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Rwanda Goat Production: A Key Element for Economic Growth and Sustainable Development

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Abstract: ***This project analyses the possibility of goat production for sustainable development and improvement of livelihoods of Bugesera district farmers. The specificity of this study relied on the mixed mechanism of crops and livestock production for tiring small land where other sustainable agricultural mechanisms are inexistence or almost impossible to implement. This study applied quantitative and qualitative methodologies to analyze the real consequences of intensive use of inorganic fertilizers and proposed a coping mechanism of goat manures as a sustainable solution for small landholders. It combines data that captured the field's yields, and applied quantity of organic and inorganic manures in experimental fields to grow different crops, the experiment fields replicated using organic and inorganic fertilizers data were collected for comparability aspect. The study associated those findings with the structured interview questionnaire to examine further the importance of goat production on livelihood improvement as ultimate objective to alleviate poverty sustainably. Also, this study concluded by showing the potential role that the goat production intervention should have for sustainable development in Bugesera district. This requires a dramatic change in both policy and technological need to foster the economic development especially to alleviate the poverty by ensuring a sustainable living mode for farmers and increase their wellbeing using affordable investment to increase the small lands productivity and provide alternative sources of income for farmers who are heavily dependent on agricultural production.***

1. Background of the Study

Rwanda embarked on the growth agenda for reaching a middle-income country status by 2020 and efforts to increase the country production, which encompasses the adoption of land consolidation strategy and the use of inorganic fertilizers to increase agricultural production. The head of state summit on the use of fertilizer held in Abuja in 2006 validated the intensification use of the fertilizer from 8kg /ha-1 to about 50 kg/ ha-1 in 2015 (Marenya et al., 2012) and Rwanda has followed those recommendations through a modernization and crop intensification program to increase field yields by intensive use of inorganic fertilizers and terracing (MINAGRI, 2013). The problem is that this substantial capital investment in fertilizers and crop intensification has occurred at the expense of the capacity of the soil to sustainably cope with intensive use of fertilizers. The current farming practices in Rwanda if not changed will be unable to contribute significantly to food security and poverty reduction within the context of soil acidity and inherently poor soils such as those found in many parts of Rwanda.

There is evidence that the current farming process not only depletes soil fertility but also reduces the coping mechanism for soils by reducing the crumb structure and soil permeability (REMA, 2013). Agricultural sector sustainability requires a radical change in the way the current farming system is done. 'The current agricultural policies aims to transform farming practice national wide and involve a rapid shift away from traditional modes of production towards specialization in a small number of government approved marketable staple cash crops' (Neil, Adrian and Thomas, 2015). The two major components of this strategy are the Rwandan Land Policy and the Crop Intensification Program (MINAGRI, 2008). The Rwandan Land Policy, introduced in 2004, states that current trends lead toward 'a completely degraded land as a result of such archaic agricultural practices, unable to meet the food demand of an ever increasing population. Cash crop production requires intensive use of inorganic fertilizer, however little attention has been paid to the consequences of using inorganic fertilizers for soil depletion, land degradation and water downstream pollution (REMA, 2011). One sustainable solution to be undertaken is the use of organic manures produced by goats (Anglo Nubian). The preference for goat manure is supported by their affordability for both tiny landholder and big landholder and the economic, social and cultural potential role played by goats in Rwanda households. Mamabolo et al. (2010) has provided evidence on the potential role played by goat production to alleviate poverty in Africa. The characteristics of goat manures in trace nutrient and quantity produced by goats have been studied by Wuta and (2012), 'they found that goat manure is rich in nitrogen (N), phosphorus (P) and potassium (K) and organic carbon and decreased soil acidity once applied'.

2. Statement of the Problem

Rwanda is called a country of a thousand hills and the steep slopes and acidic soils of highland areas make the growing of crops unsuitable and the application of inorganic fertilizers on acidic soils become problematic. Although fertilizer input can increase production in the short term, it is not sustainable as soils become more acid and depleted. The intensive use of inorganic fertilizers being used to increase agriculture production represents a danger in the near future and is not sustainable in whatever forms, not only with limited land but also with no option to use crop rotation and fallow practices because of limited land availability that forcing sedentary intensification. In this regard, there are limited researches undertaken in Rwanda on the relationship between goat production, inorganic fertilizers' usage and the crop and livestock production in economic growth and sustainable development.

3. Objectives of the study

To examine the contribution of organic manure to support crop production and reduce soil depletion in Rwanda.

4. Research design

This study is regarded as a descriptive research under category of cross-sectional study. A descriptive research is concerned with conditions, practices, structures, differences or relationships that exist, opinions held processes that are going on or trends that are evident. This study applied both quantitative and qualitative methodologies to analyze the real consequences of intensive use of inorganic fertilizers and proposed a coping mechanism of goat manures as a sustainable solution for small landholders.

Target Population

A research population is generally a large collection of individuals or objects that is the main focus on formal research. It can be known as a well-defined collection of individuals or object known to have similar characteristics. Concisely, the target group for the study in question was Mayange and Ngeruka sectors located in Bugesera district. These two chosen sectors have a population density of 203/Km^2 and 333/Km^2 respectively (NISR, 2012).

Table1: Sample frame

Sector	Members of Community Health Workers in place (Population)	Sample Size
Mayange	54	48
Ngeruka	60	52
Total	**114**	**100**

Due to logistics and the cost of travel in and out of the zone the sample size expected were 100 farmers but questionnaires were only distributed to 50 farmers due to practical reasons. This sample was representative as stated by Bryman (2012). Three rounds trips were done to visit experimental fields where RAB grows different crops of maize, Irish potatoes, sorghum and cassava using manures or inorganic fertilizers. The semi-structured interview with farmers involved in experimental studies helped assess the situation on current farming practices, the results from the use of organic manure production and the application of this new approach to farming system. The impacts on the environment were explored using the Rwanda Environment Authority (REMA) reports that are published every year.

5. Research findings

Table 2: Importance of goat manure to increase small farm productivity

		Frequency	Percent
Valid	Yes Enriching soil carbon	15	30
	By Sustaining yield	17	34
	Enhance sustainability of soil fertility	6	12
	Increase the socio-economy of smallholder farmers	6	12
	I don't know	6	12
	Total	50	100

The qualitative data collected also helps to evaluate whether growing goat and other ruminants livestock help Bugesera farmers to have a sustainable way of living by consolidating income from different sources and increase opportunities to escape from poverty. The findings from discussion with the respondents showed that 22 percent who growing goat increased their food security by having an alternative source of income. 22 percent recognized that goat production had improved the local production and consumption, whilst 18 percent affirmed that once the goat production is well managed it could help in industry expansion by providing raw materials. 18 percent believed that the expansion of goat production would create job opportunity for farmers.

Table 3: The socio-economic impact of improved goat production on small farmers' livelihood

		Frequency	Percent
Valid	Improved Food Security	11	22
	Improved Local production and consumption	11	22
	Agro-processing industry expansion	9	18
	Improved income and wellbeing	10	20
	Job creation and increase farmer opportunities	9	18
	Total	50	100

For the purpose of this research, there was also a need to understand the goat manure handling before usage in farm and for both questions of the consequences of inorganic fertilizers for human life and the proposed remedy of different results and excessive usage of inorganic fertilizers on smallholder farms has also been discussed. The two remaining questions of the importance of goat production for economic and especially poverty reduction and that of benefits of improved income and livelihood for goat breeders were also discussed. The last question of relationships with other economic sub-sector was also investigated using the IMPLAN model to evaluate the impact that may rise from increased goat production.

The data collected were useful to answer the fundamental question asked during this research. For the qualitative data that are mainly constituted by the answers collected from interviewees in Bugesera district, results were interpreted using SPSS software to compute different tables and charts for quantitative data using excel. Both quantitative and qualitative data focused on four research questions: (i) determining the consequences of successive use of inorganic fertilizers on soil depletion and pollution of water sources and on the smallholder farm; (ii) the proposed remedy to alter the consequences of inorganic fertilizers for human health and if the usage of organic fertilizer as farming practices itself is enough to reduce soil depletion and deficiencies in nutrients and support the crops production; (iii) the role of goat production in the economy, especially in poverty reduction initiatives; and finally (iv) the benefits that may come from improved income for livelihoods and its relationship with other sectors. Although the information collected may primarily help to analyze the problem, finding data on soil acidity and depletion was a main challenge. The following interpretation and discussion was done with that spirit in mind to explore in depth the issues surrounding the extensive use of inorganic fertilizers for smallholder where other farming methods are quasi- inexistent.

The first fundamental question asked was related to consequences of inorganic fertilizers usage on soil depletion and the pollution of water sources. The inorganic fertilizer has consequences on soil fertility by reducing aggregated crumb structure and soil permeability that aids in cultivation. 24 percent of respondents affirmed that intensive use of inorganic fertilizers increase nitrate leaching and soil acidification. This converse with usage of organic manure where 30 percent of respondents affirmed that marginal micronutrient deficiencies that occurred mainly after repeated fertilizing with chemicals can be avoided with additional application of manures. The farmers are aware of chemical fertilizers dangers to natural resources and particularly on their small land that is tilled by hand. In the report published by REMA (2013) the soils depletion is a danger that may be contains as it is even associated with high deficiencies of zinc, copper, manganese, iron and molybdenum in different area. By comparing the farm yield either using organic and inorganic fertilizer it shows that the application of inorganic fertilizer generally increases crops yield in short term but the yield start decline in long-term for example maize yield increased from 0.9 tons per ha in 2006 to 1.79 tons of maize in 2010 and start declining up to 0.89 tons produce per ha in 2015.

In terms of consequences of intensive use of inorganic fertilizers although the answer got from interviewees confirmed that, inorganic fertilizers have adverse negative impact on soil depletion and spoil the water source, different studies have also confirmed this hypothesis like Solomon,W.et al.(2012), Mohd, H. I.et al. (2013), Mofuranya, A.A.J. et al. (2014), Abul, K.Md. et al.2015 and Bhaskarrao,C. et al.(2015).

The numbers of goats bred by farmers are small ranging between 1 and 10 goats per farmers, which represents 84 percent. Goats in Rwanda context are kept on a small-scale land by farmers for several reasons, as goat rearing does not require many resources. The population of goats in Rwanda is estimated at 4,971,000 (MINAGRI, 2015) and are used for different reasons ranging from slaughtering them for home consummation, using as alternative incomes to handle emergencies. The most important role is that the droppings of goat are used in farming as organic manures. The economic growth of goat production is seen as a potentially direct benefit especially in rural areas; using the IMPLAN model simulation in the below describes the best-case scenario on how the interrelationships with sub-sector will benefit from goat production increase.

6. Conclusions

Despite the challenges faced by farmers in terms of goat production, the economic role played by goats in Rwandan society is very important to alleviate the poverty and increase sustainably the soil fertility. The dramatic consequences for intensive use of inorganic fertilizers especially for small landholders in studied zones were identified and responded to our assumption in context where other farming practices like crops rotation and fallow are practically impossible. The mixed mechanism (crop production and livestock production) was seen as the best durable solution to produce sustainable development for farmers.

Firstly, this study has shown that the intensive use of inorganic fertilizers constitutes the primary danger for soil depletion and pollution of water sources in general which at the end led to serious soil erosion as evidenced by State of environment and outlook report (REMA, 2015). The affordability of successive use of inorganic fertilizers for farmers remains an obstacle compare to regional prices. This also has an adverse effect on farmers as far as affordability is concerned, and reduces their ability to cope with environment degradation and climate change.

Secondly, this study reveals that the usage of organic manure constitutes the best alternative given that goats' manures are affordable, easy to manage and represent the potential to increase the structure of soils and reduce the vulnerability to soil erosion, and increase the soil fertility in long run. Goat rearing also constitutes the coping mechanism (as an alternative source of income) by farmers in case of bad harvest due to poor climate. Given Bugesera district has all the necessary conditions for rearing goats there is a full potential to produce enough manures to support crop production and goat manures are rich in nutrients to support crop production.

Thirdly, the importance of goat production for the economy and for society in general have been evaluated and confirmed. Goat production has become a profitable business, as it only requires a very low investment given its multi- functionality utilities. In Bugesera, district goat rearing contributes to district production and is one of the primary sources of nutrition, income, and manures for the local population. Although for traditional beliefs district goat milk are at lower production, goat milk has the potential to provide other products likes goat cream, butter etc. Goat meat is the best and has a good taste, is nutritious and healthy and is considered as the poor man's cow because it is the main source of regular income for most middle class families.

Lastly, this research has shown the potential impact of goat production involvement for sustainable development in Bugesera district. To reach country's ambitious target it is imperative to change both policies and technologies that are required to foster the economic development. It is beneficial for both farmers and the environment to adopting lesser investment that allow graduation from extreme poverty by ensuring easiest mode of food production and increase the wellbeing of farmers with small size lands who are heavily dependent on agriculture.

7. Recommendation

Based on the analysis, goat production was found to have a positive relationship with economic growth and sustainable development in Rwanda. This implies that an increase in goat rearing leads to enough manures to support crop production and goat manures are rich in nutrients to cope with environment degradation and climate change. In addition, goat meats improve wellbeing of farmers and are easily affordable by population with limited purchasing power. This discourages usage of inorganic fertilizers, as

they are harmful to both soil and human being in short and long term perspective.

The researcher recommended that the Government of Rwanda should find ways of increasing investment in goats rearing and work with private sector to create a conducive environment in promoting and diversifying locally and internationally goats' related products.

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