Intensification of smallholder agriculture in Rwanda: scenarios and challenges towards a sustainable transformation

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Abstract

This paper clarifies the path that Rwanda took in the quest for a modern, intensive, productive and market-oriented agriculture. The facts presented here have been collected by means of documentation that led to the review of different publications including published papers and government and development partners' reports. The paper shows that an adequate policy and institutional environment has been created by various socio-economic, institutional and agriculture-led reforms launched since the early 2000s. The literature review reveals that impressive results have been recorded in regard to smallholder agriculture intensification. In addition, the theoretical model for progressive smallholder agriculture transformation helped to show that most of the smallholders grouped in cooperatives are at the 'semi-commercial smallholders' stage while only a few are at the 'commercial smallholders' and 'advanced farmers' stages. This study also examines various challenges that hamper the sustainable intensification of smallholder agriculture at both institutional, community and smallholder level. It suggests some policy actions to be put forward by the government and other agriculture sector development partners to address those challenges.

Keywords: *smallholder agriculture, sustainable intensification, policy, institution, Rwanda.*

1. Introduction

Over the past years, Rwanda has achieved an outstanding progress in economic growth and poverty reduction rooted in various policy and institutional changes which marked the after 1994 genocide period. The contribution of agriculture sector in this remarkable economic development is not negligible as the whole economy depends largely on it. The sector continues to be the leading employer and the basis of daily livelihoods for the majority of the country's population, more than 80%, living in rural areas and holding subsistence small-scale farms with an average land size of 0.59 ha (MINAGRI, 2013:4). With these country's basic characteristics, it is clear that there is need of a policy and institutional framework fostering novel ways to boost agricultural production, and to address the issue of food insecurity for its growing population.

The issue of feeding the growing population in a convenient way is a global challenge but it is more threatening in developing countries where the level of food insecurity and poverty is high. This implies that focusing on agriculture is a must if economic growth, poverty reduction and food security issues have to be dealt with expeditiously. Therefore, it is

necessary to find out the best way to develop agriculture sector. It is in this regard that since 2007, Rwanda has embarked on intensifying its smallholder agriculture in the form of 'Crop Intensification Program (CIP)'. This was done with an aim of boosting agricultural productivity through an improvement of productive inputs use, irrigation coverage and soil quality (Cantore, 2011:2).

However, notwithstanding what has been being done in increasing the production and ensuring food security for the population, Alinda and Abbott (2012:7) affirm that farm production is still characterized by lower-than-average farm sizes coupled with deteriorating soil fertility, which poses severe challenges to increasing crop production. In addition, a study by Cantore (2011:21) reports that the crop intensification pursued in Rwanda is not economically and ecologically sustainable, confirming then the assertion by Reardon *et al.* (1999:375) that many African farmers are intensifying in ways that are economically or ecologically unsustainable.

In view of the above situation, the following concerns arise: At what extent, the policy and institutional environment of Rwanda is fostering the smallholder agriculture transformation? What are the challenges faced by farmers, policy makers and other stakeholders in intensifying Rwandan smallholder agriculture in a sustainable way? Therefore, this study seeks to analyze the policy and institutional environment of Rwanda vis-à-vis the smallholder agriculture transformation, and examines various challenges handicapping the implementation of sustainable smallholder intensification related programmes at institutional, community and small-scale farmer level.

The literature search was undertaken first by reviewing literature in databases of peer-reviewed scientific publications using the following key words: smallholder agriculture, sustainable intensification, policy, institution, agricultural transformation, Rwanda. On the other hand, books and other official publications dealing with the subject were consulted.

2. Concept of sustainable smallholder agriculture intensification

2.1 Sustainable agriculture

Sustainability is a word emanating from different schools of thought with a series of interpretations and meanings. These various meanings of the term 'sustainability' as applied in agriculture have been classified according to the issues motivating concern, their historical and ideological roots (Hansen, 1996:119). This leads to the fact that the definition of sustainability becomes part of the problem due to lack of common agreement on how to define it as any attempt to a precise definition is flawed (Pretty, 1994:39). Consequently, sustainability is not a scientific concept which can be measured according to some objective scale, or a set of practices to be fixed in time and space (Röling and Pretty, 1998:222), but a quality that results from people's application of their intelligence to maintain the long-term productivity of the natural resources on which they depend (Sriskandarajah *et al.* 1991:2). This implies that reaching the goal of the sustainability of a given system is the responsibility of all participants in the system. These include, in agriculture sector, producers, products'

traders, policymakers and agricultural development stakeholders with their respective role to play to sustain the sector.

A report by the African Development Bank (AfDB) attempts to give the meaning of sustainable agriculture. AfDB (2013:9) defines it as "*an integrated system of plant and animal production practices having a site-specific application that over the long term will: satisfy human food and fibre needs; enhance environmental quality and the natural resource base upon which the agricultural economy depends; make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls; sustain the economic viability of farm operations; enhance the quality of life for farmers and society as a whole.*" In brief, sustainable agriculture is not a simple model or package to be imposed but a process of learning and adaptation (Pretty, 1995:1249) that considers together the environment, economic and social dimensions.

2.2 Agricultural intensification and sustainable smallholder agriculture intensification

According to Pretty *et al.* (2011:7), agricultural intensification is a concept that has a traditional definition articulated in three different ways: increasing yields per hectare, increasing cropping intensity per unit of land or other inputs (water), and changing land use from low value crops or commodities to those that receive higher market prices. This concept has been of a wide use since the need to increase agricultural production was evidenced around the world. Although intensifying agriculture is seen as a solution to meet the liberalization requirements and the country's food growing demand, authors argue that it is a constraining approach especially in many African countries where, according to Snyder and Cullen (2014:9), smallholders are living and exercising under considerable pressure. This view is not fully shared by other authors who affirm that intensification of agricultural production is one of the strategic pillars for agricultural and economic growth in Sub-Saharan Africa (NEPAD, 2003:24), and a must in the more densely populated areas in order to feed the rapidly growing and urbanizing population (Vanlauwe *et al.*, 2014:16). In support of this idea, it can be argued that for small-scale farmers with limited access to formal financial services, improved agricultural technologies, and high-yield seeds and other inputs, agricultural intensification appears as an alternative solution with regard to food needs experienced indifferent regions of Africa.

With regard to 'sustainable intensification', like sustainable agriculture, it does not have a very clear definition. Garnett and Godfray (2012:8) understand the concept as a form of production wherein yields are increased without adverse environmental impact and without the cultivation of more land. In agriculture, sustainable intensification has been put forward as a means to simultaneously address the goal of enhancing agricultural production while conserving and protecting the environment (Petersen and Snapp, 2015:1). Though it is criticized for its use and lack of common and clear definition (for example, Zhou, 2010:1 and Garnett and Godfray, 2012:8), this concept received increasing attention and has been widely used by many development and government agencies as a necessary approach to food production and to address high food demand (Petersen and Snapp, 2015:2). Moreover, it

denotes a commonly accepted framework where intensification is desirable (Vanlauwe *et al.*, 2014:16).

As 'sustainable agricultural intensification' is regarded to address the food security needs (Garnett *et al.*, 2013:1), the issue of smallholder agriculture has to have its meaning and place here for its great role in feeding the population especially in developing countries. Indeed, in these countries where agriculture is characterized by small-scale farms, challenges like continuing population and economic growth in the face of scarcities of agricultural land and water and the dangers posed by climate change, agricultural pollution and biodiversity loss (Buckwell *et al.*, 2014:6) are also experienced. Therefore, there is need to intensify in a sustainable way the smallholder agriculture as it is regarded (not only for now but even in the future) as the main source of food for both rural and urban residents. Moreover, in poor and labour-abundant economies, small farm development can be a "win-win" proposition for growth and poverty reduction (Hazell, 2013:2), and based on their immense collective experience and intimate knowledge of local conditions, smallholders hold many of the practical solutions that can help place agriculture on a more sustainable and equitable footing (IFAD, 2013:7).

3. Rationale of sustainable smallholder agriculture intensification in Rwanda

Pretty *et al.* (2011:7) contend that continued population growth, rapidly changing consumption patterns, and the impacts of climate change and environmental degradation observed around the world are driving the limited resources of food, energy, water and materials towards critical thresholds. This reality is likely to be substantial in Rwanda, one of the most densely populated countries in Africa with 416 inhabitant per square kilometer and an average annual population growth of 2.6% (NISR, 2012b:6). Rwandan agriculture is characterized by the limited use of fertilizers, the low use of improved seeds and other inputs, and the high risk of erosion with 90% of domestic cropland on slopes ranging from 5% to 55% (MINAGRI, 2013:13). Food insecurity is another issue experienced by rural population as evidenced by the study conducted by NISR (2012a:2) which reveals that, in 2012, more than half (51%) of all households reported some type of difficulty in accessing food and 14% of households experienced usual and almost year round chronic difficulties in accessing food for their families. Such a situation insinuates that dealing with food insecurity in Rwanda remains one of the top priorities. Therefore, the development of agriculture too continues to be an outstanding requirement. In the medium term, the goal is to move Rwandan agriculture from a largely subsistence sector to a more knowledge-intensive, market-oriented sector, sustaining growth and adding value to products (MINAGRI, 2013:4). As stressed by Cantore (2011:2), improving agricultural productivity and preventing food insecurity in Rwanda will rely on incorporating environmental sustainability interventions into the planning process to ensure investments are adequately allocated to address environmental priorities within the relevant sectors. Therefore, Rwanda needs an intensive and sustainable smallholder agriculture that optimizes environmental management and natural resources use, ensure food security for all the population and generate increased agricultural output and income for farmers.

4. Policy and institutional environment and smallholder agriculture transformation in Rwanda

Given the hallmark of smallholder agriculture worldwide, it is clear that it cannot be effectively transformed into a more productive, vibrant and market-led sector which ensures food security and income earning for farmers unless policy and institutional arrangements targeting smallholders and innovating their way of operating are put in place. In this line, the following sections examine various adopted agriculture-led reforms and undertaken policy actions since early 2000s to understand whether they are fostering or not the smallholder transformation in Rwanda.

4.1 Policy reforms and good governance for smallholder agriculture transformation

4.1.1 Agriculture-led policy initiatives and smallholder agriculture transformation

In Rwanda, towards transforming its primary sector, a main thrust of government strategies is to promote agricultural development that puts an emphasis on small-scale farmers as they constitute the majority of agriculture sector producers. Mindful of the role of agriculture sector in alleviating poverty and enhancing the livelihoods of the population, on one hand, and aiming at the development of this sector on the other, the government of Rwanda launched in 2005 a new national agricultural policy that has been followed by three five-year strategic plans for agricultural transformation (SPAT) adopted respectively in 2005, 2009 and 2014. The National Agricultural Extension Strategy and the National Post-Harvest Staple Crop Strategy were also adopted in 2009 and 2011 respectively. These strategies were aiming at ensuring food security trough an efficient post-harvest system (MINAGRI, 2011:1), and ideal conditions for dissemination and exchange of information between producers, farmer organizations and other partners to transform and modernize the agricultural sector (MINAGRI, 2009:2).

The various adopted agriculture-led initiatives are largely based on guidelines set by the long-term strategy called 'Vision 2020', and two economic development and poverty reduction strategies adopted respectively in 2008 and 2013. According to MINECOFIN (2002:3), this long-term strategy aims at transforming Rwanda's economy into a middle income country with a per capita income of about 900 USD per year (from 290 USD in 2000) requiring an estimated annual growth rate of at least 7%. As stressed in this long-term vision, the transformation of agriculture from subsistence farming to market oriented and modern farming remains fundamental for achieving this growth. The vision further 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.

The CIP launched by the Rwandan government in August 2007 is seen as an attempted solution to the issue of low productivity and smallholder agriculture transformation. This programme aims at increasing the production of food crops across the country by focusing on six priority crops namely maize, wheat, rice, irish potato, beans and cassava. It uses 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 (Kathiresan, 2011:13).

Besides the above mentioned policy reforms, strategies and programmes, the land reform initiated in Rwanda with the National Land Policy adopted in 2004 and the Organic Land Law introduced in 2005and revised in 2013 is another institutional innovation towards smallholder agriculture transformation. It gave an opening to other important policy initiatives such as the 'land use consolidation policy' implemented as part of the CIP. This policy is in line with the government will to mitigate poverty and hunger, and involves successfully rearranged land parcels to consolidate the use of farm holdings. Although this approach is criticized by some authors who contest its beneficial effects for small-scale farmers and equity in the society (see for example Huggins, 2009:302 and Pottier, 2006:509), it is regarded as one solution to the pervasive low productivity and scarcity of arable land in Rwanda. Indeed, its economic rationale has been acknowledged in many developing countries where it has been enacted (Bizoza and Havugimana, 2013:65), and particularly in Rwanda, a positive experience has been recorded especially in terms of increasing inputs accessibility and land and crop productivity, improving household food security and reducing the number of people living in hunger and poverty (Katherisan (2011:17).

4.1.2 Role of governance in small-scale farming development and poverty reduction

The role of governance need to be mentioned as it has a strong impact on all initiated initiatives. Governance is needed in agriculture as it involves institutions decentralization, and helps to sustain agriculture development through promoting accountability, adequate implementation of all conceptualized programmes. According to World Bank (2008:18), adequate governance along with a favorable sociopolitical climate and sound macroeconomic fundamentals constitutes the starting point for making agriculture more effective in supporting sustainable growth and reducing poverty. In contrast, "*weak governance within and between the state, the private sector and local communities results in bad policy or bad policy implementation, which in turn affects peoples' lives and the health of the natural resources borrowed from future generations of farmers*" (Vorley,2002:15).

The basic assumption is that good governance is central to the development process, and that it needs state capability, responsiveness and accountability as prerequisites (UNDP, 2011:3). It is recognized that devolution of power, authority and resources plays a vital role on the fight against poverty, and through the decentralization policy, people at the grass-root are empowered to identify their needs and seek their satisfaction under the leadership of elected local authorities (MINALOC, 2002:18).

In Rwanda, since the year 2000, the government has set up a conceptual framework fostering good governance for poverty reduction resulting in the implementation of its decentralization policy. It acknowledges that good governance and poverty reduction are two linked concepts and that are not independent from one another, and believes that the country's institutions of governance exert primordial influence over the society's stability, prosperity and the wellbeing of its citizens (MINALOC, 2002:18). The National Strategy Framework Paper on

‘Strengthening Good Governance for Poverty Reduction in Rwanda', stresses that "*Sustainable poverty reduction strategy can only be achieved in a context of good governance. In turn, poverty is a constraint to the existence and even sustained good governance. Good governance will facilitate participation and therefore empower citizens to utilize their resources more efficiently"* (MINALOC, 2002:18). Therefore, given that an adequate institutional and political environment is required to sustain the undertaken process of smallholder transformation in Rwanda, the good governance and institutions decentralization currently observed in the country need to be enhanced and sustained to allow farmers, private sector and other agricultural development partners to play adequately their respective roles in transforming the primary sector.

4.2 Agricultural cooperatives, an institutional vehicle for small-scale farming transformation

As highlighted in previous sections, agriculture-led strategies, policies and programmes implemented in Rwanda focus on intensification of the predominant small-scale farms, and, farmer cooperatives are seen as an important institution to achieve this. Therefore, it is worth noting the role of farmer cooperatives in developing smallholder agriculture and improving its performance. According to Vuthy *et al.* (2014:1), the main idea behind the establishment of farmer organizations is to provide effective and collective support services to smallholders, thus loosening the major obstacles to productivity improvement, and to enhance self-help and collective power to regulate markets. These institutions help farmers to secure their land rights, enhance their bargaining power with external buyers, reduce transaction costs, benefit from community-shared infrastructure (warehouses, drying infrastructure,…), negotiate in better conditions their contracts and obtain agricultural inputs at better prices (FAO, 2012:2).

The government of Rwanda, through its Policy for the Development and Promotion of Cooperatives adopted in 2006, sees these institutions as a means of empowering small-scale farmers as they help in assisting them technically and financially, and thus strengthening their capacity. In Rwanda, all smallholders have been encouraged to be grouped into cooperatives to get support from government agencies, private sector and NGOs. It is rare (even impossible) to find a single small-scale farmer who got any kind of assistance from public or private stakeholders. All kind of assistance to smallholders is channeled through their respective organizations.

4.3 Policy and institutional framework and smallholder transformation

The realization of the smallholder farming transformation in Rwanda is made through a policy and institutional framework that requires the combined efforts of different stakeholders (Figure 1). In this regard, the major guidelines are summarized in the national socio-economic policy document. They are in turn detailed in sectoral policies, strategies and programmes tracing priority actions to be implemented.

Actions described in various policies and strategies are concretized locally by the Research and Higher Learning Institutions (R&HLIs), agriculture-led implementing institutions

(Rwanda Agriculture Board (RAB) and National Agricultural Export Development Board (NAEB)), NGOs, the private sector, decentralized administrative institutions (districts and sectors) and financial institutions. The latter support both farmers grouped in cooperatives, input suppliers, extension services providers, programmes implementers, and agricultural research and development institutions.

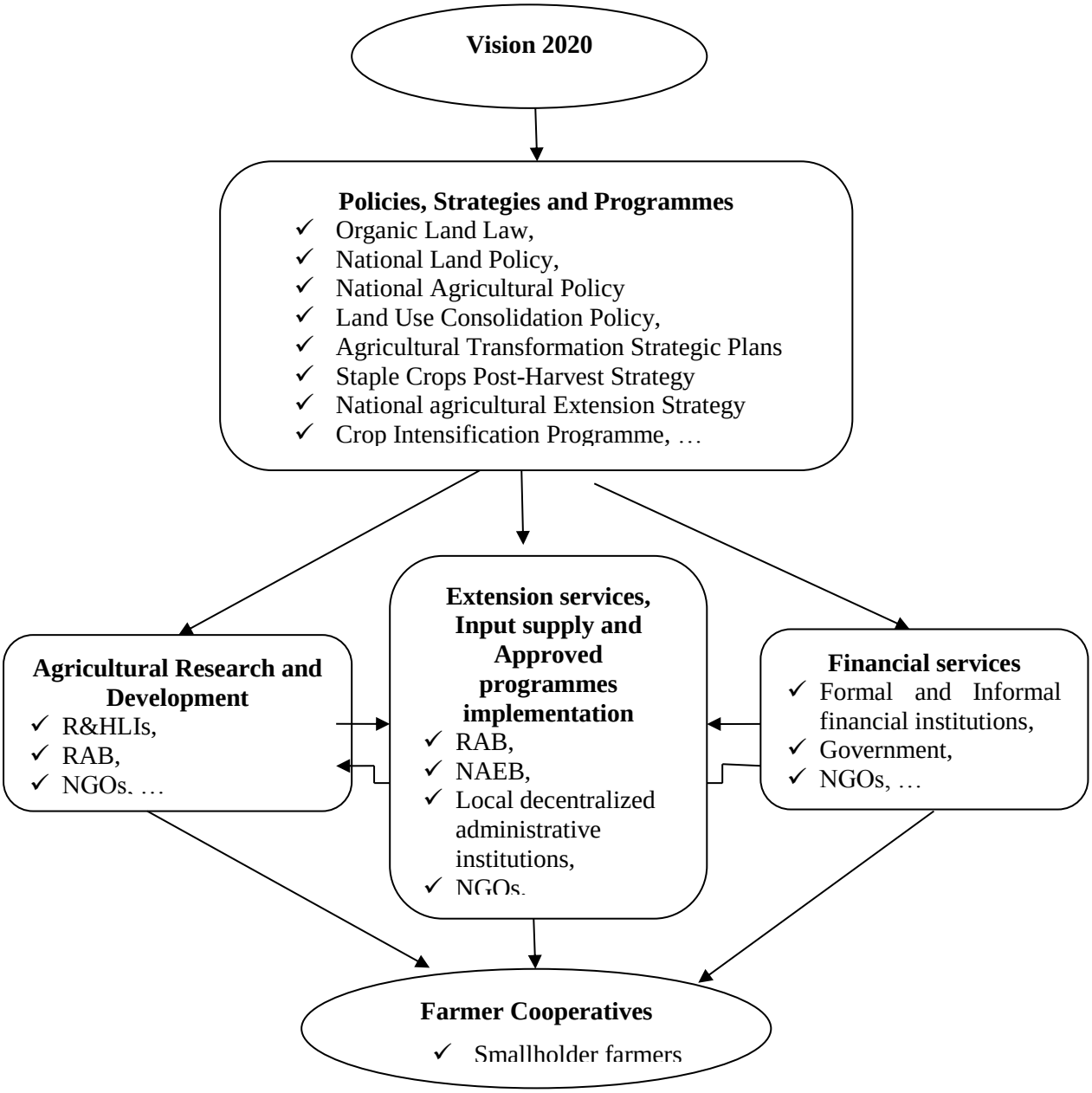

Figure 1: Policy and institutional framework for the transformation of smallholder agriculture in Rwanda

Source: Authors' own design

Services provided to farmer cooperatives by various stakeholders include the distribution of improved seeds, mineral fertilizers, and pesticides, formal or informal rural credit related services, extension services, dissemination of research results through organized workshops.

The figure below illustrates the policy and institutional framework for the transformation of smallholder agriculture in Rwanda.

4.4 Theoretical model for progressive smallholder agriculture transformation

Zhou (2010:4) presents a theoretical model of progressive development from subsistence smallholder agriculture to a market oriented agriculture which generates income for farmers (Figure 2). This model presents the progress trajectory for a smallholder farming and states that it goes together with the increase of farmers' capability and the improvement of their conditions. The very same author notes that basic conditions of smallholders are enhanced by the access to technology and knowledge considered as the key factors driving the progression towards successively more professional inputs and technologies as capability expands. The following figure indicates the additive stages of smallholder agriculture transformation.

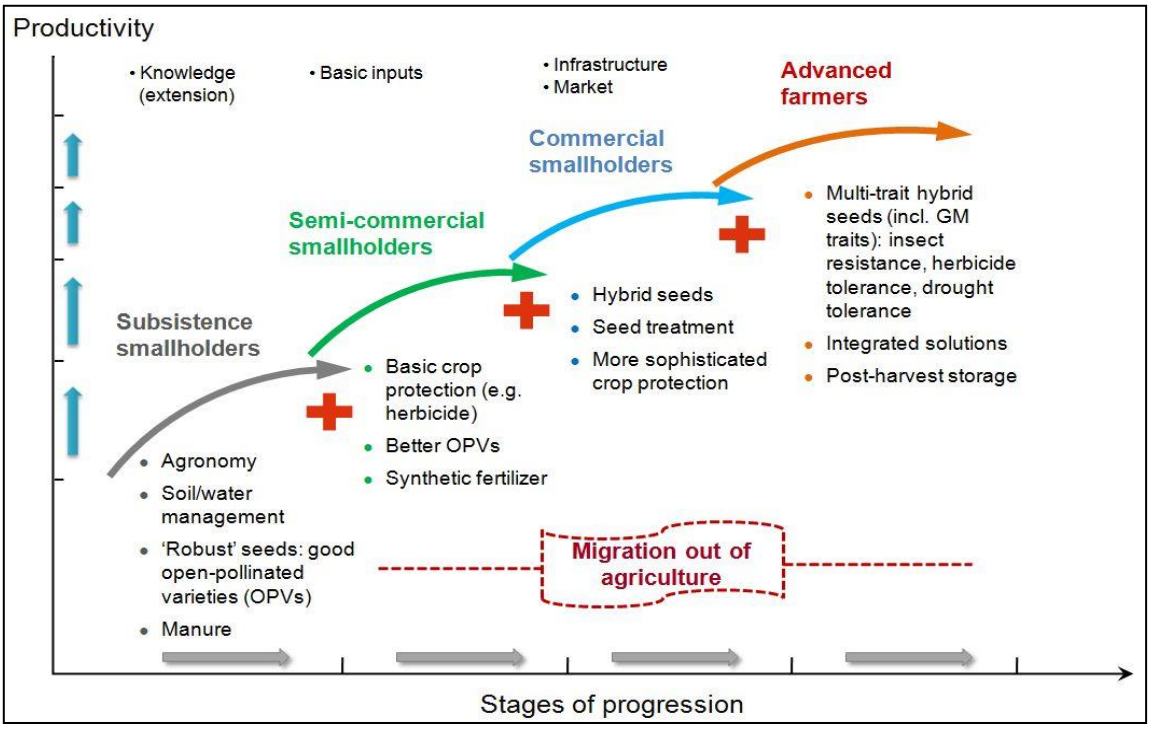

Figure 2: Additive stages of smallholder agriculture transformation

Source: Zhou (2010:4)

The journey to the stage of advanced farmers characterized by the use of post-harvest facilities, the adoption of integrated innovations and technologies passes through different 'additive' (because improvements are added to the basics) stages of agricultural intensification, namely subsistence smallholders, semi-commercial smallholders, commercial smallholders and advanced farmers. If farmers fail to comply with ongoing changes, they will remain at the previous level while others progress along the stages. This demonstrates the key role of the farmer in the process of agricultural transformation. While institutions are requested to avail all needed technologies and services, the farmer needs to adopt and apply them appropriately to reach expected results.

In Rwanda, based on the above mentioned model, it is remarkable that most of the smallholders grouped in cooperatives are at the 'semi-commercial smallholders' stage as now. They are using basic subsidized inputs (hybrid and open pollinated varieties seeds, and mineral fertilizer), and pesticides for basic crop protection. Although the use of hybrid seeds, seed treatments actions, sophisticated crop production mechanisms, integrated solutions and post-harvest storage is observable, the stages of 'commercial smallholders' and 'advanced famers' are not at all mainly characterizing the undertaken smallholder agriculture transformation. These are largely applied only in few private commercial and transformation oriented farms and in some farmer cooperatives by few farmers with a certain level of income. Note that the control over the use of inputs and the application of farming guidelines is not done with rigour because every farmer is free to operate as per his financial means with a requirement of growing the same recommended crop by authorities.

5. Recent developments and success stories

5.1 Soil conservation, irrigation and farmers empowerment

With CIP, land husbandry and soil fertility techniques have been promoted. An increase of 37.4% for radical terraces and 52.3% for progressive terraces is recorded between 2013 and 2015. As of end June 2015, the established soil conservation infrastructure was 122,319.5 ha of radical terraces and 902,844 ha of progressive terraces, and additional 2,272 ha of marshland and 903 ha of hillside were developed and equipped with irrigation infrastructure (GoR, 2015:23). Farmers' capacity has been strengthened through easy access to inputs, extension services and finance through agricultural cooperatives, and proximity advisory services to farmers with the promotion of the use of Twigire Extension model. This model, applied in farmer field schools (FFS) implemented for the first time in 2009, allowed establishing 59,453 farmer groups composed of 1,013,782 farmers countrywide (GoR, 2015:23).

5.2 Inputs use and subsidies

Since the implementation of CIP in 2007, inputs use by smallholders increased markedly. Estimates suggest that the national average fertilizer use per year has increased from 8 Kg/Ha to 23 Kg/Ha in 2010 (Kathiresan, 2011:14). To encourage their widespread use by grouped farmers, inputs subsidies have been introduced, and subsidies to distributed inputs range between 15% and 35% for mineral fertilizers and between 50% and 80% for improved seeds.

5.3 Cropped areas, yield and production

Under CIP, the cultivated area has increased from 28,788 hectares in 2007 to 254,000 hectares in 2010 (Kathiresan, 2011:15). Since 2011, rice yields have improved and passed from 3 to 6.3 tons per hectare; potato yields from 17 to nearly 20 tons/hectare; and maize yields from 1.6 to nearly 5 tons per hectare (Nkurunziza, 2015:118). In 2013, a growth of 5.5% has been recorded for agriculture sector, resulting from the increase in food crop production of 5.4% and export crops of 27.8% (GoR, 2013:27).

5.4 Poverty and food security patterns, job creation and farm income

Recent estimates reveal that the government objective of improving household food security and reducing the poverty level has been attained. For the average calorie availability for the population, estimates show an increase from around 1800kcal/person/day in 2004 to over 2500kcal/person/day in 2010, exceeding World Health Organization health guidelines (Willoughby and Forsythe, 2011:11). As for poverty and extreme poverty levels, a study by NISR (2015:21) reveals that between 2006 and 2014, they dropped from 56.7% to 39.1% and from 35.8% to 16.3% respectively.

Some studies have recently shown an increase in number of jobs created as a result of the agriculture-led policies and programmes implemented in Rwanda (Nkurunziza, 2015:118; Kathiresan, 2011:4). Moreover, since the Rwandan agriculture sector is the single largest employer, raising productivity through crop intensification has to impact positively off-farm jobs creation in rural areas through the creation of micro, small and medium rural enterprises around supply chain, agro-processing, marketing and trading. In this line, Kathiresan (2011:17) highlights that the land use consolidation and crop synchronization activities under CIP has spawned several microenterprises and small businesses in processing, trading, and transportation of farm inputs and produces in rural areas, and then generated large scale employment opportunities for men and women.

In regard to farm income, with the new extension approach, impressive results regarding the increase of farmer income have been recorded. Cantore (2011:10), citing a note by Catalyst, shows that intensive agriculture founded on inorganic fertilizers, improved seeds and crop protection chemicals provide huge improvements of the cost-benefit ratio for Rwanda farmers as it reduced the production cost by 70%, 20.3%, nearly 55% and 31.7% respectively for beans, cassava, maize and rice compared to the extensive production system.

6. Challenges towards a sustainable smallholder agriculture transformation

The success of sustainable smallholder agriculture transformation does not depend just on the motivations, skills, and knowledge of farmers, but also on policy and institutional actions taken by the government and other agricultural development stakeholders to preserve available resources and improve farmers socio-economic conditions. In the case of Rwanda, Kathiresan (2012:29) argues that the sustainability of the implemented crop intensification driven by land use consolidation depend on the ecological, economical and social benefits that are felt by the farmers and the public at large. Nonetheless, this sustainability, whether analyzed economically or environmentally, is a questionable issue (Cantore, 2011:23-26) due to a series of constraints. The following sections examine various challenges that are handicapping the implementation of sustainable smallholder intensification related programmes at institutional, community and small-scale farmer level.

6.1 At Institutional level

6.1.1 Financial resources availability and agricultural research and development

Pretty *et al.* (2014:18) argues that globally, investment in agricultural development remains an urgent priority. This has been acknowledged by the government of Rwanda and an increase of the share allocated to agriculture on its national budget has been recorded over the past few years. However, since the national budget is largely depending on external grants and aid, any external resources shock has a significant negative impact on the development, sustainability and overall performance of agriculture sector as it affects the funding of on-going programmes or the implementation of new projects. This is confirmed by the note by Concern Worldwide (Willoughby and Forsythe, 2011:12) that "*the overarching challenge for the implementation of government of Rwanda agricultural strategies remains a lack of funds"*. Giving an example of the funding of the second SPAT launched in 2009, the same authors add that there were funding gaps estimated to 86.1%, 53.9% and 81.0% respectively for improving domestic staple food production and value addition, strengthening rural financial systems, and re-structuring extension services.

As for agricultural research, although it is well recognized as fundamental for the development of agriculture sector, the level of research is still low in Rwanda, and, according to Maigaa (2016:1), there is need of greater investment in agricultural research and development as future agricultural growth will increasingly depend on technological change. In addition, research is still needed at larger scale to inform on cost-effectiveness of agricultural investments and environmental impact of CIP (Cantore, 2011:13, 18), and institutional and policy innovations and interventions required to help farmers sustaining their operations (Bizoza and Byishimo, 2013:16).

6.1.2 Agricultural policies and their integration with other policies

According to Pretty *et al.* (2014:40), a supportive policy environment acts as a significant catalyst for sustainable intensification. Therefore, agricultural policies have to create favorable conditions to enable farmers to increase household food security and have the added advantage of increasing farmer's income, generating employment and increasing expenditure within the local economy (Pretty *et al.*, 2014:18). These policies need also to be integrated with infrastructure and environment-related or other relevant policies areas (Garnett and Godfray, 2012:3) because, as stressed by Meijers and Stead (2004:1-2), policy integration help to avoid fragmented decision-making and enable adequate management of cross-cutting issues in policy-making that transcend the boundaries of established policy fields, and which do not correspond to the institutional responsibilities of individual departments.

In Rwanda, land use consolidation policy is criticized for not having considered the fact that most of small-scale farmers do not have enough means to diversify the source of income (Kabandana, 2016:12) to buy other needed foodstuffs not produced under the land use consolidation scheme. In addition, its integration with other relevant policies appears not to have been fully considered to allow an evaluation of possible side effects of the new farming approach before its implementation in regard to environment and livelihoods of famers.

6.1.3 Environment protection, soil conservation and nutrient loss control

Studies have revealed that unsuitable farming systems and land management practices are harmful to environment and the caused damages have implications for sustainable food production. Among others, Garnett and Godfray (2012:3) argue that "… *while the stability and security of the food system is underpinned by its environmental resource base, the evidence overwhelmingly suggests that these resources are being depleted and damaged in ways that threaten food production in the long term and also have broader implications for human wellbeing. Much of this damage is caused by the food system itself - food is both agent and victim of environmental harms*" (see also, Jorgenson and Kuykendall, 2008:532).
In Rwanda, a lack of adequate land management practices and environment sustainability of initiated programmes is mentioned. The Ministry of Agriculture and Animal Resources (MINAGRI, 2013:9) recognizes that there has been a lack of consideration of environment sustainability following recorded progress and significant development in land husbandry and irrigation, and this needs to be addressed through soil and water conservation mechanisms and adequate land management practices.

6.1.4 'Top-down' model used in projects and programmes implementation

Ansoms (2013:7) has characterized the relationship between authorities and farmers in Rwanda as a top-down, state-centered governance approach especially in regard to policy implementation. However, with the on-going administrative decentralization process, improvements have been recorded, although actions are still needed for the betterment of the situation as agriculture-related policies implementation need a full involvement of the farmers so far considered as the last implementers. This would require prior consultation with them to seek for their consent and to take into account (to some extent) their wishes and local context before any action. Farmers need to know and understand that they are first stakeholders rather than being like 'always ready-actors' often requested to put into practice what is decided by authorities. Stakeholders have to counteract this way of policy implementation in order to enable farmers to understand and act accordingly, and to avoid facing any local resistance to initiated changes.

6.2 At community level

Challenges at community level relate to the availability of and access to improved infrastructure and technology, though success stories have been recorded following the implementation of the National Agricultural Extension Strategy and the National Post-Harvest Staple Crop Strategy. These challenges include the poor quality of rural roads, lack of sufficient irrigation and post-harvest infrastructure, and lack of access to agricultural knowledge, technology and extension services. The latter is more pronounced for non-grouped farmers as interventions are mostly targeting farmers in cooperatives. Where the lack of storage infrastructure is reported, it becomes difficult for farmers to sell at a good price and preserve the quality of their produce. In addition, Willoughby and Forsythe (2011:12) add that: "… *a lack of post-harvesting and marketing infrastructure may reduce the incentive for farmers to make investments in intensifying crop production*". Thus, any support for improving agricultural production marketing, should also put an emphasis on making available the necessary community storage infrastructure because not only they allow

increasing the bargaining power of smallholders and, consequently, selling at a good price, but also, they help to preserve the quality of agricultural product and this lead to the increase of farmers' income.

6.3 At smallholder level

6.3.1 Financial resources availability and access to formal financial services

Working capital constraints are still a concern for the smallholders and this hampers any attempt to increase agricultural production due to lack of resources to invest. Currently, subsidized inputs are distributed to farmers grouped in cooperatives, but the farmer is still required to look for the remaining amount to pay his share. To this are added the land rental fee, the purchase of agricultural equipment, the payment of external wages, etc. In Rwanda, availability of financial institutions in rural areas has been attained with the presence of at least one serving and credit cooperative (SACCO) in each administrative sector but this does not guarantee the accessibility of their services to small-scale farmers. As evidenced by empirical studies conducted in rural Rwanda (see for instance, Musabanganji *et al.*, 2015:1816), the access by smallholders to formal financial services is still limited and this prevents resource-poor smallholders from having enough financial resources to invest in agriculture-related activities and, as stressed by Willoughby and Forsythe (2011:12), from joining marshland cooperatives due to high fees.

6.3.2 Control of side effects of inputs use

Mineral fertilizers usage needs an adequate application in order to mitigate their effects given their negative impacts on human well-being and the environment as well. Unfortunately, Kabandana (2016:2) stresses that most of farmers in Rwanda are not aware of those effects neither on their health nor on the environment. Therefore, this appears to be a big challenge to be addressed to ensure that agricultural intensification is done in a sustainable way.

6.3.3 Sustainability of inputs subsidies

Inputs use involves the disbursement of cash by the farmers. This may be the explanation behind the introduction of subsidies by the government. Nonetheless, the sustainability of these subsidies on inputs is a raising and a questionable issue. According to Bizoza and Byishimo (2013:16), it is envisaged that the government will pull out his hand in direct support towards agricultural transformation and specifically in inputs supply. The same authors add that there is little likelihood that farmers will adequately continue using inputs if subsidies are removed, which may be the case if the responsibility is transferred to private sector stakeholders. In this line, a study conducted on smallholders in Rwanda by Willoughby and Forsythe (2011:12) reports that "*a number of farmers suggested that although private sector services were available near to their household (for example, to purchase fertilizers) they felt that they were unable to afford these inputs without external support*". Therefore, there is a need to work on this issue of inputs subsidies sustainability before the withdrawal

of government from providing services to ensure the sustainability of the on-going small-scale farming intensification.

7. Concluding remarks and policy recommendations

This paper clarifies the path that Rwanda took in the quest for a modern, intensive, productive and market-oriented agriculture. Since 2007, Rwanda launched the CIP and initiated various strategies and undertook policy reforms (among which the decentralization policy to foster the good governance and the land policy) with an aim of transforming its predominant smallholder agriculture. This was followed by impressive results in terms of household food insecurity and poverty alleviation, increasing the harvested area, yield, production, farm income, empowering smallholders, improving inputs use, soil conservation and job creation. However, challenges remain at both institutional, community and farmer level, and continue to hamper implemented initiatives aiming at ensuring the sustainability of smallholder agriculture on-going intensification.

In light of the above and to scale-up sustainable smallholder farming intensification, the government and other partners should work on: (i) strengthening research institutions, (ii) creating new and revitalizing existing infrastructure (post-harvest to improve the quality of the produce and the bargaining power of farmers, irrigation, feeder roads to link farmers to markets), (iii) enhancing the FFS and extension services to allow a large number of farmers to have access to extension advice, (iv) strengthening farmer organizations to help farmers derive social and economic benefits from their respective cooperatives, (v) strengthening the technical and financial capacity of government agriculture-led agencies, (vi) monitoring the use of inputs by farmers and enhancing farmers' training and awareness regarding inputs use and their side effects, (vii) revitalizing public investments in agriculture, especially in prioritizing smallholders, (viii) improving the integration of agricultural intensification-led policies with other relevant policies to ensure the sustainability of on-going initiatives, and (ix) alleviating formal rural financial services access barriers to allow resource-poor smallholders accessing rural credits.

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