THE REASONS FOR THE CONSOLIDATION OF FRAGMENTED LANDS IN RWANDA VIEWS FROM MAIZE FARMERS

Niyonasenze Sylvestre, David Mburu, Patrick Mulyungi and Ntaganira Eric

ABSTRACT: Land consolidation model have been adopted by the government as a major agricultural transformation strategy in Rwanda, despite the consolidation of farming, a large number of farmers continue to maintain smallholdings and therefore some of the old problems still persist and some new challenges have emerged. The overall objective of this study was to evaluate the effects of land use consolidation among maize farmers in Kayonza district, Rwanda. Multistage sampling techniques were used to select respondents. Data was collected from 213 respondents using structured questionnaire. Probit model was used to determine factors influencing adoption of land use consolidation and t-test was used to estimate effect of land use consolidation on yield and level of input usage. The results from probit model showed that, farm size, age, experience, marital status, area for farming, distance to market, trainings like use of improved seeds, storage facilities and extension contacts. In order to increase adoption of land use consolidation for the farmers to derive maximum benefits from land use consolidation, the study recommends that policy makers should focus more on organizing producer groups in cooperatives and strengthen the current strategies of extension education, visits, trainings and direct contact of extension workers, develop output markets of farmers as this can increase benefit, hence increased production of maize through improved production systems, this can ensure the optimal realization of their livelihoods' potentials

Key words: Smallholder maize farmers, Land use consolidation, Adoption, Probit model.

I. BACKGROUND OF THE STUDY

Land Use Consolidation Act (LUC) was introduced in 2008 as an important component of agricultural policy in Rwanda. As part of the Government of Rwanda's broader Crop Intensification Program (CIP), LUC entails participating farmers consolidating aspects of their operations with neighboring farmers, while retaining individual ownership of their parcels. In LUC, farmers also agree to grow a single priority crop that has been identified by the Ministry of Agriculture (MINAGRI) as best suited to local conditions and consistent with Rwanda's overall agricultural strategy. The rationale for LUC is that joining small plots together to farm as a single unit would deliver important economies of scale in agricultural production, resulting in improvements to efficiency and sustainability, which would in turn, boost household well-being.LUC is a large-scale initiative and by 2011 approximately 13% of the total land area was under cultivation of LUC in Rwanda, with approximately 40% of the farmers in the country participating (A Kathiresan, 2012).Though LUC has been implemented to some extent in all districts of Rwanda, and continues to expand to additional areas but still a lot of land remains fragmented.

Among the drivers of land reform in Rwanda is largely associated with the need to improve land use management and adverse effects of land fragmentation. The pillars of land reform in Rwanda have been

the Land Policy of 2004 and Land Law of 2005(Musahara & Huggins, 2005). Five years in its implementation LUC has been studied by a limited number of scholars but stimulated a wide debate on the extent of its success (Bizoza & Havugimana, 2013).According to Arumugam Kathiresan (2012),about 36 % of the households own 6% farm lands, with an average of 0.11 Ha. The national average holding of 0.76 Ha is generally divided over 4 to 5 small plots, often in different locations. Given the demographic pressure on land in Rwanda however, securing production of food crops for the growing population from the limited land poses a serious challenge. As solution to the problem the government of Rwanda has adopted a land use consolidation model aimed at encouraging all farmers living together in one region to grow specific food crops in a synchronized fashion and thus, improve agricultural productivity. Through this approach the government envisages optimal use of resources in the agricultural sector and provides the framework for re-allocation of lands wherever necessary.

Amongst the main advantages associated with consolidated use of lands in Rwanda is that it allows farmers to benefit from the various services under CIP such as inputs (improved seeds, fertilizers), proximity extension services, post-harvest handling, storage facilities, irrigation and mechanization by public and private stakeholders.Cantore (2011), the evaluated progress on implementation and effects of land use consolidation on food crop production found that farmers across the country have started recognizing the benefits of land use consolidation he also observed that inspite of a significant physical expansion (13%) of total cultivated area in the country resulting from the consolidation program, the pressure on consolidation of lands for cultivation of priority crops has caused a steady decline in area under cultivation of other (non-priority) traditional crops from 52.6% in 2004 to 42.4% in2011(Cantore, 2011).He further found that although the usage of inputs in consolidated land areas has increased significantly, efficiency gains through further deployment of improved varieties, mechanization and natural resource management remain hidden. The findings byCantore (2011), suggest that the effects of land use consolidation policy on the increase in food crop production triggered by crop intensification program are still not clearly understood and therefore require a scientific study. In this regard,(Arumugam Kathiresan, 2012),suggests that non-land factors such as improved technologies, extension services, post-harvest handling, storage facilities, and settlement patterns also need to be improved to increase productivity and profitability of priority crops through land use consolidation. Despite the benefits accrued through Land use consolidation in Rwanda , still there is limited number of studies conducted companied by low levels of adoption and land use consolidation policy still not yet clearly understood(Bizoza & Havugimana, 2013).

II. INTRODUCTION

The current global challenges of ensuring the availability of access to food in both quantity and quality, require deliberate and far-reaching solutions historically, research for development in agriculture and land consolidation has been a strong driving force for meeting food supply around the world, countries still face major challenges of food insecurity, poverty, and malnutrition and diversity in the size, popula-

tion, and agricultural and economic development of the countries reflect the large differences in their agricultural production systems, agro climatic potential, population density, and infrastructure (Beintema & Stads, 2008). Land reform has been ubiquitous all over Africa for various purposes. The driver of land reform in Rwanda can largely be the need to improve land use management and to reverse the adverse effects of land fragmentation and related problems especially in the period after the 1994 Tutsi genocide. The pillars of land reform in Rwanda have been the Land Policy of 2005 and Land Law of 2005 (Musahara & Huggins, 2005).Five years in its implementation LUC has been studied by a limited number of scholars but stimulated a wide debate on the extent of its success (Bizoza & Havugimana, 2013).According to Binagwaho et al. (2012), Rwanda's economy is largely agrarian. More than 80% of the Rwanda's projected population of 10, 718, 3791 depends on farming. The total land area of the country measures 26,338 square kilometers. The country is the mostly densely nation in the continent faced with an average of 407 persons per square Km. Hence the land distribution is highly fragmented and skewed in Rwanda. According to Arumugam Kathiresan (2012),about 36 % of the households own 6% of the farm lands, with an average of 0.11 Ha. The national average holding of 0.76 Ha is generally divided over 4 to 5 small plots, often in multiple locations. Given the demographic pressure on land in Rwanda however, securing production of food crops for the growing population from the limited land poses a persistent challenge. The priority food crops under land consolidation in Rwanda include maize, wheat, rice, Irish potato, cassava, soya bean and beans. To a great extent, the volumes of production of these food crops determine the levels of food security in Rwanda. Consolidated use of lands allows farmers to benefit from the various services under CIP such as inputs (improved seeds, fertilizers), proximity extension services, post harvest handling and storage facilities, irrigation and mechanization by public and private stakeholders. However, the effects of land use consolidation policy on the increase in food crop production triggered by crop intensification program are still not clearly understood and therefore require a scientific study.

The acceptance of land use consolidation is generally more widespread in Eastern and Northern provinces than in the Southern and Western provinces. Despite a significant physical expansion (13%) of total cultivated area in the country, the pressure on consolidation of lands for cultivation of priority crops has caused a steady decline in area under cultivation of other (non priority) traditional crops – from 52.6% in 2004 to 42.4% in 2011(Cantore, 2011).Land use consolidation mission by itself is challenging as it deals with uneducated rural poor with the aim of changing their behavior positively. There is also problem of market access resulting in low prices of agricultural products as production increases, which is expected under extension based farming. According to A Kathiresan (2012),despite the consolidation of farming, a large number of farmers continue to maintain smallholdings and therefore some of the old problems still persist and some new challenges have emerged. Both the agents and farmers in several places still have not yet clearly understood the voluntary nature of the program and the benefits associated with land use consolidation. This is a research gap that needs to be filled through scientific research and this study contribute to give a clear image of land use consolidation with empirical evidence on the objective to evaluate effect of land use consolidation in Kayonza district.

III. METHODOLOGY

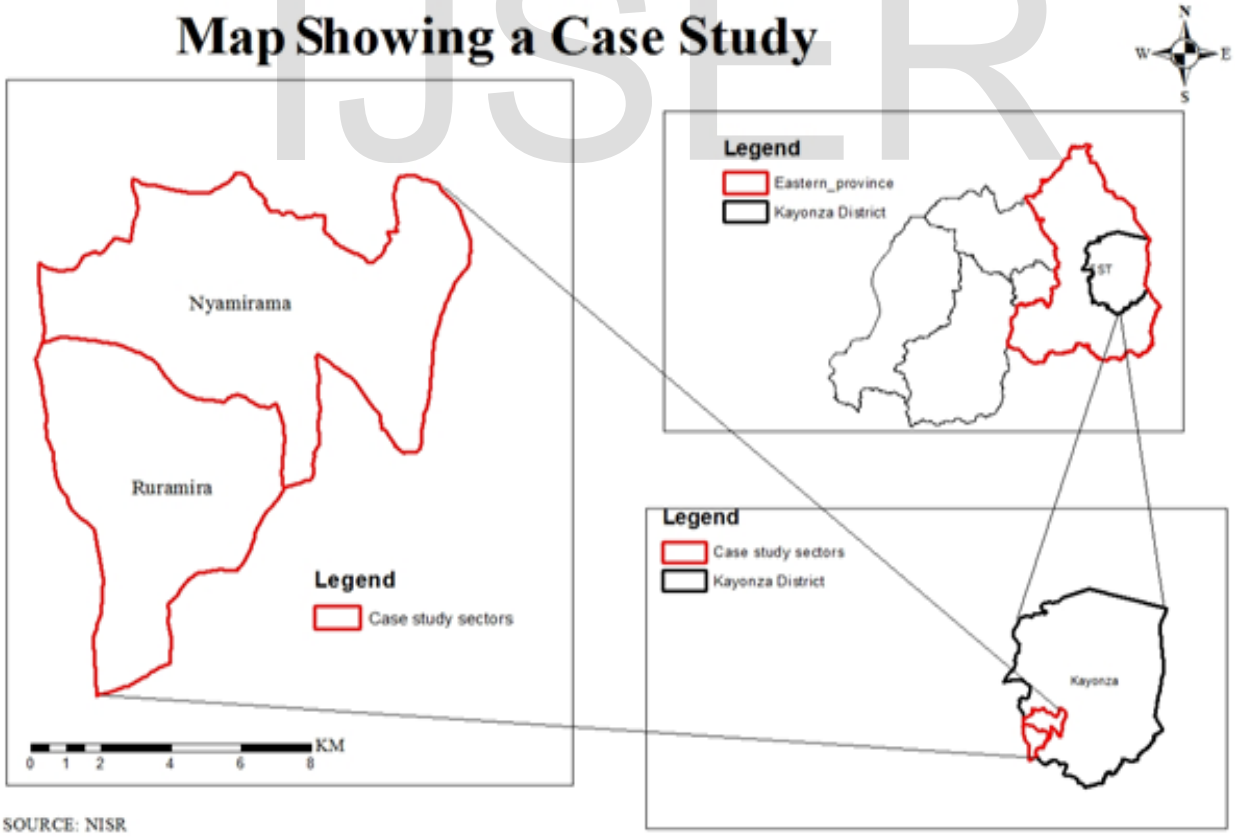
Research design

Household surveys with structured questionnaires, were methods adopted for the primary data collection. Relevant secondary data were obtained from different publications, books, journals, newspaper articles, dissertations, year-end reports and others. A structured questionnaire (closed as well as open ended) were developed in order to retrieve the quantitative and qualitative information, pre-testing survey was done for this study.

Study area

Kayonza district is a second order administrative division and is located in Eastern Province, Rwanda. The estimate terrain elevation above sea level is 1462 metres with Latitude2°11'7.15"Longitude30°28'.6". Agriculture in the district has adopted land consolidation policy which has provided benefits like good harvest and markets and farmers have organized themselves into cooperatives and this has helped them in changing their standards of living.

Case study map



Target population

This study targeted Kayonza district maize farmers in the selected sectors of Nyamirama and Ruramira with the population of 213 farmers with 93 non-adopters of land use consolidation and 120 adopters randomly selected from the two cooperatives in the selected sectors of Nyamirama and Ruramira.

The reason for more respondents in Ruramira sector was due to high population in the sector, the study was conducted purposely because there is a lot of maize growing in this district and the primary targeted respondents of the study were farmers who have the history and experience of growing maize. Therefore, the random sampling selection approach was effective.

Sample size determination

The sample size was determined based on groups of maize farmers who adopted land consolidation and farmers who did not adopt in two sectors. The sample size was determined by a mathematical formula given by (Dhokhikah, Trihadiningrum, & Sunaryo, 2015).

$$n = \frac{N}{1+N(\alpha)^2}(1)$$

Where Nis the sample frame, **n** is the sample size and α is the margin of error

$$n = \frac{460}{1+460\,(0.05)^2} = 213\ (2)$$

Sampling procedure

The study adopted multistage sampling procedure to select the farm households for this study. The Eastern Province was selected purposely out of the total 4 provinces of Rwanda. The motivations for such choice are that, it is a potential agricultural zone; the area is qualified for food diversity and a food reserve of the country. It is sub-divided into seven districts by which purposive sampling was used to select Kayonza district since it is a strategic district hosting a lot maize farmers and land consolidation has been apparently effective. Stratified sampling was used to divide respondents into two strata of those who adopted land consolidation and those who did not.

Simple random sampling was used to select respondents in the two cooperatives and every member had a chance of being selected for the sample. The sample unit was a household head who is a maize farmer who either adopted land consolidation or not.

Table 1.3: Simple random sampling

Sector	Name of coopative	Total population of each coop	Target population	
			Adopters	Non adopters
Nyamirama	Imbereheza	220	55	43
Ruramira	Twitekumurimo	240	65	50

Data collection tools

Primary survey data was collected for maize production year 2014/2016 through a structured questionnaire which included both closed and open-ended questions. The questionnaire was modified before execution of the survey. Secondary data collection involved reviewing existing information in the form of documents, text books and journals. Focus group discussions were used to collect data from respondents.

MEASUREMENT OF THE VARIABLES

It is hypothesized that the decision to adopt land use consolidation is influenced by a set of independent variables. Based on the review of adoption literature, past research findings and considering the information from informal survey; among the large number of factors which were expected to influence farmers' adoption decision, only nine potential explanatory variables were considered for this study and ex-

amined for their effect in farmers' adoption decision on land use consolidation. These are presented as follows:

Gender (G): It is a dummy variable which takes a value of 1 if the respondent is male and 0, otherwise. In most cases male headed-households have better access to information on technologies and are more likely to adopt new technologies than female.

Sex is therefore expected to positively influence adoption. This is supported by (Odendo, Obare, & Salasya, 2010),argues that male headed-households are more likely to participate in programmes relative to the female headed households.

Marital status (MAR): It is a dummy variable which is represented by 1 if the respondent is married, 0 if otherwise. It is assumed that married households can handle and manage their overall livelihood (social duties and farm activities) better than households who are not this enabling them to produce more and generate more income. Therefore, married households are more likely to adopt than the non-married. Thus, this variable was hypothesized to have positive relationship with adoption of the land use consolidation.

Age (AGE): This variable refers to the chronological age of household head at the time of the survey, measured in years. As the age of the household head increases, the probability of adopting is likely to decrease. Because, with age, a farmer can become more risk averse and then tend to be reluctant to new technologies. Therefore, age was hypothesized to negatively influence adoption.

Family size (FAMSZ): Large family size is an indicator for availability of labor provided that the majority of the family members are within the age range of active labor force. Availability of labor in the household is again one of the important resources in maize production. Based on this assumption, this variable was hypothesized to have positive relationship with adoption of the land use consolidation.

Education (EDUC): It measures formal education of household head in the family. It is measured in number of years spent in school. Education enhances farmers' ability to perceive, interpret and respond to the new events. Therefore, in this study education was expected to positively influence adoption of land use consolidation.

Land holding (LAND): It is an indicator of wealth and social status and influence within a community. It was expected to be positively associated with the decision to adopt land use consolidation. This means that farmers who have relatively small landholding would be more initiated to adopt land use consolidation.

Distance to market and extension offices (DIST): It is a continuous variable measured as the walking distance in minutes that the household travel to reach the nearby social infrastructures. Those farmers having access to agricultural market have better market information. It was hypothesized to have a positive contribution to adoption.

Access to credit (AC): This is a dummy variable which takes the value of"1"and"0"for adopters and non-adopters respectively. Maize farmers may be attracted by the credit that they can get from the co-operatives. Hence, access to credit was hypothesized to be positively associated with the decision to adopt.

Data analysis tools

Data was analyzed using stata13 program. The analysis includes, descriptive, T-test and econometric analysis. The probit model assumes that while we only observe the values of 0 and 1 for the variable Y, there is a latent, unobserved continuous variable that determines the value of Y. The advantages of the probit model include believable error term distribution as well as realistic probabilities (Sebopetji & Belete, 2009).Thus, for this study the probit model is preferred and used. In this study only two options

were available, namely "adopters"and "non adopters of land use consolidation" a binary model was set up to define Y=1 for situation where the farmer used adopted and Y=0 for situations where the farmer did not adopt.

The empirical model suggested for this study is a probit regression model indicating the relationship between the variables as follows;

$Y= \beta 0 + \beta 1\ X1 + \beta 2\ X2 + \beta 0 + \beta X1 + \beta 2\ X2 + \beta 3\ X3 + \beta 4\ X4 + \beta 5\ X5 + \beta 6\ X6 + \beta 7\ X7 + \beta 8\ X8\ e$

Where

Y = Maize production (MP)

β0 = Constant (C)

β1, β2 = Regression coefficients to be estimated

ε = Stochastic term

X1 = Distance to market, X2 = Access to credit, X3 = Access to improved seeds, X4= Information on use of irrigation, X5=Access to extension services, X6= Co-operative membership, X7=Trainings, X8=Distance to extension agents.

IV. Results and Discussions

Estimation of social economic factors influencing demand and adoption

The results of the study indicate that factors that influenced adoption of land consolidation was farm size which is not surprising in Rwandan context because land consolidation was based on the criteria for the farmer who owned at least a plot of land, so land holding influenced farmers' adoption behavior because land holding is an important unit where agricultural activities take place and findings from this study are relevant to studies of (Bayu et al., 2005).The results of the study found that gender influenced adoption of land consolidation in the study area and even Rwandan context the results are not as expected because Rwandan agriculture is dominated by female headed families. However the sample is dominated by male headed families and this indicates the reason for positive effect and findings of this study are relevant to studies of Techane (2002).

Results shows that about 89.7 % of the respondents were married and living with their spouses and 10.3% of the households were not i.e. either they were divorced, single or widowed. This indicates that the society in the study areas is stable. A stable society in general and stable households in particular can concentrate more on production than unstable society or family. The study findings in table 2.4, illustrate that age and experience is significant to adoption of LUC at 95% confidence interval meaning that as experience in farming increases adoption increases. In Rwandan context experience means ability and capacity to anticipate all contingencies related to production methods thus this can increase supply and if a farmer is less experienced there is high chances of failing, the results of the study conflict with findings by Kifle et al. (2016).

The mean age for adopters was 42.15 and non adopters39.84; for the sample and the age structure of the sample households was not significantly different between adopters and non-adopters with P at 0.045**. It was found that old aged respondents were observed to adopt the new technologies and were significantly different from non-adopters which suggest that there is positive correlation between adoption and the experience gained by age. This could have facilitated them enough to have the required physical strength in the adoption process. The role of age in explaining technology adoption is controversial. It is usually considered in adoption studies with the assumption that older people have more farming experience that helps them to adopt new technologies. On the other side, because of risk averting nature, older aged farmers are more conservative than the youngest ones to adopt new technology. It is thus evidence that adopters had a higher age than non-

adopters; this probably implies that older farmers accumulate more information and have adequate experience about the institutions that help them to adopt. From the findings, the average family size of the sample respondent households was 5.64 for adopters and 5.27 non adopters and size was significantly higher among adopters compared to the non-adopters and the reason for no statistical significance can be attributed to the fact that maize is not labour intensive crop that require more energetic labour. The average land holding were 0.741 for adopters and 0.723 non adopters respectively.

The study illustrates that the means for adopters and non-adopters with respect to household size was 5.64 and 5.27, area for farming was 0.66 for adopters and 0.62 for non-adopters, community support was 8.67 and 5.63, trust with in community was at 73.42% for adopters and 69.06 % for non-adopters and the way society trusted their leaders was at 77.26 for adopters and 73.88 % for non-adopters respectively in all these variables there was no statistical significance as p-value is greater than 5% level of significance, this means that means for the entire population are different.

Results further show that average livestock holding including cattle, sheep, goats, pigs, and poultry in the area was 0.3 for adopters and non-adopters owned 0.11 respectively. These figures show that the difference in livestock ownership between adopters and non-adopters was statistically significant at which imply that having large number of livestock is correlated with adopting the land consolidation in the study area, similar results were reported by (Roschinsky, Kluszczynska, Sölkner, Puskur, & Wurzinger, 2015).

Table showing T-test for equality of means on socio-economic factors of adopters and non-adopters.

Variable	Mean		Test for equality of means	
	Adopter	Non adopter	T-test	P-value
Age of respondent	42.2	39.8	1.6	0.045**
House hold size	5.6	5.27	1.368	0.89
Experience	21.68	18.69	2.13	0.011**
Education	6.22	5.59	1.5559	0.023**
Farm size	0.741	0.723	0.23	0.049**
Livestock assets	0.39	0.11	2.76	0.0031**
Community support	8.67	5.63	2.06	0.98
Community trust %	73.42	69.06	1.89	0.97
Leaders trust %	77.26	73.88	1.57	0.94
Marital status	2.08	2.21	1.7923	0.0372**

Note: ** significant at 5%

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

The study used the probit analysis method to determine social economic factors which influence de-

mand and adoption of LUC and all factors thought to influence demand and adoption were hypothesized.

Conclusion

The results of the study confirmed that key factors identified were farm size, age, experience, marital status and area for farming. Therefore, the study concludes that social economic factors are key factors to the adoption of land use and consolidation.

Recommendations

The study recommends that the government and other relevant stakeholders help in the improvement of farmers' social economic factors such as the income levels, education, and land ownership amongst others through adult education, creating opportunities for off farm income, land registration so as to enhance adoption of LUC. In this regard the study further recommends the government of Rwanda to increase the numbers of extension worker providers to reduce the farmers' extension worker ratio.

The study therefore recommends more government participation in LUC adoption through provision of extension services for purposes of training and information dissemination about importance and practice of LUC.

It's further recommended that the Rwandan government enhance policies on maize market strategies through providing better policies and decentralization of local markets enabling farmers to gain higher returns from the costs of adopting LUC.

Further research

This study focused on one aspect of land consolidation. However, there are many aspects of land consolidation that need to be researched and data pertains to only two sectors in one district in rural Rwanda, given the limited scope of the study, this research suggests that further research should be undertaken in other districts of the country where land consolidation is in progress more especially on challenges faced in land consolidation and effect of mono cropping in land consolidation of production.

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- ***Niyonasenze Sylvestre "the first author"*** *is finishing his thesis of MSc in Agriculture and applied economics in Jomo Kenyata University of Agriculture and Technology (JKUAT). Currently He is the Agriculture Quality Assurence Officer in WDA and He has been the Trainer in Agiculture/MYICT, Rwanda. Email:* niyonasenzesylvestre@yahoo.fr

- ***Prof. David Mburu****, the Dean of the faculty of Agriculture at JKUAT and senior Lecturer*

- ***Patrick Mulyungi (PhD,*** *is the senior lecturer at Jomo Kenyata University of Agriculture and Technology (JKUAT)*

- ***Ntaganira Eric, is*** *MSc holder in Agriculture and applied economics from JKUAT, the former Assistant Lecturer at JKUAT, Kigali Campus,*