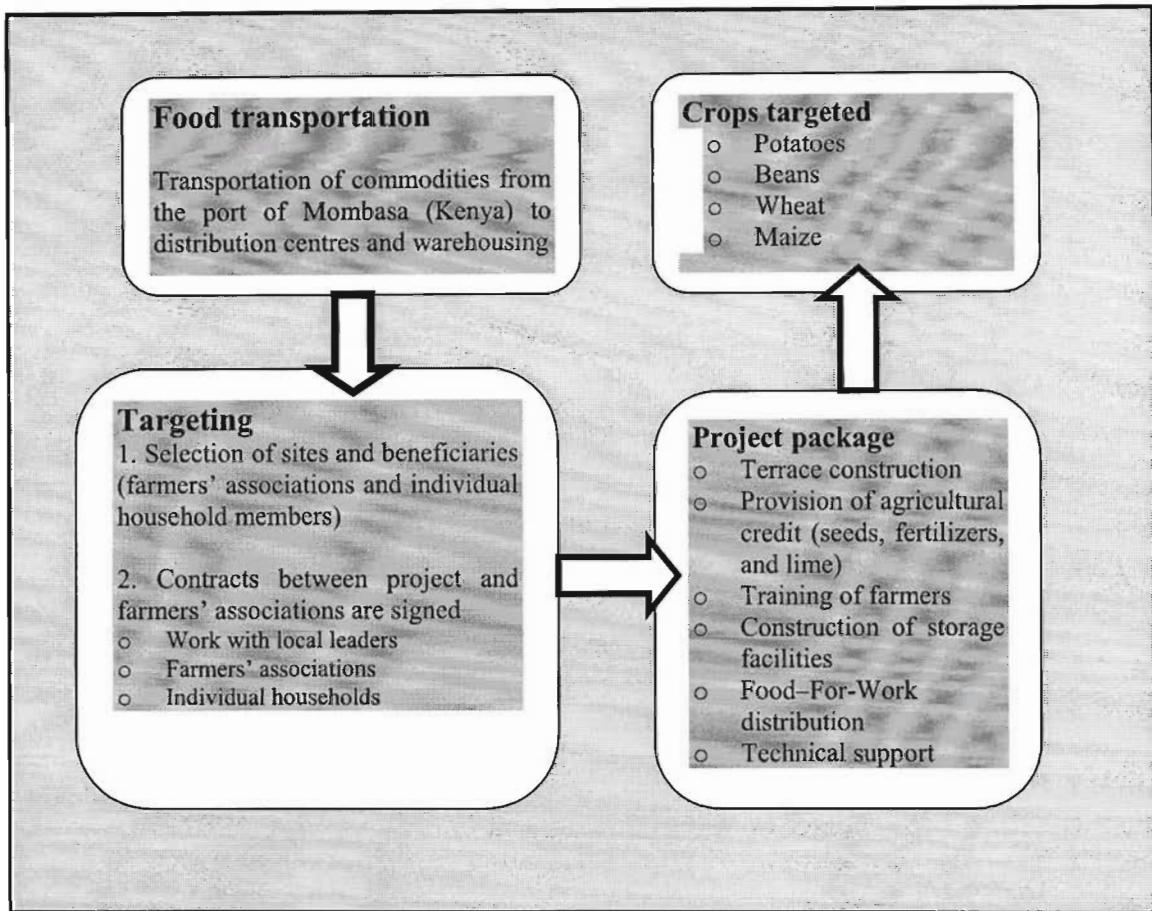
Participating in development projects is part of training (Otachi, 1999) because it enables people to increase their sense of controlling issues that affect their lives. Training farmers with different appropriate approaches, such as demonstrations, organized discussions, and field visits, encourages self-reliance and promotion of awareness. If this is properly managed, it increases the level of productivity (Hussain *et al*, 1994, citing Feder and Slade, 1986).

FFW programmes, as recommended in the 1979 FAO conference (Abbott, 1992), can provide advice and training on improved agricultural production methods. For example, they can train farmers, especially in: (1) use of new inputs that allow the increase of output per unit area and investment of labour and capital; (2) techniques of production such as land use management and methods of sowing, rates and techniques

of fertilization; and (3) in economic factors of production – a farmer should not only be a farm technician but he should also be a businessman.

The DAP project of World Vision International has opted in its activity implementation to train about 6,750 farmers in various areas of business and financial management, planting and post-harvest technologies. One of the problems of training in rural areas is that people are trained in fields that do not match their real needs. Furthermore, the training curriculum is often designed without involvement of the trainees. This increases dependency of farmers on the training provider. Having farmer extensionists, whose main activity is to transfer research findings from research institutions to farmers, cannot be efficient when the farmers are not trained in new agricultural technologies to improve their adoption levels (Adesina, A.A. & Baidu-forson (1995).

Three groups at the field level basically comprise the DAP project: FFW distribution team, agronomists team, and a support team based at the main office of World Vision International, Rwanda. Figure 2.4 summarizes the main activities pursued with the DAP project at the field level in which farmers also participate. The DAP project has various activities mostly related to food distribution, technical support by the agronomists once terraces are constructed by farmers, logistics and transportation of commodities, and staff management. Each district targeted by the project has two assigned staff: one in charge of food distribution and an agronomist that technically supports farmers during and after terrace construction. Farmers' associations are involved in some activities at the field level, such as site selection for terracing and in food distribution after terrace construction.



**Figure 2.4 Scenario of DAP activities in Gikongoro province, Rwanda**

The next chapter deals with the research methodology applied in this study and the characteristics of sample households who are members of farmers' associations.

## CHAPTER 3

### RESEARCH METHODOLOGY AND HOUSEHOLD CHARACTERISTICS

This chapter presents the research approach to this study and sources of data used to analyze the impact of DAP support and socio-economic characteristics of sample households on agricultural production in Gikongoro province.

#### 3.1 Research methods

Research methods used for the verification of the research hypotheses and for the achievement of the research objectives were grouped into three main categories, namely a review of the literature, interviews with key resource people (e.g., DAP staff and representatives of the Ministry of Agriculture in Gikongoro province), and a sample survey of household heads who were members of DAP supported and unsupported farmers' associations in Gikongoro province.

##### 3.1.1 Contacts and meetings

To obtain relevant information for this study initially required contact and meetings with individuals of the Department of Agricultural Statistics in the Ministry of Agriculture, representatives of FFW projects and local leaders. This led to clarification of specific issues related to the research. Organizations and development projects contacted include the USAID (Rwanda chapter) and the DAP project of World Vision International, Rwanda. Through these contacts, the author accessed annual reports and other relevant documents. Meetings with local leaders in Gikongoro province, especially those in the sample survey districts, namely Nyamagabe, Mudasomwa and Kivu<sup>3</sup>, where the DAP project operates, were held before conducting the household survey. In these meetings, local leaders were informed about the purpose of the survey to be conducted in their respective districts.

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<sup>3</sup> This district has been attached to Mudasomwa and Nshili for administration reform



### 3.1.2 The survey of sample households

Gikongoro province, the location of this study is generally known as the poorest province and experiences soil fertility problems caused by highly acidic soils and soil erosion, and hence receives more support from the DAP than other DAP supported provinces. Data for this study were collected during July and August 2004 from a stratified multistage sample of 204 household heads in three districts of Gikongoro province, namely Mudasomwa, Nyamagabe, and Kivu, using a standardized questionnaire (see Appendix 1). The estimated number of farmers' associations working with the DAP project (stratum 1) in the three study districts is 104. In the same target area, 136 farmers' associations are not supported by the DAP (stratum 2). Since associations are of similar size, stratified multistage sampling (10 percent random sampling rate of associations within each stratum, and a 60 percent random sampling rate of members within each selected association) was used to draw a representative sample of respondents (Lyne, 2004). Therefore, farmers surveyed were household heads from 10 farmers' associations supported by the DAP and 14 unsupported farmers' associations. In Gikongoro province, farmers supported by the DAP engage in activities such as terrace construction and are provided with fertilizers, lime, and improved seeds. Four important crops – potatoes, beans, wheat, and maize - are promoted by the support projects as they are some of the main commercial and subsistence crops in the study area. Data were collected from the two groups of farmers - DAP supported and not supported – to elicit information on association membership, activities and benefits within their associations, and data on the DAP support package.

Socio-economic characteristics such as gender of the household head, years of education, family size, household income, and age of the producer are normally not considered in supporting farmers to improve their agricultural productivity although they potentially affect farmers' productivity through labour productivity adjustments and use of operating inputs (Hazarika & Alwang, 2003). Data collected during the survey also include socio-economic characteristics of household heads, operational costs (fertilizers, seeds, and lime), and annual household crop yields (potatoes, beans, wheat and maize). Table 3.1 presents the total number of cases interviewed from the sample households within the three study districts (Mudasomwa, Nyamagabe and

Kivu). Among these districts, Mudasomwa had the greatest representation, estimated at 39 percent of respondents. The main reason for this is the high rate of DAP activities in this district compared to the other districts. The SPSS (Clark, 2003) program was used to compute descriptive statistics and cross tabulations for the survey data.

**Table 3.1: Representative cases by district and type of farmer in Gikongoro province, Rwanda, 2003/2004 (n=204)**

District	DAP supported respondents	Unsupported respondents	Total per district
Nyamagabe	31 (34.8)*	35 (30.4)	66 (32.4)
Mudasomwa	36 (40.5)	44 (38.3)	80 (39.2)
Kivu	22 (24.7)	36 (31.3)	58 (28.4)
Total	89 (43.6)	115 (56.4)	204 (100)

*Note:* \* Numbers in parentheses are percentages

### 3.2 Background to surveyed farmers' associations

This section provides a profile of surveyed farmers' associations in terms of association membership, legal recognition by local leaders, main activities, benefits to members, and a descriptive comparison of the two groups of survey respondents - DAP supported or not supported - in relation to family size, household income, crop yields, available arable land per household, and education and age of the household head.

#### 3.2.1 Association membership

Farmers' associations in Gikongoro province have been, and are being, established because of potential assistance in terms of access to agricultural inputs and technical assistance from the Rwandan Ministry of Agriculture and other agricultural projects. The 1994 war and genocide has increased this need for assistance and the formation of more farmers' associations (Munyankunsi, 2001) in which their respective

members could gain access to facilities and services provided by government and non-governmental projects (Geran, 1996). Questions related to association membership, positions (e.g., president of the association, vice-president, treasurer, secretary, and advisor), and joining costs. The period considered during the survey was four years, coinciding with the period of DAP activities (2000-2004). Within this period, 43 percent of respondents reported being members of their associations for less than four years compared to 53 percent who had been members for more than four years. Thus, most farmers' associations were created even before the DAP to allow their members to enjoy mutual support in meeting their individual needs. About 61 percent of respondents are ordinary members and 39 percent have positions such as president of the association, vice-president, treasurer, secretary, and advisors in their respective associations. The high representation of association leaders in the sample is mainly explained by small size of associations (average of nine members) relative to the number of office bearers within each association. Low levels of formal education (mean of 4.26 years) characterize these association leaders.

With the ongoing decentralization of government decision making processes in Rwanda since 2001, it is compulsory for all small associations to be legally recognized by local leaders at the district level (third level of administration). Each registered association pays roughly 1200 Rwandan francs (2US\$) for a "quittance or receipt" authorizing them to operate as a small-scale farmers' association. Of 204 household head respondents, 85 percent maintained that their associations are registered at the district level while 12 percent pointed out that their associations are yet to register. Farmers are given technical assistance by district agronomists and sometimes are connected to potential support projects (e.g., DAP) during the preliminary phase of targeting the support beneficiaries. However, the technical support received from district agronomists was reported by farmer respondents to be poor. Therefore, linking farmers' associations to support organizations should also be accompanied by an appropriate way of monitoring the performance of support organizations.

To become a member of any association usually involves a joining cost – money or share. Out of 204 survey respondents, 61 percent confirmed the joining cost in their associations while 39 percent stated that no joining cost was required for new

members. The joining cost in terms of shares, which is mainly applied, is determined by dividing the value of the association's property in Rwandan francs (e.g. cash in an account plus other valuable assets) by the total number of association members.

### **3.2.2 Activities and expected benefits within surveyed farmers' associations**

The survey revealed that farmers' associations in the study area deal not only with farming activities but also with other activities such as small businesses (sale of agricultural produce and inputs) and tontines (in which association members contribute a certain amount of cash on a monthly basis for their mutual support). Survey estimates in Table 3.2 show that 65 percent of respondents are engaged only in farming activities in their respective associations, 15 percent deal with farming activities and small businesses, and 20 percent are engaged in farming activities and tontines. The activities performed by farmers are correlated with their expectations in terms of benefits, which in turn, explain their motivation to join associations. During the survey, farmers confirmed some of the benefits expected to influence a farmer's decision to join an association: share in agricultural produce (28 percent), receive income from tontines or from the sale of agricultural produce in the association (41 percent), team work/spirit (40 percent), access to improved seeds and fertilizers (30 percent), access to agricultural and other types of credit (13 percent), share experiences or learning from each other (29 percent), and having access to different types of training (6 percent). Receiving income from the association is the most common benefit (motivation) for respondents. Apart from the cash motivation, building team spirit (working in a group) was also a frequent reason for joining a farmers' association. This allows them also to obtain some intangible social benefits, such as a network of support.

**Table 3.2: Main activities of surveyed farmers' associations, Gikongoro province, Rwanda, 2003/2004 (n= 204)**

Districts	Farming only (%)	Farming and small business (%)	Farm and Tontines (%)
Nyamagabe	43	26	2
Mudasomwa	25	48	78
Kivu	32	26	20
Totals	65	15	20

A better understanding of labour allocation in rural households is required if interventions are to be directed at supporting farmers to develop agriculture (Matshe & Young, 2004). Labour allocation within a household depends also on the total labour time available (Lawrence *et al.*, 1999). Kimhi (1995) assumes three possible uses of time for a farmer: farm work, off-farm work, and home time (including leisure). During the survey, the reference total working hours considered was eight hours per day. Based on survey estimates, a household head allocates on average 2.09 hours per day for home agricultural activities, 5.15 hours per day for association activities, and 5.50 hours per day for terrace construction for those employed. These estimates show that farmers must work more than eight hours when they are employed in terrace construction. In practice, household members substitute for one another across these three activities. For example, a father can be represented by his son or daughter for terrace construction activities although he is the one who is registered with the association.

### **3.2.3 Farmers' associations supported by the Development Activity Program (DAP)**

As already indicated, DAP deals mainly with land terracing in Gikongoro province although DAP supported farmers also receive agricultural credit and modern inputs, such as fertilizer, seed and lime. Mkhabela (2002) states that many soil conservation

practices, such as terracing, require large capital outlays and may also reduce yields for the first few years. Shiferaw and Holden (2000) agree that conservation structures may affect yield positively and/or negatively. For example, conservation may improve certain soil properties (e.g., improve water holding capacity) but may increase the need for more fertilizers. It may, therefore, be financially difficult for farmers to invest in terrace construction practices due to higher input requirements and lack of liquidity. This is a constraint when there is no government or NGO support as there are some terraces already constructed by the DAP but not utilized in the study area. Currently, local leaders are encouraging the maintenance of terraces already achieved in lieu of constructing more terraces.

Rwanda, like other developing countries, attempts to create conditions that encourage high yield production by facilitating imports of necessary inputs, such as inorganic fertilizers and improved seeds (African Development Fund, 2000). The continual low capacity of farmers to acquire these external inputs (due to financial constraints) motivates government subsidies and support from agricultural projects. The provision of agricultural credit in terms of fertilizer, seed and lime by the DAP has allowed relatively easy access to these inputs by supported farmers, although the quantities received for individual use are low resulting in relatively low applications of inputs. For example, survey estimates indicate that DAP supported farmers planted about 11kg of potatoes per are (0.01ha) on average compared to 25kg proposed by the DAP during September 2003 to August 2004. The repayment of the credit offered by the DAP is based only on the principal credit, which is paid at harvest time with no interest. Of 89 members from DAP supported farmers' associations, 51 percent mentioned that conditions for access to credit provided by the DAP are easy while a further 32 percent maintained that these conditions are acceptable given that no collateral is available to access credit. But, as pointed out by respondents, credit is often provided very late in the season, which can affect crop yields. To cope with the under-supply of fertilizers, farmers also prefer to gain access to some livestock (e.g., goats, pigs) that would allow them to use manure in their farming activities.

The training offered to DAP supported farmers relates to basic agricultural techniques (land terracing and planting techniques), business and financial management, marketing, and post-harvest technologies. Most of the respondents (75 percent) have

been trained on essentials of terracing practices, planting, and harvesting techniques. A consistent policy with regard to government extension services could reinforce these basics as part of agricultural literacy, which is likely to have positive effects on farmers' organizational and managerial skills and the adoption of new agricultural technologies (Huffman, 2001; Pudasaine, 1983; Welch, 1978; Carin *et al.*, 1998).

The DAP's support policy normally runs for five years, and is renewable. During the period 2000-2004, only 15 percent of 89 DAP supported respondents received support for five years compared to 39 percent and 45 percent who received this support for three and four years, respectively. The continuation of activities by farmers after the termination of support is often of concern. A question related to the continuation of DAP supported activities after the termination of this project indicated that 88 percent of respondents agreed that they would continue operating by applying the lessons learnt during the project's life, compared to 12 percent who may not continue unless another support project is found. This shows confidence amongst farmers to continue operating even after DAP support ends. However, this higher self-confidence might be related more to the expected benefits of working as associates since other factors are likely to affect their progress. These factors include, for example, lack of skills for managing their associations which is reflected in a low level of formal education of association members (mean of 4.26 years), lack of income for the purchase of different inputs to increase their productivity, and limited technical expertise and economic opportunities that cause them to remain poor and incapable of making management decisions (Kojo, 1997). This provides a good reason for an effective policy to support farmers' associations and thus sustainable production practices.

#### **3.2.4 Preference between FFW and CFW systems among surveyed farmers**

Marco and de Boar (2003), in their preliminary analyses on FFW and CFW, argue that the two systems of payment should not be regarded and evaluated just on the "food" and the "cash" side, but on the work side as well. Food rations had been distributed as FFW to farmers providing labour for terrace construction in Gikongoro province for almost five years. Farmers from both DAP supported and unsupported associations were employed in terrace construction. Out of 204 respondents, 75 percent were employed and all maintained that they favoured FFW to CFW although

their **desired** package of payment in FFW (115.4 kg) is greater than the current one applied by DAP - 78.7 kg, comprising maize, beans, and vegetable oil. Nevertheless, as reported by survey respondents, the food distributed to farmers helps them to deal with the food deficit in the period between two harvesting seasons.

### **3.2.5 DAP supported versus unsupported farmers**

Anticipated outcomes by the DAP include increased annual crop yields, improved cultivation techniques through terrace construction, use of modern inputs, and increased household income (World Vision International Rwanda, 1999). This section uses univariate analysis to compare outcomes for the two categories of survey respondents - DAP supported and unsupported farmers - to examine the impact of DAP support in Gikongoro province. Descriptive results are presented in Table 3.3. Four important crops - potatoes, beans, wheat, and maize - were considered to test for increased yields under the DAP programme. Significant mean differences for potatoes (560.56 kg), beans (78.56 kg), wheat (54.09 kg), and maize (85.61kg) indicate higher yields for DAP supported farmers compared to those not supported. DAP supported farmers also used more inputs than those not supported as evidenced by significant mean differences in operating inputs (fertilizer, seed, and lime). These differences can most likely be attributed to significantly larger farms of DAP supported respondents compared to unsupported respondents. Therefore, land tenure reform needs to promote a rental market in land so that household willing and able to farm can grow their enterprises.

There is also a significant mean difference in household income (62,680 Rfrancs) between the two groups. Reported sources of income include mainly the selling of agricultural produce and livestock (e.g., goats and pigs). Although DAP supported farmers enjoy higher incomes, there is still a need to complement this income by promoting non-farm activities (e.g. food processing), which could improve the well-being of households.



**Table 3.3: Household characteristics of DAP supported versus unsupported sample farmers, Gikongoro Province, Rwanda, 2003/2004**

Farmers	DAP supported farmers		Unsupported farmers		Differences (t-test for significance)
Characteristics	Valid cases	Mean (Std. Dev)	Valid cases	Mean (Std. Dev)	Mean Differences
Family size	89	5.51 ( 2.07)	115	5.61 (2.14)	-0.10
Education of the household head (years)	89	4.98 (3.95)	115	3.64 (3.28)	1.34**
Age of the household head (years)	89	41.79 ( 12.58)	115	41.87 (13.90)	-0.08
Land area (Are)/ household (1 Are = 0.01 ha)	89	130.88 (127.69)	115	98.41 (110.59)	32.47*
Annual household income (R francs)	89	95,226 (145,287)	115	32,546 (52,413)	62,680***
Potato yield (kg/household)	66	909.35 ( 2,220.79)	77	348.77 (504.658)	560.56**
Operating inputs for potatoes (R francs) <sup>1</sup>	66	24,922.08 ( 26,473.13)	77	12,771.75 (15,886.74)	12150.33***
Wheat yield (kg/household)	56	133.16 (194.30)	62	79.07 (76.72)	54.09**
Operating inputs for wheat (R francs)	56	11,064.02 ( 16,132.551)	62	3553.51 (3,561.74)	7510.51***
Bean yield (kg/household)	75	119.32 (222.60)	92	40.76 (37.51)	78.56***
Operating inputs for beans (R francs)	75	3,715.72 (4262.01)	92	1,964.39 (2,241.48)	1,751.33***
Maize yield(kg/household)	51	125.58 (220.127)	56	39.96 (45.79)	85.61**
Operating inputs for maize (R francs)	51	2,744.41 (4,128.14)	56	884.73 (964.592)	1,859.68**
Land terraced	89	Respondents (%)	115	Respondents (%)	
Totally		23.6		5.2	
Partly		42.7		7.0	
Not terraced		33.7		87.8	
Total		100		100	

Notes: \*, \*\*, \*\*\* indicate significance at the 10 %, 5% and 1% levels of probability, respectively

<sup>1</sup> Operating inputs include the cost of seed, fertilizer and lime.

With regard to terrace construction, sample farmers were asked if their land is totally, partly or not terraced. Out of 89 DAP supported farmers, 43 percent reported their land to be partly terraced compared to 88 percent of unsupported farmers whose land is not terraced. About 24 percent of DAP supported farmers maintained that their land was totally terraced compared to 5 percent of unsupported farmers. These statistics clearly show the positive impact of DAP support on terrace construction. It is also interesting that there is a significant difference between the two groups in terms of their level of formal education, with DAP supported respondents showing a higher level of education. The statistics summarized in Table 3.3 seem to indicate that DAP support has had a significant impact on agricultural production and household income in the study area. However, these differences may not be the result of DAP because the causality is not clear. In addition, the significant differences in univariate means computed for yield and income could be attributed to other variables like differences in farm size and education. This is analyzed for potato production in a multivariate analysis in the next chapter.

### **3.3 Socio-economic characteristics of the sample households**

#### **3.3.1 Marital status of the household head**

Four categories of household head - married male, married female, widows, and child household heads - were considered in the survey, these being the most common heads found in Rwandan families. Child household heads are orphaned children under the age of 16 years. Table 3.4 reports the marital status of sample household heads. Married males represent 51 percent of the sample and married females 30 percent across DAP supported and unsupported farmers' associations. Various factors explain this gender difference in membership of farmers' associations. For example, women in the rural areas are mostly involved in domestic activities such as collecting water and firewood. Therefore, it may not be easy for women to find extra time for association activities. However, once the husband is a member of the association, benefits are shared. During the survey it was noticed that in association meetings or in associations' activities a wife or husband, depending on who is a member of the association, can represent the other.

**Table 3.4: Marital status of sample household heads in Nyamagabe, Mudasomwa and Kivu, Gikongoro province, Rwanda, 2003/2004 (n=204)**

Category	Total respondents	Percentage
Married male household head	104	51
Married female <i>de facto</i> household head	62	30
Widowed household head	24	12
Child household head	14	7

At the household level, the decision making process depends on the consensus of the spouses. According to Sarah (2001), economic decision-making in rural households is a consensual process in which women have at least an equal voice with their husbands in decisions regarding land use (when, what and how much to plant). In this study, the aspect of how decisions are made in the surveyed households was not considered. The aim of the question related to marital status was simply to establish gender representation in the farmers' associations of the study area. Table 3.5 summarizes other socio-economic characteristics of sample households in Gikongoro province.

**Table 3.5: Summary of other socio-economic characteristics of sample households in Gikongoro province, Rwanda, 2003/2004 (n=204)**

Characteristic	Minimum	Maximum	Mean	Standard Deviation
Family size	1	13	5.55	2.10
Education (years)	0	13	4.26	3.65
Age (years)	15	75	41.88	13.33
Household income (Rw Francs)	0*	1,000,000	60,975	108,695
Rights to land (ha)	0	8	1.13	119.15

*Note:* \* According to survey results, some respondents are very poor and do not have any source of cash income.

### 3.3.2 Family size and profession of household head

Family size (number of people in the household) can explain the level of production and other related interactions such as labour availability at the household level and consumption. The family size determines household supply of labour for farm work and possibly non-farm work (kimhi, 1995), which may generate the liquidity necessary for purchasing the inputs to produce (Matungul *et al.*, 2001; Matshe & Young, 2004). Clay and Reardon (1998) argue that development sustainability and population growth are not independent problems because their solution is simultaneous and requires an understanding not of how they are unique, but how they are linked. The current average family size in Rwanda is about five people per household (MINECOFIN, 2003a), which is similar to the mean family size of the study sample of 5.55. Given increasing family sizes in rural areas, it may be argued that farmers will use their land to the limit (Clay & Reardon, 1998). Since the total area of arable land is constant, increased family size will reduce the share for each family member once the land is divided according to customary laws of inheritance (Bizimana, 2002).

The mean size of land owned<sup>4</sup> by a household is 1.13 ha. With an average household size of 5.55 members, the share of each member if the land is divided equally is only 0.20 ha. One of the options currently encouraged by the Rwandan government with the support of different organizations, mainly the World Bank and IMF, is the development of the non-farm sector. Investment in this sector can reduce the number of agricultural dependents and also increase the current level of farmers' incomes. This is possible when poor farm households with little access to land and income can obtain support, such as training, capital and credit to facilitate their participation in the non-farm sector (Clay *et al.*, 1997). With regard to the profession of the household head, two categories were considered in the questionnaire, namely being a farmer or working off-farm. About 94 percent of the 204 respondents reported that farming was their profession. Only five percent are engaged in off-farm activities, such as teaching at primary school and as district government employees.

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<sup>4</sup> Land owned implies use rights only

### **3.3.3 Education and household head's productivity**

Due to an expected positive relationship between education level and management productivity (Atchoarena & Gasperini, 2002; Huffman, 2001; Pudasaini, 1983), years of schooling of the household head was further analyzed. The survey shows that the average years of formal education for the sample household heads is 4.26. This relatively low level of education is due mainly to poverty in rural families. For example, about 61 percent of respondents pay school fees for their own dependants. Only six percent are supported by government (through social funds at the district level) or by non-governmental projects such as Compassion International and World Vision through its Area Development Programs (ADPs) in the study area. Despite the relatively low level of education, most households have access to primary and secondary schools, which are, on average, 1.65 and 5.49 kilometers from home, respectively. One of the advantages for a farmer being located near a primary or secondary school is the potential technical support from teachers, such as writing small project proposals for agricultural credit and advice on the allocation of scarce production resources.

The expected positive effect of education on labour productivity (Atchoarena & Gasperini, 2002; Huffman, 2001; Pudasaini, 1983) may take three forms: (1) education can improve the quality of farmers' management and enable them to produce more with their available stock of production factors (other than labour); (2) education can increase the efficiency of resource allocation (allocative efficiency effects); and (3) education can help farmers to choose more effective means of production by adopting new technologies. With frequent changes in agricultural technology, education is important in determining a farmer's ability to understand and manage unfamiliar technology (Doss & Morris, 2001; Lin, 1991; Admassie & Asfaw, 2004).

### **3.3.4 Age and productivity of the household head**

In economic studies, aggregate productivity refers to the amount of output obtained from given levels of inputs used. Productivity is one of the two important sources of larger income streams, the other being savings which permit more inputs to be

employed (Fulginiti & Perrin, 1998). Barnes *et al.* (1999) conclude that an indirect link between productivity and age may be more important than a direct link. Age might be positively correlated with particular skills and experience that will be the object of employment demands. However, findings on the impact of age on job performance suggest a slight negative impact; only a small part of productivity variation could be attributed to age (Waldman & Avolio, 1986). Studies that estimate the influence of age on individual productivity are based on different indices, including supervisors' evaluations, work-sample tests and analyses of employer-employee data sets (Vegard, 2003). Vegard (2003) argues that individual job performance decreases from around 50 years of age. Productivity reductions at older ages are particularly strong for work tasks where problem solving, learning and speed are needed. In jobs where experience and verbal abilities are important, older individuals maintain a relatively high productivity level.

The average age of respondents in the study is 41.9 years. The minimum and maximum ages recorded are respectively 15 and 75 years with a standard deviation of 13.33. Since farming activities consist mainly of management tasks, and with reference to a benchmark age of 50 years as suggested by Vegard (2003), most farmer respondents (75 percent are younger than 50 years) are below their most productive age and thus an overall positive effect of the household head's age on potato production is anticipated.

### **3.3.5 Household income**

Given that the Rwandan economy is dominated mainly by agricultural activities, the main source of income for sample households is the selling of agricultural produce and livestock. However, farmers face liquidity constraints related to low levels of output on their very small farms, poor access to agricultural credit, low investment by the private sector in agricultural production, lack of processing technologies, and lack of storage facilities. Off-farm activities are not diversified and this results in the annual household income remaining very low, which makes it difficult to meet household expenses. Table 3.5 shows that from all their activities, respondents are able to generate a mean income of about 60,975 Rwandan francs per year (105 US\$). This relates to an equivalent income per person per year in the average sample

household of about 10,987 Rwandan francs (about US\$19). It is clearly difficult for household members to cope financially with the daily needs such as food, health, school fees, clothing, salt, and soap.

As indicated earlier, only about five percent of survey respondents earn income from the non-farm sector. Income sources reported are mainly small businesses (shops and kiosks), salaries as night guards, employment in tea plantations, and teaching at primary schools in the same area. Promoting off-farm activities, such as small and medium enterprises, in the rural area could alleviate on-farm liquidity constraints. It could also encourage young and better-trained work seekers to remain in rural areas.

The next chapter deals with potato production by sample households, and focuses on the factors that impact on potato production in the study area.

## **CHAPTER 4**

### **FACTORS AFFECTING POTATO PRODUCTION IN GIKONGORO PROVINCE, RWANDA**

An empirical analysis of the relationship between socio-economic characteristics and potato farmers' productivity is the focus of this chapter. The hypothesis to be tested states that investment in operating inputs (fertilizer, seed, and lime) depends on the socio-economic characteristics of the household, support by the DAP project, and location. This investment, in turn, influences household potato production in the study area. The assumption in this analysis is that the household's intention to produce potatoes is better reflected in the investment in operating inputs (fertilizer, seed and lime) that the household applies, given that the yield of potatoes is also influenced by other factors over which the household has no control (e.g., weather).

#### **4.1 Operating inputs and potato yields of households**

The survey results show that 70.1 percent of the 204 survey respondents cultivated potatoes during the study period. Respondents argue that the shortage of sufficient cultivatable land and lack of cash to purchase modern inputs (such as fertilizer, improved seeds, and lime) to increase soil fertility are the main constraints to achieve higher yields. Farmers supported by agricultural projects (like DAP) have tended to share their inputs with unsupported farmers, thus causing low application of inputs and consequently low yields per hectare. However, DAP supported farmers are advised on the use of fertilizer, seed and lime by DAP staff. Table 4.1 shows the applications of fertilizer, seed and lime, operating costs, cultivated potato area, and average potato production per household for the period September 2003 to August 2004.



**Table 4.1: Annual operating inputs and potato yields of sample households in Gikongoro province, Rwanda, 2003/2004 (n=143)**

Operating inputs and potato yields in kg	Minimum	Maximum	Mean	Standard Deviation
Fertilizer (kg/household)	0*	120	9.7	15.12
Seed (kg/household)	10	1000	129.14	158.98
Lime (kg/household)	0*	500	82.33	117.33
Potato yield (kg/household)	3	17500	607.50	1572.43
Cultivated potato area (Are)**	1	150	9.67	18.025
Operating costs (Rwandan francs)***	80	155,800	18,380	22,199.77
Total inputs in Rwandan francs /Are ****	40	9,156	2,572	1,528.18

*Note:* \* Some farmers reported not using inorganic fertilizers and lime due to a lack of access to these inputs

\*\* 1 Are = 0.01 hectare

\*\*\* Include costs of fertilizer, seed and lime

\*\*\*\* Operating costs (fertilizer, seed and lime) / cultivated potato area (Are)

## 4.2 Recursive model of factors affecting potato yields

A recursive model comprising linear and log-linear equations was used to estimate the relationship between specified socio-economic variables and a household's productivity as represented by household potato yields. Explanatory variables considered for the estimation of the investment model include gender of the household head, years of education of the household head (EDUC), family size (FAMSIZE), household income (INCOME), age (AGE) of the household head, and cultivated potato area (LAND). Since the household heads interviewed are from DAP supported and unsupported farmers' associations, an intercept dummy variable was used to capture this effect. Furthermore, two other dummy variables were used to account for agronomic differences in the three study districts. Potato yields were then taken as dependent variable in an identity equation with investment (fertilizer, seed and lime) as the explanatory variable. The first equation was estimated by OLS, while the second equation was estimated using the 2SLS routine in SPSS to account for possible correlation between the endogenous explanatory variable and the error term. Therefore, the two equations constitute a recursive model (Gujarati, 2003).

Information provided during the survey on potato yields and other variables was based on respondents' recall as they did not keep records. Since not all respondents had cultivated potatoes in the study period, the number of usable observations decreased from 204 to 143. The two equations to be estimated are presented below:

$$\begin{aligned} \text{INVESTMENT}_i = & \beta_0 + \beta_1 \text{LAND}_i + \beta_2 \text{INCOME}_i + \beta_3 \text{EDUC}_i + \beta_4 \text{FAMSIZE}_i + \\ & \beta_5 \text{AGE}_i + \beta_6 \text{GENDER}_i + \beta_7 \text{DAP}_i + \beta_8 \text{KIVU}_i + \beta_9 \text{NYAMAGABE}_i \\ & + \mu_i \dots\dots\dots(1) \end{aligned}$$

$$\ln \text{YIELD}_i = \alpha + \beta_1 \text{INVESTMENT}_i + \mu_i \dots\dots\dots(2)$$

Equation (1) shows the relationship between investment in fertilizer, seed and lime and socio-economic characteristics of the household, their location, and DAP support. Equation (2) represents the regression of potato yields on investment as a semi-log equation. The investment stands as a “proxy” for the explanatory variables included in equation (1). Therefore, the exogenous variables included in equation (1) are hypothesized to have an indirect effect on potato yields in the study area. Table 4.2 summarizes the definition of variables considered in the equations and the expected signs for their influence on the dependent variable.

Land under potato cultivation is expected to have a direct and positive impact on household potato production. Variables such as education, family size, age and gender are often considered by researchers for estimating labour productivity (e.g., Mundlak, 2001; Ball, 1985). According to Hazarika and Alwang (2003), household income provides liquidity for market inputs. Thus, a positive relationship between investment and income is expected. The impact of education on investment in operating inputs is regarded mainly in the form of efficiency and allocative effects (Admassie & Asfaw, 2004; Huffman, 2001). Accordingly, education is expected to have a positive impact on the adoption of modern inputs. More educated farmers are likely to be more efficient in allocating their income to production factors than those who are less educated. Furthermore, their ability to process information about the merits of adopting new agricultural techniques may also affect the use of operating inputs and increase farm profitability (Welch, 1978; Huffman, 2001; Admassie & Asfaw, 2004).

**Table 4.2: Definition of variables included in the postulated models**

Variable	Name	Definition	Expected signs
Dependent variables	INVESTMENT	Operating costs (fertilizer, seed and lime)	
	YIELD	Potato yields in kg/household	
Independent variables	LAND	Cultivated potato area in Are <sup>1</sup> / household	+
	INCOME	Annual household income (liquidity) in	
		Rwandan francs	+
	EDUC	Number of years of formal schooling of household head	+
	FAMSIZE	Number of people in the household	+
	AGE	Age of household head (years)	+
Dummy variables	GENDER	A dummy variable = 1 if male household head, 0 otherwise.	+
	DAP	A dummy variable = 1 for farmers supported by the DAP project, 0 otherwise.	+
	KIVU	A dummy variable = 1 for farmers from Kivu District, 0 otherwise.	+
	NYAMAGABE	A dummy variable = 1 for farmers from Nyamagabe District, 0 otherwise.	-

Note: 1 Are = 0.01 hectare

Age and gender of the household head are also individual characteristics that could have an impact on household performance (Vegard, 2003). Farmers with more experience may have lower marginal production and transaction costs (Gorton & Davido, 2004). For these reasons, a positive regression coefficient is anticipated for age in explaining use of operating inputs. Non-linear terms were not included for age because the vast majority of respondents were relatively young. Lastly, rural women are thought to have a wider range of production activities than rural men, but limited access to production resources. Consequently, a positive coefficient is anticipated for the gender dummy variable (Due & Gladwin, 1991).

Soil erosion, soil acidity and nutrient depletion undermine soil productivity in Gikongoro province, which results in relatively poor crop yields (Pender *et al.*, 2001). This has served as a basis for motivating many projects and policy interventions to stimulate technology diffusion (Barrett *et al.*, 2004). The level of crop production is reflected in the use of capital inputs (e.g., education) and other intermediate inputs such as fertilizers, seeds, lime and other modern inputs (Wu, 1977; Spio, 1996; Seyoum *et al.*, 1998). The DAP supports farmers in providing these inputs for the increase of potato production, hence a positive coefficient for this dummy variable is expected. Kivu district is characterized by high rainfall compared to Mudasomwa (the benchmark district), hence a positive sign is expected. Nyamagabe is an urban district and farmers in this region may not have sufficient access to inputs compared to the base district (Mudasomwa) where DAP concentrates its activities, hence a negative coefficient for this dummy variable is expected. However, transactions costs in product markets may be lower in Nyamagabe.

#### 4.3 Regression results

OLS estimates of the first equation are presented in Table 4.3. All signs of the estimated coefficients are consistent with *a priori* expectations, although the educations, gender, DAP and district coefficient estimates are not statistically significant. The coefficient estimates for land (potato cultivated area), household income, family size and age are statistically significant at least at the 5 percent level of probability. Land is the most important variable in terms of its contribution to expenditure on operating inputs, followed by household income and family size. The adjusted  $R^2$  of 0.492 is satisfactory for cross-sectional data. There is no evidence of multicollinearity as indicated by the Variance Inflation Factor (VIF) values.

**Table 4.3: OLS regression results of investment on socio-economic variables  
in Gikongoro Province, Rwanda, 2003/04**

*Dependent variable: Investment in operating inputs in Rwandan francs/household*

Independent Variables	Unstandardized Coefficient	Beta Coefficient	<i>t</i> -Statistic	VIF value
LnLAND	9,858.929	0.465	6.724**	1.333
INCOME	0.040	0.224	3.309**	1.283
EDUC	274.643	0.046	0.652	1.385
FAMSIZE	2,150.942	0.212	3.435**	1.065
AGE	245.704	0.147	2.182*	1.270
GENDER	2,136.201	0.047	0.752	1.097
DAP	2,566.613	0.058	0.845	1.310
KIVU	2,145.483	0.047	0.662	1.399
NYAMAGABE	-5,831.153	-0.112	-1.596	1.380
<i>R Squared</i>	0.524			
<i>Adjusted R squared</i>	0.492			
<i>n</i> = 143	<i>F</i> statistic = 16.255		Significance <i>F</i> = 0.000**	

Note: \*\* and \* indicate significance at the 1 % and 5% levels of probability respectively.

VIF = Variance Inflation Factor

The gender coefficient shows no statistically significant difference ( $t = 0.752$ ) between male and female household heads in the use of operating inputs. The estimated impact of education on investment is positive but is also not statistically significant. This might reflect Welch's (1978) argument that the marginal product of education in agriculture is low on very small farms. Also, the contribution of education is expected to be higher in modern agriculture compared to traditional agriculture where increased skills in farm management and adoption capacity of new agricultural technologies are mostly required (Carin *et al.*, 1998).

The large (standardized) Beta coefficient estimated for LnLAND (0.465) shows that an increase in land area per household will make the greatest partial contribution to investment in operating inputs for potato production. The next largest contributions to investment in operating inputs come from liquidity (Beta=0.224 for INCOME) and labour (Beta=0.212 for FAMSIZE).

The positive coefficient of family size implies that an extra person in a given household might increase the family's capacity to do farm work and thus improve family productivity. Chieko *et al.* (2003) point out that an increase in family size may not be a sufficient condition for the increase of agricultural production. Investment in public infrastructure (such as roads, schools and health centres) and promotion of higher input use through incentives such as input subsidies could allow farmers to increase their agricultural production. In respect to the age of the household head (producer), the estimated positive coefficient suggests that an increase in age and thus experience will lead to increased use of inputs. Acquired skills and experience and reduced transaction costs in the use of market inputs may allow older farmers to increase their productivity. The estimated coefficient for the DAP support dummy variable was positive but not significant. This was expected because DAP beneficiaries share their resources with unsupported farmers (Bimenyimana, 2004). With higher rainfall expected in Kivu district compared to the benchmark Mudasomwa district, the estimated coefficient of the Kivu dummy variable was not significant implying no major difference in how farmers apply market inputs in the two districts. Furthermore, the negative coefficient estimate of the Nyamagabe district dummy variable is significant at the 15 percent level of probability, indicating lower use of operating inputs compared to the benchmark district. The results show that most of the socio-economic variables impact on households' use of operating inputs in the study area. Investment in operating inputs can now be included as an exogenous variable in a potato production function [equation (2)], assuming that investment in operating inputs (fertilizer, seed and lime) affect potato yields.

Due to the endogenous nature of the explanatory variable in equation (2), it was replaced with an instrumental variable estimated from all of the exogenous variables in equation 1 using the 2SLS procedure. The results are presented in Table 4.4, and confirm a significant positive relationship between potato production and investment in operating inputs (adjusted  $R^2 = 34.3\%$ ). This relationship was estimated as a semilog model in which the regressand (potato yields) appears in logarithmic form. Since the investment stands as a proxy for the socio-economic characteristics considered earlier, the 2SLS results support expectations that certain socio-economic variables of sample households indirectly and significantly affect the level of potato

production. In particular, the socio-economic variables significant in equation (1) could be considered as part information for policy measures dealing with agricultural development in Gikongoro province.

**Table 4.4: 2SLS estimate of log – linear model of potato yields on operating costs in Gikongoro province, Rwanda, 2003/04**

*Dependent variable: Natural log of potato yields in kg/household*

Independent Variable	Unstandardized Coefficient	Standardized Coefficient	t-Statistic value
Estimated investment	2.423	0.886	8.669*
<i>R Squared</i>		0.347	
<i>Adjusted R squared</i>		0.343	
<i>n=143</i>	<i>F Statistic 75.15</i>	<i>Significance</i>	<i>F = 0.000*</i>

*Note:\** indicates significance at the 1% level of probability.

The next chapter proposes a networking model towards sustainable agriculture in Gikongoro province, Rwanda.

## CHAPTER 5

### NETWORKING MODEL TOWARDS SUSTAINABLE AGRICULTURE IN GIKONGORO PROVINCE, RWANDA

The empirical results show that farmers are likely to be adversely affected by cash flow problems, low levels of agricultural skills, high transaction costs and small farm sizes. In addition, DAP support for operating inputs is short-term and this might prevent farmers from realising long-term benefits. Developing a support policy, such as development networks in which farmers can participate and take control of their own development (Haverkort, 1993), is considered a key to long-term sustainable agriculture in Rwanda. This chapter proposes a networking model for supporting farmers' associations with the objective of helping farmers to achieve a sustainable agricultural system in Gikongoro province, Rwanda. Practical steps needed to implement such a model are also suggested.

#### 5.1 Networking model for supporting farmers' associations

Due to the potential role that farmers' associations can play in developing Rwandan agriculture (Bingen *et al.*, 2003), government and non-governmental organizations (NGOs) have been supporting farmers' associations in their activities. However, the drawback is the dispersed nature and lack of consistency of their support approaches (Bingen & Mpyisi, 2001) which, in turn, led to short-term benefits of farmers' associations and unsustainable agricultural performance. Furthermore, institutional limitations, such as inefficient coordination of organizations and projects involved in agriculture, reduce the effectiveness of their interventions, resulting in poor support to farmers. Limited channels or networks for sharing information with regard to the real problems (e.g. soil infertility, limited sources of income) faced by their programme beneficiaries (farmers) constitute another constraint to sustainable agriculture in Rwanda.

Haverkort *et al.* (1993) and Bingen and Munyankunsi (2002) have suggested networking as a powerful and cost-effective way of achieving goals that individuals cannot achieve alone. Feenstra (1997) points out that reaching toward the goal of



sustainable agriculture is the responsibility of all participants in the agricultural system, including farmers, labourers, policy-makers, researchers, retailers, and consumers. Accordingly, each group has its own unique contribution to make to strengthen a sustainable agricultural community. Ehui and Spencer (1993:282), citing CGIAR (1989), define a sustainable agricultural system as “the successful management of resources for agriculture to satisfy the changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources”. According to Feenstra (1997), sustainable agriculture integrates three goals, namely environmental health, economic profitability, and social and economic equity. Strategies and policies to achieve the system’s goals are often crafted by the government, academic and research institutions and organizations involved in the agricultural sector. It is with these in mind that the term “sustainable agriculture” is used in this study.

## **5.2 Proposed model**

In the scope of this study, the proposed model for supporting farmers is the networking of farmers’ associations and other possible agents in the agricultural sector comprising the Rwandan government, academic and research institutions, NGOs, and the private sector (business persons and banks). A joint role of these networkers, although there may be differences in their respective objectives and activities, may be possible since farm and non-farm linkages help to increase incomes (Makhura, 2001), which is the main goal of all participants. Working together may do better than individual actions, and thus a more participatory approach to agricultural research and development is recommended (Haverkort *et al.*, 1993).

The Rwandan government through its ministries could develop rural infrastructure (roads and telecommunication) to promote contact between farmers’ associations (producers) and market centres. It is also important for the Rwandan government to reinforce legal infrastructure (i.e., courts and policing) to protect property rights and contractual arrangements (Ortmann, 2005). At the district level, technical assistance to farmers (e.g. demonstration of planting and harvesting technologies) could be reinforced by extension agents to allow them to be actively part of the sustainable agricultural system. The links of academic and research institutions with activities of

farmers' associations in Rwanda have been poor and still need to be improved through participatory agricultural research. More investment and incentives in agricultural research could help to bridge the gap between researchers and farmers (Anderson *et al.*, 1994).

The role of academic and research institutions is, firstly, that they can support farmers technically through training programmes and student internships to strengthen organizational and management skills of farmers. They could also contribute through demonstration of seed multiplication and dissemination of their research findings and other new agricultural technologies. This can be supported by continual and participative research on critical development issues faced by farmers.

Agricultural projects managed by NGOs in supporting farmers could take account of government agricultural policies and research findings (e.g. innovations on improved agricultural technology) in supportive actions. Integrating farmers in the development practice and at the beginning of the support process is likely to have a sustainable impact on their farm activities. Agricultural projects (NGOs) can support farmers financially (through promotion of microfinance schemes) and technically (training skills) in a coordinated way with academic and bank institutions (e.g. project-mediated inputs/credit) in the network. The support should also be of a long-term nature to enable beneficiaries to gain benefits over the long-run. Concentrating on a particular problem for a particular population based on available means is better than spreading efforts that may result in unsustainable agricultural practices and thus an unsustainable agricultural system.

The potential role that private sector business, especially input traders and commercial banks, could play in the proposed network is likely to be inhibited by the insufficient volume of business leading to poor private sector service provision (Matungul *et al.*, 2001). Gikongoro province has poor infrastructure, such as roads and telecommunication facilities, which, in turn, affect the cost and level of business and thus contacts between farmers and private sector business. Improved infrastructure (e.g., construction and/or rehabilitation of roads and communication facilities) may promote services provided by the private sector to farmers. Given that low levels of liquidity constitute one of the major constraints preventing farmers from increasing

their production, reinforcing or introducing credit schemes (under government projects or by passing legislation), such interlinked credit/input/output contracts for processed products<sup>5</sup> proposed by Jayne *et al.* (2004), could enhance farmers' production. The investment by private sector businesses in activities performed by farmers' associations (e.g., small business) and off-farm activities (e.g., food processing) could also promote alternative sources of employment to complement farm incomes.

Although farmers' managerial abilities differ for reasons of schooling, health, and experience in their ability to perceive, interpret, and respond to new events in their farm activities, they provide an essential human resource (Schultz, 1978). Also, other potential assets, such as farmers' motivation to work in a group and the determination to succeed in their activities, could be the cornerstone for the proposed networking model. Furthermore, this could be an appropriate opportunity for farmers not only to propose solutions to the agricultural constraints that they face, but also to improve their participation in the agricultural development process.

Surveyed farmers in Gikongoro province have been receiving support from governmental and non-governmental projects, such as the DAP, in terms of terrace construction, supplying modern inputs (fertilizer, seed, and lime), and training. Collective action in the form of farmer cooperatives can contribute to their self-reliance by reducing transaction costs (e.g., costs of searching for a partner with whom to exchange) in the purchasing of inputs and marketing of products (Holloway *et al.*, 2000). Clearly, as for each group, the need for a cooperative depends on the prevailing circumstances (Van Niekerk, 1988). However, the likely gaps in human and organizational capital (due to poor education) and high transaction costs (due to poor infrastructure (roads and telecommunication), constrain the establishment of cooperatives (Escobal *et al.*, 2000). Moreover, the small-scale farming system in Rwanda, as in Ethiopia (Belet *et al.*, 1991), is still the most dominant one in the agricultural sector. Consequently, private companies are less involved in this sector owing to perceived lower returns on capital. Thus, establishing cooperatives may

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<sup>5</sup> Interlinked schemes are programmes where farmers receive inputs on loan from traders and pay back the loan through sale of the crop at harvest (Jayne *et al.*, 2004). But these contracts are difficult to enforce if farmers can sell the product to buyers other than the lender. Such 'side selling' is a problem when the product does not have to pass through a processor.

enhance the link between farmers and private companies (e.g., AGROTECH), and could help farmers to overcome access barriers to inputs. Figure 5.1 presents a summary of the proposed networking model towards helping farmers to achieve a sustainable agriculture in Gikongoro province, Rwanda.

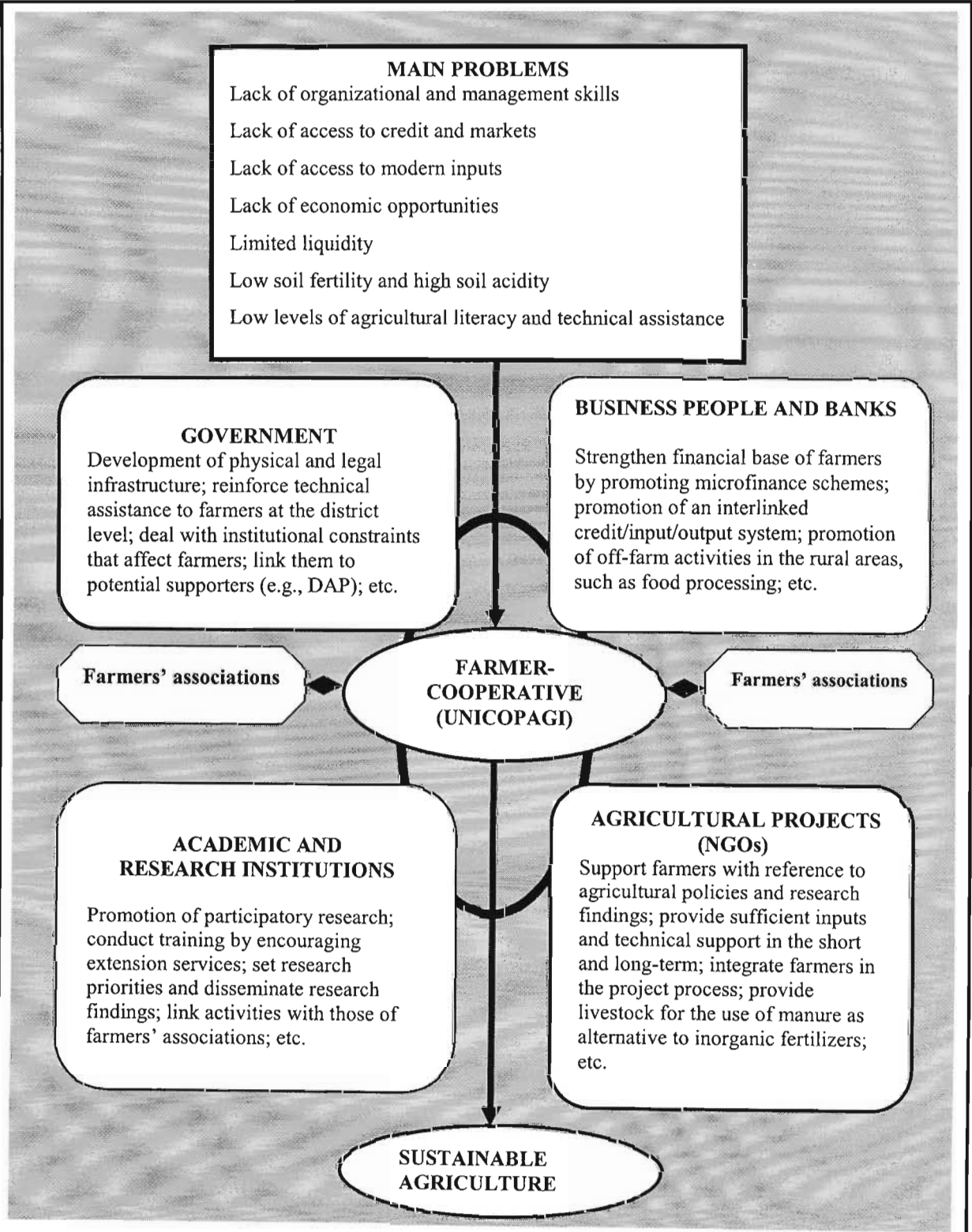


Figure 5.1: Flow chart of the proposed networking model for supporting farmers' associations in Gikongoro province, Rwanda

### 5.3 Implementation of the proposed networking model

This section suggests some practical steps leading to the implementation of the proposed networking model. Driven by government policy, the Ministry of Agriculture in Rwanda calls for public and private actions for sustaining farmers in input use, provision of necessary services and their monitoring (Bingen & Munyankunsi, 2002). However, the main concern is how farmers respond to different agricultural policies introduced by governmental and private agencies (Grepperud, 1995). This study reveals significant differences between crop yields and incomes of sample farmers supported by DAP and those not supported, but attributes most of these differences to other factors than DAP. Implementing the proposed networking model may contribute to sustainable agricultural development in Rwanda because it considers these factors in addition to DAP.

The implementation of the proposed model may be achieved through increased public and private investments. According to Zhang and Fan (2004), public investments can be allocated to promote growth directly by providing a range of public goods (e.g., provision of research and development, infrastructure and education), or indirectly by creating an attractive business environment for private investors. Apart from the provision of these services by the Rwandan government, it is also important to ensure that agricultural policies (present and future) are articulated in such a way that the networking of all agricultural partners involved in agricultural development adds value to their work (Engel, 1993).

Institutional support, including agricultural research and development (R&D) (through agricultural research stations), extension services (e.g. demonstration of new agricultural technology) and agricultural credit facilities (Due & Magayane, 1990; IFAP, 1990), are part of practical actions that can link farmers to academic and research institutions, NGOs, and commercial banks. Holloway *et al.* (2000) suggest that farmer-led cooperatives are helpful in overcoming access barriers to assets, information and services. There are some new agricultural cooperatives emerging in Gikongoro province, such as UNICOPAGI<sup>6</sup>; however, lack of management

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<sup>6</sup> Union des Cooperatives Agricoles de Gikongoro

experience and inadequate capital resources are constraints that may affect their performance (Van Niekerk, 1988; Kimhi, 1995). Hence, it may be important for government to support the emergence of these cooperatives by bearing some of the transaction costs (organizing, maintaining, and enforcing rules of institutional arrangements) (Holloway *et al.*, 2000; Matungul *et al.*, 2001). Due to the likely improved bargaining power that may result from operating as cooperatives compared to individual associations (e.g., in the purchasing of inputs and selling of products), cooperatives can effectively promote the link of farmers to private sector business (e.g., input traders and commercial banks), leading to enhanced participation of farmers in agricultural development.

Gerpacio (2003), citing Morris (1998), affirms that state-sponsored organizations tend to play a dominant role in developing improved technology and disseminating it to farmers. Thus, agricultural R&D, encouraged through related incentives (e.g., attractive salaries and marketing of new technologies), can support the link between activities of farmers to those of academic and research institutions. According to Huffman and Just (1999), apart from the public investment in agricultural R&D, the private sector could also contribute to agricultural research to ease fiscal problems that may occur. However, the government needs to create a favourable regulatory environment (Alfranca & Huffman, 2001) that encourages possible private investment in R&D. The joint role of public and private investment may, therefore, lead to more agricultural research findings which, in turn, are translated to farmers by extension agents in a way that will allow farmers to easily understand and apply them in their farming activities.

With regard to agricultural projects (NGOs), the government has to ensure that agricultural policies are respected by NGOs (working according to government policy), who may also contribute to capacity building of farmers' associations to help them improve their overall organizational and management skills, and thus learn how to operate as independent economic actors (Bingen *et al.*, 2003). The government could also play a role in establishing an institutional framework that helps farmer cooperatives to evolve their link with commercial banks. For example, secure land tenure may add value to the bargaining power of farmer cooperatives when making collateralized loans to farmers (MINITERE, 2004; Holloway *et al.*, 2000). However,

the Rwandan government needs to accelerate its current plans to secure land tenure and to promote marketable rights in land that will create collateral value. Since lack of access to modern inputs is one of the main challenges for farmers in the study area, interlinked credit/input/output system (Jayne *et al.*, 2004) could be supported by commercial banks and support agencies (e.g., World Bank and USAID). This can be done under agreements with farmer cooperatives, such as UNICOPAGI, to allow farmers to gain access to fertilizers, seeds and lime. These cooperatives may also help to reduce some transaction cost, such as bargaining to reach agreements, transferring the credit/input to farmers and monitoring the fulfillment of agreements (Holloway *et al.*, 2000).

Ortmann (2001: 473-474) suggests that “farmer-led cooperatives can provide numerous benefits to members (e.g. helping to overcome liquidity constraints, information asymmetries, and minimum efficient scales of production and marketing)”. However, conventional cooperatives entrench free and forced rider problems that undermine their ability to raise equity and debt capital, making them dependent on external support (Cook & Iliopoulos, 1999; Hendrikse & Veerman, 2001). However, these conventional cooperatives can be converted to private company or ‘new generation cooperative’ status to reduce their dependence on government (Cook & Iliopoulos, 2000).

Some obstacles are likely to restrain the implementation process of the proposed networking model. The implementing phase of such development policy requires a direct or an indirect sponsor to cover at least some of the operational costs (Engel, 1993). Secondly, given that the respondents were used to free services, such as the provision of modern inputs by the Ministry of Agriculture and NGOs during the transition period, the likely reluctance in shifting from free services to microfinance and other credit schemes constitute another obstacle. However, the coordinating role of government played through various forums of discussions and regular consultation meetings of all partners, including farmers, may facilitate this shift to long-run services. Consequently, farmers may then receive services pooled in one “basket” by all stakeholders, leading to sustainable agriculture in Rwanda.

## CONCLUSIONS AND POLICY RECOMMENDATIONS

Constraints to the access of agricultural production resources by farmers in Rwanda undermine their level of production. The role of food aid has changed from free food distribution to Food-For-Work (FFW) in development activities, such as soil erosion control in the agricultural sector. The current agricultural policy in Rwanda aims to shift the agricultural sector from a traditional to a modern one by promoting the role of farmers' associations towards this goal. Due to their potential role in development, farmers' associations have been receiving support from government and non-governmental organizations in the use of modern inputs and in soil erosion control practices. For the period 2000 to 2004, farmers' associations in Gikongoro province have been supported by the Development Activity Program (DAP) under the umbrella of World Vision International, Rwanda. The DAP supports farmers in land terracing, but supported farmers are also provided with modern inputs (seed, fertilizer and lime), which farmers generally cannot afford due to income and credit constraints.

Results from descriptive analyses show a higher rate of participation by men than women in the activities of farmers' associations in Gikongoro province in 2004. A low level of formal education (4.26 years) characterizes the household head and the family size is relatively large (average of 5.55 people per household). It is generally assumed that agricultural assistance to farmers' associations and member households by the DAP allows them to increase their agricultural production and incomes. Surveyed farmers are members of associations, some of which are supported by the DAP. These farmers engage mainly in farming activities where lack of sufficient inputs and highly acidic soils negatively affect their crop yields. The study compares DAP supported and unsupported farmers in terms of differences in household income, use of operating inputs and crop yields. A univariate analysis indicates that DAP supported farmers have significantly higher crop yields, household income, and greater investment in modern inputs and terraced land than unsupported farmers. However, it does not attribute these differences to DAP.

To determine what factors that affect food production in Gikongoro province, this study estimates a system of linear and log-linear equations to analyze the effects of



DAP participation, cultivated potato area, household income, gender of the household head (producer), years of schooling, family size, and age of the producer on farmers' productivity as measured by potato yields. It was hypothesized that investment in operating inputs depends on the socio-economic characteristics of the household, support by the DAP project, and location. This investment, in turn, influences household potato production in Gikongoro province. Estimates from the regression analysis support the expected relationship between specified socio-economic characteristics and household potato production. Cultivated potato area, household income (liquidity), family size and age of the producer were found to have a significant positive effect on investment in operating inputs (fertilizer, seed and lime), which in turn had a significant impact on potato production. Thus, socio-economic factors have a significant indirect effect on potato production.

The estimated effect of DAP support farmers was positive but not significant, possibly because DAP supported farmers tend to share inputs with unsupported farmers. DAP support was reported by survey respondents to be important as it improves access to operating inputs – albeit for a short period of time. Family size appears to have a positive impact on input use (agricultural production). Due to the combined effects of high population growth and land scarcity in Rwanda, an extra worker in the family could be regarded as a source of knowledge, by adding technical expertise, rather than a source of labour (Pingali, 1997). Liquidity constraints also explain changes in investment in operating inputs. Although age (experience) also explained the level of investment in operating inputs, less experienced farmers should be advised to join experienced producers in farmers' associations, as currently encouraged by the Rwandan government, to reduce transaction costs in input and product markets and to facilitate transfer of skills.

Potato cultivated area was highly correlated with investment in operating inputs. The land cultivated by the sample households is characterized by poor soil fertility; the main option of increasing potato production would be land intensification, which in turn requires access to relatively expensive (purchased) inputs. This study proposes government interventions to promote competitive financial markets in rural areas. Amongst these are policies to improve tenure security and hence marketability of all assets, including land, in order to create collateral value and to strengthen incentives

to invest. Furthermore, the study recommends that the DAP project, the Rwandan government and other possible agricultural projects such as the Catholic Relief Services (CRS), could review their approaches in supporting farmers by considering possible effects of socio-economic characteristics on household production.

Descriptive statistics show a higher participation of men than women in farmers' associations. The Rwandan government could reinforce the ongoing gender policy of encouraging women's participation in socio-economic activities for an integrated and sustainable agricultural development. This may equate the decision power between men and women with regard to the allocation of production resources and agricultural surplus. The positive relationship between age of the household head and investment in operating inputs may indicate that investing in farmers' skills could have positive outcomes. Agricultural literacy could be promoted by all development agencies, especially education and research institutions, to produce informed citizens able to participate in establishing the policies that will support a competitive agricultural industry in Rwanda.

Maintaining agricultural growth achieved by farmers once DAP support has been terminated is a key challenge for policy makers. This study proposes a networking model towards sustainable agriculture in the study area. The proposed model focuses on cooperation between farmers, academic and research institutions, agricultural projects (NGOs), private sector business, and the Rwandan government. Some practical actions for implementing the proposed model include linking farmers and development agents through farmer cooperatives (e.g., UNICOPAGI) to allow them to gain inputs and other services in a cost-effective way. The government could play a central role in coordinating the activities of various role players, and may bear some transaction costs related to the implementation phase. However, the proposed model is not without limitations since the list of development agencies and their respective activities can be extended.

At the beginning of this study, two hypotheses were formulated. Results from a univariate analysis seem to support the hypothesis that "agricultural assistance through Food-For-Work projects allows targeted farmers' associations and member households to increase their level of agricultural production". Furthermore, based on

estimates of a recursive model of factors affecting potato production in Gikongoro province, the second hypothesis was partly verified; namely, that investment in operating inputs (fertilizer, seed, and lime) depends on the socio-economic characteristics of the farm household, including area of cultivated land, household income, family size and age of the household head. This investment, in turn, influences household potato production in the study area. The study suggests that the DAP may need to be more selective, focusing more on farm size, education and family size profile of association members when deciding where to channel support. The study also recommends more research into the efficiency of land rental and credit markets to better understand land and liquidity constraints to improved household production in Gikongoro province, Rwanda.

## SUMMARY

Farmers' contribution to the development of Rwandan agriculture cannot be overstated. However, it is important to consider various constraints that prevent them from contributing more towards agricultural development. The Rwandan economy is dominated by the agricultural sector which contributes 45 percent to the Rwandan GDP and 90 percent of the employment share. The high population pressure in Rwanda (estimated at 8.3 million people and a density of about 315 persons per square km) is a major factor contributing to land fragmentation and small farm sizes. Apart from farm size limitations, land degradation in the form of soil erosion and poor soil fertility also constrain agricultural production. Despite considerable opportunities for employment in the agricultural sector, low investment in human capital inhibits farmers' ability to adapt to new situations and adopt new technologies.

Farmers in Rwanda, in the transition phase since 1994, have received agricultural support from governmental and non-governmental projects. Since most activities carried out by support projects are community based, labour payment is mainly done in the form of food. Hence, since 1994, Rwanda experienced two systems of labour payment, namely Food-For-Work (FFW) and Cash-For-Work (CFW). Activities undertaken in the scope of FFW projects depend on problems faced by the targeted population, such as land degradation due to soil erosion and floods, and road destruction. The Development Activity Program (DAP) of World Vision International, Rwanda is a FFW oriented project aimed at sustaining farmers' associations and member households through mainly land terracing for control of soil erosion. DAP supported farmers also receive agricultural credit in terms of fertilizer, seed and lime. The DAP operates in four provinces of Rwanda, namely Butare, Byumba, Ruhengeri, and Gikongoro. Gikongoro province is generally known as the poorest province and has soil fertility problems caused by highly acidic soils and soil erosion, and hence receives more support from the DAP than other provinces. Therefore, the main objective of this study is to analyze the impact of DAP support and socio-economic characteristics of households on agricultural production in Gikongoro province. The study hypothesized that agricultural assistance through FFW projects allows targeted households and farmers' associations to increase their level of

agricultural production, and that investment in operating inputs depends on the socio-economic characteristics of the households, DAP support and farmer location.

This study verified the stated hypotheses and objectives based on data collected from July to August 2004 from a stratified multistage sample of 204 household heads in three districts of Gikongoro province, namely Mudasomwa, Nyamagabe and Kivu. The 204 household heads are members of 10 farmers' associations supported by DAP and 14 associations not supported. These farmers' associations have been, and are being, formed because of potential agricultural assistance from governmental and non-governmental projects. For the period 2000 to 2004, out of 204 survey respondents the majority (53 percent) have been members of their associations for more than four years. This shows that most of these associations were created even before DAP support came into effect (2000-2004). Farmers receive technical assistance from district agronomists, although it was reported to be inadequate. Improved ways of monitoring activities achieved by farmers under the support of agricultural projects (like DAP) at the district level is recommended.

Farming is the most common activity (65 percent) performed by surveyed farmers in their associations. Other respondents combine farming activities with small businesses and *tontines*. Receiving cash income from the farmers' association is the main motivation for membership (41 percent), followed by the team work/spirit generated (40 percent). However, estimates show that respondents employed in terrace construction need to work more than eight hours per day because they allocate their time to home activities, association activities, and terrace construction. Farmer respondents generally face liquidity constraints in the purchase of modern inputs (seed, fertilizer and lime) and depend on support from the Ministry of Agriculture and other non-governmental projects. The provision of these modern inputs by the DAP has allowed relatively easy access to these inputs, although the quantities received for individual use were reported to be low, leading to low applications. A univariate analysis was used to determine the impact of DAP support by comparing outcomes of DAP supported and unsupported farmers. Results indicate significant mean differences between the two categories of farmers in their use of operating inputs, yields of potatoes, beans, wheat, and maize, and household income; i.e., DAP supported farmers have greater farm sizes than those not supported and this may

explain more the intensive use of inputs, higher yields and household incomes compared to not supported. However, it does not attribute solely these differences to DAP although results seem to indicate that DAP support has had a positive and significant impact on agricultural production in Gikongoro province.

Estimated results from a recursive model on factors affecting household potato production reveal significant positive impacts of potato cultivated area ( $t = 6.724$ ), household income ( $t = 3.309$ ), family size ( $t = 3.435$ ), and age of the household head ( $t = 2.182$ ) on the use of operating inputs, which, in turn, has a significant positive impact on potato yield. From these estimates, it is clear that other factors also impact significantly on household potato production in Gikongoro province. This study recommends that these significant explanatory factors should be considered for any policy measures dealing with agricultural development in Rwanda. Low levels of formal education characterizing the household heads across the two groups of farmers point to the need for education and vocational training programmes to enable households to improve their literacy levels and agricultural knowledge in order to increase production and reduce food insecurity.

The sustainability of agricultural growth once DAP support has been terminated is a major challenge for policy makers. This study proposed a networking model involving the cooperation of farmers, academic and research institutions, agricultural projects (NGOs), private sector business, and the Rwandan government towards sustainable agricultural development. The study also suggests that the DAP may need to be more selective in supporting farmers, focusing more on farm size, education, family size and liquidity profile of association members when deciding where to channel support. The study also recommends more research into the efficiency of land rental and credit markets to better understand land and liquidity constraints to improved household production in Gikongoro province, Rwanda.

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APPENDICES

## APPENDIX 1



University of KwaZulu-Natal  
 School of Agricultural Sciences and Agribusiness  
 Discipline of Agricultural Economics  
 Pietermaritzburg  
 2004

### THE STANDARDIZED QUESTIONNAIRE

The main objective of this questionnaire is to investigate the impact of agricultural assistance by the Development Activity Program (DAP) and socio-economic characteristics on household production in Gikongoro province, Rwanda. It has to be completed by household heads who are members of DAP supported and unsupported farmers' associations. Data collected using this questionnaire will inform the study hypotheses and objectives.

#### IDENTIFICATION

Date: \_\_\_\_\_

District: \_\_\_\_\_

Sector: \_\_\_\_\_

Respondent's name: \_\_\_\_\_

#### Status of the respondent

Married male household head

☐

Married female *de facto* household head

☐

Widowed household head

Child Household head

Farm Association’s name: \_\_\_\_\_

SECTION 1. PERSONAL CHARACTERISTICS OF THE RESPONDENT

Household members	Years of formal education	Occupation	Gender (M or F)	Age (years)
1				
2				
3				
4				
5				
6				
7				

1.1 Do you have a source of off-farm income? Yes  No

1.2 If yes what are the main sources of off-farm income?  
\_\_\_\_\_

1.3 What is the proportion of total annual income? \_\_\_\_\_(RWF)

2. BACKGROUND INFORMATION ON THE ASSOCIATION

2.1 For how long are you a member of this association?

Years > 4 4 3 2 1 <1

2.2 What is your position?

President  V. President  Treasurer

Secretary  Advisor  Member

2.3 Is your Association legally recognized?

Yes  No  Don't know

2.4 What are the main activities of the Association?

1) \_\_\_\_\_

2) \_\_\_\_\_

3) \_\_\_\_\_

2.5 Is there any cost of joining the Association? Yes  No

If yes, what type of cost and how much?

Type of Cost	How much

2.6. Is there any benefit you get from the Association? Yes  No

If yes, which benefit?

1 \_\_\_\_\_

2 \_\_\_\_\_

3 \_\_\_\_\_

2.7 Why did you join this Association?

District request	Decided yourself for group work	Wanted to work with the project	Other (specify)



SECTION 3. FORMAL EDUCATION

How far is the nearest primary school? \_\_\_\_\_ Km

3.1 How far is the nearest secondary school? \_\_\_\_\_ Km

3.2 How do you pay tuition fees for your children or other dependents?

I pay myself in what I do ☐ I am supported ☐ I don't have them ☐

SECTION 4. REVIEW OF DAP SUPPORT

4.1 Have your association worked with the Developmental Activity Program (DAP) of World Vision?

Yes ☐ No ☐

If yes what time period?

2000	2001	2002	2003	2004	Number of years or months

4.2 If yes, how many hours or days/ month do you spend on project activities and on own activities?

Activities	Hours/day	Days/month
Association activities		
Home agricultural activities		

Note: 22 is the number of working days considered

4.3 How many family members work for the project?: \_\_\_\_\_

4.4 Have you got any arable land? Yes ☐ No ☐

4.5 If yes, how many hectares? \_\_\_\_\_ ha

4.6 What is the land characteristics    Very good ☐    Good soil ☐    bad ☐

4.7 Has your land been terraced or improved by the DAP project

Yes ☐    No ☐    One part ☐

**Provision of agricultural credit (supported farmers only)**

4.8 Have you received any agricultural credit from the DAP project in terms of seeds, fertilizers, lime, and Cultivation tools?

Yes ☐    No ☐

If yes, what type of agricultural credit?

Improved seeds ☐    Fertilizers ☐    Lime ☐

Cultivation tools ☐    Money

4.9 How do you appreciate the conditions of credit access?

Very Difficult ☐    Acceptable ☐    Easy ☐    I don't know ☐

4.10 What are the modalities of reimbursement of the credit received?

Annual interest rate in %	Period of reimbursement in months	Not planned	I don't know

4.11 What collateral did you need to get the loan?

---

4.12 Have you been employed in terrace construction by the DAP project?

Yes ☐    No ☐

If yes, how many hours allocated to Project activities and home agricultural activities?

Activities	Hours/day	Days/month
Project activities		
Home agricultural activities		

4.13 If you had the choice, what the proportion of wage would you like paid as food and what proportion of cash?

Payment in Food	Quantity in Kg	Payment in Cash
Maize		
Beans		
Vegetable Oil		
Total		

4.14 If you had a choice of a wage of 11750 RWF in food and a wage of 10.000 in cash,

What would you choose between payment in food and payment in cash \_\_\_\_\_

Why? \_\_\_\_\_

4.15 How do you use the food received?

Eat part of it	Sell part of it to the market	Sell to the distribution site	Payment of your debt in kind	Other (specify)

4.16 Do you have any crop storage facilities? Yes ☐ No ☐

4.17 If yes, who constructed it (them)?

DAP Project	Yourself	Together	If other specify

4.18 How many extension advisors do you have access to?

---

4.19 Rate your access to government/Project/Associations extension advising:

Poor

Good

4.20 Rate the quality of advice received:

Poor

Good

4.21 Who trained them? \_\_\_\_\_

4.22 Have you been trained in any of the following fields by the DAP project or by others?

Fields of training	Yes (x)	No (x)	By whom (DAP) or Others	When
1.Improved Agricultural techniques				
2.Business &financial management				
3. Marketing				
4.Post-harvest technologies				

If other field (specify)\_\_\_\_\_

4.23 Have you applied the training received? Yes  No

## SECTION 5. ANNUAL HOUSEHOLD YIELD AND OPERATING INPUTS

5.1 What is the estimated production of the following crops for the last two seasons?

Crop	Season A (In Kg) <sup>1</sup>		Season B (in Kg) <sup>2</sup>	
	Area (Ares)	Yield/ household	Area (are)	Yield/household
Potatoes				
Beans				
Wheat				
Maize				

1. Season A= September 2003- February 2004 2. Season B= February 2004- August 2004

5.2 What are the estimated quantity of inputs used and the price of the following crops?

Crop = Potatoes	Season A (in Kg) <sup>1</sup>		Season B (in Kg) <sup>2</sup>	
	Quantity/Are	Price in R francs	Quantity /Ares	Prices in R francs
Fertilizers				
Seeds				
Lime				
Labour (man days)				

1. Season A= September 2003- February 2004 2. Season B= February 2004- August 2004

Crop= Beans	Season A (in Kg) <sup>1</sup>		Season B (in Kg) <sup>2</sup>	
	Quantity/Ares	Price in R francs	Quantity /Ares	Prices in R francs
Fertilizers				
Seeds				
Lime				
Labour (man days)				

1. Season A= September 2003- February 2004 2. Season B= February 2004- August 2004

Crop= Wheat	Season A (in Kg) <sup>1</sup>		Season B (in Kg) <sup>2</sup>	
	Quantity/Ares	Price in R francs	Quantity /Ares	Prices in R francs
Fertilizers				
Seeds				
Lime				
Labour (man days)				

1. Season A= September 2003- February 2004      2. Season B= February 2004- August 2004

Crop= Maize	Season A (in Kg) <sup>1</sup>		Season B (in Kg) <sup>2</sup>	
	Quantity/Ares	Price in R francs	Quantity /Ares	Prices in R francs
Fertilizers				
Seeds				
Lime				
Labour (man days)				

1 .Season A= September 2003- February 2004      2. Season B= February 2004- August 2004

5.3 If the DAP stops its activities, how are you going to manage the activities you were doing with it.

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**THANK YOU FOR PARTICIPATING IN THIS STUDY**

## APPENDIX 2

### SURVEY POPULATION AND SURVEY SAMPLE SIZE PER SELECTED DISTRICT, GIKONGORO PROVINCE, RWANDA

#### Appendix 2.1 Survey population, Gikongoro province, Rwanda, 2004

District	Associations applied (N)	Members	Associations Accepted	Members	Associations Rejected	Members
Mudasomwa	100	1530	42	746	58	784
Kivu	74	1230	34	532	40	698
Nyamagabe	66	1038	28	489	38	549
Total	240	3798	104	1767	136	2031

#### Appendix 2.2 Survey sample size, Gikongoro province, Rwanda, 2004

District	Associations Accepted	Supported Members	Associations Rejected	Unsupported Members
Mudasomwa	4	42	6	49
Kivu	3	28	4	42
Nyamagabe	3	31	4	35
Totals	10	101	14	126

### APPENDIX 3

#### SOME OTHER DESCRIPTIVE STATISTICS

##### Appendix 3.1 Membership of farmers' associations, Gikongoro, province, Rwanda (n=204)

Membership in Years	Percentage (%)	Types of Members	Percentage (%)	Joining cost	Respondents (%)
<1	4.9	President	7.8	With cost	61
1	7.8	V. president	7.8	With no cost	39
2	18	Treasurer	6.4		-
3	10.8	Secretary	7.4		-
4	5.8	Advisor	9.8		-
>4	52.5	Member	60.8		-

##### Appendix 3.2 Types of benefits, and reasons of joining farmers' associations ( n= 204)

Benefits	Shares Ag.produces	Income	Team Work	Inputs	Experience	Access to credit	Training
Farmers (%)	28	41	40	30	29	13	6

##### Appendix 3.3 Types of credit received, conditions of access, and access to storage facilities

Types of credit (n= 94)	Improved. seeds	Fertilizers	Lime	Cultivation tools	Money or loan
Beneficiaries (%)	66	70	68	9	2
Conditions (n= 89)	Very difficult	Acceptable	Easy	Don't know	-
Beneficiaries (%)	15	32	51	1	-
Storage facilities (n=204)	No storage	Provided by DAP	DAP & Farmers	Self construction	-
Beneficiaries ( %)	92	3	2	1	-



Table 3.4 Time allocation by farmers in Gikongoro province, Rwanda, 2003/2004  
(n =153)

Time allocation	Association		Home agricultural activities (1)	Terrace construction	Home agricultural activities (2)
	Time (hrs)	Days			
Minimum	0	0	0	0	0
Maximum	6	16	8	8	7
Mean	5.15	7.21	2.09	5.50	2.30
Standard deviation	0.87	2.72	1.28	0.72	1.21

Note: Estimates are on daily basis

Appendix 3.5 Training received by DAP supported farmers in Gikongoro province,  
Rwanda, 2004 (n = 89)

Trained	Agricultural techniques	Business &Financial management	Marketing	Post harvest technologies	Application
Yes	75	51	50	60	74
No	25	50	51	40	26

\* Figures are in percentages

Appendix 3.6 Desired level of food rations and cash payment in terrace  
construction, Gikongoro, Rwanda (n= 153)

Desired Food Rations ( Kg)	Minimum	Maximum	Mean	St. Deviation
Maize	10	150	69.93	23.7
Beans	5	100	40.43	15.3
Vegetable oil	3.0	15	5.05	2.2
Desired cash (R francs)	4400	37000	12,790	4,536