

REPUBLIC OF RWANDA

MINISTRY OF AGRICULTURE AND ANIMAL RESOURCES

# Strategies for Sustainable Crop Intensification in Rwanda

Shifting focus from producing enough to  
producing surplus

Arumugam KATHIRESAN

2011



KIGALI

## Contents

Executive Summary .....	4
1. Introduction .....	8
2. Global Context .....	10
2.1. Millennium Development Goal .....	10
2.2. New Partnership for Africa's Development .....	10
3. National Context .....	10
3.1. Vision 2020 .....	10
3.2. Government Program (2010-2017) .....	11
3.3. Economic Development and Poverty Reduction Strategies .....	11
3.4. Strategic Plan for the Transformation of Agriculture in Rwanda – Phase II .....	12
3.5. National Post Harvest Staple Crop Strategy (PHSCS) .....	12
4. The Crop Intensification Program .....	13
4.1. Distribution of improved inputs .....	13
4.1.1. Improved Seeds .....	13
4.1.2. Distribution of fertilizers .....	13
4.2. Consolidation of land use .....	15
4.3. Proximity extension services .....	16
4.4. Post Harvest Handling and Storage (PHHS) .....	16
4.5. Outputs of CIP .....	16
4.6. Impacts .....	17
4.7. Constraints and Challenges .....	18
5. Strategy Formulations .....	19
5.1. Vision .....	19
5.2. Goal .....	19
5.3. Objectives .....	19
5.4. Framework .....	19
5.5. Strategic Axes of Intervention .....	20
5.5.1. Increased Input-use efficiency .....	20
5.5.1.1. Crop and Varietal appropriation .....	21
5.5.1.2. Integrated Pest and Disease Management .....	22
5.5.1.3. Mechanization of farm activities .....	22
5.5.1.4. Integrated Soil Fertility Management .....	23
5.5.1.5. Efficient use of water resources .....	24
5.5.2. Enhance demand and supply of inputs and outputs .....	25
5.5.2.1. Demonstration of profitability .....	25
5.5.2.2. Development of standards, grades, and certification of processes .....	26
5.5.2.3. Strengthening agricultural extension and distribution networks .....	26
5.5.3. More Gradual Exit and Further diversification of Input subsidies .....	27
5.5.3.1. Re-packing of subsidies .....	28
5.5.3.2. Improving the affordability .....	29
5.5.3.3. Use of smart cards in place of vouchers .....	29
5.5.3.4. Rationing and targeting of effective subsidies .....	29
5.5.3.5. Linking with performance .....	29
5.5.4. Strengthening smallholders' links to market .....	30
5.5.4.1. Cooperatives as nodal points .....	30
5.5.4.2. Access to Value chain Finance .....	30
5.5.4.3. Facilitating market information .....	31
5.5.5. Harnessing the production with no or minimal losses .....	32
5.5.5.1. Awareness and knowledge creation on post harvest management practices .....	32

5.5.5.2. Engaging private entrepreneurs in integrated marketing .....	33
5.5.5.3. Linkages through Food Purchase Programs .....	35
5.5.6. Focused development of 'Bread Baskets' .....	36
5.5.6.1. The potential for production.....	37
5.5.6.2. Accessibility to markets .....	37
5.5.6.3. Population density.....	38
6. Roles and responsibilities of stakeholders .....	39
6.1. Roles of the program (CIP).....	39
6.2. Roles of RAB.....	40
6.3. Roles of private sector and service providers.....	41
6.4. Roles of Banks and Financial Institutions (FI) .....	42
6.5. Roles of line Ministries and para-statal organizations .....	42
7. Coordination, Monitoring and Evaluation.....	43
8. Estimated cost .....	44
9. Action Plan and Time Table .....	49
10. Logical Framework of Crop Intensification Strategies .....	51
Annexes.....	54
Annex 1: Projections in production under different scenarios for the next 7 years .....	54
1.1. Maize .....	54
1.2. Wheat .....	55
1.3. Rice .....	56
1.4. Irish Potato.....	57
1.5. Cassava .....	58
1.6. Beans .....	59

## Executive Summary

Large improvements in the productivity of food crops are required to support the growing rural and urban population in Rwanda. Productivity is a function of the usage of improved inputs such as seeds, fertilizers, water and machineries. Owing to the limited land resources and the demographic pressure on land, intensification of existing production systems represents a tangible approach for increasing food production in the country. The recent efforts made by Ministry of Agriculture and Animal Resources (MINAGRI) under a flagship Crop Intensification Program (CIP) have revealed the potential of achieving food security.

Started in September 2007, the CIP focuses on six priority crops namely maize, wheat, rice, Irish potato, beans and cassava. Under this program, the farmers synchronize the cultivation of crops in lands that are consolidated and rearranged to form larger and more rational holdings. Farm inputs such as improved seeds and fertilizers were imported and distributed to farmers through public-private partnerships, and extension services on the use of inputs and improved cultivation practices are rendered to farmers. As a result, the crop productivity has increased. The production of maize and wheat has increased by 6-fold, and that of Irish potato and cassava has tripled. The production of rice and beans has increased by 30% in the past 4 years. These outputs have pushed Rwanda to the verge of becoming a food secure country.

Upholding the increases in productivity and taking the country further beyond the food security to produce surplus quantities that will enable the country to export food crops to markets in the region however requires drawing of viable strategies on the sustainability of crop intensification process. The strategies proposed here aim to double the productivity levels and emphasize the need for renewed focus on value chain in order to sustain the intensification process.

Since increasing productivity requires the use of modern inputs, the profitability of smallholder farmers and therefore the adoption will largely depend on increased efficiency of use of the inputs. Promotion of input-responsive crops and varieties that are appropriate to the given ecosystem shall increase the participation of smallholder farmers in the intensification process. Facilitation of small irrigation equipments such as pumps and weeding tools shall serve as a primer in avoiding risks and yet raising the efficiency of other inputs, especially in smallholder farms. Integrated approaches on managing pests, diseases and soil fertility that are economically viable will provide sustainability to the production systems. Furthermore, mechanization in consolidated land use areas shall increase the land productivity, and efficiency and consistency of land preparations and crop management. The mechanization shall also reduce the time and drudgery of labor force, predominantly women, and thereby providing more time for family and social activities, and off-farm jobs and revenues. Such an integrated approach will enable the social transformation through agriculture, as envisioned in the overarching economic development and poverty reduction strategies of the government.

The subsidized low prices of inputs and the facilitation of supplying inputs through the program have eased the access to inputs by farmers in the country. To ensure that the accessibility will prevail in the absence of such interventions, it is important to elicit a genuine demand for the inputs from the farmers. The demand for inputs shall be raised by convincing the smallholder farmers through demonstrations of the profitability of the use of inputs and through aggressive

extension services. Wider distribution networks that would reach the far remote areas are critical for increasing the use of fertilizers. As the input prices will become market driven on a long run, the farmers need to be constantly communicated on volatility in prices and availability of inputs in order to sustain the demand. The reliability of the input use and therefore the consistency in profitability of using inputs shall be raised by establishing standards, grades and certification process for agro inputs.

Until the demand and use of improved inputs become more prevalent and stable, the government shall continue to serve as a catalyst in facilitating the inputs at subsidized prices. For past experience in other African countries such as Malawi and Nigeria suggests that any abrupt halt or downscaling of the subsidies would likely reverse the progress made during the past three years and therefore must be avoided. The subsidy packages shall instead be diversified by including pesticides and small tools and/or machineries. The participation of agro dealers in distributing the subsidized inputs shall be encouraged by providing incentives for achieving targets in remote areas. Replacing vouchers with smart cards shall reduce the logistics and overcome the capacity constraints in distributing the inputs on time. The program shall improve the efficiency of attaining its goals by effectively targeting those farmers who have not yet adopted the use of improved inputs. While it is important to eventually withdraw fully from the input subsidies in consistence with globalized world trade principles, the proposed strategies here emphasize that the pace of withdrawal should rather be made more gradual and be linked to the performance of indicators such as adoption and the required degrees of soil amelioration.

Societies in countries that underwent green revolution in the 1980s face widening gaps between rich and poor, especially in rural areas. This negative consequence was largely due to poor accessibility of resource poor farmers to inputs. Strengthening the linkages between smallholder farmers and the market for both input and outputs is therefore critical in reducing any negative impacts on social transformation. Cooperatives provide vital entry points to reach smallholder farmers. The program needs to forge strong relationship and inculcate business skills in accessing finance from micro finance institutions and rural banks, in obtaining market information, and in collective bargaining of prices for inputs and outputs.

The rapid increase in food crop production in the recent years has highlighted the need to minimize losses that occur between harvesting and storage, and improved marketing capacities in rural areas. Significant gains can be made in total production and productivity in real terms if losses are prevented through improved harvesting, post harvest handling (cleaning, drying and packing) and storage practices. The program shall embark on creating awareness through hands-on training to farmers and establishing appropriate storage facilities across the country. In collaboration with other initiatives under Post Harvest Staple Crop Strategies (PHSCS), the CIP should conduct comprehensive training programs and establish infrastructures around crop clusters (areas with high consolidated land use and production) for handling, storage and processing of farm outputs. Private entrepreneurs engaged in processing and marketing of local outputs shall be encouraged to access community storage facilities in order to facilitate agro processing and marketing in such areas. The shift from subsistence farming to market orientated agriculture envisaged in Vision 2020 shall not be achieved unless considerable advances are made in establishing efficient marketing network in areas of intensive production under CIP. Through a network of operations, the management of strategic reserves of food

crops shall be linked to such storage facilities through which individual farmers can use their stored farm produces as collateral to avail finance for accessing inputs.

Zones with better endowed agro-ecological potential to sustain high productivity levels of two or more food crops shall be developed as breadbaskets. Areas with good rural infrastructure such as roads and storage facilities and with relatively closer distance to national and/or regional markets shall prove advantageous. If the population densities are high enough to support market demand pull for inputs and outputs and to reduce the cost of reaching farmers with innovations/extension services, impacts shall become more visible.

It is estimated that the implementation of the proposed strategies will require a total budget of 114,621,262 USD. The diverse elements embedded in the strategies require coordination of several initiatives in public- and private sector by the program. By implementing the strategies described here, the program shall significantly raise productivity, reduce on-farm yield gaps and promote exports, increase farm revenues, and thereby enable the shift from subsistence farming to market oriented agriculture as envisaged in the Government Program (2010-2017) and under the Vision 2020.

## List of Tables

Table 1: Distribution of improved seeds (tons) and planting materials (units) under Crop Intensification Program

Table 2: List of service providers engaged under CIP in distributing the fertilizers and other inputs to farmers

Table 3: The projected expansion of land areas (Ha) under cultivation of major crops planned by MINAGRI

Table 4: Summary of budget for the proposed strategic components

Table 5: Budget estimates of the various activities proposed CIP strategic components

## List of Figures

Figure 1: Increments (%) in production of food crops under intensification process. Levels were normalized to production in the base year of 2007

Figure 2: Recent trends in consolidation of areas under cultivation of priority crops in Rwanda

Figure 3: Total cultivated area under the priority crops in Rwanda

Figure 4: Changes in on-farm productivity of major crops in response to the use of distributed inputs (improved seeds/planting materials and/or fertilizers)

Figure 5: Illustration of possible linkages between farmer, storage facility and food purchase program that allows the farmer to purchase inputs and clear the debt in kind

Figure 6: Overview of strategies for crop intensification program (2010-2017)

## 1. Introduction

Agriculture is a major component of Rwanda's national economy. In 2009, agriculture contributed 34% to the country's GDP<sup>1</sup>. About 84% of the population, of which 52% are women, depends either directly or indirectly on agriculture for living<sup>2</sup>. Due to the mountainous nature of Rwanda's geography, only about 60% of the total land area is currently under cultivation (1,735,025 Ha)<sup>3</sup>. With a total population of 1, 205,090<sup>4</sup> and an estimated growth rate of 2.9% however, Rwanda represents one of the most densely populated countries in Sub-Saharan Africa. Given the limited availability of arable land for agriculture and the constantly growing food requirements of the population, ensuring food security poses a major challenge.

Owing to aggressive growth in other sectors of the economy, the per capita income of Rwandan population has begun to rise and in turn increased the demand for food in both rural and urban areas where a significant share of income is spent on food. Thus Rwanda's demand for farm outputs are increasingly driven by the growing population, higher expectations for standard of living, increase in disposable income, and greater energy needs. Evidences suggest for instance that the demand for rice, wheat and beans in Rwanda are more income-elastic when compared to maize and Irish potato in Rwanda<sup>5</sup>.

The favorable climatic conditions and the generally fertile soils allow cultivation of a wide range of crops in Rwanda. Major food crops include maize, rice, banana (cooking, beer and fruit), Irish potato, sweet potato, cassava, sorghum and beans. Vegetables such as onions, cabbages, dodo, gourds, and eggplants are also widely grown. Cash crops such as coffee, tea and sugarcane are grown on commercial scales for exports and domestic consumption in Rwanda. Cultivation of food crops on the other hand have long been predominantly by smallholder farmers for subsistence living. As a result, the on-farm productivity levels have been very low in Rwanda.

The low productivity is mainly attributed to the low use of inputs. In a vicious cycle, the low productivity continue to prevent farmers from using the inputs, as many farmers barely produce sufficient food to feed their family with no surplus, and therefore have no income with which to purchase yield enhancing inputs. Thus the solution lies in breaking this vicious cycle through appropriate intervention. Green revolution in Asia and elsewhere was mediated by the facilitation of modern inputs such as improved seeds, fertilizers and pesticides to farmers. With the introduction and adoption of these improved inputs, the farmers were able to substantially increase their crop production levels by several folds. The increased yields provided food security and stability which in turn triggered an array of social and economic transformation.

Increasing agricultural productivity and food security in Rwanda therefore requires replication of such adoption of modern inputs by the smallholder farmers. Setting this as the goal, the Ministry of Agriculture and Animal Resources (MINAGRI) developed Crop Intensification Program (CIP) in 2008. Since most of the inputs have to be imported, the cost of transportation to remote

---

<sup>1</sup> Press release, 26 March 2010, National Institute of Statistics of Rwanda

<sup>2</sup> National Agricultural Survey (2008) National Institute of Statistics of Rwanda

<sup>3</sup>Rwanda Statistical Year Book (2010), National Institute of Statistics of Rwanda

<sup>4</sup>Rwanda Statistical Year Book (2009), National Institute of Statistics of Rwanda

<sup>5</sup> World Bank Report No. 39881-RW (2007) Promoting pro-poor agricultural growth in Rwanda: Challenges and opportunities



areas combined with the inherent poor demand for inputs keep the prices of the inputs high. The government with the help of development partners overcame this hurdle through bulk procurement of improved seeds and fertilizers from neighboring countries and distributed the inputs to farmers through a network of public and private partnerships. Through sheer efficiency, the program was able to deliver the expected change in production levels (Fig. 1).

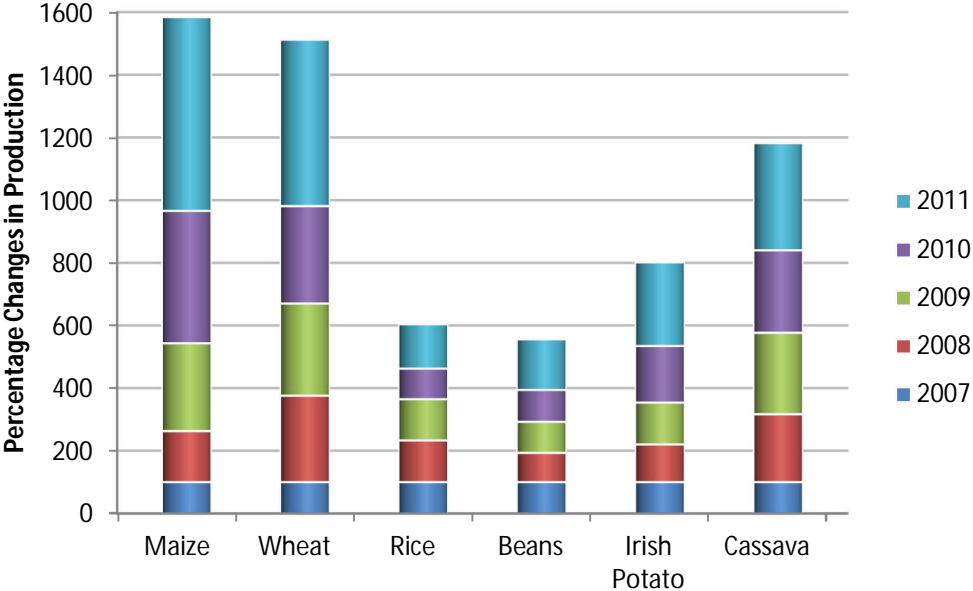


Fig 1: Increments (%) in production of food crops under intensification process. Levels were normalized to production in the base year of 2007.

It is now evident that the aggregate yields of food crops in Rwanda have increased substantially as a result of the increased use of inputs, particularly the improved seeds and fertilizers. Although the subsequent increase in marketing has not yet shown dynamism, the prevalent conditions create a scenario for drawing viable strategies that would sustain the initial momentum gained under the intensification process and take the country further beyond producing enough food crops for security to producing exportable surpluses. This forms the general objective of this document.

The transition from traditional agriculture to green revolution agriculture, which required the purchase of inputs, has led to the widespread disparity in income levels and other social consequences in other countries as some farmers were able to adopt green revolution more readily than others. Faced with globalization of trades, the small farmers have to contend with volatility in prices of inputs and competition in selling their outputs from near and far in their own domestic markets. Taking cues from such lessons and experience of other countries which had already undergone green revolution, the strategies presented here attempt to evolve a holistic approach on sustainable intensification of food crops in the context of Rwandan agriculture.

## 2. Global Context

### 2.1. Millennium Development Goal

The ambitions of Rwanda's crop intensification process are in alignment with the broader agenda set by international and regional developmental agencies. The first of millennium development goal (MDG) developed by the United Nations (UN) aims to eradicate extreme poverty and hunger<sup>6</sup>. The linkage of crop intensification process is strong for achieving this MDG. Crop intensification process enables agriculture-led economic growth in rural areas by raising employment in the farms which represents the only means for a majority of poor to satisfy their basic needs. More than 80 percent of the target group of MDG1 lives in rural areas. For most of the rural poor agriculture is a critical component in accessing food and employment. Even though structural transformations are important in the longer term, crop intensification provides more immediate gains in poor households. The volumes of food crops created through intensified production can help the poor overcome some of the critical constraints they now face in meeting their basic needs. Thus CIP provides a vital linkage for accomplishing MDG1 through agriculture.

### 2.2. New Partnership for Africa's Development

At the continental level, the New Partnership for Africa's Development (NEPAD) serves a framework for development programs of the African Union (AU) that aims at driving economic integration in Africa. NEPAD emphasizes that agriculture will provide the engine for growth in Africa<sup>7</sup>. NEPAD aspires to stimulate growth by raising agricultural productivity by at least 6% per year and by increasing public investment in agriculture to 10% of national budgets per year. Through consultations with its partners and donors, NEPAD developed a Comprehensive Africa Agriculture Development Program (CAADP) in 2003. CAADP acknowledges that the high economic growth rates envisaged by NEPAD can be realized if agricultural production is significantly increased<sup>8</sup>. CAADP focuses on improving food security, nutrition, and increasing incomes in Africa's largely farming based economies. CAADP reckons that the higher farm outputs will directly reduce hunger and bring down the cost of food imports. Thus agricultural intensification is one of the priority areas under CAADP that are supported by its four pillars viz. (i) sustainable land and water management, (ii) market access, (iii) food supply and hunger, and (iv) agricultural research. The crop intensification process embraces these mutually supporting pillars in attaining its goal of improving crop productivity.

## 3. National Context

### 3.1. Vision 2020

Envisaging the future, the government of Rwanda aims to transform Rwanda's economy into a middle income country (per capita income of about 900 USD per year). The country's economy need to grow at a rate of above 7% to accomplish this goal. To facilitate this growth, the country aims to transform agriculture from subsistence farming to market oriented modern farming<sup>9</sup>. Transformation of agriculture into a productive, high value, market oriented sector is one of the

---

<sup>6</sup> Millennium Development Goals <http://www.un.org/millenniumgoals/poverty.shtml>

<sup>7</sup> The New Partnership for Africa's Development (2001) <http://www.dfa.gov.za/events/nepad.pdf>

<sup>8</sup> Bwalya M (2010) Accelerating CAADP Country Implementation - A guide for implementers

<sup>9</sup> Ministry of Finance and Economic Planning (2000) Rwanda Vision 2020

pillars of the country's long-term strategy. Vision 2020 acknowledges that the most important issue retarding Rwanda's agricultural development is not land size, but low productivity associated with traditional peasant-based subsistence farming. It intends to overhaul agricultural policies in order to promote agricultural intensification. Vision 2020 sets a target for growth rate for agriculture at 4.5-5% per year through increase in productivity. The CIP attempts to address the concerns reflected in Vision 2020 on the reduction in productivity due to lack of simultaneous application of fertilizer use by emphasizing that intensification should be accompanied by the use of appropriate inputs.

### **3.2. Government Program (2010-2017)**

Government of Rwanda aims to change Rwanda into a middle income country by 2017<sup>10</sup>. The government program intends to build on the four pillars viz., good governance, justice, economy and social well being of Rwandans. The program acknowledges that the pace of economic development shall become sustainable when the recent increases in agriculture production become sustainable. It shall be noted that most of the recent increases in national agriculture production has come from the initiatives of crop intensification program. The program intends to raise the profits of farming by modernizing the practices. Land use consolidation will be promoted and the acreage under consolidation will be increased from 18% to 70%. Such initiative from the program will provide a vital support to CIP in accomplishing its goals. Besides putting efforts in irrigation and mechanization, the government program seeks to set up seed production nurseries and raise the fertilizer use from 14 Kg/Ha to 45 Kg/Ha. It intends to set up crop collection centers and marketing outlets in all districts and thereby enhance the storage capacity to 20,000 tons. By setting up a development bank for agriculture sector, the access to finance by farmers will also be increased to 8%. Through such integrated efforts, the program intends to increase the volumes and quality of production, and thereby also increase off-farm jobs in agriculture sector.

### **3.3. Economic Development and Poverty Reduction Strategies**

Economic Development and Poverty Reduction Strategies of Rwanda aims at increasing economic growth by investing in and modernizing agriculture. It recognizes that food crops constitute a major component of agriculture and national GDP<sup>11</sup>. It clarifies that the slackening in GDP growth is due to limited increments in farm outputs. EDPRS thus aims to increase the production of food crops which is constrained by several factors such as land use patterns, soil quality and supply of technology and infrastructures in rural areas. EDPRS particularly targets to improve the agricultural productivity and increase the profitability of small farm holds. Survey results suggest that Rwandan farmers identify fertilizer, insecticide and improved seeds as top priorities for improving agriculture. EDPRS intends to encourage increased participation of the private sector in transfer of technology to farmers, after the initial transfer by the public sector. It insists that the government will assist the private sector by improving the investment climate, so that Rwandan produces become competitive in regional and world markets. EDPRS intends to encourage surplus production of farm produces by subsidizing the acquisition of key inputs by farmers. To improve the quality of production, EDPRS aspires for significant improvements in quality and standards.

---

<sup>10</sup> Government Programme (2010-2017), October 2010, <http://www.primature.gov.rw/images/2010-2017%20government%20program%20english%20version.pdf>

<sup>11</sup> Government of Rwanda (2001) Economic Development and Poverty Reduction Strategy (2008-2012)

### **3.4. Strategic Plan for the Transformation of Agriculture in Rwanda – Phase II**

The programs of the Strategic Plan for the Transformation of Agriculture in Rwanda - Phase II (PSTA II) for the period of 2009-2012 forms the operational framework for implementing agriculture's contribution to the EDPRS. Taking a sector wide approach, the PSTA II is also aligned with regional frameworks of NEPAD/CAADP and Rwanda Vision 2020. It envisions significant increases in productivity of priority crops to ensure food security. The four main programs of PSTA II include the intensification of sustainable production systems in crop cultivation and animal husbandry, building the technical and organizational capacity of farmers; promoting commodity chains and agribusiness, and strengthening the institutional framework of the sector at central- and local levels<sup>12</sup>. The program 1 of PSTA II identifies a series of actions to intensify and develop sustainable production systems in agriculture under different ecosystems. PSTA II acknowledges that raising agricultural productivity and ensuring food security in a sustainable manner is the key to reducing poverty. The crop intensification process interlaces all of these four programs during its implementation. PSTA II emphasizes that appropriate incentive structures need to be put in place to drive the desired transformations of the sector. It intends to use subsidy program to deliver inputs such as improved seeds and fertilizers until farmers become familiar with the benefits of new approaches and technologies and generate enough revenue to take on cost burdens themselves. PSTA II also insists that subsidy programs should be complemented by a strategy to increase the informed use of organic and inorganic fertilizers. Thus the intensification process of priority crops is clearly in alignment with overarching goals and strategies at national and regional levels.

### **3.5. National Post Harvest Staple Crop Strategy (PHSCS)**

In consultation with MINAGRI, MINICOM and MINECOFIN, USAID has drawn national strategies for strengthening the value chains of staple crops through a policy framework on harvesting, post harvest handling, storage, and marketing<sup>13</sup>. PHSCS aims to develop an efficient post harvest system driven by private sector to ensure food security of staple crops. It envisages supporting the private sector to invest in strengthening the competitiveness by improving the efficiency and decreasing the marketing costs along the value- and supply chains, and enhancing farmers' access and strengthening their linkage with markets. The elements of PHSCS include (i) rendering basic market data available to public- and private stakeholders, (ii) placing transport infrastructure that could support movement of staple commodities, (iii) facilitate appropriate technologies at the production and aggregation points along the value chain, (iv) engaging the private enterprises through facilitation of training and infrastructure, (v) increase the investments and financial services, (vi) improve the structures and grading of farm outputs, and (vii) leverage the management of strategic grain reserve to create a fair and transparent market for staple crops in the country. Although the PHSCS is not yet cleared by the cabinet, its approaches will bear significant relevance and linkages with the strategies on crop intensification discussed in this document.

---

<sup>12</sup> Ministry of Agriculture and Animal Resources (2008) Strategic Plan for the Transformation of Agriculture in Rwanda - Phase II

<sup>13</sup> National Post-Harvest Staple Crop Strategies (March 2011) Ministry of Agriculture and Animal Resources

## 4. The Crop Intensification Program

Crop Intensification Program (CIP) is a flagship program implemented by the Ministry of Agriculture and Animal Resources to attain the goal of increasing agricultural productivity under PSTA II. CIP aims to accomplish this goal by significantly increasing the production of food crops across the country. CIP currently undertakes a multi-pronged approach that includes facilitation of inputs (improved seeds and fertilizers), consolidation of land use, provision of extension services, and improvement of post harvest handling and storage mechanisms. Started in September 2007, the CIP program focuses on six priority crops namely maize, wheat, rice, Irish potato, beans and cassava.

### 4.1. Distribution of improved inputs

Access to improved inputs has long been inhibiting the farmers from raising the productivity levels. The access was curtailed by the low demand and costs which are further amplified by the difficulties in transportation to rural areas. To overcome these constraints, CIP took a 'supply-push' approach whereby the inputs are initially supplied by the government and the farmers are persuaded to use.

#### 4.1.1. Improved Seeds

To augment increase in productivity of these crops, CIP imported improved seeds from the neighboring countries such as Kenya and Tanzania in the region. In 2008, 765 tons of seeds of maize and wheat were imported for cultivation in season A. The amount gradually increased from 1200 t in 2009A to 3512 t in 2011 A. In addition, improved planting materials (cuttings) of cassava and potato were also distributed to farmers (Table 1).

Table 1: Distribution of improved seeds (tons) and planting materials (units) under CIP<sup>14</sup>

Crop	2008 A	2009 A	2009 B	2010 A	Total
<b>Maize</b>	520	893	179.58	1,417	3,009.58
<b>Wheat</b>	60	327	300.85	181	687.85
<b>Cassava</b>	42,932,600	95,987,000	0	0	138,919,600
<b>Beans</b>	0	32	28	0	60
<b>Potato</b>	400	0	0	0	400

Under CIP, the use of improved seeds by farmers has risen from 3% to 40%. By encouraging farmers to use improved seeds, CIP has substantially increased the local demand and the capacity for seed production. With the exception of hybrid seeds, the open pollinated varieties of maize and self pollinated varieties of wheat, rice and beans are multiplied by public (RAB) and entrepreneurial farmers in the country.

#### 4.1.2. Distribution of fertilizers

Through bulk orders, CIP imported 6,000 tons of fertilizers and distributed to farmers for free through various service providers (table 2). About 83% of fertilizers were used by farmers growing maize, wheat, rice and potato. In 2009, CIP imported 14,427 tons and distributed to maize and wheat growers at subsidized rates (50%) covering the overhead (transportation and

<sup>14</sup> Key Figures and Records (2010) Personal Communication with Francois Nsengiyumva, Coordinator, Crop Intensification Program (Ministry of Agriculture and Animal Resources, Kigali)

administrative costs) from Mumbasa to rural areas were covered by the government. CIP continued to import and distribute in 2010 (33,500 t) and 2011 (22,000 t). Through an auction process, the CIP auctions the imported fertilizers to private distributors. To access these fertilizers at subsidized prices, CIP distributes vouchers to farmers through service providers. The farmers buy fertilizers from the distributor/dealer by presenting the vouchers. The distributor transacts the vouchers at the financial bank outlets which in turn collect from MINAGRI/MINICOM. Estimates suggest that as a result of these efforts, the national average fertilizer use per year has increased from 8 Kg/Ha to 23 Kg/Ha in 2010<sup>15</sup>.

Table 2: List of service providers engaged under CIP in distributing the fertilizers and other inputs to farmers

District	Service provider
Nyarugenge	APEPARWA
Kicukiro	RAB
Gasabo	RAB
Kamonyi	IBAKWE
Muhanga	IBAKWE
Ruhango	IBAKWE
Nyanza	IBAKWE
Huye	UNICOOPAGI
Nyaruguru	UNICOOPAGI
Nyamagabe	UNICOOPAGI
Gisagara	ARDI
Rusizi	TUBURA
Nyamasheke	TUBURA
Karongi	TUBURA
Rutsiro	ALUPA
Ngororero	OTP
Rubavu	OTP
Nyabihu	OTP
Musanze	IMBARAGA
Burera	IMBARAGA
Gakenke	IMBARAGA
Rulindo	IMBARAGA
Gicumbi	APAPERWA
Nyagatare	RDO
Gatsibo	Forest Company
Kayonza	ARDR
Ngoma	INATEK
Kirehe	ENAS
Rwamagana	ARDR
Bugesera	APAPERWA

<sup>15</sup> Evaluation Report on Crop Intensification Program (2010) International Center for Soil Fertility and Agricultural Development, Kigali



## 4.2. Consolidation of land use

Due to the growing demographic pressure on land, the agricultural lands in Rwanda are highly fragmented. Since the use of inputs such as the improved seeds and fertilizer can be translated into profitability for smallholder farmers only if the land fragmentation is overcome, the land use patterns need to be organized. With the help of recent government's policy reforms, the crop intensification program advocated consolidation of land use by farmers. The consolidation of land use involves successfully rearranged land parcels to consolidate the use of farm holdings. Under the land consolidation policy, farmers in a given area need to grow specific food crops in a synchronized fashion that will improve the productivity and environmental sustainability. It also required resettlement of family housing in an administrative area (Umudugudu) from the agriculturally productive lands. Although met with reluctance from farmers at initial stages of implementation, CIP successfully convinced farmers by explaining the various advantages of land consolidation as it;

- reduces volume/cost ratio, logistics and transportation costs of inputs and outputs
- increases accessibility of inputs, by providing a focused market for farm inputs as the agro dealers can have a larger coverage
- facilitates a concentrated market for farm produces
- provides increased coverage of proximity extension services
- enables equitable distribution of natural resources such as soil and water and
- increases land- and crop productivity

As a result, the consolidated use of land area under these crops has increased from 28,788 Ha in 2007 to 254,000 Ha in 2010 (Fig. 2). The percentage share of different prioritized crops under consolidations is shown in Fig. 3. It is important to note that the consolidation of land use area has resulted in increases in productivity (Fig. 4) without expanding the total area under cultivation of crops. These trends clearly clarify that the purpose of CIP is to raise the productivity levels through an intensification process.

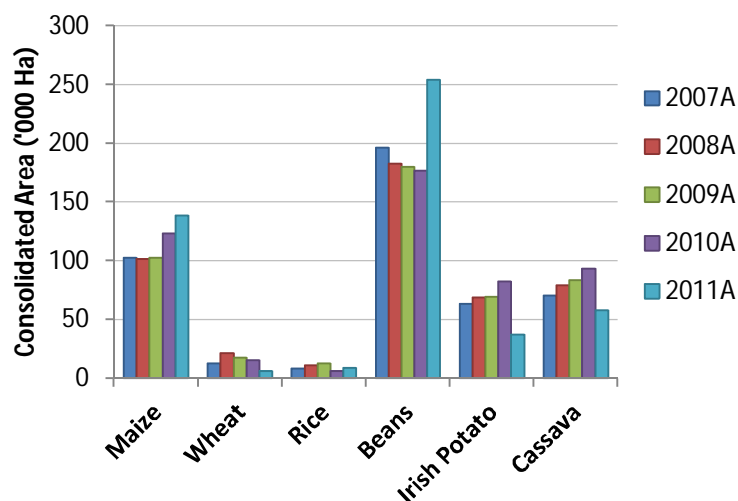


Fig 2: Recent trends in consolidation of land use areas under cultivation of priority crops in Season A in Rwanda

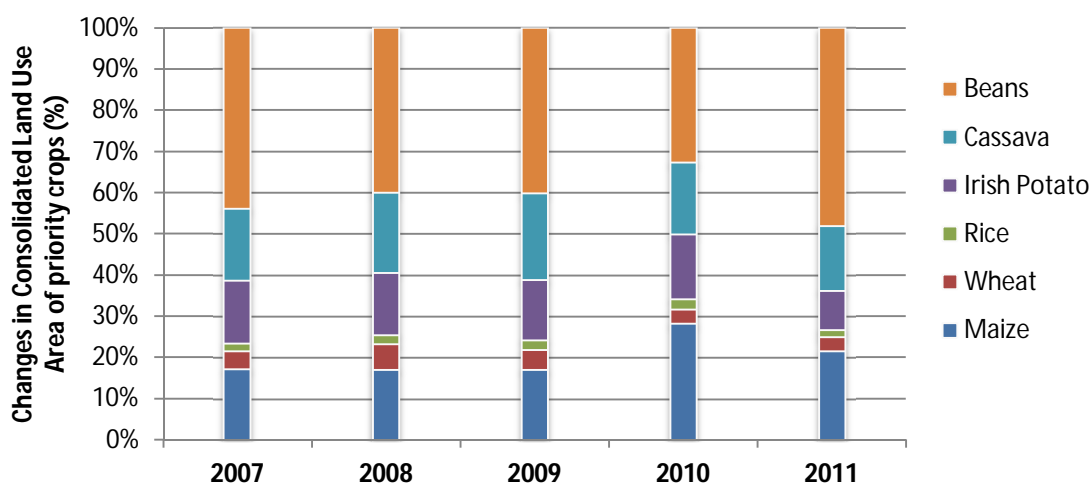


Fig 3: Total cultivated area under the priority crops in Rwanda

### 4.3. Proximity extension services

The extension services under CIP are performed by agronomist (A2 and A1 grades) in areas under intensification process. Currently each extension agent covers about 500 Ha of consolidated land use areas. The materials and knowledge distributed by the extension agents are managed by the service providers in each district. Rwanda Agriculture Board (RAB) coordinates the extension services and serves as a nodal agency for knowledge dissemination - and other consulting services for farmers.

### 4.4. Post Harvest Handling and Storage (PHHS)

The program has recently taken several initiatives to minimize the post harvest losses of priority crops. These initiatives aim to improve the handling and storage of harvested farm produces. CIP is currently engaged in making an inventory of available community storage facilities in the country and attempt repairing of such facilities as CIP is also responsible for the management of country's strategic food stocks. The program intends to provide hands-on training to farmers at two levels - farmers' cooperative and household levels. The program is also embarking on construction of public drying areas in each district. It is also currently in the process of acquiring small tools and equipments for improving the current practices of post harvest processing and storage by farmers. CIP also intends to establish models of storage house in each district.

### 4.5. Outputs of CIP

Through the above described approaches, CIP has increased the total production of maize; wheat and cassava have tripled in the past 3 years. During this time, the beans production has doubled. The production of rice and Irish potato has increased by 30% in the past 3 years. The total production improved mainly because of the increase in productivity per unit land area (Fig. 4). Such outputs have transformed Rwanda from a list of food insecure countries to a country with improved food security. The program has provided the much needed foundation for a positive change in Rwanda's agriculture development. CIP has also revealed the massive potential that exists in the country in increasing the smallholder agricultural productivity. It has also testified that the cost of achieving food security is fiscally manageable and responsible. It demonstrates that land use patterns can define the growth in productivity and development of the agriculture sector. It shows that a program of national scale is feasible.



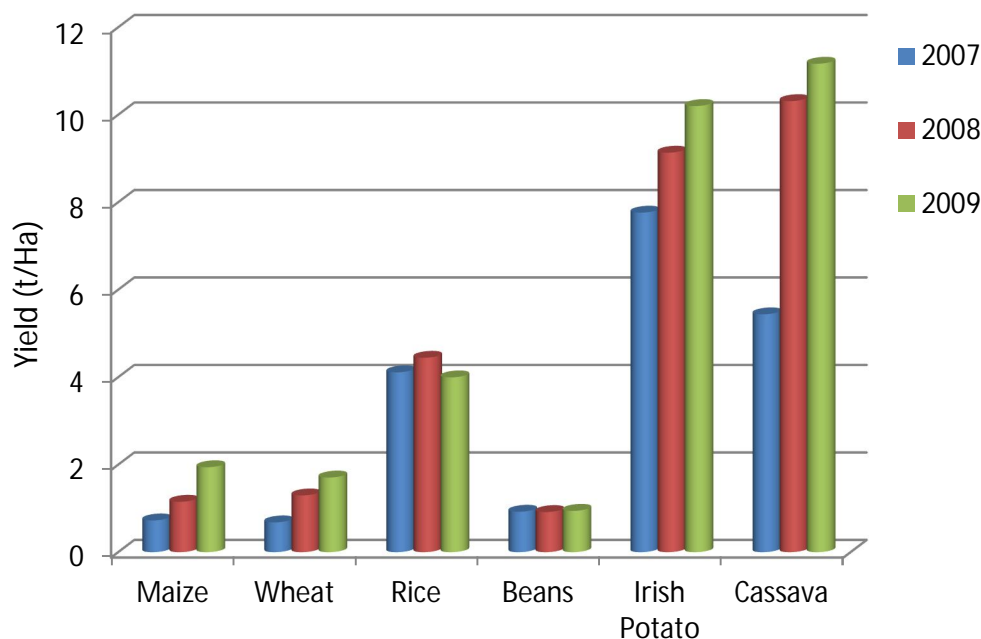


Fig 4: Changes in on-farm productivity of major crops in response to the use of distributed inputs (improved seeds/planting materials and/or fertilizers)

#### 4.6. Impacts

The CIP program has made a significant impact on the livelihoods in both rural and urban areas. By virtue of improving food security, CIP contributes to attaining the millennium development goal of halving the number of people living in hunger and poverty in Rwanda. The scale of success has shown that cost of achieving food security is fiscally manageable and responsible and that supporting inputs rather than food aid makes economic sense. The increased profitability through crop production has uplifted the economic well being of thousands of farmers and farm families. The consolidated use of land and synchronization of crop activities during the season have generated large scale employment opportunities for men and women. CIP has spawned several microenterprises and small businesses in processing, trading, and transportation of farm inputs and produces in rural areas. By improving the agrarian structure and the social viability in rural areas, the CIP has made a positive effect on rural development. For instance, the emphasis of CIP on consolidation of land use has brought renewed focus on achieving efficient use of rural space by balancing the interests of housing, agriculture, conservation of natural resources, and transportation.

The increases in production of staple crops in the country have created large supply of food in local markets. The seasonal production in some high production areas is more than the demand from the regions. In such areas, the government and the World Food Program are embarked on purchase of food. The government is also engaged in creating a strategic food grain reserve so as to redistribute the food crops in other needy areas and seasons. This has been possible through the crop intensification process that has raised the productivity of crops through use of modern seeds and fertilizers and consolidation of land use. The large scale of production has also prompted the creation of storage facilities in several parts of the country. In addition, the

high production has also begun to invoke interests amongst private entrepreneurs in service provision, trading, marketing and agro-processing in rural areas.

#### 4.7. Constraints and Challenges

Given the scale of operations in diverse parts of the country, CIP faces several operational and administrative challenges. The operational challenges involve identifying the required inputs for distribution in collaboration with service providers and planning for the seasons. Timely delivery of inputs is often hindered by limitations in human and administrative capacities at administrative levels. For instance, the distribution of vouchers was discontinued in 2009 owing to the difficulties in printing and issuing to farmers on time. The pitfalls in conception of land use consolidation amongst farmers exposes the limitations in proximity extension services. The issues, concerns and confusions on land ownership need to be addressed by the extension service providers to improve adoption rates. In addition to the constraints involved in human and other implementation capacities that were documented<sup>16</sup>, coordination, monitoring and evaluation of seasonal outputs under CIP also poses serious challenges.

To build on its early successes, CIP needs to take a holistic approach in ensuring sustainability of the crop intensification process as it requires addressing of problems from multiple dimensions. For instance, the on-farm yield gaps are still high for almost all the crops. The technical challenges associated with raising productivity in smallholder farms increasingly revolve around management of other natural resources such as soil and water. Such approaches will not only improve the efficiency of the use of inputs distributed under CIP, but also increase the economic profitability of smallholder farmers on a sustainable basis. CIP also needs to emphasize on combating pests and diseases through the use of pesticides and crop rotation. CIP also requires devising of comprehensive ways to efficiently absorb the surplus production while paying attention to increase the demand for inputs. To sustain the recent trends in input use, CIP also has to create innovative public-private partnerships in developing the value chain. The viability and the impact of subsidy program will depend on clear setting of goals and indicators. Approaches for continuing or exiting the subsidy program on inputs need to be defined and made available to private entrepreneurs, donors and development partners. Sustainable crop intensification will also depend on establishing new and firm multiple linkages between farmers, private entrepreneurs, public programs and microfinance and/or banking institutions in rural areas.

Projections based on the current trends of crop production and the expected consumer demand for priority crops over the next 7 years suggest that in order to enable market orientation of agriculture as aimed under Vision 2020, the country needs to increase the pace of momentum more than at the current level for all the priority crops (Annex 1). With raising income levels, the demand for the three cereals namely maize, wheat and rice are expected to be higher than the production level (Figures in Annex 1.1a, 1.2a and 1.3a). Given the limitations in arable land, it is improbable to expand the area under cultivation of the crops substantially. Therefore more emphasis needs to be laid on increasing productivity. When the productivity levels are assumed to have doubled by 2017 with moderate expansion in area under cultivation, the production of maize, wheat and rice could exceed the demand and enable export of these commodities to the

---

<sup>16</sup> Pell JD (2010) Strategic capacity constraints in delivering the crop intensification programme, Ministry of Agriculture and Animal Resources, Kigali

region (Annex 1). To produce surplus quantities of cassava, Irish potato and beans, the productivity levels require to be doubled by 2017. These challenges require renewed focus on the sustainability and further acceleration of the current intensification process over the next 7 years.

## **5. Strategy Formulations**

The characterization of food security has changed considerably over the past 3 decades. While the emphasis has long been on volume and stability of food crop production and supplies, the access to enough food that is necessary to meet the dietary needs of an active and healthy life has come to define food security in the recent years. Since the dietary needs of human involve carbohydrates, proteins and lipids (fat), banana, soy bean and sunflower shall be added to the list of priority crops which include maize, rice, wheat, beans, cassava, and Irish potato under the current crop intensification process.

### **5.1. Vision**

It is envisaged that the renewed focus on sustainable intensification of crop production will enable Rwanda to move further beyond from ensuring food security to become a food supplier in the region by 2017.

### **5.2. Goal**

The strategies proposed here aim to raise the productivity of priority crops, increase the revenues in small holder farms and thereby ensure food security through sustainable intensification processes.

### **5.3. Objectives**

The general objective of the proposed strategies is to double the productivity levels of maize, rice, wheat, beans, soy bean, cassava, Irish potato and sunflower. The strategies aspire to achieve this goal by pursuing the following specific objectives;

- increase the effectiveness of the farm inputs by improving the appropriateness of their use and response to the inputs
- shifting focus from supply to enhancing the demand for inputs by farmers and market-driven forces within the system
- progressively exit from subsidy program while ensuring the initial purpose of subsidies are achieved
- strengthen the smallholders' links to market for inputs and outputs through improved access to finance and market information
- minimize the post harvest losses and facilitate linkages to upstream of the value chain upstream through improved storage and
- develop areas with superior production potential as breadbaskets of Rwanda to ensure food security and promote exports to regional markets

### **5.4. Framework**

Raising the productivity and thereby the profitability of smallholder farmers is paramount for achieving the goal of modernizing agriculture in Rwanda as aspired in Vision2020. The maximum

expandable area under cultivation of the major crops is shown in table 3. The target figures for 2013 show the maximum possible expansion. Hence it is assumed that no further significant expansion of lands possible beyond 2013. Given these limitations, the projections under 3 different scenarios of growth in productivity are shown in Annex 1.

Table3: The projected expansion of land areas (Ha) under cultivation of major crops planned by MINAGRI. \*Figures under 2013 show the maximum possible expansion.

<b>Crop</b>	<b>2011</b>	<b>2012</b>	<b>2013*</b>
<b>Maize</b>	208800	261000	286412.5
<b>Wheat</b>	45718	57147.5	62862.25
<b>Rice</b>	16000	18000	20000
<b>Irish Potato</b>	201561	251148	277145.1
<b>Cassava</b>	203741.4	240979	305613
<b>Beans</b>	332285.6	418610.9	481402.6

It is important to note that the demand for food consumption will increase as the population grows at a rate of 2.9%. In addition, the demand for high income-elastic foods such as wheat will grow at faster rates than the population rate. Hence an additional growth in demand of 6% per annum (equivalent of the expected growth in GDP over the next 7 years) shall be assumed. At the current productivity rate (Figs A in Annex 1), it is not possible to produce sufficient surplus for exports. Hence renewed intensification at moderate growth in productivity (Figs B in Annex 1) and at extreme pace of growth in productivity (Figs C in Annex 1) are projected. It is important that the interventions provide sustainability to production systems such that the ecologically sustainable practices are promoted to provide the much needed economic sustainability for the stakeholders in order to ensure the sustainability for the envisioned social transformation. Hence ecological-, economical- and social sustainability represent important criteria in determining the strategic interventions. Improving the efficiency and demand for improved inputs through a balanced supply facilitated by public- and private sector while minimizing the losses of production and development of breadbaskets form the framework of proposed strategies.

## 5.5. Strategic Axes of Intervention

The crop intensification program should continue to embark on the current approaches viz., (a) land use consolidation, (b) proximity services, and (c) provision of inputs and raise the productivity of crops. In addition, the following strategies are proposed in order to sustain the momentum that the program has gained, and fill the gaps so that the impacts of the program are equitably shared amongst the various segments of the Rwandan farming. It is envisaged that the consolidated use of land will create 'crop clusters' and that all activities proposed under the strategic elements are focused in these clusters so as to facilitate synergies amongst the efforts and their socioeconomic impacts.

### 5.5.1. Increased Input-use efficiency

Agricultural productivity depends on the adoption of modern technology that involves the use of higher levels of inputs. At grass root level, farmers generally have different production decisions

and ability to source and use the available inputs. This is mainly due to the generally expensive nature of inputs. Hence increasing agricultural productivity in smallholder farms will depend more on the efficient use of available inputs. For instance, while the fertilizers may become available in rural markets, the smallholder farmers may not be able to afford the recommended quantities of fertilizer on a sustainable basis. Yet the efficient use of such inputs shall allow the farmers to manage a substantial increase in productivity from their lands. Hence efficient use of inputs becomes an essential strategy for the success of the crop intensification program as it encourages the smallholder farmer who would otherwise be intimidated by the cost and the diminishing returns of inputs.

Since the productivity is a function of interactions between the various inputs, training farmers on when (and when not) and how to use inputs is essential. Input responsive crops and varieties are more efficient and profitable to farmers. For instance, the response of hybrid maize to fertilizers would differ from that of an open pollinated or pooled variety. Hence the optimal use efficiency levels vary. Since over use of inputs will reduce profitability and hence the sustainability of crop intensification process, the adoption rate may decline particularly amongst smallholder farmers. To avoid such scenarios, CIP shall establish the combination of such variables and make them available to farmers as packages. Shifting from blanket recommendations of fertilizers to site-specific recommendations shall improve the input use efficiency in different agro-climatic zones.

#### **5.5.1.1. Crop and Varietal appropriation**

Selection of crop and varieties that can fit aptly to the length and diversity of agricultural seasons shall improve the efficiency of farm inputs. Currently the farmers are growing the seeds that are available through the CIP within the system. Most of these seeds were obtained from neighboring countries based on the availability of stocks. Studies conducted on the agronomic performance and suitability of the introduced varieties from across the country suggests that while most of the varieties of wheat and maize performed well, careful selection of varieties that are suited to the agro-climatic conditions is critical for the sustainability of crop intensification process in the country. Since raise in temperatures and occurrence of droughts and floods negatively affect crop yields, crops and cultivars that are resilient to such negative impacts of climate change should be considered for sustainable crop intensification process.

Improved inputs such as short duration varieties shall allow cultivation of three crops in a year. By producing 3 crops instead of 2 crops will increase the total production per unit land and thus contribute to fast track the CIP's goal of raising productivity significantly. Shorter duration varieties shall also allow efficient use of water and other natural resources. To produce surplus amounts of food crop production and to stimulate export of commodities such as maize, rice and beans, CIP needs to aggressively promote hybrid seeds in these crops. When the input use efficiency is at optimally exploited, hybrid maize shall enable a total production of up to 2.5 million tons per year. Similarly, technical projections suggest that hybrid rice when cultivated under optimal conditions in a total area of 35,000 Ha by 2017, Rwanda can produce 3.0 million tons per year. Besides hybrid seeds, CIP shall also explore and promote direct seeding technology wherever applicable. Direct seeding of rice has been shown to be more efficient

over the traditional transplanting of seedlings from nursery in Asia<sup>17</sup>. The appropriateness of such technology for marshlands needs to be explored and implemented in Rwanda.

*Estimated Budget: 1,053,000 USD (631,800,000 RWF)*

#### **5.5.1.2. Integrated Pest and Disease Management**

With the sudden growth in density of cropping under intensification program, the pressure from pests and diseases has started to influence yield levels. In rice for example, epidemics of blast disease and hoppers occur frequently in different marshlands. To combat the pests and diseases, smallholder farmer needs appropriate pesticides that can reduce the impact on yields. The CIP shall take initiatives to ensure delivery of pesticides in rural areas through the same delivery route of fertilizers. The extension service shall focus more on creating the awareness of the type of combat measures that the farmers need to take. Wherever possible, integration of biological controls and other pest management practices that can provide the sustainability under intensification process should be explored.

Crop rotation is extremely critical in controlling the pressure from pests and diseases. Cereal followed by legumes (beans, soybean) or root crop systems (cassava, Irish potato) should provide sustainability and stability against the growing incidences of pests and diseases. Records show that under crop intensification, the total area under cultivation of each crop has not changed significantly (except for Cassava). The CIP has been effectively causing the shifts in seasons of major food crops grown by farmers. This is in accordance of the goal under CIP which aims to intensify the crop production but not expand the area under cultivation. However, experience from other countries suggests that this trend might change. Now that farmers have access to seeds of improved varieties, the farmers will be tempted to grow corn and wheat varieties continuously over several seasons. Hence concepts of crop rotation need to be instilled amongst farmers. In addition to maize and wheat, seeds of improved varieties of non-cereal crops such as beans, sunflower and soy bean shall be made available to farmers to encourage crop rotation.

*Estimated Budget: 4,404,400 USD (2,642,640,000 RWF)*

#### **5.5.1.3. Mechanization of farm activities**

The crop intensification process has increased the need for rapid and synchronized land preparation in consolidated areas. This requires significant reduction in turnaround time between agricultural seasons. In several parts of the country, labor shortages are becoming a new and serious constraint, especially during the peak seasons in wet lands and marshlands. A significant proportion of the farmers (42.2%) engage family members for their field operations. The over reliance of farmers on family members and human muscle (of which 77.2% are women<sup>18</sup>) for the arduous tasks in land preparation and other farming chores seriously threaten productivity and long term sustainability of crop intensification. Appropriate mechanization of such farm activities shall improve timeliness, efficiency and consistency in field operations. This is critical for sequential cropping and for increasing land productivity.

---

<sup>17</sup> Pandey S (2002) Direct Seeding: Research strategies and opportunities. International Rice Research Institute

<sup>18</sup> Agricultural mechanization strategies for Rwanda: Shifting from subsistence to market-oriented agriculture (2010). Ministry of Agriculture and Animal Resources



Under CIP, as the lands are used in a consolidated fashion, the needs and scopes of mechanization of farm activities improve significantly. Therefore promoting mechanization in such crop clusters will have increased adoption. Currently the mechanization taskforce promotes mechanization through village service centers. It will be synergistic if such village service centers are co-located in crop clusters. In coordination with mechanization taskforce, farmers in crop clusters need to be mobilized to create favorable field designs that would increase the use of appropriate machineries. It is imperative to demonstrate the economic feasibility and profitability of proposed mechanization activities in crop production. Training and field demonstration should therefore effectively exhibit cost efficiency, land productivity and operational consistency of machineries.

Promoting private service providers in farm mechanization needs to be improved in crop clusters. Through CIP, the scope for scaling up of service provisions in crop clusters need to be endorsed amongst private entrepreneurs. Encouraging use of machineries such as pumps, diesel engines and related equipments shall serve as primers for mechanization in consolidated land use areas, and yet also facilitate equitable access to water, especially by small holder farmers under CIP. Mechanization of post harvest activities such as drying, cleaning, primary processing and storage shall also be envisaged in crop clusters. Communal ownership and access to machineries shall also increase the adoption of mechanization in a cost efficient fashion by smallholders.

*Estimated Budget: 298,870 USD (179,322,000 RWF)*

#### **5.5.1.4. Integrated Soil Fertility Management**

The sustainability of crop intensification processes can be significantly enhanced by taking a holistic and dynamic approach that integrates technical and traditional practices on soil fertility management. It involves making the best use of inherent soil nutrient stocks, locally available soil amendments (e.g., crop residues, compost, manure), and mineral fertilizers to increase productivity while maintaining or enhancing the agricultural resource base. The options should focus on the following;

- a. building soil nutrient capital,
- b. better management of available organic resources, and
- c. increased efficiency of mineral (both macro and micro) fertilizers

CIP should pay utmost attention to Conservation Agriculture (CA) - the use of residues of previous crops and nitrogen fixing legumes to create mulches into which seed and fertilizer are sown directly. Such no till farming will provide sustainability to intensification process in hills and slopes. As soils tend to lose the crucial organic matter due to intensification, they become less porous and lose their ability to absorb and retain water. Subsequently the water uptake by crops is reduced and more water (and the applied inorganic chemicals) runs off the land surface, causing floods, erosion and contamination of drinking water. No tillage farming is increasingly becoming an integral part of agricultural production systems in Brazil, China and India<sup>19</sup>.

---

<sup>19</sup> FAO (2008) Integrated Crop Management Volume 6. Investing in sustainable crop intensification: The case for improving soil health

Fine tuning of fertilizer recommendations to conform to specific combinations of crops, soil conditions is important in sustaining the yields in marshlands. Besides contributing to the increase in crop yields the mineral fertilizers also contribute to the improvement of the availability and quality of soil organic matter and, therefore, eventually their own efficiency. It should be acknowledged that organic resources are not the substitutes for mineral fertilizers because they have low or rather inaccessible nutrient content and are usually not abundantly available. They however condition the soil and improve mineral fertilizer use efficiency. The CIP should enhance the capacities of farmers and local entrepreneurs to anticipate and adopt integrated soil fertility management practices. It is important to note that women play an important role in such initiatives as they are more receptive to environmentally sound practices.

*Estimated Budget: 896,610 USD (537,966,000 RWF)*

#### **5.5.1.5. Efficient use of water resources**

Given the rapid growth in crop intensification and the expansion of land area for agricultural use, there is a growing pressure on water resources. In addition, the dry areas of Eastern province face severe challenges due to limited and inconsistent rainfall coupled with the rapidly growing demand for water resources from the rest of the country. Hence water resource management is one of the most important economic and social issues of crop intensification program. Water allocation, water quality, growing and changing social demands for available water, changing technologies, water-use efficiency, and economic feasibility are the issues that need to be tackled by integrating the activities of Land husbandry, water harvesting and hillsides irrigation (LWH) project. Since irrigation accounts for 80-90 per cent of all water consumed in the country, improving on-farm water-use efficiency can contribute directly to increased supply of water for other end users. Therefore crop intensification can be extended to hill areas. In collaboration with LWH project, performance and sustenance of the priority crops under CIP needs to be explored in hill areas in order to expand the area under cultivation and production.

By improving the timing and uniformity of irrigation and other water applications in a given Umudugudu, the water can be used efficiently. Farmers, on their part, generally tend to over-irrigate as a result of their perceptions of water requirements and their expectations of rainfall and market values. Excessive and under-irrigation of fields or parts of the intensified area will also bear negative effects on crop yields. Hence CIP needs to collaborate with operators of irrigation systems under the water user associations and advocate critical stages of target crops in order ensure timely and reliable delivery of water. By working with irrigation taskforce, CIP should establish appropriate irrigation facilities/infrastructure in vulnerable areas such as Kirehe, Nyagatare, Bugesera in order to avoid risks and ensure crop production in drought seasons. Promoting improved technologies in water management that have the potential to optimize water-use efficiency at the farm levels such as the alternate wetting and drying for rice during dry seasons, need to be explored and recommended to farmers. Sound extension strategies and the provision of pertinent advice to farmers will be important for efficient management of water use. These approaches should focus on the following elements

- (i) saving precious water resources
- (ii) sensitizing farmers on water harvesting methods and benefits
- (iii) maximizing productivity of crops



- (iv) reducing the adverse effects of water-logging on the productivity of land which are caused by over-irrigation
- (v) minimizing losses due to evaporation, run off or subsurface drainage and
- (vi) able organization of irrigation water users association (IWUA) towards equitable and efficient water sharing

Conservation efforts that concentrate on maximizing the efficiency of the existing irrigation networks and system will also provide the sustainability for crop intensification. Thus through optimization of water resources and water-use efficiency of crops, it is possible to increase agricultural productivity.

Consolidation of land use provides a viable approach to integrated use and management of inputs. Currently farmers undergoing land consolidation require clarification on land ownership issues. Adequate amendments in policy are needed in elucidating the differences in land value, benefits on productivity and the time involved in administrative processes. At the implementation level, the local authorities and extension agents shall be engaged in determining and explaining the advantages of land subject to consolidation.

*Estimated Budget:* 929,500 USD (557,700,000 RWF)

### **5.5.2. Enhance demand and supply of inputs and outputs**

The facilitation of farm inputs (seeds and fertilizers) to farmers through subsidy under CIP keeps the prices artificially low. The low prices will promote the use of seeds and fertilizers amongst smallholders. With the supply of inputs, the extension activities and the low prices also indirectly push on farmers to use fertilizers. To ensure that the smallholder farmers will continue to use the improved inputs on a sustainable basis, it is essential that the smallholder farmers will continue to seek (demand) the inputs. Hence there is a need to shift from the current 'supply-push' approach to 'demand-pull' approach. This can be realized if the demand for the use of inputs can come from within the system. In a market economy, the stronger demand for inputs shall be expected to elicit an increased supply of fertilizer as profit-seeking input distributors and dealers respond to new opportunities to increase sales and income.

#### **5.5.2.1. Demonstration of profitability**

Profitability of using the inputs, and the readiness of farmers and their affordability are key factors in raising the demand for such inputs. While the affordability of farmers will largely be influenced by the market prices of inputs and the outputs, the readiness of farmers will directly depend on the profitability which is generally determined mostly by the response of crops to the input. Hence, crop intensification process will have to successfully approach the farmers in convincing the profitability of input use through demonstration, workshop and multimedia. Earlier studies have suggested that the yield response, input prices, and output prices interact in determining the fertilizer demand in Rwanda<sup>20</sup>. The demonstration of financial profitability for the entrepreneurs should also become an integral part of extension services in facilitating the shift from supply-push approach to demand-pull approach.

*Estimated Budget:* 154,000 USD (92,400,000 RWF)

---

<sup>20</sup> Kelly V and Murekezi A (2000) Fertilizer response and profitability in Rwanda

### 5.5.2.2. Development of standards, grades, and certification of processes

The demand for inputs and outputs shall enhance substantially only if the value chain is driven by markets. A key criterion in ensuring sustainability of market driven demands of farm inputs and outputs is establishment of standards, grades and certification processes. Seeds, fertilizers, and pesticides used in Rwanda are currently not going through the process of certification. Those grades and standards that are established by law are enforced only at the point of entry into the country through sampling systems. However the standards and grades shall change through adulteration and other malpractices during distribution. The need for quality controls is particularly apparent, for fertilizer that is repackaged at the retail level to accommodate farmers' needs for small package sizes.

CIP should assist farmers in selection of good seeds, fertilizers and other agro inputs for the different crops under the various agro-climatic conditions prevalent in the country. Grades and standards of the inputs can play a fundamental role in also increasing the market demand for outputs in Rwanda. They provide uniform and consistent understanding as to the characteristics of the products of Rwanda. As the country moves to exports of food crops and sale of its farm produces to such entities as World Food Program, the need for grades and standards that meet international and regional norms also becomes urgent.

*Estimated Budget:* 120,000 USD (72,000,000 RWF)

### 5.5.2.3. Strengthening agricultural extension and distribution networks

Crop intensification process require strong agricultural extension network to sustainably increase agricultural productivity in Rwanda. Through proximity extension services, demonstrations and training should be conducted on a routine basis. Efficient use of inputs should be promoted as part of a wider extension services in order to enhance the demand.

By promoting viable competition amongst distributors and/or dealers, the proximity extension services can also ensure the lowest cost and quality of inputs that are available to farmers. The purpose of these demonstrations and training sessions should focus on helping smallholders optimize their use of inputs and thereby enhancing the demand for inputs. Experience from countries such as Kenya suggests that extension providers<sup>21</sup> are desirable only in high agricultural potential regions and high-value cash crops such as coffee. In other cases however, private extension is not a substitute for public extension. Hence the public sector should fund extension significantly but in ways that do not duplicate services already being provided by sustainable alternative service providers.

Communication through creative low-cost methods can help improve information exchange with farmers. For instance, mobile services on the availability and price of seeds, fertilizers and pesticides shall be communicated to a group of registered farmers. Such services will create demand for inputs in rural areas. Wherever applicable, the private entrepreneurs who are interested in mobilizing their sales can capitalize such services. Partial cost recovery from private sector for such services will also provide the sustainability of communication systems.

---

<sup>21</sup> Muyanga M, Jayne TS (2006) Agricultural Extension in Kenya: Practice and Policy Lessons, Working Paper, Egerton University

Integration of Agricultural Knowledge and Information Systems (AKIS) developed by World Bank on dissemination of knowledge and information on agriculture production, marketing, and post-harvest handling of agricultural products and management of natural resources could add more value to such extension services.

The input distribution systems can be effectively strengthened by investing in the skills of agro dealers and stockists. Farm input dealers need to be trained using commercially-delivered training modules to develop their technical knowledge and business management skills. Economies of scale can be increased through sourcing and transporting of farm inputs if the dealers can be organized at the district or province level into purchasing groups. Encouraging formation of national agro-dealers associations shall enable the dealers to negotiate lower price and reduce transportation costs. The increased credit flow through joint collaterals for the procurement of inputs from production centers/companies will also allow dealers to establish strong distribution networks in rural areas. Investments in rural roads can significantly reduce the cost of transportation and logistics and thereby also reduce the prices. It is also important to improve coordination and regulations along the marketing chain of inputs and outputs.

Increased density of agro-dealer networks shall significantly reduce distances the farmers have to travel to access and thereby shall increase the adoption. To help achieve economies of scale in sourcing and transporting fertilizer and other inputs, the agro input dealers shall be encouraged to organize themselves at the district level into purchasing groups for collective sourcing of inputs. Formation of national agro-dealers association/groups will enable them to negotiate lower prices and improve credit financing arrangements with suppliers. Instilling annual and/or seasonal awards for highest sales and service personnel or stores will motivate the dealers. Provision of awards for farmers who obtain the highest yield levels of each crop would further enhance the demand for inputs.

*Estimated Budget:* 1,372,800 USD (823,680,000 RWF)

### **5.5.3. More Gradual Exit and Further diversification of Input subsidies**

Under CIP, the government procured inputs (seeds, cuttings and fertilizers) and distributed to farmers at subsidized prices. These input subsidies have played an important role in successful implementation of CIP and the overall development of agriculture sector in Rwanda, with major gains in food production and food security. The reduced (subsidized) prices have significantly improved the accessibility and affordability of inputs and profitability of production systems throughout the country. They also have induced establishment of supply systems and markets in rural areas. The dynamic effects of subsidies have also overcome information gaps on the benefits of inputs and about their efficient use. They have greatest potential in contributing to wider growth when applied to production of staple crops with a key contribution to consumers' welfare and real incomes through lowering food prices, but this requires larger programs with complementary investment and output market development policies. An effective and efficient subsidy program implemented in the context of consistent agricultural and macro-economic management policies has the potential to drive Rwanda's agricultural growth to become self-sustainable.

Taking cues from other countries that had gone through green revolution shall help make appropriate adjustments to the policy reforms that are implemented in many developing

countries. These reforms include trade liberalization, privatization, removal of price and administrative controls, reduction or elimination of subsidies and price supports particularly for farm inputs and outputs. Lessons from such countries show that any abrupt halt or downscaling of the subsidies before the impacts on the value chain is fully realized, the progress achieved during the initial phase will be reversed.<sup>22,23,24</sup> In most cases, the poor farmers bear the brunt of subsidy withdrawal leading sharp declines in adoption rate, profitability and drops in agricultural productivity in smallholder farms<sup>20,25,26</sup>. For instance, in Malawi, the slowdown of the Starter pack program two years after its implementation has caused considerable slow down in its maize production until the subsidies were reintroduced aggressively shortly after<sup>27</sup>.

Nonetheless, the government has recently drawn a fertilizer action plan for 2010-2013 where by the subsidized price at farmers' level will gradually be reduced from 50% to 20% by 2013. It also seeks to distribute the inputs through vouchers with an upper limit of 125% by 2012 of the incurred cost. The upper limit on prices will be liberated from 2013 onwards. The strategies proposed here suggest that while Rwanda should eventually exit in full from the subsidy program, it is important to decide the timing of exit based on the indicators on adoption of the inputs and the extent of degradation in marginal lands that need amelioration. The exit stage of the input subsidy program can be determined by evaluating whether the program has accomplished the initial objectives it had set and to what extent. Evaluations shall use various indices such as import figures of private entrepreneurs, credit recovery of finance institutions (MFI/Banks), extent of use of fertilizer and improved seeds, increments in agricultural trade and access to agricultural lending.

In the meantime, CIP shall continue to focus on diversifying and reinforcing a far-reaching and more comprehensive subsidy programs covering seeds, pesticides, fertilizers and small tools. Several options that can improve the cost effectiveness of the current input subsidy program and its benefits shall also be explored. While each approach needs to be carefully appraised for its cost efficiency and impact on government budget, the following options shall be explored.

#### **5.5.3.1. Re-packing of subsidies**

The subsidies for various inputs can be tied together in order to attain mutual synergy in enhancing the demand and use. Different options shall be considered. For example, to promote uptake of new and improved seeds, small packs of hybrids or other high yielding varieties shall be provided at free of cost for every purchase of 10 Kg of fertilizers at the retailer shop. To

---

<sup>22</sup> Bigman, D (2002) Globalization and the Developing Countries: Emerging strategies for rural development and poverty alleviation. International Service for National Agricultural Research, CABI Publishing, Hague (Netherlands) p 1-26

<sup>23</sup> Levy S, editor. (2005) Starter Packs: A strategy to fight hunger in developing countries. Wallingford (UK): CABI Publishing. 320 p

<sup>24</sup> Agriculture at crossroads (2009): Global Summary of Decision Makers. International Assessment of Agricultural Knowledge, Science and Technology for Development

<sup>25</sup> Fan, S., A. Gulati, et al. (2007) Investment, Subsidies, and Pro-Poor Growth in Rural India. IFPRI Discussion paper 00716. New Delhi.

<sup>26</sup> Bigman D (2002) The pros and cons of globalization for developing countries. In Globalization and the Developing Countries: Emerging Strategies for rural development and poverty alleviation. ISNAR CABI Publishing, Hague (Netherlands) p 27-82

<sup>27</sup> Conroy AC (2006) Poverty, AIDS and hunger: Breaking the poverty trap in Malawi. New York: Palgrave Macmillan. 280 p

further encourage the sales of these two inputs, a 10% value of the seeds shall become payable to the retailer and distributor. Similar approaches shall be attempted for encouraging the use of safe pest control measures and/or farm tools.

#### **5.5.3.2. Improving the affordability**

Farmers shall be weaned from direct subsidies on the retail price of fertilizer by having the size of the top-up payment increase gradually over a period. The adjustment process could be made more market friendly by allowing competitive forces determine the size of the top-up payment. For example, for a 50 kg bag of urea (currently worth 32,000 RWF), the government could agree to pay the first 5,000 RWF (<15% subsidy), and farmers would have to pay anything above that amount. The final price to be paid by farmers shall be determined by the markets. Through this approach, the companies/distributors/retailers offering lower prices would sell more fertilizer, and those offering higher prices would sell less. Such schemes shall be offered to farmers growing economically more profitable crops such as rice under CIP since rice growers are not currently covered by subsidy program.

#### **5.5.3.3. Use of smart cards in place of vouchers**

Owing to the limited capacity of service providers, CIP experienced serious difficulties in printing and distributing the vouchers to farmers across the country on time. The cumbersome process of issuing vouchers can be overcome by issuing cost efficient 'one-off' smart cards. The use of durable smart cards in place of vouchers shall also save the time and hassle involved in printing the vouchers by the service providers every season. Besides using them for fertilizers, these smart cards shall be used by smallholder farmers in a range of other input subsidy and credit programs, and offers potential low cost solution. The smart cards shall also be used in receiving and/or paying agricultural credits, micro finance, remittances, and thus enabling farmers to easily reach out to the financial sector.

#### **5.5.3.4. Rationing and targeting of effective subsidies**

To limit costs and ensure that subsidies are largely delivered to enhance input use and productivity in remote areas, the subsidies shall be targeted to producers whose effective input use is constrained by their accessibility to market. The input subsidies shall also target specific household types and specific types of farmers who would otherwise use very little or no inputs as a result of their inability to access credit. To promote ecological sustainability, the subsidy program can also target those farmers who will increase their input use substantially as a result of adoption of new and integrated technology packages. The subsidy program should scale back the subsidies in areas where farmers adopt overuse of inputs that is not economically viable.

#### **5.5.3.5. Linking with performance**

Measures designed to strengthen private fertilizer distribution systems shall be combined with measures designed to phase out direct subsidies on retail fertilizer prices. Several options can be envisioned. For example, fertilizer transport costs could be subsidized for those distributors who have a turnover of 100 tons and above by arranging for shipment to rural distribution points in rural/high altitude zones via government-owned vehicles or selectively by offering retailers a bonus for fertilizers sold through shops located in remote areas. Similarly, government funds could be used to provide partial loan guarantees on inventories held by retailers when the input prices are highly volatile. The purpose of these measures would be to encourage the expansion of competitive trade as a means to reduce costs and promote price discipline.



*Estimated Budget (cumulative for all sub components): 103,155,547 USD (61,893,328,200 RWF)*

#### **5.5.4. Strengthening smallholders' links to market**

Experience from the first phase of CIP clearly show that while the farmers were able to produce more, the weak trading network makes the marketing of farm outputs in rural and far remote areas. However, the rapid growth in production of food crops across the country necessitates strong linkages between small farmers and market. The physical access to market by the smallholders is a key impediment in marketing of agricultural produces. Establishing feeder roads that will enable transport systems in staple crop producing areas require apt coordination between CIP and related programs/projects such as PHSCS, and ministries such as MINICOM and MININFRA. One of the negative impacts experienced in Asian countries such as India that have already undergone green revolution is the widening gap between rich and poor. Large farmers who had better access to finance and inputs were able to benefit more than the small farmers<sup>28</sup>. This has triggered inequitable distribution of opportunities and income levels. To avoid such problems and ensure that the adoption is more uniform, CIP should focus on strengthening smallholders' links to input- and output markets.

##### **5.5.4.1. Cooperatives as nodal points**

The culture of farmers to associate under cooperative structure is strong in Rwanda. Cooperatives have long been serving local farmers by facilitating various inputs, outputs and knowledge dissemination in the past. CIP shall extend their working relationship with cooperatives in order to strengthen the links between smallholders and the market for inputs and outputs. Newer access to markets for smallholder farmers in remote sectors/areas needs to be created. Farmers also need to be sensitized on the benefits and importance of modernization of agriculture in maximizing their revenues. By forging strong partnerships between farmers and private sector, the production, storage and marketing opportunities shall be diversified. Wherever possible, the primary emphasis shall be laid on developing business-oriented skills such as in preparing business plans and accessing credits for developing the value chain. CIP can also assist cooperatives and thereby smallholder farmers in establishing their collective bargaining power, gender equality, market analysis, climate change and sales through advocacy. CIP can also help establish minimum suggested prices and predetermined contracts between cooperatives and agro dealers on inputs and outputs. The model purchase for progress (P4P) established between cooperatives and World Food Program shall be extended further to public and private traders.

*Estimated Budget: 200,200 USD (120,120,000 RWF)*

##### **5.5.4.2. Access to Value chain Finance**

One of the major constraints limiting the use of inputs and thereby inhibiting the agricultural productivity in smallholder farms is the accessibility to finance towards purchasing the inputs. In addition to farmers, the access to adequate and timely financial services for other actors in the value chain such as input distributors and dealers also remain as a constraint. The recent developments in microfinance institutions (MFI) in Rwanda exemplified the success of CAF-

---

<sup>28</sup> Junankar PN (1989) The Response of Peasant Farmers to Price Incentives: The Use and Misuse of Profit Functions, Journal of Development Studies 25, 169-182

ISONGA and COOPEC COMICOKA. However the operations are limited to small pockets and are restricted to few selected crops. For instance CAF-ISONGA's operations are more dominant in the district of Muhanga with focus on value chains of rice and maize. Engagement of such MFIs in expanding services and diversifying financing to other key players along the value chain holds the key for successful integration of smallholders in the crop intensification process. Through collaborations with Banque Rwandaise de développement (BRD), the CIP shall scale up the credit through facilities such as Rural Investment Facility (RIF), Agriculture Credit Guarantee Fund (ACGF) or the newly combined Business Development Fund (BDF) for agro input dealers and distributors that would allow large scale importation of inputs. Setting revolving funds that can be used as guarantee loans for cooperatives to avail inputs from distributors will improve the access of smallholder farmers to the inputs.

CIP shall also pilot innovative financial products and services on risk management products such as insurance and over-drafts. In collaboration with banks and financial institutions (FIs), new and efficient financial service products that could link the marketing of inputs with marketing of outputs need to be developed. For instance, financial products that would provide term loans to agro dealers who can trade inputs such as seeds, fertilizers for farm produces. Besides helping smallholder farmers overcome the need for cash, such transactions through kind will efficiently link smallholders with markets. Furthermore, it shall allow farmers to reinvest a portion of the benefits back in farming that could lead to further intensification. Promoting such financial products in high production areas will improve the use of inputs and enable marketing of outputs by smallholder farmers.

*Estimated Budget: 94,500 USD (56,700,000 RWF)*

#### **5.5.4.3. Facilitating market information**

A critical component of crop intensification process involves risk management which requires generation and dissemination of information on market prices of inputs and outputs. Market price information systems have positive effects on the marketing cycles such that producers optimize prices obtained and better regulate the timing of sales throughout the year. CIP should constantly liaise with other programs and institutions responsible for collection, analysis, and dissemination of information on input markets. CIP should make projections on expected demand of inputs and forecast production of outputs available to all the stakeholders on a seasonable basis. Agro input dealers need information to decide how much product to procure to meet projected demand. Farmers, on the other hand, need information about the inventory levels being retained by sellers, as well as information about current and expected future prices. Making such information available to farmers will enable to make informed judgments about when and where to source or purchase inputs.

The information shall be relayed through proximity extension services and using other appropriate information and technology modules to targeted cooperatives and service providers in each district. Disseminating market information through mobile services to individual farmers will also empower smallholder farmers to access market. CIP should initially target market information services towards those farmers who know about the benefits of inputs, know how to use effectively, and have the resources to purchase. CIP should ensure the quality and reliability of market information in order to facilitate better decision making in fertilizer purchases and reduce price volatility in input and output markets. Over the longer term, public-

private partnerships could be explored to support the development of market information systems that would not only monitor and report fertilizer prices but would also report inventory levels and market trends.

*Estimated Budget: 200,000 USD (120,000,000 RWF)*

### **5.5.5. Harnessing the production with no or minimal losses**

Recently the national post harvest staple crops strategy (PHSCS) has been developed. The strategy proposes (i) facilitating information for public and private sector decision making, (ii) providing efficient and equitable transport systems, (iii) reducing losses at producer and first aggregator level, (iv) strengthening of private enterprises in value chains, (v) increasing private sector post harvest investment, (vi) enhancing structured trade, and (vii) minimizing the effects of transparent grain reserves on markets as the seven axes of intervention. These elements require coordination of MINAGRI, MINICOM and MINECOFIN. Since CIP is largely implemented by MINAGRI, the strategies proposed below aims to minimize post harvest losses, improve storage and marketing practices of the crops within the ambit of CIP, and yet attempt to find linkages and mutual synergies with the elements of PHSCS.

In the recent past, the crop intensification process has generated surpluses in small farms across the country. The surplus harvests have highlighted the need to improve postharvest handling through appropriate management of farm produces and the need for efficient marketing system in areas of intensive production. Post harvest losses are attributed to a combination of factors at harvesting, cleaning, drying, and storing stages. These losses include direct physical losses (spilling, breaking), deterioration of quality which reduces the commercial value. Although no precise estimates of post harvest losses are made for the crops under intensification, it is expected to range between 20 and 40%. Hence unless the post harvest management practices are urgently improved, the losses will drag the shift from subsistence farming to market orientated agriculture.

The CIP provides a crucial platform for linking the upstream and downstream segments of value chain. By working together, both CIP and PHSCS shall focus their activities around the consolidated land areas. Through the respective strategic approaches, synergies can be tapped on various activities along the commodity chain by improving the post harvest handling, storage, marketing and trading. For instance, the extension services such as training programs, demonstrations and other awareness programs shall be rendered to producers around the consolidated land use areas will increase the rate of adoption of post harvest technologies. Establishment of primary aggregation centers around the consolidated areas will enable synchronized coordination of post harvest activities and marketing envisaged under the CIP and PHSCS.

#### **5.5.5.1. Awareness and knowledge creation on post harvest management practices**

The sequential cropping under the intensification process prompt farmers to overlook some of the key steps involved in the physiological maturation process of farm produces that would improve the quality and marketability. Sensitization of farmers on the importance of harvesting and handling of the produces after the harvest until the storage is therefore critical for the success of CIP. RAB should identify the gaps and weaknesses in the current post harvest technologies that are adopted by farmers, and make appropriate recommendations on



minimizing post harvest losses of the prioritized crops and improving the quality and marketability of farm produces.

MINAGRI has recently embarked on establishing silos and other infrastructures for storage in high production areas. CIP needs to endorse the usage of such new facilities through appropriate institutional arrangements that will enable both the farmers and processors to minimize losses (quantitative and qualitative) and thereby improve productivity in their operations. The program should provide low-cost solutions on basic post harvest measures such as cleaning of tubers, drying of grains, and packaging. Creating awareness through various extension modules such as radio, multi-media, and workshops should become an integral component of CIP. Wherever possible, CIP should coordinate with the activities under PHSCS which aims to identify technologies and promote adoption of such technologies through field days and other extension models at the producer and primary aggregator level.

By working together with PHSCS, CIP shall embark on training of farmers and farmer cooperatives on the improved post harvest practices will further enrich the knowledge of farmers on improving the quality of farm produces. Since the post harvest practices vary depending on the nature of produces, the training program should be specific. For maize, farmers need to be trained on improved drying, shelling, grading and storage techniques. Rice grains require different modes of drying, grading and storage techniques. Some rice and soy bean varieties require training of farmers on minimizing losses through shattering in the fields. The rapid physiological deterioration of cassava and Irish potato requires training on cleaning, drying and storing techniques. Because some of the post harvest management practices can be costlier, CIP with the assistance of RAB and local authorities should organize cooperatives in adopting economically viable communal post harvest infrastructures such as winnowing machines, electrical driers/ovens, etc. Awareness should also focus on the importance of continuum between production and post production practices on marketability and profitability of farming.

*Estimated Budget: 717,860 USD (430,716,000 RWF)*

#### **5.5.5.2. Engaging private entrepreneurs in integrated marketing**

Lack of active participation by private sector in marketing and trading of farm outputs is a major hurdle in transferring the economic benefits of crop intensification to livelihoods in rural areas. Given the scale of farming operations under CIP in the country, the private sector shall be able to tap benefits if it could scale up their operations around consolidated land use areas under CIP. The margins from such operations can further horizontally scaled up by integrating post harvest tools and technologies in the marketing menus. For instance, establishment of agro dealer networks that market the routine farm inputs such as seeds and fertilizers will be able to market also the post harvest tools, chemicals (fumigators, pesticides/rodenticides, etc.). Such integrated marketing of both on-farm and off-farm inputs shall efficiently provide the linkage between pre- and post production segments of the value chain.

This will require strong forging of partnerships between farmers, private sector and other stakeholders in post harvest management and storage, marketing opportunities for smallholder farmers shall be expanded. Currently trading is the only activity in which private entrepreneurs are involved in the value chain between harvest and storage. The principal limitations of private

enterprise development in the post-harvest sector include lack of reliable storage facilities in production areas, physical access to existing public storage facilities and access to credit. CIP is currently engaged in revamping the storage facilities in all the districts. CIP should forecast and accordingly prepare the storage requirements of different produces under an intensified process. A crucial issue for the private sector will be availing access to suitable storage capacity through, for example, leasing arrangements. Besides engaging farmers, CIP should encourage the use and maintenance of storage facilities by private entrepreneurs and traders for a subsidized fee. The stockists shall be allowed to take credits from banks and other micro finance institutions against the inventory in public storage facilities. Since small-scale entrepreneurs in the postproduction sector invest in technologies and are profit driven, rural infrastructural requirements shall be administered to by the Government but shall become operated by cooperatives and/or private sector.

Through coordination between the lead institutions involved in implementing the strategic components on facilitating information available for decision making by private sector under PHSCS and MINICOM, CIP should engage private enterprises in setting up marketing networks in consolidated land use areas. In high production areas, it is also paramount to encourage private entrepreneurs in investing in storage facilities by providing matching grants for construction and/or through shared ownerships. CIP shall extend the public storage facilities in high production areas to arrange 'fresh markets' where weighing services, quality control services such as moisture meters and minimum suggested prices are available. The farmers, traders and consumers shall come together to sell/buy produces at farm gate prices at these markets. Such markets shall establish a networking system linking cooperatives in the zone to private entrepreneurs and consumers who have use for their agricultural products to trade effectively. The spot buying reduces the regular post-harvest losses by reducing the time post production and by eliminating the need for storage. Such platforms will also provide immediate cash to farmers and thereby facilitate reinvesting in immediate farm operations and/or personal needs. Participation of active private entrepreneurs and traders shall help move locally produced commodities from the non-industrial production storage centers into accredited warehouses and silos, in standardized lots, graded, shelf-life certified and insured with no or minimized losses.

Promotion of activities of private sector/companies that are engaged in processing and medium/large scale trading will also be able to harness the production with minimized losses in both quantitative and qualitative terms. CIP should engage such private entities by highlighting the advantages of scale and margins of business operations in consolidated land use areas. This will require CIP to establish data on volumes and marketability of production in the given area/region and make them available to private sector and help making investment decisions. Since the PHSCS envisages establishing basic data on household consumption, production, market volumes and price elasticity, it is imperative that appropriate linkages are established with CIP in the data collection, and render the data accessible to the private sector.

Establishing aggregation centers and/or storage facilities in the consolidated land use areas where the production is higher will allow collective bargaining by small holder farmers. Shared storage facilities and aggregation centers will provide an avenue for dissemination of improved post harvest technologies and market information. Furthermore, establishment of such facilities will efficiently reduce the cost of storage and transportation of farm outputs by both the

smallholder farmers and the traders. By leveraging the volumes and quality of the farm produces, the smallholder farmers' profitability shall be substantially raised. Thus aggregation centers and storage facilities in high production areas shall serve as marketing points for both buyers and sellers. This requires an effective coordination between CIP and PHSCS units of MINAGRI.

*Estimated Budget: 160,875 USD (96,525,000 RWF)*

#### **5.5.5.3. Linkages through Food Purchase Programs**

As the CIP is involved in generating strategic food reserves, the surplus production shall be tapped directly from the farmers. Currently CIP is engaged in building the strategic stocks through bidding for large quantities of food grains through private traders and/or stock holders. To benefit the smallholder farmers more directly, CIP shall bid for food collection agencies such as cooperatives and/or private service agencies that shall collect directly from the storage centers and/or individual farm gates across the country at suggested prices through a food purchase program. Each farm/farm families shall be entitled to a minimum amount of selling their farm products to the collection agency. Besides encouraging farmers to use the storage facilities, the food purchase program for building the strategic food reserves shall also directly provide the cash to the producers. By enabling the purchase of locally produced food produces, the program shall benefit both the producers and national consumers, and thereby ensures food security and food sovereignty.

To improve the recovery of credit for farm inputs, multiple linkages between storage, subsidy program, creditor (bank) and food purchase program shall also be envisioned (Fig. 5). For instance, when the same financial bank or microfinance institution in a given area is involved in both providing the credit for farm inputs and paying for the produces sold to the food purchase program, the recovery of credit becomes faster and efficient for both the creditor and the farmer. The farmers can use the stored farm produces in the storage centers shall be used as 'collateral' for availing the credits from the banker towards the purchase of inputs. Thus the linkage between subsidy program and food purchase program will synergistically promote the use of improved inputs such as seeds, fertilizers and pesticides by the farmers who would otherwise be reluctant to buy for lack of purchasing power. The storage facilities being set by CIP can also provide the linkage between the farmer and financial sector. Such linkages will minimize the post harvest losses along the continuum of processing and marketing chains.

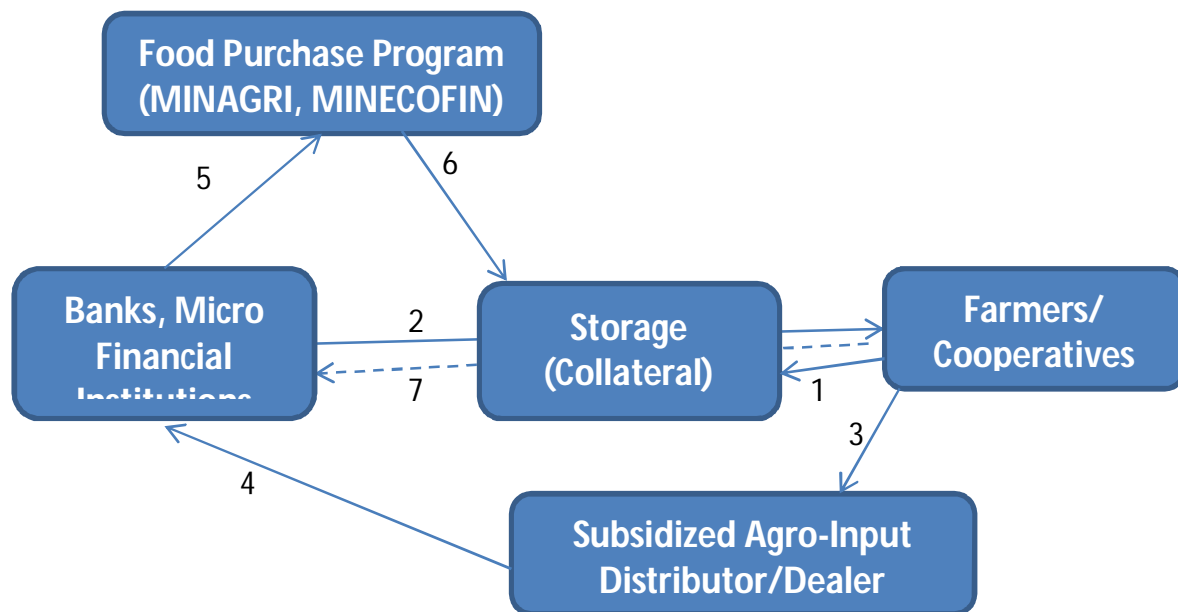


Fig. 5: Illustration of possible linkages between farmer, storage facility and food purchase program that allows the farmer to purchase inputs and clear the debt in kind.

1: Farmer stores the produces at Storage facility established by CIP, 2: Banks provide line of credit through smart card/vouchers/stamps to smallholder farmers against the collateral of stored produces, 3: Farmer avails the subsidized inputs from the distributor/dealer using the line of credit, 4: Input distributor/dealer receives the cash from bank, 5: The bank receives money from Food Purchase Program, 6: Food purchase program collects the stored food crops, and 7: Credit given to farmer is recovered 'in kind'.

The linkages enable smallholder farmer to avail finance for inputs without the need to borrow money in the open market at higher rates of interest. The need to provide collateral in the form of properties is avoided. The problems associated with the procurement of inputs such as sourcing, arranging payment and transportation are eliminated, thus giving farmer more time to attend to farm chores. The farmer receives the necessary inputs at no extra cost and the dealer is assured of payment by bank. Post-harvest problems of handling, storage and transportation, and the sourcing of markets for the produce are undertaken by storage facilities. Such linkages provide a win-win situation for CIP as it promotes use of inputs by farmers and yet minimize the post harvest losses.

*Estimated Budget: 97,500 USD (58,500,000 RWF)*

### 5.5.6. Focused development of 'Bread Baskets'

Breadbasket is a region which because of its high potential can be used to produce selected food crops intensively on a large scale. Given the pressure on land in Rwanda, such focused production of food crops in selected areas will not only help reduce the pressure on land, but also shall ensure food security. If appropriate intensification process is put in place, the breadbasket shall allow surplus production that can turn the country into one of the largest food exporter in the region. The three major selection criteria for a region to be selected as breadbasket include (i) agronomic potential of the area, (ii) accessibility to national and regional

markets, and (iii) population density. CIP provides the most appropriate platform for laying the foundation and implementation of the concept of breadbasket(s) in Rwanda.

#### **5.5.6.1. The potential for production**

The diverse agro climatic conditions prevalent in Rwanda offer good diversity of zones for the major food crops. The agronomic potential richness of each zone need to be assessed based on factors that influence production such as:

- length of duration for the target crops (maturity period)
- soil fertility (nutrient balance, type, depth, texture)
- water availability (water reserves, irrigation potential, drainage, ground water table)
- terrain features (slope and vegetation)
- climate (rainfall pattern, temperature regimes)

The capability of soil to produce a range of staple crops with good water resources and less climatic instability/restrictions is important in selecting the area. Water availability during the dry season is paramount for sustainable intensification and production in the zone. The consistency in yield levels under the two seasons of crop intensification process since 2008 from a number of representative zones such as Bugarama (rice, maize and beans), Kirehe and Umutara (maize and beans), Nyabihu and Kinigi (Irish potato) shall serve as a guideline. Use of modern inputs such as improved seeds, fertilizer adoption and control measures of pests and diseases must be widespread in the given area. On-farm yield gaps amongst farmers, progressiveness of farmers, and business and structural integrities of cooperatives shall also be considered for selection. Regions where activities under LWH and integrated soil fertility management are already carried out by public, non-governmental and international agencies such as IFDC can be an advantageous. Careful environmental monitoring, and conserving biodiversity, water and land should also be given high priority while selecting the area as breadbasket. It would be highly desirable if a research station that undertakes research on major interventions on improving soil and crops in the given agro-climatic zone is also located.

*Estimated Budget:* 101,200 USD (60,720,000 RWF)

#### **5.5.6.2. Accessibility to markets**

Since the ability to reach markets efficiently by smallholders in breadbasket holds the key to flows of inputs and outputs of the entire food value chain, the accessibility to national/regional markets (measured in terms of physical distance and time taken to reach market centers) plays a pivotal role in sustaining the production. The breadbasket should have reliable market outlets for inputs and outputs and higher rates of market participation among rural households. Presence of vibrant and large distribution networks in the zone will reduce the variability in market prices through competition. In the presence of competitive marketing networks, the consistency in demand shall also help reduce the volatility in prices. It is also important that the farmers in breadbasket area have access to timely and accurate market information. The success of crop intensification in breadbasket therefore depends largely on the ability of smallholder farmer in efficiently accessing various farm inputs and finding markets where the farmers can sell the outputs.

Rural infrastructure such as storage facilities and feeder roads that will reduce the logistics and cost of transportation will also increase the volumes of trade in the rural areas of breadbasket zone. Participation of private sector will improve efficiency of marketing and enable rapid growth in agricultural markets in the breadbasket and eventually diversification of rural economy. Furthermore, increased density of agro-dealer networks shall significantly reduced distances farmers have to travel to access much needed inputs at competitive prices. Mechanisms and organizations to gain critical mass and economies of scale need to be implemented in breadbasket zone. In order to improve profitability to all the stakeholders, the markets should dynamically adapt to structural changes in regional and global trading as large markets for farm produces are zooming into very concentrated retail- and food sector.

*Estimated Budget:* 50,600 USD (30,360,000 RWF)

### **5.5.6.3. Population density**

From an agriculture perspective population density refers to the ratio of farmers to the amount of arable land. Historically, the distribution of agricultural production is linked with density of human population. The combination of favorable rainfall and temperature regimes and proximity to water bodies and rivers define the distribution of both people and agriculture in Rwanda<sup>29</sup>. When other production factors are prevalent, farmers in densely populated areas are more likely to undertake labor-intensive production strategies than are those in areas of low density. Hence the population density is a potentially useful criterion for creating fundamental opportunities for breadbaskets. When the population density is high, the likelihood for market demand pull for agricultural production will also be higher. In addition the cost for reaching farmers with agricultural innovations will also get reduced. Since agriculture is Rwanda's single largest employer, raising productivity will also imply that crop intensification will also generate jobs needed by households to buy food. The increased agricultural produce also will create jobs in agro-based industries and services. Hence the higher population density will be able to support and benefit from the intensification process with in the breadbasket. CIP should therefore identify areas where the ratio of farmers to the amount of arable land is high as the candidate zones for breadbasket in Rwanda.

The higher population density will also provide the necessary workforce for the intensified agricultural activities. The cooperatives in such areas will represent the interests of a larger portion of country's smallholder farmers. In addition, the demand for food and hence the market for farm outputs will also be more in areas with higher population density. Subsequently the number of beneficiaries and therefore the impact of various development efforts by the participating stakeholders such as the government, donors and development partners will likely to be higher when areas with higher population density are chosen as breadbaskets.

*Estimated Budget:* 613,800 USD (368,280,000 RWF)

---

<sup>29</sup> Omamo W, Diao X, et al. (2006) Strategic priorities for agricultural development in Eastern and Central Africa, International Food Policy Research Institute Research Report 150

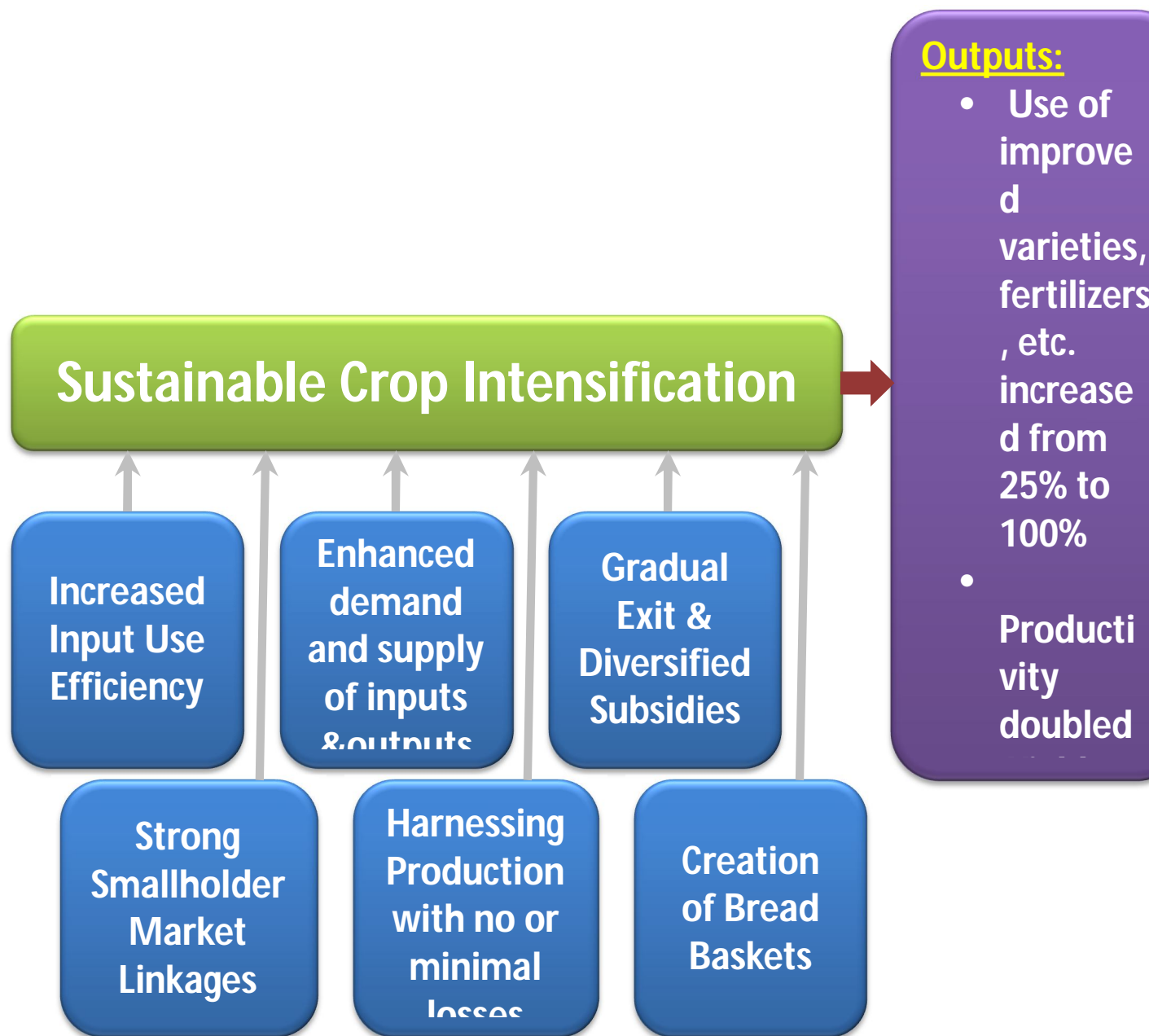


Fig 6: Overview of strategies for crop intensification program (2010-2017)

## 6. Roles and responsibilities of stakeholders

### 6.1. Roles of the program (CIP)

CIP along with the taskforces of PHHS, irrigation and mechanization shall spearhead the intensification of the priority crops. The program shall be responsible for the following activities:

- 6.1.1. *Forecasting:* With the help of district- and sector administrators, the program shall estimate the seasonal requirements of inputs such as seeds, fertilizers, pesticides, tools/machineries and infrastructure. The program shall also make forecasts on the special needs such as training on technologies and appropriate policy interventions to extend the



impact of the program. Such forecasts shall be made available to the Directorate of Planning at MINAGRI for further actions.

6.1.2. *Procurement of inputs*: In consistence with the overall policy framework on subsidies and subsector strategies, the program shall make recommendations on the bulk procurement of fertilizers, seeds, pesticides and tools by public and private sector.

6.1.3. *Distribution of inputs through vouchers/smart cards*: In collaboration with RAB, the program shall engage in the auctioning of the procured inputs and ensure that a healthy competition is stimulated among distributors and smooth transition of procured inputs through the tender process.

6.1.4. *Facilitation of private sector*: The program should enhance the capacity of the private sector and entrepreneurs to gradually replace the public sector in the procurement and distribution of farm inputs by strengthening and collaborating with such entities as fertilizer associations, seed associations and retailer networks.

6.1.5. *Coordination of activities amongst decentralized entities*: To enable equitable transfer of resources and technologies to the farming communities and to harmonize planning and budgeting processes between central and local level, the program should coordinate with the local government authorities at the sector and Umudugudu levels.

6.1.6. *Promotion of the strategic initiatives*: The program should ensure that in the long run, important segments of the poor and small holder farmers are not left out in the process/benefits of crop intensification.

6.1.7. *Survey and Data collection*: With the help of local authorities and extension network, the program shall conduct surveys to collect data on the performance and adoption of inputs and technologies disseminated through the program. These data shall include, but not limited to, such components as area under consolidated use, input usage, production, standards/grades of produces and prices.

6.1.8. *Assessment of impact*: Through participatory appraisals and informal interviews with all the stakeholders along the value chain of the prioritized crops, the program shall continuously evaluate both the positive and negative (if any) impacts of the crop intensification. If necessary, the program should ensure that such assessments lead to a review of strategic initiatives and policy frameworks in order to ensure sustainability of crop intensification.

6.1.9. *Outreach activities*: Broad interactions with the general public in consolidated areas and specific groups involving communities and organizations need to be handled by the program to ensure that the achievements of CIP are readily available to people working in all fields of socioeconomic development.

6.1.10. *Monitoring and evaluation*: Since the implementation of CIP involves a wide spectrum of stakeholders involving public- and private sectors, the program should supervise the overall activities of the stakeholders in implementing the programs and appraise the setbacks, progress and achievements, and report to MINAGRI on a seasonal basis (every 6 months).

## 6.2. Roles of RAB

Sustainability of the crop intensification process requires diverse subject matters that can efficiently address the more pressing, issue driven demands by the farmers. Hence the organization and coordination of research and extension services assume greater importance. RAB shall coordinate all the applied research and extension programs conducted under CIP.



These include the various findings and appropriation of technologies that are required and described under the various strategic elements/axes.

Both RAB and the CIP should consult each other on a continuing basis. In collaboration with the CIP, the planning for each season should be done by RAB researchers and extension workers at zonal (province) level. This requires effective coordination between the RAB Directorates of crop research and extension in various zones, the RAB Directorate of Planning and CIP. Through the zonal institutions, RAB should efficiently integrate its proximity extension services on crop intensification processes with other extension agents/agronomes working under district- and sector levels, and cooperatives. In addition to the dissemination of on- and off farm technologies, the extension services should also strengthen the management skills of stakeholders along the entire value chain.

Owing to the weaknesses in the marketing systems and the absence of a strong private sector participation in the value chain of the mandate crops under CIP, the RAB needs to assume additional roles and responsibilities to accelerate and sustain the impacts of CIP. Wherever possible, training programs and on-farm demonstrations shall be extended to and/or include relevant entrepreneurs, importers, wholesalers, distributors, retailers and service providers. RAB should also play a pivotal role in strengthening the segments of the trading systems that shall enable farmers in consolidated land use areas under CIP to market their farm outputs in local and regional markets. In addition to creating choices of new and appropriate technologies, RAB should assist farmers in developing and adopting production practices in line with market demand and quality standards.

It is therefore imperative that RAB develops a responsive system of research for development that can adapt to the demands of CIP in a timely and effective fashion. Research should render assistance to CIP in determining the appropriation of crops and varieties that would utilize the advantages of agro-climatic conditions in a given ecosystem. RAB shall also be involved in site-specific fine-tuning of fertilizer recommendations (both macro- and micro nutrients). Agronomic management practices that would significantly improve the efficiency of inputs need to be identified and advocated by the research program. To sustain the yield advantages of priority crops, RAB should characterize the already released varieties, attend maintenance breeding of all released varieties, and explore the relevant exogenous genetic materials for further improvement (with additional emphasis on quality and marketability). Research and dissemination of post harvest technologies and mechanization are the two key components that can help the shift from subsistence farming to market oriented CIP. Besides playing a key supportive role to such strategic elements of CIP, RAB should take research initiatives that could help farmers identify tangible solutions to such issues as climate change, pests and diseases, soil fertility and crop residue management through multidisciplinary research.

### 6.3. Roles of private sector and service providers

Establishing a strong and dynamic value chain is essential for sustainable crop intensification in Rwanda. This, however, requires the active participation of private sector along the entire value chain. While the government plays a paramount role in the implementation of the current phase of CIP through policy guidelines, land use consolidation, outsourcing of seeds, procurement of fertilizers, provision of proximity services, subsidies, and support in irrigation and mechanization, the importance of the private sector is being increasingly recognized by all

the stakeholders in future sustenance of CIP. Investments in procurement and distribution of inputs, service provisions, storage, processing and trading of farm produces need to be mobilized by private entrepreneurs/companies. Private sector should take advantage of the consolidated areas of crop production for scaling up of the marketing of inputs (seeds, fertilizers, pesticides and tools), providing mechanization services, processing operations and trading of outputs. The private companies, be they national or multinational can contribute to the economic development of farmers by providing goods and services that shall help sustain and improve crop yields as well as quality of produces. The private entrepreneurs need to be incentivized for broadening their distribution network to remote areas. While the entrepreneurial spirits should ensure profit motivation, the private entities should follow fair practices on pricing in the market places and supply without any compromise on the quality of inputs. Wherever possible, the private sector shall be encouraged to collect and trade farm produces in local and regional markets.

#### 6.4. Roles of Banks and Financial Institutions (FI)

Banks and FIs (both macro and micro finance institutions) play a key role in the agri-business sector primarily by facilitating finance to the various stakeholders along the value chain. They should be an integral component of the system and finance should be available at each and every stage of the value chain in order to make crop intensification sustainable. Banks and Micro finance institutions (MFIs) may find it advantageous to have outlets in consolidated areas under CIP. Banks and FIs must consider setting up focused groups/projects in such consolidated areas that cater specifically on the policy- and governance fronts. This shall enable effective integration of the financial sector with agriculture sector. It would be advantageous for the financial institutions and the farmers to be able to transact both cash and kind in order to improve the performance of credits given out to farmers. The possibility of tie-ups with NGOs and private sector in providing inputs and training farmers in technologies that will aid in sustainable crop intensification also need to be explored.

#### 6.5. Roles of line Ministries and para-statal organizations

The operations of CIP are almost entirely handled by MINAGRI. Strategic elements such as proximity services and distribution of inputs will require efficient coordination with Ministry of Local Government, Good Governance, Community Development and Social Affairs (MINALOC). The extension agents/agronomes working under district and sector authorities need to be advised by CIP and the extension agents and researchers of RAB on the dissemination of on-farm technologies and off-farm technologies. Training programs and demonstrations should be conducted in partnership with authorities and organizers at the grass root level.

Until the private sector becomes deep rooted in the input distribution system, the MINAGRI shall continue to make the first moves to sustain the recently undertaken initiatives. While the bulk procurement of seeds and fertilizers from outside the country are to be assisted by the Ministry of Trade and Industry (MINICOM), the budget requirements and financial transactions of procurement and distribution to farmers through auctions and voucher schemes require the advisory and mediatory roles of Ministry of Finance and Economic Planning (MINECOFIN). In addition, MINECOFIN will also be responsible for facilitating the information available to public- and private enterprises for making appropriate financial/investment decisions. Provision of efficient transport systems in rural areas that could improve trading and marketing of farm

produces, and overall strengthening of private sector participation in the value chain shall be guided by MINICOM.

MINAGRI shall gradually hand the procurement and distribution process entirely over to private entities, but continue to monitor ways of reducing the costs and volatility in prices to sustain the adoption amongst farmers. Thus MINAGRI needs to act as a catalyst ensuring sustainability of the various components involved in the value- and food chains and ensure that the process is focused on enhancing productivity.

In collaboration with non-government organizations (NGO), the service providers should expand the horizon and reach of extension services. The NGOs shall play a role in motivating the farmers and farmer cooperatives on the principles and benefits of technologies and that of consolidated land use. The role of other para-statal organizations such as Rwanda Bureau of Standards (RBS) is imperative for the successful implementation of CIP. RBS should establish quality standards and grades for the farm inputs such as seeds, fertilizers and pesticides to ensure that the profitability of the use of these inputs is not affected by fraudulent practices in the market. Given the constraints in capacity of extension network in the country, Agricultural Information and Communication Centre (CICA) should play an active role in dissemination of knowledge through the use of modern information and technology services. These shall include dissemination of the seasonal information to farmers through communication networks and establishment of a database on market information capturing the sources, fluctuations in prices of sensitive inputs such as fertilizers and pesticides, and forecasts on weather and prices of both inputs and outputs.

## **7. Coordination, Monitoring and Evaluation**

The CIP unit is responsible for the overall conduct of the program. By effectively coordinating with the taskforce of PHSCS, RAB structures and local authorities at the district- and sector level, the program should play a lead role in coordinating, monitoring and evaluation of the intensification strategies. The program (CIP) should coordinate and ensure appropriate linkages between various stakeholders. The management of strategic food reserves for instance shall be tied to the storage facilities and the banking institutions to absorb and provide stability to the local food production. CIP should constantly monitor the progress made on the quantitative- and qualitative indicators designed for the exit of subsidy program needs to be assessed on a seasonal basis.

The targeting of farmers under subsidy program and ensuring transparency in bidding and distribution of subsidized inputs in the system needs constant monitoring. The various responsibilities of para-statal organizations and service providers need to be evaluated on a semi-annual basis. With the help of CICA, the CIP shall monitor the prices of inputs and outputs and ensure fairness amongst market players. While CIP should ensure minimal or no interference in the marketing of inputs, CIP has to ensure that the farmers are protected from the profit motivations of private enterprises. CIP shall monitor the credibility of practices and the quality of produces distributed to farmers by ensuring appropriate rules and regulations in the market place.

In addition to monitoring the feat indicators set under the program, the CIP also needs to routinely monitor/assess the indices such as the volumes of performing and non-performing loans, interest rate, and rate of credit recovery of financial services under the intensification program. CIP shall coordinate with other programs under PSTA II to ensure that the capacity constraints are addressed in effectively implementing the program. With the help of RAB and the service providers, CIP needs to control the authenticity of information on sustainable crop management practices and their dissemination through proximity extension service channels. CIP shall also ensure proper coordination of inputs from other relevant programs such as Land husbandry, water harvesting and hillsides irrigation (LWH) project, mechanization program, and other programs under PSTA II that are focused on improving the productivity of target crops. The coordination with local district authorities is important on proper implementation of government policies on consolidation of land use and in managing natural resources that provide the sustainability to the intensification process.

## **8. Estimated cost**

Budget for the activities proposed under each of the strategic element is drawn (table 5) based on the current and empirical values of similar activities under on-going projects/programs in agriculture sector in the country. The evaluation of on-farm technologies will be made in representative sites across the country for each of the mandate crops. Under the required component, at least one site needs to be chosen for each crop. To supplement the existing human capacities of the existing institutions engaged in research, extension and outreach, additional human resources may be required to attain the goals and objectives of the components. Such requirements shall be on the basis of need for the desired length of time under the program. Hence budget for recruitment of experts, national consultants, agronomes and technical assistants are also added. Under the component of bread basket, there is a need for recruiting experts for assessing the soil, water and agro-climatic suitability and for appraising the socio-economic impacts of the proposed areas or zones. While experts in these fields shall be recruited for 4-months each at two separate time windows, the national consultants shall be recruited so as to enable them to interact with both the sets of experts ensuring an overlap of time for the national consultants.

In consistence with the government's fertilizer action plan, subsidies for the fertilizer were calculated with a gradual reduction in volumes of requirement. The end user prices for fertilizer will be accordingly reflected as 50% (2011), 35% (2012), 25% (2013), 20% (2014) and 15% (2015). From 2016 onwards, a subsidy of 10% has been included in the cost of inputs, in accordance with the strategy proposed under component #3. Since most of the months of 2011 have lapsed at the time of the preparation of this document, only 50% of the estimated costs were included for the year. Training activities under various components involve permissible daily allowances for the participating farmers and the trainers for the respective number of days. For each of the activity, administrative cost of 10% of the cost of activity has been added to meet the expenses in logistical requirements. The costs were calculated in US dollars and converted into Rwandan Francs (RWF) using a conversion value of 600 RWF/USD.

Table 4: Summary of budget for the proposed strategic components

Sl. No	Strategic Components	Estimated Budget	
		USD	RWF
1	Improve the efficiency of use of inputs in smallholder farms	7,582,380	4,549,428,000
2	Enhance demand for inputs and farm outputs	1,646,800	988,080,000
3	Prolonged exit and further diversification of input subsidies	103,155,547	61,893,328,200
4	Strengthen smallholders' link to market for inputs and outputs	494,700	296,820,000
5	Minimize the losses in farm produces along the continuum of harvesting and storage points	976,235	585,741,000
6	Develop breadbaskets for the crops under intensification process	765,600	459,360,000
	Total	114,621,262	68,772,757,200

Table 5: Budget estimates of the various activities proposed CIP strategic components

Strategic axes	Activities	2011	2012	2013	2014	2015	2016	2017	Total (RWF)	Total (USD)	Component Budget	
1. Improve the efficiency of use of inputs in smallholder farms	1.1. Determine the appropriateness of priority crops and varieties in different districts ( <i>6 representative sites; 8 crops; 1 trial each year; 1 Expert; 1 Technical assistant</i> )	81000	162000	162000	162000	162000	162000	162000	631800000	1053000		
	1.2. Integrate chemical and agronomic management of pests and diseases through crop rotation											
	1.2.1. Identify and create awareness on the combat measures for major pests and diseases through demonstration and knowledge dissemination ( <i>1 Expert; 1 technical assistant; 5 representative sites/year; 8 crops</i> )	214500	429000	429000	429000	429000	429000	429000	429000	1673100000	2788500	
	1.2.2. Validation of crop rotation ( <i>8 crops, 5 representative sites, every year, 1 Expert, 1 technical assistant</i> )	115500	231000	231000	231000	231000	231000	231000	231000	900900000	1501500	
	1.2.3. Knowledge dissemination on IPM ( <i>Hand outs, Multi-media and Demonstrations across the country</i> )	8800	17600	17600	17600	17600	17600	17600	17600	68640000	114400	
	1.3. Facilitate mechanization of land preparation and other seasonal field operations that will overcome labor constraints ( <i>Demonstrations; 8 crops; 5 representative sites; each year; 1 technical assistant</i> )	22990	45980	45980	45980	45980	45980	45980	45980	179322000	298870	
	1.4. Combine appropriate traditional and modern technological soil management practices ( <i>Demonstrations; 8 sites (1 site/crop) per year; 1 Expert, 1 technical assistant</i> )	68970	137940	137940	137940	137940	137940	137940	137940	537966000	896610	
1.5. Improve water use efficiency through dissemination of technologies and collaboration with irrigation water users association ( <i>Demonstrations; 8 crops; 1 site/crop/year; 1 Expert, 1 technical assistant</i> )	71500	143000	143000	143000	143000	143000	143000	143000	557700000	929500	7582380	
2. Enhance demand for inputs and farm	2.1. Demonstrate the economic profitability of crops under intensification process ( <i>Demonstrations; 8 crops; 1 site/crop; 3years; 2 technical</i> )	30800	61600	61600					92400000	154000	1646800	

Strategic axes	Activities	2011	2012	2013	2014	2015	2016	2017	Total (RWF)	Total (USD)	Component Budget
outputs	assistants)										
	2.2. Establish standards, grades and certification of process ( <i>Validation of EAC standards; 2 Experts (Inputs, Outputs, Services); 6-months each</i> )		120000						72000000	120000	
	2.3. Improve proximity extension services through integration of information and technology and capacity building ( <i>5 agronomes /zones; 4 zones; recurring</i> )	105600	211200	211200	211200	211200	211200	211200	823680000	1372800	
3. Prolonged exit and further diversification of input subsidies	3.1. Re-packing of subsidies by tying up various inputs ( <i>Cost of average importation in the past 4 years; 50% (2011), 35% (2012), 25%(2013), 20% (2014), 15% (2015), 10% (2016-17)</i> )	15796435	22115009	15796435	12637148	9477861	6318574	6318574	53076022776	88460038	
	3.2. Increase fertilizer affordability of farmers growing economically profitable crops such as rice through top-up schemes ( <i>10% of the cost of subsidized inputs</i> )	789822	2211501	1579644	1263715	947786	631857	631857	4833709217	8056182	
	3.3. Improve efficiency of subsidy programs by replacing vouchers with smart cards ( <i>8 crops; 50 outlets/crop; 40% (2012, 2013); 20% (2014)</i> )		400000	400000	200000				600000000	1000000	
	3.4. Targeting subsidies to farmers who otherwise would not use inputs ( <i>5% of the cost of subsidized inputs</i> )	394911	1105750	789822	631857	473893	315929	315929	2416854609	4028091	
	3.5. Absorbing overhead costs of distributors/dealers with higher turnover ( <i>20% of overhead costs (10%of subsidized inputs)</i> )	157964	442300	315929	252743	189557	126371	126371	966741843	1611236	103155547
4. Strengthen smallholders' link to market for inputs and outputs	4.1. Energize cooperatives by enriching business skills and linkage with market entities ( <i>Training workshop; 4 provinces; 50 participants; every year; 1 Expert; 2 National Consultants; 3 days</i> )	15400	30800	30800	30800	30800	30800	30800	120120000	200200	
	4.2. Facilitate services of financial sector to farmers and entrepreneurs along the value chain ( <i>1 Financial Specialist; 1 National Consultant; 30 days; every 2 years</i> )		31500		31500		31500		56700000	94500	494700



Strategic axes	Activities	2011	2012	2013	2014	2015	2016	2017	Total (RWF)	Total (USD)	Component Budget
	4.3. Provide market information on availability, sourcing and prices of inputs and outputs through proximity and mobile extension services ( <i>Lumsum; 4000 for each crop every year</i> )	8000	32000	32000	32000	32000	32000	32000	120000000	200000	
5. Minimize the losses in farm produces along the continuum of harvesting and storage points	5.1. Create awareness and provide technical guidance on harvesting, cleaning, drying, packing and storing of harvested farm produces through training ( <i>Training, 8 sessions (crops)/year; 50 farmers; 1 Expert, 2 National Consultants; 5-days</i> )	55220	110440	110440	110440	110440	110440	110440	430716000	717860	
	5.2. Forge partnerships between farmers/cooperatives and private entrepreneurs along commodity chain ( <i>1 Expert, 1 National Consultant; 30-days; every year</i> )	12375	24750	24750	24750	24750	24750	24750	96525000	160875	
	5.3. Establish linkage between food purchase program for strategic reserve and storage program ( <i>2 National Consultants; 30-days; every year</i> )	7500	15000	15000	15000	15000	15000	15000	58500000	97500	976235
6. Develop breadbaskets for the crops under intensification process	6.1. Establish the suitability of areas/zones based on soil, water and climatic conditions for the priority crops ( <i>1 Agronomist, 1 Irrigation specialist, 2 technical assistants, 4-months</i> )		101200						60720000	101200	
	6.2. Appraise the accessibility of zones to domestic and regional markets ( <i>1 Socio-economist, 1 technical assistant, 4-months</i> )		50600						30360000	50600	
	6.3. Identify areas with higher population density amongst the potential areas ( <i>2 National Consultants; 6-months</i> )		613800						368280000	613800	765600
<b>Total (USD)</b>		2684793	17957287	28843971	20534139	16607673	12679808	9014942	8983442		114621262
<b>Total (RWF; *1 USD = 600 RWF)</b>		1610875906	10774372413	17306382662	12320483616	9964604093	7607884569	5408965046	5390065046	68772757445	

## 9. Action Plan and Time Table

Strategic Objectives	Activities	2011	2012	2013	2014	2015	2016	2017
1. Improve the efficiency of use of inputs in smallholder farms	1.1. Determine the appropriateness of priority crops and varieties in different districts							
	1.2. Integrate chemical and agronomic management of pests and diseases through crop rotation							
	1.3. Facilitate mechanization of land preparation and other seasonal field operations that will overcome labor constraints							
	1.4. Combine appropriate traditional and modern technological soil management practices							
	1.5. Improve water use efficiency through dissemination of technologies and collaboration with water users association							
2. Enhance demand for inputs and farm outputs	2.1. Demonstrate the economic profitability of crops under intensification process							
	2.2. Establish standards, grades and certification of process							
	2.3. Improve proximity extension services through integration of information and technology and capacity building							
3. Prolonged exit and further diversification of input subsidies	3.1. Re-packing of subsidies by tying up various inputs							
	3.2. Increase fertilizer affordability of farmers growing economically profitable crops such as rice through top-up schemes							
	3.3. Improve efficiency of subsidy programs by replacing vouchers with smart cards							
	3.4. Targeting subsidies to farmers who otherwise							

Strategic Objectives	Activities	2011	2012	2013	2014	2015	2016	2017
	would not use inputs							
	3.5. Absorbing overhead costs of distributors/dealers with higher turnover							
4. Strengthen smallholders' link to market for inputs and outputs	4.1. Energize cooperatives by enriching business skills and linkage with market entities							
	4.2. Facilitate services of financial sector to farmers and entrepreneurs along the value chain							
	4.3. Provide market information on availability, sourcing and prices of inputs and outputs through proximity and mobile extension services							
5. Minimize the losses in farm produces along the continuum of harvesting and storage points	5.1. Create awareness and provide technical guidance on harvesting, cleaning, drying, packing and storing of harvested farm produces through training							
	5.2. Forge partnerships between farmers/ Cooperatives and private entrepreneurs involved in the commodity chain							
	5.3. Establish linkage between food purchase program for strategic reserve and storage program							
6. Develop breadbaskets for the crops under intensification process	6.1. Establish the suitability of areas/zones based on soil, water and climatic conditions for the priority crops							
	6.2. Appraise the accessibility of zones to domestic and regional markets							
	6.3. Identify areas with higher population density amongst the potential areas							

## 10. Logical Framework of Crop Intensification Strategies

Strategic Axes	Activities	Lead Institutions	Expected Outputs	Indicators
1. Improve the efficiency of use of inputs in smallholder farms	1.1. Determine the appropriateness of priority crops and varieties in different districts	RAB, MINAGRI	1.1.1. Intensification of only those crops that are suitable for a given location are distributed	1.1.1.1. Length of cropping seasons are optimized to a maximum of 5 months
			1.2.1. Maximum advantage of agricultural seasons utilized by choosing appropriate varieties	1.2.1.1. Number of short duration varieties distributed
				1.2.1.2. Number of hybrid maize varieties available to farmers
	1.2. Integrate chemical and agronomic management of pests and diseases through crop rotation	RAB, MINAGRI	1.2.1. Suitable crop rotation practices disseminated	1.2.1.1. Adoption of crop rotation increased from 20% to 80%
			1.2.2. Efficient and ecologically safe pesticides used by farmers	1.2.2.1. Amount of pesticides distributed increased to 100 tons/year
			1.2.3. Pressure from pests and diseases reduced	1.2.3.1. Epidemics of pests and diseases eliminated
	1.3. Facilitate mechanization of land preparation and other seasonal field operations that will overcome labor constraints	MINAGRI	1.3.1. Consistency, efficiency and speed of field operations improved	1.3.1.1. Turnaround time between agricultural seasons reduced from 3 weeks to 1 week
	1.4. Combine appropriate traditional and modern technological soil management practices	RAB	1.4.1. Soil nutrients are replenished by sustainable means	1.4.1.1. Amount of organic manure used increased from negligible to 0.5 t/Ha/year
			1.4.2. Site-specific fertilizer management recommendations	1.4.2.1. Distribution of blended (macro- and micro) fertilizers increased by 5-fold
	1.5. Improve water use efficiency through dissemination of technologies and collaboration with water users association	RAB, MINAGRI	1.5.1. Water saving technologies such as alternate drying and wetting in rice promoted	1.5.1.1. Yield differences between seasons minimized to <10%
1.5.2. Awareness of critical stages of water requirement of target crops created			1.5.2.1. Water use efficiency by crops improved to 0.75	
2. Enhance demand for inputs	2.1. Demonstrate the economic profitability of crops under intensification	MINAGRI, MINALOC	2.1.1. Smallholder farmers are able to make informed decisions on improving productivity	2.1.1.1. Fertilizer use increased from the current 23 Kg/Ha to 50 Kg/Ha

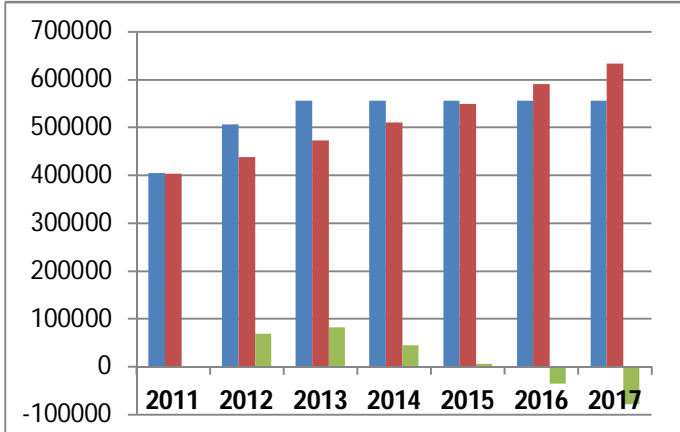
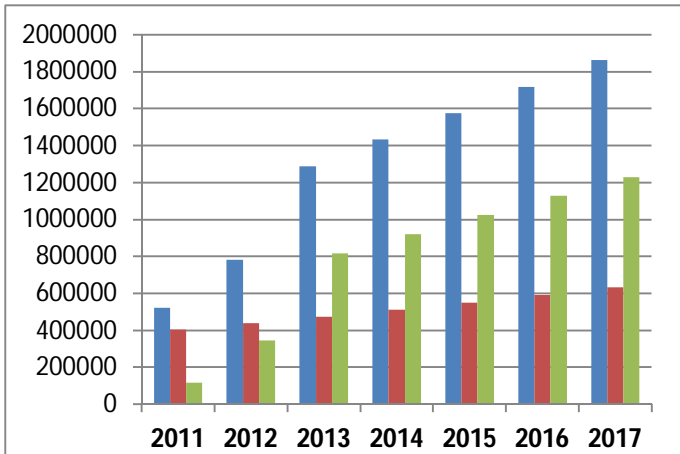
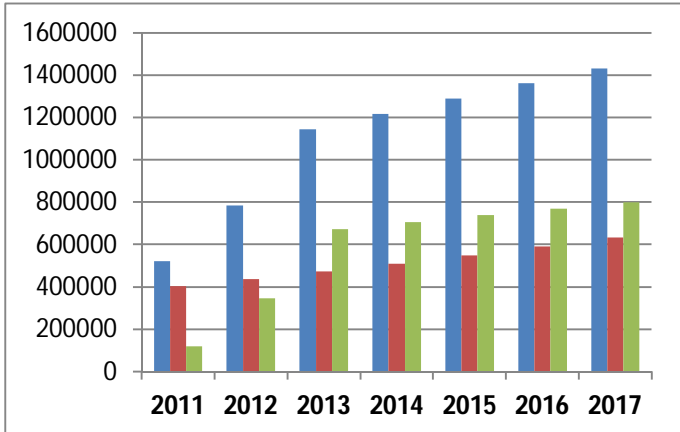
Strategic Axes	Activities	Lead Institutions	Expected Outputs	Indicators
and farm outputs	process			2.1.1.2. Productivity of priority crops doubled (base: 2010)
	2.2. Establish standards, grades and certification of process	RBS, MINAGRI	2.2.1. Quality of farm inputs are improved	2.2.1.1. Number of complaints of adulteration or fraudulence in input distribution
	2.3. Improve proximity extension services through integration of information and technology and capacity building	MINAGRI, RAB, MINALOC	2.3.1. Key information are passed to farmers through mobile technology 2.3.2. The proximity extension service personnel increased	2.3.1.1. Number of text messages sent to farmers 2.3.2.1. The ratio of proximity extension service reduced to 1:500 in consolidated land use areas
3. Prolonged exit and further diversification of input subsidies	3.1. Re-packing of subsidies by tying up various inputs	MINAGRI	3.1.1. Use of inputs such as pesticides and blue green algae improved	3.1.1.1. Adoption rate of pesticides increased by 3-fold
	3.2. Increase fertilizer affordability of farmers growing economically profitable crops such as rice through top-up schemes	MINAGRI	3.2.1. Use of fertilizers increased amongst smallholder farmers growing rice	3.2.1.1. Fertilizer use doubled in crops that are not directly covered under subsidy program
	3.3. Improve efficiency of subsidy programs by replacing vouchers with smart cards	MINAGRI	3.3.1. Operational constraints in issuing vouchers every season eliminated	3.3.1.1. Time and cost in preparing for the implementation of subsidy program halved
	3.4. Targeting subsidies to farmers who otherwise would not use inputs	MINAGRI	3.4.1. Resource-poor farmers benefited from the subsidy program	3.4.1.1. Credit volumes for availing subsidies increased by 50%
	3.5. Absorbing overhead costs of distributors/dealers with higher turnover	MINAGRI	3.5.1. Uses of improved inputs in remote areas increased	3.5.1.1. Adoption rate of improved seeds and fertilizers in wheat doubled
4. Strengthen smallholders' link to market for inputs and outputs	4.1. Energize cooperatives by enriching business skills and linkage with market entities	RAB, MINAGRI, MINALOC	4.1.1. Cooperatives are not limited by the availability of inputs and market for outputs	4.1.1.1. Number of cooperative-private entrepreneur ventures increased from zero to 30 (at least 1 per district)
	4.2. Facilitate services of financial sector to farmers and entrepreneurs	MINAGRI, RAB, Banks, FIs	4.2.1. Improved access to credit for smallholder farmers and entrepreneurs	4.2.1.1. Number of loans availed by farmers, cooperatives and entrepreneurs increased

Strategic Axes	Activities	Lead Institutions	Expected Outputs	Indicators
	along the value chain			by 10-fold
	4.3. Provide market information on availability, sourcing and prices of inputs and outputs through proximity and mobile extension services	MINAGRI	4.3.1. Knowledge on when and where to buy/sell inputs/produces are available to farmers	4.3.1.1. Number of agro input dealers increased from 49 to 300 (at least 10 per district) 4.3.1.2. On-farm yield gaps reduced to 20%
5. Minimize the losses in farm produces along the continuum of harvesting and storage points	5.1. Create awareness and provide technical guidance on harvesting, cleaning, drying, packing and storing of harvested farm produces through training	RAB, MINAGRI	5.1.1. Knowledge on harvest management practices for the targeted crop produces improved amongst smallholder farmers	5.1.1.1. Post harvest losses reduced from 40% to 5 %
	5.2. Forge partnerships between farmers/ Cooperatives and private entrepreneurs involved in the commodity chain	MINAGRI, MINALOC, MINICOM	5.2.1. Quality and competitiveness of farm produces improved	5.2.1.1. Profitability of smallholder farmer increased by 30% through savings in post harvest handling
	5.3. Establish linkage between food purchase program for strategic reserve and storage program	MINAGRI, MINECOFIN	5.3.1. Increased financial access to smallholder farmer by using storage as collateral	5.3.1.1. Participation of smallholder in storage facilities increased to 75%
6. Develop breadbaskets for the crops under intensification process	6.1. Establish the suitability of areas/zones based on soil, water and climatic conditions for the priority crops	RAB, MINAGRI	6.1.1. Zones with high potential of greater productivity levels identified for priority crops	6.1.1.1. At least 3 breadbaskets developed 6.1.1.2. On-farm yield gaps in breadbasket reduced to 10%
	6.2. Appraise the accessibility of zones to domestic and regional markets	RAB, MINAGRI	6.2.1. Distribution network of inputs and outputs developed	6.2.1.1. At least 10 agro dealers are active in the area
	6.3. Identify areas with higher population density amongst the potential areas	RAB, MINAGRI	6.3.1. Impact of breadbasket on local food value chain is maximized	6.3.1.1. Significant reductions (20-50%) in cost of reaching farmers with technological innovations

# Annexes

## Annex 1: Projections in production under different scenarios for the next 7 years

### 1.1. Maize

Scenarios <sup>30</sup>	Productivity	Remarks
<p><b>A</b></p> 	<p>1.94 t/Ha            In 2010:            148,000 Ha            By 2017:            286,413 Ha            1.94 t/Ha</p>	<p>Current trends in production suggest that there will be a surplus of about 50,000 t of maize by 2017, if the recent momentum continues through 2017</p>
<p><b>B</b></p> 	<p>@ 6.5 t/Ha            By 2017:            286,413 Ha            Surplus:            1,228,178 t</p>	<p>Requires;</p> <ul style="list-style-type: none"> <li>• Hybrids (80%)</li> <li>• Mechanization</li> <li>• Extensive Infrastructure</li> <li>• Fertilizers, Pesticides</li> </ul>
<p><b>C</b></p> 	<p>@5 t/Ha            By 2017:            286,413 Ha            Surplus:            798,560 t</p>	<p>Requires;</p> <ul style="list-style-type: none"> <li>• Hybrids (50%)</li> <li>• Fertilizers, Pesticides,</li> <li>• Storage</li> </ul> <p>✓ High Feasibility</p>

<sup>30</sup> Vertical axes show the production quantities in metric tons. Projections are made at current (A), extreme growth (B), and moderate growth (C) in rate of productivity levels through 2017.

■ Production, ■ Demand, ■ Deficit/Surplus



## 1.2. Wheat

Scenarios	Productivity	Remarks																																
<p><b>A</b></p> <table border="1"> <caption>Data for Scenario A</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>100,000</td><td>110,000</td><td>-10,000</td></tr> <tr><td>2012</td><td>100,000</td><td>120,000</td><td>-20,000</td></tr> <tr><td>2013</td><td>100,000</td><td>130,000</td><td>-30,000</td></tr> <tr><td>2014</td><td>100,000</td><td>140,000</td><td>-40,000</td></tr> <tr><td>2015</td><td>100,000</td><td>150,000</td><td>-50,000</td></tr> <tr><td>2016</td><td>100,000</td><td>160,000</td><td>-60,000</td></tr> <tr><td>2017</td><td>100,000</td><td>180,000</td><td>-80,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	100,000	110,000	-10,000	2012	100,000	120,000	-20,000	2013	100,000	130,000	-30,000	2014	100,000	140,000	-40,000	2015	100,000	150,000	-50,000	2016	100,000	160,000	-60,000	2017	100,000	180,000	-80,000	<p>@ 1.7 t/Ha By 2017: 62,862 Ha Deficit: -79,396 t</p>	<p>If the momentum continues, the consumption demand will be higher than the expected production by 2017</p>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	100,000	110,000	-10,000																															
2012	100,000	120,000	-20,000																															
2013	100,000	130,000	-30,000																															
2014	100,000	140,000	-40,000																															
2015	100,000	150,000	-50,000																															
2016	100,000	160,000	-60,000																															
2017	100,000	180,000	-80,000																															
<p><b>B</b></p> <table border="1"> <caption>Data for Scenario B</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>100,000</td><td>120,000</td><td>-10,000</td></tr> <tr><td>2012</td><td>150,000</td><td>130,000</td><td>20,000</td></tr> <tr><td>2013</td><td>200,000</td><td>140,000</td><td>60,000</td></tr> <tr><td>2014</td><td>220,000</td><td>150,000</td><td>70,000</td></tr> <tr><td>2015</td><td>250,000</td><td>160,000</td><td>90,000</td></tr> <tr><td>2016</td><td>280,000</td><td>170,000</td><td>110,000</td></tr> <tr><td>2017</td><td>320,000</td><td>190,000</td><td>130,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	100,000	120,000	-10,000	2012	150,000	130,000	20,000	2013	200,000	140,000	60,000	2014	220,000	150,000	70,000	2015	250,000	160,000	90,000	2016	280,000	170,000	110,000	2017	320,000	190,000	130,000	<p>@ 5 t/Ha By 2017: 62,862 Ha Surplus: 128,049 t</p>	<p>Requires;</p> <ul style="list-style-type: none"> <li>• Extensive expansion of areas</li> <li>• Extensive soil reclamation</li> <li>• Hybrids</li> <li>• Mechanization</li> </ul>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	100,000	120,000	-10,000																															
2012	150,000	130,000	20,000																															
2013	200,000	140,000	60,000																															
2014	220,000	150,000	70,000																															
2015	250,000	160,000	90,000																															
2016	280,000	170,000	110,000																															
2017	320,000	190,000	130,000																															
<p><b>C</b></p> <table border="1"> <caption>Data for Scenario C</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>100,000</td><td>120,000</td><td>-10,000</td></tr> <tr><td>2012</td><td>150,000</td><td>130,000</td><td>20,000</td></tr> <tr><td>2013</td><td>200,000</td><td>140,000</td><td>60,000</td></tr> <tr><td>2014</td><td>220,000</td><td>150,000</td><td>70,000</td></tr> <tr><td>2015</td><td>240,000</td><td>160,000</td><td>80,000</td></tr> <tr><td>2016</td><td>250,000</td><td>170,000</td><td>80,000</td></tr> <tr><td>2017</td><td>270,000</td><td>190,000</td><td>80,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	100,000	120,000	-10,000	2012	150,000	130,000	20,000	2013	200,000	140,000	60,000	2014	220,000	150,000	70,000	2015	240,000	160,000	80,000	2016	250,000	170,000	80,000	2017	270,000	190,000	80,000	<p>At 4 t/Ha; By 2017: 62,862 Ha Surplus: 80,902 t</p>	<p>Requires;</p> <ul style="list-style-type: none"> <li>• Moderate expansion of areas</li> <li>• Renewed Intensification</li> <li>• HYV, Triticale Varieties</li> <li>• Fertilizer, Irrigation</li> </ul> <p>✓ High Feasibility</p>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	100,000	120,000	-10,000																															
2012	150,000	130,000	20,000																															
2013	200,000	140,000	60,000																															
2014	220,000	150,000	70,000																															
2015	240,000	160,000	80,000																															
2016	250,000	170,000	80,000																															
2017	270,000	190,000	80,000																															

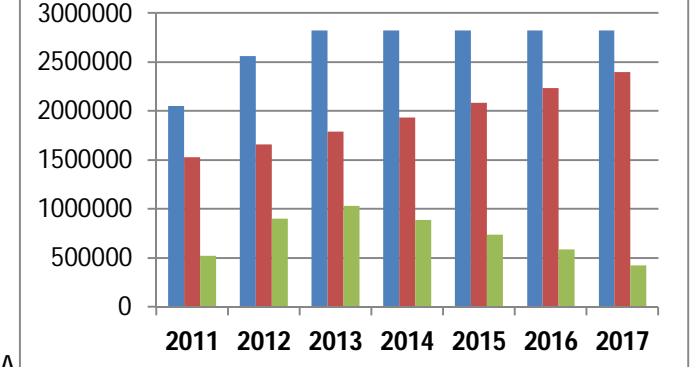
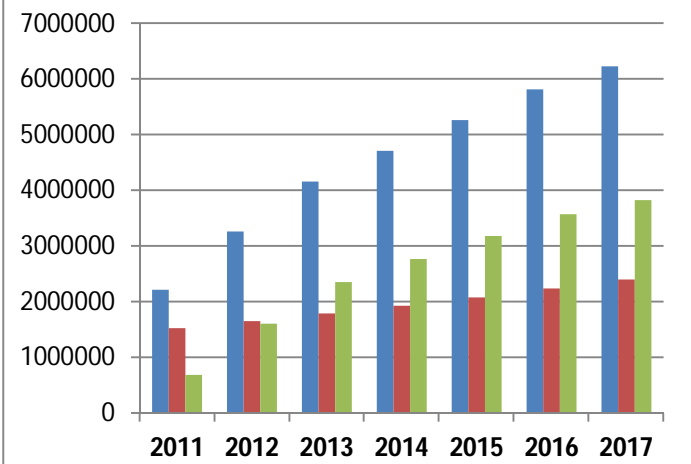
■ Production, ■ Demand, ■ Deficit/Surplus

### 1.3. Rice

Scenarios	Productivity	Remarks																																
<p>A</p> <table border="1"> <caption>Data for Scenario A</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>60,000</td><td>80,000</td><td>-20,000</td></tr> <tr><td>2012</td><td>60,000</td><td>85,000</td><td>-25,000</td></tr> <tr><td>2013</td><td>60,000</td><td>90,000</td><td>-30,000</td></tr> <tr><td>2014</td><td>60,000</td><td>95,000</td><td>-35,000</td></tr> <tr><td>2015</td><td>60,000</td><td>100,000</td><td>-40,000</td></tr> <tr><td>2016</td><td>60,000</td><td>105,000</td><td>-45,000</td></tr> <tr><td>2017</td><td>60,000</td><td>130,000</td><td>-66,109</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	60,000	80,000	-20,000	2012	60,000	85,000	-25,000	2013	60,000	90,000	-30,000	2014	60,000	95,000	-35,000	2015	60,000	100,000	-40,000	2016	60,000	105,000	-45,000	2017	60,000	130,000	-66,109	<p>By 2017: 20,000 Ha 4.1 t/Ha Deficit: -66,109 t</p>	<p>The consumption will continue to outstrip domestic production</p>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	60,000	80,000	-20,000																															
2012	60,000	85,000	-25,000																															
2013	60,000	90,000	-30,000																															
2014	60,000	95,000	-35,000																															
2015	60,000	100,000	-40,000																															
2016	60,000	105,000	-45,000																															
2017	60,000	130,000	-66,109																															
<p>B</p> <table border="1"> <caption>Data for Scenario B</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>75,000</td><td>80,000</td><td>-10,000</td></tr> <tr><td>2012</td><td>90,000</td><td>90,000</td><td>0</td></tr> <tr><td>2013</td><td>110,000</td><td>95,000</td><td>15,000</td></tr> <tr><td>2014</td><td>125,000</td><td>100,000</td><td>25,000</td></tr> <tr><td>2015</td><td>130,000</td><td>110,000</td><td>20,000</td></tr> <tr><td>2016</td><td>135,000</td><td>120,000</td><td>15,000</td></tr> <tr><td>2017</td><td>140,000</td><td>130,000</td><td>10,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	75,000	80,000	-10,000	2012	90,000	90,000	0	2013	110,000	95,000	15,000	2014	125,000	100,000	25,000	2015	130,000	110,000	20,000	2016	135,000	120,000	15,000	2017	140,000	130,000	10,000	<p>@ 6 t/Ha; By 2017: 20,000 Ha Surplus: 8,290 t</p>	<p>Requires;</p> <ul style="list-style-type: none"> <li>• Expansion of marshlands (reclamation)</li> <li>• Short duration varieties</li> <li>• Hybrids</li> <li>• Quality improvement</li> <li>• Self Sufficiency</li> <li>• Export of Premium rice</li> </ul> <p>✓ High Feasibility</p>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	75,000	80,000	-10,000																															
2012	90,000	90,000	0																															
2013	110,000	95,000	15,000																															
2014	125,000	100,000	25,000																															
2015	130,000	110,000	20,000																															
2016	135,000	120,000	15,000																															
2017	140,000	130,000	10,000																															
<p>C</p> <table border="1"> <caption>Data for Scenario C</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>65,000</td><td>80,000</td><td>-15,000</td></tr> <tr><td>2012</td><td>80,000</td><td>85,000</td><td>-5,000</td></tr> <tr><td>2013</td><td>95,000</td><td>90,000</td><td>5,000</td></tr> <tr><td>2014</td><td>100,000</td><td>100,000</td><td>0</td></tr> <tr><td>2015</td><td>105,000</td><td>110,000</td><td>-5,000</td></tr> <tr><td>2016</td><td>110,000</td><td>120,000</td><td>-10,000</td></tr> <tr><td>2017</td><td>115,000</td><td>130,000</td><td>-15,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	65,000	80,000	-15,000	2012	80,000	85,000	-5,000	2013	95,000	90,000	5,000	2014	100,000	100,000	0	2015	105,000	110,000	-5,000	2016	110,000	120,000	-10,000	2017	115,000	130,000	-15,000	<p>@ 7 t/Ha; By 2017: 20,000 Ha Deficit: -11,710 t</p>	<ul style="list-style-type: none"> <li>• Improved varieties</li> <li>• Pesticides, fertilizers</li> <li>• Quality improvement</li> </ul>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	65,000	80,000	-15,000																															
2012	80,000	85,000	-5,000																															
2013	95,000	90,000	5,000																															
2014	100,000	100,000	0																															
2015	105,000	110,000	-5,000																															
2016	110,000	120,000	-10,000																															
2017	115,000	130,000	-15,000																															

■ Production, ■ Demand, ■ Deficit/Surplus

### 1.4. Irish Potato

Scenarios	Productivity	Remarks																																
<p>A</p>  <table border="1"> <caption>Data for Scenario A</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>2,100,000</td><td>1,500,000</td><td>500,000</td></tr> <tr><td>2012</td><td>2,500,000</td><td>1,600,000</td><td>900,000</td></tr> <tr><td>2013</td><td>2,800,000</td><td>1,700,000</td><td>1,000,000</td></tr> <tr><td>2014</td><td>2,800,000</td><td>1,900,000</td><td>900,000</td></tr> <tr><td>2015</td><td>2,800,000</td><td>2,100,000</td><td>700,000</td></tr> <tr><td>2016</td><td>2,800,000</td><td>2,200,000</td><td>600,000</td></tr> <tr><td>2017</td><td>2,800,000</td><td>2,400,000</td><td>400,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	2,100,000	1,500,000	500,000	2012	2,500,000	1,600,000	900,000	2013	2,800,000	1,700,000	1,000,000	2014	2,800,000	1,900,000	900,000	2015	2,800,000	2,100,000	700,000	2016	2,800,000	2,200,000	600,000	2017	2,800,000	2,400,000	400,000	<p>@ 10.2 t/Ha By 2017: 277,145 Ha Surplus: 425,617 t</p>	<p>If the momentum continues, the country will continue to remain self-sufficient in Irish potato production in 2017</p>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	2,100,000	1,500,000	500,000																															
2012	2,500,000	1,600,000	900,000																															
2013	2,800,000	1,700,000	1,000,000																															
2014	2,800,000	1,900,000	900,000																															
2015	2,800,000	2,100,000	700,000																															
2016	2,800,000	2,200,000	600,000																															
2017	2,800,000	2,400,000	400,000																															
<p>B</p>  <table border="1"> <caption>Data for Scenario B</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>2,200,000</td><td>1,500,000</td><td>600,000</td></tr> <tr><td>2012</td><td>3,200,000</td><td>1,600,000</td><td>1,600,000</td></tr> <tr><td>2013</td><td>4,100,000</td><td>1,700,000</td><td>2,400,000</td></tr> <tr><td>2014</td><td>4,600,000</td><td>1,900,000</td><td>2,700,000</td></tr> <tr><td>2015</td><td>5,200,000</td><td>2,000,000</td><td>3,200,000</td></tr> <tr><td>2016</td><td>5,800,000</td><td>2,200,000</td><td>3,600,000</td></tr> <tr><td>2017</td><td>6,200,000</td><td>2,400,000</td><td>3,800,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	2,200,000	1,500,000	600,000	2012	3,200,000	1,600,000	1,600,000	2013	4,100,000	1,700,000	2,400,000	2014	4,600,000	1,900,000	2,700,000	2015	5,200,000	2,000,000	3,200,000	2016	5,800,000	2,200,000	3,600,000	2017	6,200,000	2,400,000	3,800,000	<p>@ 25 t/Ha; By 2017: 277,145 Ha Surplus: 3,834,502 t</p>	<ul style="list-style-type: none"> <li>• Improved varieties</li> <li>• Mechanization</li> <li>• Improved Marketing</li> </ul>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	2,200,000	1,500,000	600,000																															
2012	3,200,000	1,600,000	1,600,000																															
2013	4,100,000	1,700,000	2,400,000																															
2014	4,600,000	1,900,000	2,700,000																															
2015	5,200,000	2,000,000	3,200,000																															
2016	5,800,000	2,200,000	3,600,000																															
2017	6,200,000	2,400,000	3,800,000																															
<p>C</p>  <table border="1"> <caption>Data for Scenario C</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>2,200,000</td><td>1,500,000</td><td>600,000</td></tr> <tr><td>2012</td><td>3,100,000</td><td>1,600,000</td><td>1,500,000</td></tr> <tr><td>2013</td><td>3,800,000</td><td>1,700,000</td><td>2,100,000</td></tr> <tr><td>2014</td><td>4,200,000</td><td>1,900,000</td><td>2,300,000</td></tr> <tr><td>2015</td><td>4,600,000</td><td>2,000,000</td><td>2,600,000</td></tr> <tr><td>2016</td><td>4,900,000</td><td>2,200,000</td><td>2,700,000</td></tr> <tr><td>2017</td><td>5,000,000</td><td>2,400,000</td><td>2,600,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	2,200,000	1,500,000	600,000	2012	3,100,000	1,600,000	1,500,000	2013	3,800,000	1,700,000	2,100,000	2014	4,200,000	1,900,000	2,300,000	2015	4,600,000	2,000,000	2,600,000	2016	4,900,000	2,200,000	2,700,000	2017	5,000,000	2,400,000	2,600,000	<p>@ 15 t/Ha; By 2017: 277,145 Ha Surplus: 2,656,636 t</p>	<p>Requires;</p> <ul style="list-style-type: none"> <li>• Fertilizers, Pesticides</li> <li>• Storage, Transport</li> </ul> <p>✓ High Feasibility</p>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	2,200,000	1,500,000	600,000																															
2012	3,100,000	1,600,000	1,500,000																															
2013	3,800,000	1,700,000	2,100,000																															
2014	4,200,000	1,900,000	2,300,000																															
2015	4,600,000	2,000,000	2,600,000																															
2016	4,900,000	2,200,000	2,700,000																															
2017	5,000,000	2,400,000	2,600,000																															

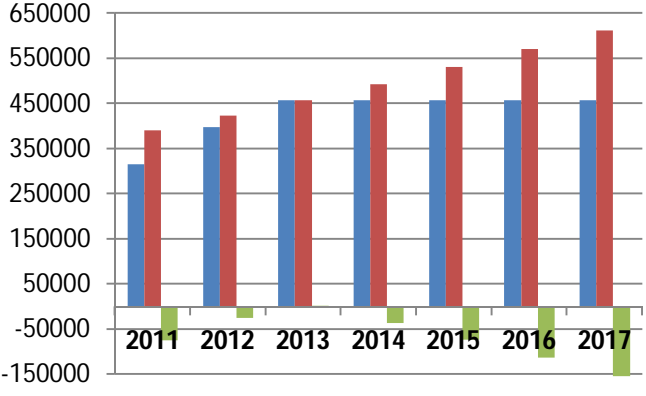
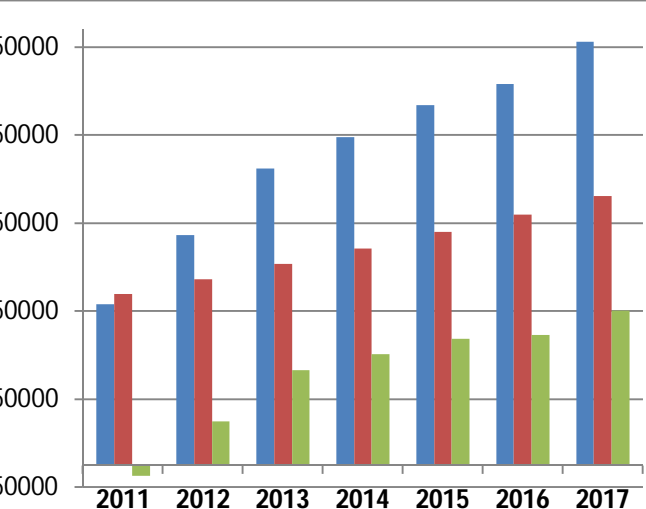
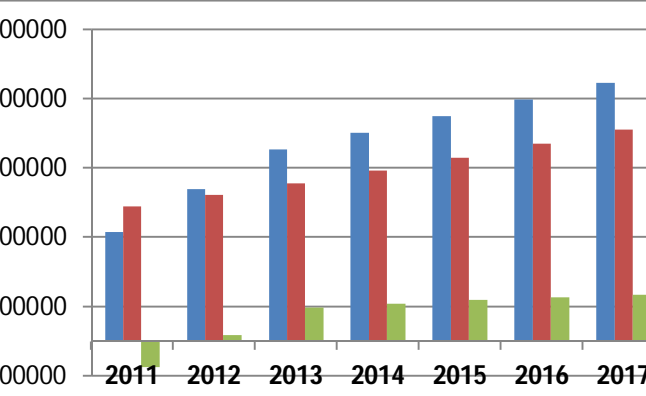
■ Production, ■ Demand, ■ Deficit/Surplus

### 1.5. Cassava

Scenarios	Productivity	Remarks																																
<p>A</p> <table border="1"> <caption>Data for Scenario A</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>2,200,000</td><td>2,300,000</td><td>-100,000</td></tr> <tr><td>2012</td><td>2,600,000</td><td>2,500,000</td><td>100,000</td></tr> <tr><td>2013</td><td>3,400,000</td><td>2,700,000</td><td>700,000</td></tr> <tr><td>2014</td><td>3,400,000</td><td>2,900,000</td><td>500,000</td></tr> <tr><td>2015</td><td>3,400,000</td><td>3,200,000</td><td>200,000</td></tr> <tr><td>2016</td><td>3,400,000</td><td>3,500,000</td><td>-100,000</td></tr> <tr><td>2017</td><td>3,400,000</td><td>3,600,000</td><td>-200,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	2,200,000	2,300,000	-100,000	2012	2,600,000	2,500,000	100,000	2013	3,400,000	2,700,000	700,000	2014	3,400,000	2,900,000	500,000	2015	3,400,000	3,200,000	200,000	2016	3,400,000	3,500,000	-100,000	2017	3,400,000	3,600,000	-200,000	<p>@ 11.17 t/Ha By 2017: 305,613 Ha Deficit: -349,689 t</p>	<p>If the momentum continues, the country will need to import Irish potato in 2017</p>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	2,200,000	2,300,000	-100,000																															
2012	2,600,000	2,500,000	100,000																															
2013	3,400,000	2,700,000	700,000																															
2014	3,400,000	2,900,000	500,000																															
2015	3,400,000	3,200,000	200,000																															
2016	3,400,000	3,500,000	-100,000																															
2017	3,400,000	3,600,000	-200,000																															
<p>B</p> <table border="1"> <caption>Data for Scenario B</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>2,500,000</td><td>2,400,000</td><td>100,000</td></tr> <tr><td>2012</td><td>3,100,000</td><td>2,600,000</td><td>500,000</td></tr> <tr><td>2013</td><td>4,200,000</td><td>2,800,000</td><td>1,400,000</td></tr> <tr><td>2014</td><td>4,400,000</td><td>3,000,000</td><td>1,400,000</td></tr> <tr><td>2015</td><td>4,700,000</td><td>3,300,000</td><td>1,400,000</td></tr> <tr><td>2016</td><td>4,900,000</td><td>3,500,000</td><td>1,400,000</td></tr> <tr><td>2017</td><td>5,000,000</td><td>3,800,000</td><td>1,200,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	2,500,000	2,400,000	100,000	2012	3,100,000	2,600,000	500,000	2013	4,200,000	2,800,000	1,400,000	2014	4,400,000	3,000,000	1,400,000	2015	4,700,000	3,300,000	1,400,000	2016	4,900,000	3,500,000	1,400,000	2017	5,000,000	3,800,000	1,200,000	<p>@ 20 t/Ha; By 2017: 305,613 Ha Surplus: 2,348,873 t</p>	<p>Requires;</p> <ul style="list-style-type: none"> <li>• Renewed Intensification</li> <li>• High yielding varieties</li> <li>• Fertilizers, Pesticides, Crop Management, Irrigation</li> </ul> <p>✓ High Feasibility</p>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	2,500,000	2,400,000	100,000																															
2012	3,100,000	2,600,000	500,000																															
2013	4,200,000	2,800,000	1,400,000																															
2014	4,400,000	3,000,000	1,400,000																															
2015	4,700,000	3,300,000	1,400,000																															
2016	4,900,000	3,500,000	1,400,000																															
2017	5,000,000	3,800,000	1,200,000																															
<p>C</p> <table border="1"> <caption>Data for Scenario C</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>2,500,000</td><td>2,400,000</td><td>100,000</td></tr> <tr><td>2012</td><td>3,200,000</td><td>2,600,000</td><td>600,000</td></tr> <tr><td>2013</td><td>4,600,000</td><td>2,800,000</td><td>1,800,000</td></tr> <tr><td>2014</td><td>5,200,000</td><td>3,000,000</td><td>2,200,000</td></tr> <tr><td>2015</td><td>5,500,000</td><td>3,300,000</td><td>2,200,000</td></tr> <tr><td>2016</td><td>5,800,000</td><td>3,500,000</td><td>2,300,000</td></tr> <tr><td>2017</td><td>6,100,000</td><td>3,800,000</td><td>2,300,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	2,500,000	2,400,000	100,000	2012	3,200,000	2,600,000	600,000	2013	4,600,000	2,800,000	1,800,000	2014	5,200,000	3,000,000	2,200,000	2015	5,500,000	3,300,000	2,200,000	2016	5,800,000	3,500,000	2,300,000	2017	6,100,000	3,800,000	2,300,000	<p>@ 15 t/Ha By 2017: 305,613 Ha Surplus: 1,355,631 t</p>	<p>Requires;</p> <ul style="list-style-type: none"> <li>• Fertilizers</li> <li>• Crop Management</li> <li>• Irrigation</li> </ul>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	2,500,000	2,400,000	100,000																															
2012	3,200,000	2,600,000	600,000																															
2013	4,600,000	2,800,000	1,800,000																															
2014	5,200,000	3,000,000	2,200,000																															
2015	5,500,000	3,300,000	2,200,000																															
2016	5,800,000	3,500,000	2,300,000																															
2017	6,100,000	3,800,000	2,300,000																															

■ Production, ■ Demand, ■ Deficit/Surplus

### 1.6. Beans

Scenarios	Productivity	Remarks																																
<p>A</p>  <table border="1"> <caption>Data for Scenario A</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>400,000</td><td>380,000</td><td>-20,000</td></tr> <tr><td>2012</td><td>400,000</td><td>420,000</td><td>-20,000</td></tr> <tr><td>2013</td><td>400,000</td><td>450,000</td><td>-50,000</td></tr> <tr><td>2014</td><td>400,000</td><td>480,000</td><td>-80,000</td></tr> <tr><td>2015</td><td>400,000</td><td>520,000</td><td>-120,000</td></tr> <tr><td>2016</td><td>400,000</td><td>550,000</td><td>-150,000</td></tr> <tr><td>2017</td><td>400,000</td><td>600,000</td><td>-200,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	400,000	380,000	-20,000	2012	400,000	420,000	-20,000	2013	400,000	450,000	-50,000	2014	400,000	480,000	-80,000	2015	400,000	520,000	-120,000	2016	400,000	550,000	-150,000	2017	400,000	600,000	-200,000	<p>0.95 t/Ha By 2017: 481,403 Ha Deficit: -154,408 t</p>	<p>If the momentum continues at the current pace through 2017, the country will need to import beans to meet the local demand</p>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	400,000	380,000	-20,000																															
2012	400,000	420,000	-20,000																															
2013	400,000	450,000	-50,000																															
2014	400,000	480,000	-80,000																															
2015	400,000	520,000	-120,000																															
2016	400,000	550,000	-150,000																															
2017	400,000	600,000	-200,000																															
<p>B</p>  <table border="1"> <caption>Data for Scenario B</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>350,000</td><td>380,000</td><td>-20,000</td></tr> <tr><td>2012</td><td>450,000</td><td>420,000</td><td>30,000</td></tr> <tr><td>2013</td><td>650,000</td><td>450,000</td><td>200,000</td></tr> <tr><td>2014</td><td>750,000</td><td>480,000</td><td>270,000</td></tr> <tr><td>2015</td><td>850,000</td><td>520,000</td><td>330,000</td></tr> <tr><td>2016</td><td>900,000</td><td>550,000</td><td>350,000</td></tr> <tr><td>2017</td><td>950,000</td><td>580,000</td><td>370,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	350,000	380,000	-20,000	2012	450,000	420,000	30,000	2013	650,000	450,000	200,000	2014	750,000	480,000	270,000	2015	850,000	520,000	330,000	2016	900,000	550,000	350,000	2017	950,000	580,000	370,000	<p>@ 2.0 t/Ha By 2017: 481,403 Ha Surplus: 351,065 t</p>	<p>Requires;</p> <ul style="list-style-type: none"> <li>• Renewed Intensification</li> <li>• Improved varieties</li> <li>• Pesticides, Fertilizers</li> <li>• Storage</li> </ul> <p>✓ High Feasibility</p>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	350,000	380,000	-20,000																															
2012	450,000	420,000	30,000																															
2013	650,000	450,000	200,000																															
2014	750,000	480,000	270,000																															
2015	850,000	520,000	330,000																															
2016	900,000	550,000	350,000																															
2017	950,000	580,000	370,000																															
<p>C</p>  <table border="1"> <caption>Data for Scenario C</caption> <thead> <tr> <th>Year</th> <th>Production (t)</th> <th>Demand (t)</th> <th>Deficit/Surplus (t)</th> </tr> </thead> <tbody> <tr><td>2011</td><td>300,000</td><td>380,000</td><td>-20,000</td></tr> <tr><td>2012</td><td>400,000</td><td>420,000</td><td>-20,000</td></tr> <tr><td>2013</td><td>500,000</td><td>450,000</td><td>50,000</td></tr> <tr><td>2014</td><td>600,000</td><td>480,000</td><td>120,000</td></tr> <tr><td>2015</td><td>650,000</td><td>520,000</td><td>130,000</td></tr> <tr><td>2016</td><td>700,000</td><td>550,000</td><td>150,000</td></tr> <tr><td>2017</td><td>750,000</td><td>600,000</td><td>150,000</td></tr> </tbody> </table>	Year	Production (t)	Demand (t)	Deficit/Surplus (t)	2011	300,000	380,000	-20,000	2012	400,000	420,000	-20,000	2013	500,000	450,000	50,000	2014	600,000	480,000	120,000	2015	650,000	520,000	130,000	2016	700,000	550,000	150,000	2017	750,000	600,000	150,000	<p>@ 1.6 t/Ha By 2017: 481,403 Ha</p>	<p>Stability and Self-sufficiency</p> <p>Requires;</p> <ul style="list-style-type: none"> <li>• High yielding varieties</li> <li>• Fertilizers</li> </ul>
Year	Production (t)	Demand (t)	Deficit/Surplus (t)																															
2011	300,000	380,000	-20,000																															
2012	400,000	420,000	-20,000																															
2013	500,000	450,000	50,000																															
2014	600,000	480,000	120,000																															
2015	650,000	520,000	130,000																															
2016	700,000	550,000	150,000																															
2017	750,000	600,000	150,000																															

■ Production, ■ Demand, ■ Deficit/Surplus