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Agricultural Productivity and Policy Interventions in Nyamagabe District, Southern Province Rwanda

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Abstract

Improving agricultural productivity has received considerable policy intervention in many African countries and particularly in Rwanda. The question remains to know the extent to which the policy contributes to the variation being upwards or downwards of the crop productivity. There are number of determinant factors some being personal and others institutional. This study examines the variation of agricultural productivity to document the extent to which agricultural productivity has shifted and what factors have contributed to the shift, with focus to the voucher system and the land use consolidation introduced by the Ministry of Agriculture in Rwanda. Secondary data were collected to describe the trends in agricultural productivity in Nyamagabe District, Southern Province in Rwanda. In addition, a household survey of 100 households was conducted in two Cells of Kamegeri Sector to assess at household level how the agricultural policy has contributed to the shifting of agricultural productivity. This shift is time-bounded and effects of agricultural policy are gradual overtime. Results from the analysis of secondary data show that greater agricultural productivity for both food and cash crops grown in Nyamagabe District is observed mostly in the period starting from 2007 and onwards. This period coincides with more policy innovations and interventions including the Crop Intensification Programme and specifically the introduction of the voucher system, land use consolidation and crop regionalization. To validate these macro-level findings, the Probit and Instrumental variable models were estimated to establish the marginal effects of these policy interventions on agricultural productivity measured by yield at household level. Findings substantiate that the voucher system has significant marginal effects on change in crop yield (measured by farmer's perception) at 5% level of significance (Z= 2.41 P> [Z] =0.016 and Z= 2.77, P> [Z] =0.006). Further policy innovations and interventions should focus on how farmers can maintain the same momentum themselves beyond policy interventions in Rwanda.

1. Introduction

Rwanda has embarked on agricultural intensification. This is seen as prerequisite for agricultural production and hence economic development. Recent estimates show 3.2. Per cent for the period 2010-2011 (NISR 2011). The agriculture sector contributes about 31 per cent to the Gross Domestic Product (NISR, 2012; MINAGRI, 2011). Similarly, the sector occupies more work forces about 79.5 per cent of the total population of which 86 per cent are women compared to 71.2% males. However, the population growth, although at a diminishing rate, is increasing posing the land size equation to be more complicated due to declining per capita farm size and land fragmentation into smaller pieces of land parcels. This situation makes difficult the option of increasing agricultural production through increased cultivated space. The alternative at hand is the crop intensification as sustained by the on-going Crop Intensification Program (CIP) initiated in the fall of 2007.

The CIP program represents part of aspects of the invisible hand of the Adam Smith's classical theory linking agriculture and economic development. Through CIP, Rwandan Government is seeking how to intensify agricultural production and raise farmer's income on existing small lands. For this reason, heavy investments are being to render marshlands cultivable, putting in place irrigation systems, facilitate inputs and mechanization to diversify and enhance the level of productivity in small farms (Kathiresan, 2012). The question is to know the extent to what policy interventions in agriculture determine crop productivity. Scholars have argued for different factors explaining agricultural productivity across the world. These can be regrouped into different bio-physical characteristics of land resources, socio-economic characteristics of farmers, institutional factors such as markets and transaction costs, and inter-sectorial linkages. For the case of Rwanda, little interest has been made to show empirically how institutional factors explain agricultural productivity.

For example, Bizoza (2010) analysed farm, household, and institutional–level effects on potato productivity in Nyamagabe District. The intention was to examine changes occurred in potato productivity and if these can be attributed to policy intervention in terms of bench terracing in the same District of the study area. Results from this study substantiated significant differences in potato yield between sample households over the period 2004 to 2009 and these are partly due to changes in some household characteristics (such as education and access to seeds) and the cultivation in bench terraces were found to be the major driving factors for potato productivity as measured in yield. An earlier study of Bizoza et al. (2004)

in the same District of this study area also assessed the determinants of potato yield. Their findings from an analysis of a system of equations relating farm, household, and farm characteristics to investment in operating inputs and to potato yield also indicatethat area cultivated, liquidity, family size and farmer's age all impact positively on investment in operating inputs, whichin turn had a positive impact on potato yield. Therefore, the aim of this study is to assess determinant factors of variation in agricultural productivity, with focus to policy intervention in the contest of the on-going Crop Intensification Program (CIP) and particular looking at the voucher system, land use consolidation, and irrigation as promoted by the Ministry of Agriculture in Rwanda.

The Rest of the paper is organized as follows. The second section provides research methods and materials as well as the empirical model opted for the data analysis. In section three we present and discuss the results while Section 4 concludes the paper with some policy recommendations.

2. Decade's Trends of crop yields in Nyamagabe District, Southern Province

The agricultural production trends observed are results of combination of different factors and efforts by different stakeholders. Farmers are working jointly with research and extension service providers (e.g. Rwanda Agricultural Board and NAEB under the Ministry of Agriculture). Academic institutions also contribute towards agricultural production in training qualified professionals in the very domain. Research leads to new technologies leading to higher yielding crop varieties, improved livestock breeding practices, more effective fertilizers and pesticides, and better farm management practices (MINAGRI, 2004).

Table 1: Trends in crop yields of major crops grown in Nyamagabe District (2002-2012A)

Crop/ Year (Season)	Maize		Beans		Irish Potato		Cassava	
Year (Season)	Area (ha)	Yield (kg/ha)	Area (ha)	Yield (kg/ha)	Area (ha)	Yield (kg/ha)	Area (ha)	Yield (kg/ha)
2002(A)	5330	550	9691	500	6720	7000	2423	5000
2002(B)	2400	480	5280	500	6000	6299	3360	5500
2003(A)	5698	450	8547	600	5698	7000	2849	4500
2003(B)	2400	750	4800	500	6720	6000	3360	5300
2004(A)	1899	400	5223	550	34188	6000	10684	4500
2004(B)	1440	650	4800	450	4800	5500	3360	5000
2005(A)	4748	400	9497	550	5223	6000	2374	4500
2005(B)	960	600	3360	450	4800	7000	2400	5000
2006(A)	4748	400	9497	550	5223	6000	2374	4500
2006(B)	545	600	4089	900	1636	9000	1636	5000
2007(A)	3140	600	4972	900	3925	9000	1832	5000
2007(B)	-	-	-	-	-	-	-	-
2008(A)	3441	600	5230	900	3728	9000	-	-
2008(B)	778	625	5615	650	1755	8750	2808	10000
2009(A)	3441	1100	5230	1000	3447	8000	2104	12500
2009(B)	733	1512	4014	650	1522	8750	3124	10000
2010(A)	2780	1447	5716	800	2512	6494.5	3777.5	12719
2010(B)	783	1732	3890	667.5	1739	8617	3006	10266
2011(A)	2119	1794	6203	600	1578	4986	5451	12939
2011(B)	833	1952	3766	685	1956	8484	2888	10532
2012 (A)	4598	1800	2105	566	2151	5235	6129	14492

Source: MINAGRI (2012)

Positive trends of the crop yield are partly explained by the different policy intervention in terms of facilitating farmer's access fertilizers and improved seeds. It is under the voucher system that this facilitation is becoming possible. Imported fertilizers are used mainly for the crops promoted under the CIP such as maize, wheat, rice, and Irish potato. For example, in 2009 about 14,427 metric tonnes were imported and distributed among maize and wheat farmers at a subsidized rate of 50%. The overhead costs including transportation and administrative costs from Mombasa to rural areas are covered by the government. The quantity of imported fertilizers increased in 2010 (about 33500 metric tonnes) and in 2011 (22000 metric tonnes).Due to these efforts, among others, the use of fertilisers has substantially increased. Estimates from the third Integrated Household Living Survey (EICV3) show that use by farmer households of fertilisershas increased from 18% in 2005 to 38% in 2010/11. Use of chemical fertilisers– which is mostly imported - has increased from 11% to 29% for the same period compared to 7% -9% for organic fertilisers (NISR, 2012). This is highly attributed to the imports in bulks of fertilisers by the

government. Statistics from MINAGRI (2012) shows that through the CIP, the government imported 43,500 tons for 2012A (DAP: 19 000 tons, Urea: 5000 tons, NPK: 19 500 tons).The count from crop assessment by MINAGRI 2012 (A) shows that 43.6% of inorganic fertilisers used by farmers are from MINAGRI, NAEB, and the District. These input- imports translate to greater farmer's access to fertilisers and hence to increased crop yields. Table 1 (above) and Figure 1 (below) depict the trends of crop yields for sample crops grown in the study area as supported by the Crop Intensification Program (CIP).

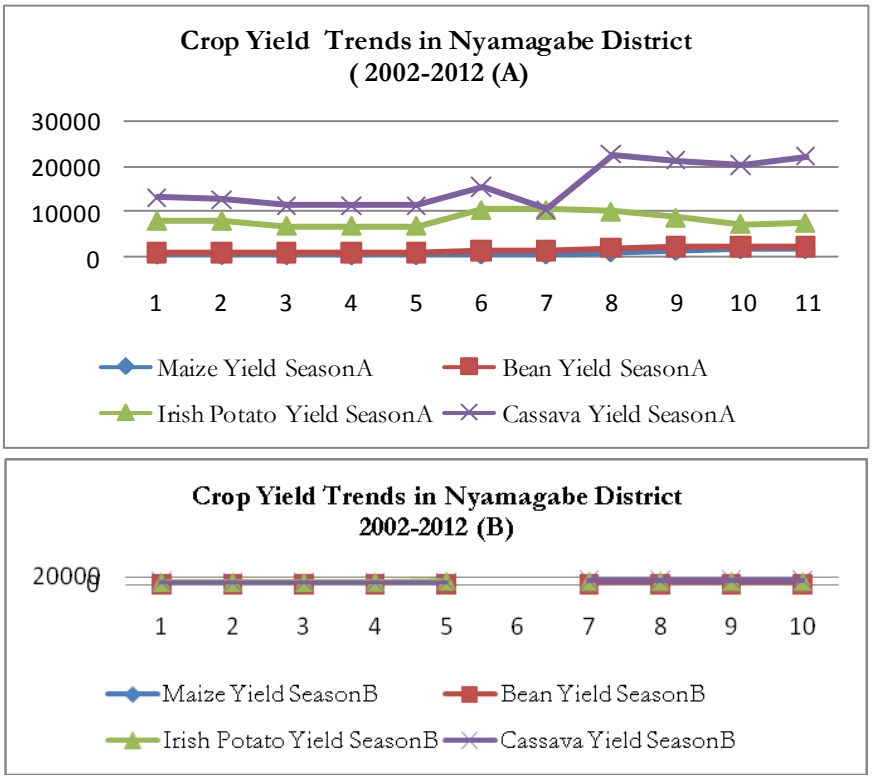

Figure 1: *Yield trends for some crops grown in Nyamagabe district (2002-2012-A), MINAGRI (2012)*

Apart from the voucher system, land use consolidation is seen also important driving factor of the increased crop yields. The consolidation of fragmented holdings did result in improved agricultural productivity (FAO, 2003). Figure 2 below shows the trends of the cultivated area for each crop in the same period for the two seasons (2002-2012A). Greater change is observed for Cassava which is partly explained by its promotion under the

CIP. This crop is seen both for food subsistence and for commercial intends. It is well document in the existing literature on land in Rwanda that the scopes of expanding cultivable space are limited. The remaining option at hand is the optimum use of the existing land through land intensification. The later requires various innovations on how to improve productivity of the same existing land resource. Land use consolidation is one of the options opted by the GOR since the fall of 2007. The farming model calls for farmers to consolidate the use of their existing small plots and grow the priority food crops under CIP in a synchronized way keeping the individual land rights constant. The adoption of the model is voluntary upon condition of benefits such as subsidized inputs under CIP (Khatiresan, 2012).

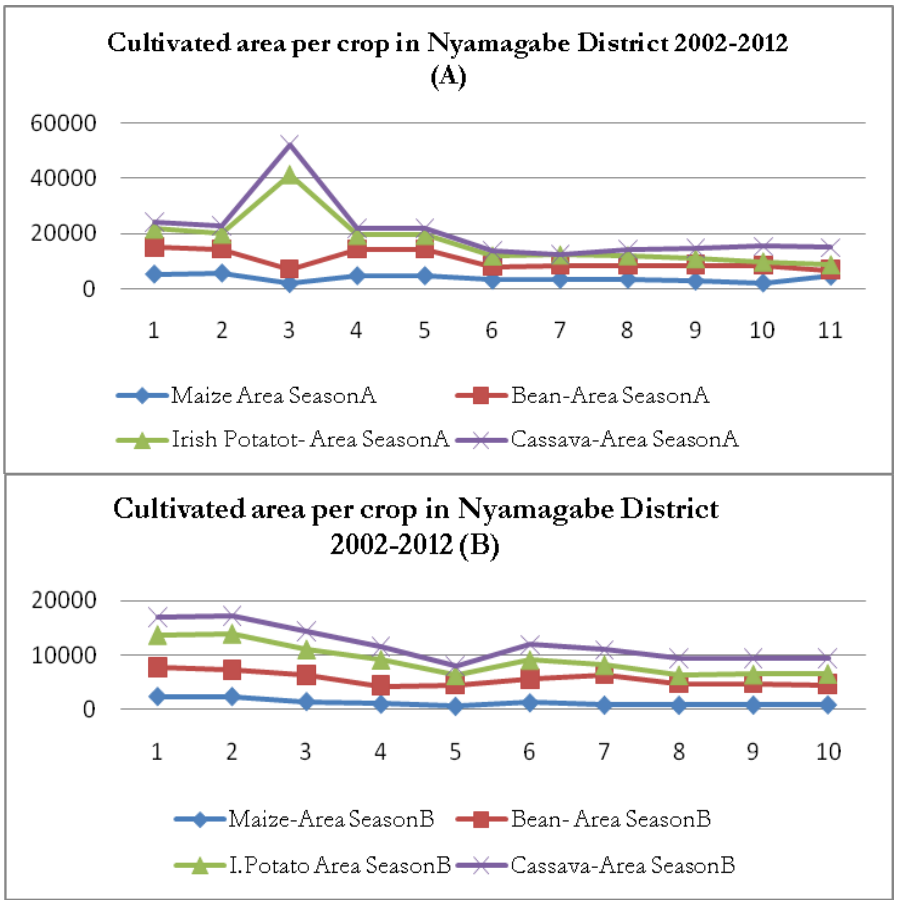

Figure 2: *Cultivated area for some crops grown in Nyamagabe district (2002-2012-A)*

The adoption of land consolidation is relatively increasing of time. Khatiresan (2012) shows an increase in land area under consolidated cultivation of priority food crops from 28,788 Ha in 2007 to 254,000 Ha in 2010 and 502,916 Ha in 2011.Reference to data from Table 2, maize and beans are the most cultivated under consolidated land followed by cassava. Likewise, estimates from the Integrated Household Living Survey (NISR, 2012) sustain that 22% of crop- producing households have at least one plot consolidated with high percentage observed in the Northern Province (about 40%) compared to an average of 19-20% in other provinces. A number of factors explain reluctance to adoption for other plots. A study by Bizoza and Havugimana (2010) in Nyanza District, Southern Rwanda supports that gender (being female headed households is not conducive to land use consolidation), family size, trust among the community members, distance from home to the plot, cropping/farming practices are important determinants of farmer's decision to consolidate the use of lands. In this article, we assume that land use consolidation is conducive to increased yield and this is tested in the model estimation (see Section 4).

Table 2. Land area (ha) under consolidated cultivation of priority Crops

Crop/Year	2008 A	2009 A	2010 A	2010 B	2011 A	2011B	Total	% of total consolidated area
Maize	17808	35000	83427	29474.29	138490	83470	387669.29	27.3
Irish Potato	160	5000	36420	2728.71	37183	60263	141754.71	10.0
Cassava	9448	10000	5748	-	57981	102528	185705	13.1
Wheat	600	10000	7340	3721.00	5800.2	29679	57140.2	4.0
Rice	0	6000	6703	6900.00	8700	8500	36803	2.6
Soya bean	0	0	5570	-	751	2000	8321	0.6
Beans	0	0	105580	-	254011	237745.25	597336.25	42.1
Peas	0	0	3660	-	-	-	3660	0.3
Total	28016	66000	254448	42824	502916.2	524185.25	1418389.45	100

Source: Adapted from Khatiresan (2012)

Land use consolidation goes with other land management practices. Soil erosion control and soil protection adheres mostly to the policy intervention. The same Integrated Household Living Survey by NISR (2012) indicates that about 84% of crop-producing households have at least one of their plots protected from erosion. This is highly observed in the Southern Province (93%) compared to other three province outside Kigali City with an average of 81% to 84%.

3. Model and Data

Data used to validate the assumptions of this paper were collected mainly from the Department of statistics of the Ministry of Agriculture in Rwanda

and from a household sample survey. Secondary data were collected to describe the trends in agricultural productivity in Nyamagabe District, Southern Province in Rwanda. In addition, a household survey of 100 households selected randomly among program beneficiaries was conducted in two Cells of Kamegeri Sector (Kizi and Bwama) to assess at household level how policy interventions in terms of voucher system, land use consolidation and Irrigation have impacted the shift of agricultural productivity. Sampled households include those who have been supported by the government through the voucher system and those who have adopted the land use consolidation policy. Information collected include some socio-economic characteristics of sampled heads of households and perception related information on the shifting of agricultural production due to voucher system, land use consolidation and irrigation, all else. The following map shows the study area within Nyamagabe District, Southern Province.

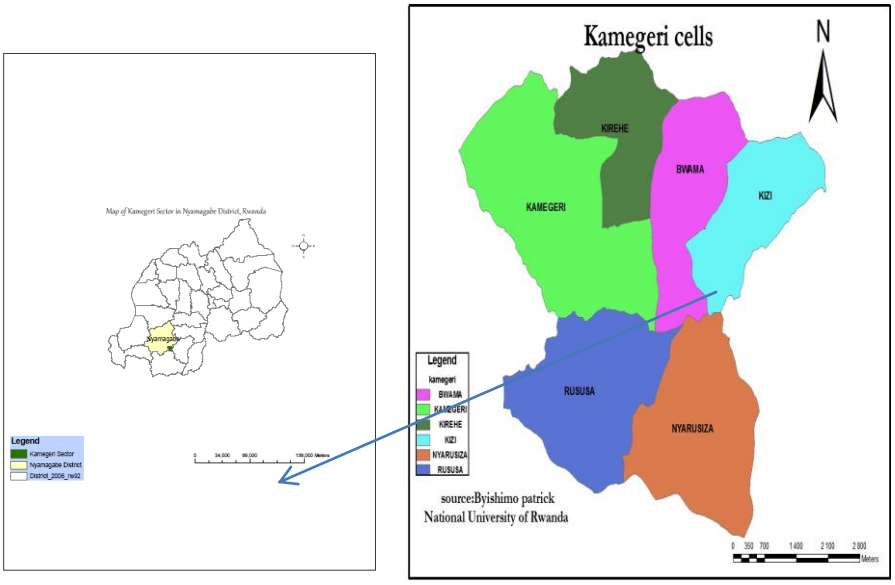

Figure 3: *Map of the Study area in Nyamagabe District, Rwanda*

For the choice of the model we followed Maddala (1983) and Bizoza (2012). The model to be estimated is a linear model regressing crop yield over land size, a dummy for land use consolidation, a dummy representing benefiting inputs through the voucher system, having irrigated areas and other social characteristics of the heads of households (gender, age, education, family size). How these social characteristics affects yield have

been extensively discussed in the existing literature (e.g. Byringiro*et al.* 1996;Bizoza*et al.* 2007).With respect to the program components, their expected effects are positive. For example, access to inputs such as fertilizer and improved seeds has been greatly documented as enabling factor for improved yield in Rwanda. Due to different related transaction costs; it is assumed , *all things remain*, that facilitating farmers have access to these inputs through the voucher system allows them to improve land productivity and hence increase yield. Similarly, fragmented land parcels have been well indicated in the literature on Rwanda as a restraining factor for increased agricultural production as well as yields. Government of Rwanda initiated this land use consolidation towards increased agricultural production. Thus, we expect that land use consolidation affects positively crop yields, all equal.

$Y_1^* = x'_{1i}\beta_1 + u_{1i}$ (1) $Y_2^* = X'_{2i}\beta_2 + \delta_2 \hat{Y}^*_1 + u_{3i}$ (2)

We assume two latent response variable for the two equations with their respective explanatory variables. Equation 1 represents the perception of improved yield for the period 2002-2012 and particularly the period after 2007. Estimates of this equation helps to assess the effect of the CIP elements namely voucher system, land use consolidation and irrigation on the perception of improved yield for the same period. Given that the CIP program is promoted to increase food security and reduce rural poverty; we specified equation 2 to determine the indirect effect of the voucher system on food security and household income. Therefore, equation 2 represents the perception of improved food security (with focus to food availability dimension) and increased household income. Thus, equation 2 contains predicted variable of the first equation to take into account of the possible indirect effect of the first equation in equation 2. We use the Probit Maximum Likelihood (Probit ML) to estimate equation 1 while the classical two-stage least square (2-SLS) to estimate equation 2. Given that the system is recursive and has some endogenous explanatory variables with no restriction on parameters, the 2-SLS method can be applied to estimate the whole system equation (Bizoza, 2012). Similarly, the fact that each equation of the system has at least one variable that does not appear in the other equation, the condition for identification holds (Maddala,1983:120). Two models are estimated for each equation. For equation one we estimate the perception for the period 2002-2011 and the period after 2007-2011. With regard to equation, we estimate the perception of improved food security and household income for the period 2007-2011 to capture the potential effect of the voucher system. The following Table 3 provides the description of model variables.

Table3: Description of model variables

Exp. Variables	Mean	Std. Dev.	Description
(i) Socioeconomic factors			
Male head	0.69	0.5	Equals 1 if Male and 0, otherwise
Age of head	45.18	13.65	Number of years old of the head of household
Family size	4.5	1.76	Total family members
Head's formal education	0.36	0.48	Years of formal education completed
Land size (Ares)	17.18	13.07	The size of total land holdings
(ii) Elements of Policy Interventions			
Voucher System	0.42	0.49	Equal 1 if a farmer has benefited inputs from the voucher system and 0, if otherwise
Land use consolidation	0.27	0.45	Equals 1 if the farmer consolidated one of her or his plots and 0, if otherwise.
Irrigation	0.2	0.40	Equal 1 if a farmer has benefited from the irrigation program and 0, if otherwise
(iii) Endogenous variables			
Change in yield 2002-2012	0.58	0.49	Equals 1 if the farmer perceives that crop yield have improved during 2002-20012.
Change in yield after 2007	0.74	0.44	Equals 1 if the farmer perceives that crop yield have improved after 2007 (the period after which CIP was introduced and hence the voucher and land use consolidation programs).
Change in Food Security	0.7	0.46	Equals 1 if the farmer perceives that food security has improved.
Change in Household Income	0.72	0.45	Equals 1 if the farmer perceives that Household income has improved.

4. Empirical Results

The first attempt in looking at the difference in crop yield for the period before and after 2007 that is 2002 A -2007A and 2008 A-2012 A; we computed mean difference for sample crops namely maize, beans, Irish potato, and Cassava for about 20agricultural seasons. The choice of these crops was guided by the crops cultivated in the area and that are among the priority crops as per CIP. The Two-sample Mann-Whitney test show statistically significant difference (at 5% and 1% levels) between the two periods for these crops.

Table 4: Mean differences of crop yield for the period 2002 A - 2007A and 2008 A-2012 A: Two-sample Mann-Whitney test

Farmer Characteristics	2011 Sample Valid cases	Mean diff (T value)	Prob> [Z]
Sample size	20		
Maize	20	3.055	0.0023***
Beans	20	3.667	0.0002***
Irish Potato	20	2.178	0.0294**
Cassava	20	3.146	0.0017***

*P <0.1, **P <0.05, and *** P <0.01.

Information in the above Table 4 establishes the mean difference of crop yield for the above period. But it does not tell attributes of this difference which may vary from different factors including those that are farmer or site specific and those linked to policy interventions. Results in Table 5 show the estimates of the specified equations/models. The intention in model specification was to assess the impact of the policy intervention in crop yield, with focus to the voucher system and land use consolidation. The survey asked farmers if they perceive improved crop productivity or yield for the period 2002-2011 and particularly the period after 2007 when the voucher system and land use consolidation were introduced (Yes=1, and 0 if otherwise). Among all specified parameters, only the voucher system and the head's formal education were found statistically significant at 5 % and 10% levels of significance, respectively. This result postulates that the observed change in crop yield for sample crops is highly explained by subsidized fertilisers and improved seeds through the voucher system, *among other factors*. The marginal effect of the voucher system was also found statistically significant for the two equations (Z= 2.41 P> [Z] =0.016 and Z= 2.77, P> [Z] =0.006).

Table 5 : Probit MLand 2-SLS estimates of crop yield, food security, and household income

Estimation option	Probit ML (Robust)	Probit ML (Robust)	2-SLS (Robust)	2-SLS (Robust)
Variables/Equation	Perception of improved yield (2002-2012) (Equ.1)	Perception of improved yield for the period 2007 to 20011 (Equ.2)	Change in food Security (Equ.3)	Change in Household income
(i) Socio-economic characteristics				
Female head	0.37 (1.08)	0.03 (0.08)		
Age of head	-0.005 (-0.57)	(0.004) (0.36)		
Family size	-0.039 (-0.45)	0.12 (1.40)	0.0005 (0.02)	-0.03 (-1.21)
Head's formal education	0.14 (0.45)	0.60 (1.64)*		
Land Size	0.006(0.61)	0.10 (0.87)	0.002 (0.52)	0.0036 (1.17)
(ii) Elements of the CIP				
Voucher System	0.67 (2.28)**	0.82 (2.56)**	0.599 (1.88)*	0.345 (1.13)
Land Use consolidation	-0.27 (-0.72)	-0.70(-167)		
Irrigation	0.12(0.30)	0.53 (1.08)		
Constant	0.002 (00)	-0.66 (-0.96)	0.41107 (2.03)**	0.657 (4.13)***
Regression Diagnostics				
Wald Chi-square /(F)	8.42	15.43	4.46	5.35
Probability > χ^2 /Prob>F	0.3936	0.0514	0.218	0.147
Pseudo *R*-square / R-Square	0.0668	0.1262	-	-
LR	-63.48	-50.07	-	-
Sample size (*n*)	100	100	100	100

Significant levels: * P $\prec$ 0.1, ** P $\prec$ 0.05, *** P $\prec$ 0.01

The effect of land use consolidation was also estimated to see if there is a differential effect on improved yield. The estimate shows a negative and not statistically significant effect. This is consistent with the descriptive mean value (Table 3) that shows only 27% would have consolidated the use of land for at least one of their plots. The land use consolidation program is still on-going and yet requires more enabling conditions beyond input subsidies; leading to more adoption of land use consolidation both in the marchlands and the hillsides.

The Two Stage Least Square (2-SLS) estimates of the perceived change in food security and household income sustain an indirect and statistically significant effect (at 10% significance level) of voucher system on food security. But this perception of improved food security is more likely seen in terms of foo availability dimension of food security which in turn is highly correlated with the crop production. No significant effect (even at 15 % level) of the voucher system was estimated for the change in household income; but this was found to be positive. The implication of this result would probably mean that no indirect effect of the voucher

system in changing household income and hence reducing poverty among sample population.

5. Conclusion and Discussion

The article attempts to assess the effect of policy interventions in increasing crop yield in Nyamagabe District, with focus to the voucher system. Information used for the analysis was collected at household level in two cells of Nyamagabe District namely Bwama and Kizi. Descriptive results show relatively positive trends of crop yields for the period 2002 to 2012 (A). Crop yields of maize and beans seem to be somewhat stable compared to cassava and Irish potatoes. More explanations may be provided including differentials in use of fertilisers and improved seed varieties among these different crops. Secondly, maize and bean seem to be more food crops for substance; therefore they attract more farmers' interest. Irish potatoes and cassava are also cultivated but they tend to be more for commercial interests.

The comparison of mean crop yield between the period before (2002A - 2007) and after (2008-2012A) show that the means of crop yields for maize, bean, Irish potatoes, and cassava for the two period are very statistically different. Although, these difference can not solely attributed to policy interventions; but there indication that the CIP elements – subsidised inputs through the voucher system played major role. To validate these macro-level findings, the Probitand Instrumental variable models were estimated to establish the marginal effects of these policy interventions on agricultural productivity. Findings substantiate that the voucher system has significant marginal effects on change in crop yield (measured by farmer's perception) at 5% level of significance ($Z= 2.41$ $P> [Z] =0.016$ and $Z= 2.77$, $P> [Z] =0.006$).

We also investigated whether farmers perceive improved food security and household income – the two major goals of the CIP- and if there is an indirect effect of the policy intervention via the voucher system. Results show that about 70% of the sample respondents sustain that food security has improved in the last decade. The estimate of the voucher system is also found positive and statistically significant at 5% level; meaning that policy intervention through the voucher system has contributed in securing food at household level in terms of food availability. The marginal effect of the voucher system of $dy/dx= 0.560$ guides to put into perspective the role of input subsidies in agricultural productivity in Rwanda.

Results of this paper, although studied at a lower scale, give some indication on government's hand in the agricultural transformation in

Rwanda. At the same time, these results brings some research and development questions. For example, what will happen if the government pulls out his hand in direct support towards agricultural transformation and specifically in input distribution as currently envisaged? The option at hand is the transfer of such responsibility to the private sector and farmers. But, there is little likelihood that the private sector or farmers themselves will take the lead and sustain the observed tremendous increments in agricultural production. This requires more and careful institutional arrangements and environment to facilitate the transfer of this noble task from the government to the private sector. Secondly, given that the observed change in crop yield depends heavily on policy intervention; what are further policy innovations and interventions that will allow farmers maintain the same momentum of crop yield which in turn is upon farmer's socio-economic conditions. More research is needed at a larger scale to inform on farmers' ability to finance their farming activities and what other support models that the government of Rwanda may follow to support farmers in a sustainable way.

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References

1. Bingen, J. and Munyankusi, L. (2002). *farmer associations, decentralization and development in Rwanda: challenges ahead. Agricultural policy Synthesis, Rwanda Food Security Research Project.* Kigali.
2. Bizoza, A. R. (2012). Farm, Household and institutional- level effects on Potato productivity in Nyamagabe District, Southern Rwanda.
3. Byiringiro et al. (1996). *Promotion food security in Rwanda through sustainable agricultural productivity.* Michigan.
4. Doug Gollin. (2010). Agricultural Productivity, Economic growth and food security. *Agriculture for Development* .
5. FAO. (2003). *the design of land consolidation pilot projects in Central and Eastern Europe*. Land tenure studies 6, Rome 2003
6. Berkeley and R. Derek. (1987). *Economics for agriculture, food farming and the rural Economy.* London: Macmillan Education Ltd.
7. IFDC. International Center for Soil Fertility and Agricultural Development. (2010). *Evaluation report on Crop Intensification Program, Kigali, Rwanda.*
8. John Pender et al. (2004). *Strategies to Increase Agricultural Productivity and Reduce Land Degradation in Uganda.*
9. Kazi Ali Toufique. (2002). *Hands not land: How Livelihoods are Changing in Rural Bangladesh.*
10. Musemwa and A. Mushunje. (2012). Factors affecting yields of field crops and land utilisation amongst land reform beneficiaries of Mashonaland Central Province in Zimbabwe. *Journal of Development and Agricultural Economics Vol. 4(4)* .
11. MINAGRI. (2004). *Natioanal Agricultural Policy*. Kigali,Rwanda .
12. MINAGRI. (2011). *Strategies for sustainable crop intensification in Rwanda* . Kigali,Rwanda .
13. MINECOFIN. (2000). *Rwanda vision 2020, Ministry of finance and economic planning.* Kigali.
14. NISR. (2010/11). *Main indicator report, Third Integrated Household Living Condition Survey (EICV3). National Institute of Statistics of Rwanda.* Kigali.
15. NISR. (2012). *The evolution of poverty in Rwanda from 2000 to 2011: results from the household surveys (EICV). National Institute of Statistics of Rwanda.* Kigali.
16. Wilfred Nyangena and Gunnar Kohlin. (2008). *Estimating returns to soil and water conservation investiments, an application to crop yield in Kenya,*. Kenya.

17. World Bank. (2011). *Seeds for higher growth,Rwanda economy update*. (S. edition, Ed.) Kigali.
18. Yannick, G. (2007). *Building capacity for sustainable land use and management in Rwanda, UNDP/GEF-MSP Project on land degradation in Rwanda*. Kigali.