

Cattle manure management in Rwanda – A case of Girinka cow beneficiaries in the district of Ngoma

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Abstract

Girinka – or the “one-cow per poor family” program – is currently being promoted as a poverty reduction strategy in Rwanda. One potential benefit of the program is the possibility to improve soil fertility through the collection and application of cow manure. No research, however, has been conducted to date to assess the effectiveness of manure usage amongst the Girinka cow beneficiaries in the country. To address this, a comprehensive study was conducted in the Ngoma district to assess current levels of manure knowledge, attitudes, and practices (KAPs) among Girinka beneficiaries. Preliminary results suggest that >90% of Girinka beneficiaries are using manure, and beneficiaries positively attributed increased yields and improved soil fertility to manure use. However, beneficiaries were not consistently using recommended manure management practices, citing lack of manure handling and transporting tools, distance to fields, and poor construction of cow sheds (particularly the roofing) as key limiting factors. We recommend stronger emphasis on manure usage during Girinka trainings and future research to determine the best manure management practices for one-cow farm systems to maximize the potential benefits of manure application for Girinka farmers in Rwanda.

Key words: *Girinka program; manure; Ngoma district; Rwanda*

1. Introduction

In Rwanda, a national pro-poor growth program called “Girinka” (pronounced ghee-ring-ha in Kinyarwanda) or the “one-cow per poor family” program was initiated in 2006. The program aims to: i) reduce the country’s chronic child malnutrition rate; ii) increase household food security; and iii) generate alternative income through

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integrated crop farming and dairy cattle rearing (RARDA 2006). The program objectives also touch upon numerous constraints present in Rwandan agriculture today. For example, according to the Food and Agriculture Organisation (FAO) of the United Nations, about 40% of Rwanda's land is highly susceptible to erosion, 37% requires soil retention measures prior to cultivation, and soil quality – including both organic matter and soil fertility – is rapidly being degraded (PSTA II 2009). In response to this, the Girinka program offers a possibility to improve soil quality through the application of manure on its beneficiaries' farmland (RARDA 2006). Given the current situations of high population density and limited arable land (inducing cultivation of marginal lands and short fallow periods), Rwandan smallholder farmers, in particular Girinka cow beneficiaries are encouraged to maximize manure usage.

Despite the importance of manure application for the Girinka program however, there are no previous studies that have measured the knowledge, attitudes, and practices of Girinka beneficiaries concerning manure usage and its effect on soil fertility and crop yields. The main objective of the current study is to determine if farmers who have received a cow through the Girinka program in the Ngoma district of Rwanda use manure as a fertilizer source, as promoted by the Girinka program. In addition, farmers' perceived benefits and challenges of using manure are identified to bridge the potential gaps between beneficiaries' priorities and program deliveries and objectives.

2. Methodology

Description of the study area

The district of Ngoma is located approximately 100 km south-east of Kigali and is one of the seven districts that make up the Eastern Province of Rwanda. The district has an average altitude ranging from 1,400 to 1,700 masl. The regional economy is typically agrarian, with >90% of the population working in the agriculture sector (DDP 2009). Agriculture in the Ngoma district is based on rain-fed cultivation. The average annual temperature is 20°C and annual precipitation is 1,100 mm. A small rainy season occurs from mid-October until the end of December (locally known as Season A);

a big rainy season occurs from mid-February until mid-May (Season B); and a dry period separates these two seasons from May to October (Season C). The Ngoma district is composed of 14 sectors, comprised of 64 cells and a total of 474 villages. Approximately 235,000 people live in the district (DDP 2009) and a total of 3,060 households have received Girinka cows since 2006 (RARDA 2011).

Sampling frame and data collection

A mixture of qualitative and quantitative methods was used in this study. Focus group meetings and household surveys were conducted throughout the district in June and July 2011. Using the total number of Girinka cows distributed in the Ngoma district since 2006, a 95% confidence level, +/- 5% tolerable range of error in the estimates, the estimated representative district-level sample size was calculated to be 341 (Creative Research Systems 2011).

A focus group meeting with 10 Girinka beneficiaries was held in Jarama sector to help design the household survey questionnaire. A complete list of beneficiaries in the district was not available at the time of fieldwork. Therefore, using local extension networks, 40 beneficiaries were randomly selected to be interviewed in 12 of the 14 sectors. Pretesting surveys (data not presented) were conducted in three sectors namely Karemba, Mutenderi, and Remera for training and quality control purposes by a team of ten local university students from the Institute of Agriculture, Technology, and Education of Kibungo (INATEK). In nine sectors of the district (i.e., Gashanda, Kazo, Mugesera, Murama, Rukira, Rukumberi, Rurenge, Sake and Zaza), a total of 360 interviews were conducted and used for analysis in this study. Lastly, a focus group meeting with 20 beneficiaries was held in the Kibungo sector to explore additional open-ended questions to complement the survey data.

In addition, interviews with key informants including officials of the district, sector level veterinarians and agronomists, staff from the Ministry of Agriculture and Animal Resources (MINAGRI) and Rwanda Animal Resources Development Authority (RARDA) were conducted (data not presented). After interviews were completed, all surveys were carefully examined to ensure the quality of recorded data. The data were entered in MS Excel spreadsheets and imported

to STATA version 11.0 (StataCorp) to determine the full range of descriptive analyses.

3. Results and discussion

Socio-economic characteristics

Of the total sample population of Girinka beneficiaries interviewed, 69% were male and 31% were female, with ages ranging from 18 to 85 years (median and mean age of 43 and 45, respectively). Over 70% of respondents have received formal education, of which 75% had stopped at primary level.

The surveyed beneficiaries are smallholder farmers, with 50% and 48% associating their livelihood as crop-farming and crop-livestock farming, respectively. Ninety four percent of surveyed beneficiaries had their own land for cultivation, with a total average size of 0.55 ha of landholdings. The breakdown shows 61% owning less than 0.50 ha; 26% between 0.51 and 1 ha; and 13% greater than 1 ha. Adding to this, nearly 70% of the beneficiaries were farming 2 to 6 plots, resulting in fragmented farms and smaller fields (averaging 0.22 ha per plot).

Three types of cow breed were given in the district of Ngoma: local *ankole* (28%), exotic Friesian or Jersey (18%), and/or a crossed breed between *ankole* and exotic (55%). The main distributor of Girinka cows in Ngoma was the *Ubudehe* program (89%), which is a government funded but locally managed community program. In regards to cow keeping history, 21% of beneficiaries had their cows for more than three years, 31% for two years, 35% for one year, and 13% less than a year. Keeping the respective classifications of cow keeping history, 13%, 15%, 10%, and 2% of beneficiaries claimed to own more than one cow at the time of interview.

Manure management and practices – collection, preparation and applications

The Girinka program mandates a zero-grazing system. This is done for two reasons: i) to contain cow's manure for agriculture fertilizer; and ii) to reduce the potential contamination and tropical disease transmissions from open grazing (PSTA II 2009). The recommended cattle housing design suggests open cattle sheds with roofing, sloping

concrete floor, slurry pit, and manger (Snijders et al. 2008; MINAGRI 1990 and 2010). Although most beneficiaries kept their cows under cattle sheds (79%), many of these sheds were of poor quality construction materials based on field observations and focus group meetings held in July 2011.

To facilitate manure handling and transportation, Girinka beneficiaries interviewed primarily used tridents, hoes and baskets (51%, 24% and 47%, respectively). Even though tools were available and used by those who owned them, approximately 65% of farmers still used their hands to collect cow manure. The manure collection and preparation work took on average of 50 minutes per occasion, but the majority of beneficiaries interviewed (81%) considered this task short or at least indifferent in terms of lost opportunities.

Collected manure was mainly stored in over-ground piling or heaping (40%) or under-ground pit or ditch (59%). Both storage methods are considered as recommended management practices provided that optimal nitrogen (N) retention conditions are in place (i.e., a compacted, covered heap or pit to reduce ammonia volatilisation, and an impermeable floor to reducing nitrate leaching; Snijders et al. 2008).

Manure was typically collected daily (46%) or weekly (46%) and stored, but a small percentage of beneficiaries only collected manure once a month (7%). The preferred method depends on household labour allocation and manure production capacity, but the recommended practice is for frequent dung removal and if possible, separate urine collection and drainage to limit N losses (Snijders et al. 2008).

Common waiting or maturing durations for stored manure are classified as follow: <1 month (9%), 1 to 2 months (32%), 3 to 4 months (30%), 5 to 6 months (17%) and >6 months (12%). According to a participatory farm experiment conducted in Central Uganda, the application of manure with shorter retention periods (4 weeks) resulted in greater maize yields than fields which received manure with longer maturing period (20 weeks; Zake et al. 2010). Similarly, Tittonell et al. (2009) suggest that close to half of the amount of carbon (C) and nutrients were lost after 5 to 6 months of

storage in Kenya. Although most of the farmers interviewed in this study are storing manure for longer than 2 months, future research is needed to determine the nutrient content and plant yield advantages of the shorter storage and maturing time for Girinka farming system before recommendations can be made.

Approximately 93% of beneficiaries used cow dung as a fertilizer source. Additionally, only 6% of farmers interviewed used inorganic fertilizer in the past year at minimal rates (average 0.03 kg ha^{-1}). This reaffirms the importance of manure use to improve soil fertility for resource-poor, small-scale farmers in this region of Rwanda. However, despite the high rate of manure usage, the estimated quantity of manure used varied considerably amongst beneficiaries. On average, Girinka beneficiaries in the Ngoma district used about $1,900 \text{ kg of manure yr}^{-1}$ on their fields. Assuming an average field size of 0.55 ha , this is approximately $3,500 \text{ kg ha}^{-1} \text{ yr}^{-1}$, which is considerably below the recommended rate for food crops in Rwanda (i.e., $10,000 \text{ kg of manure per ha}$; MINAGRI 2010). The applied amount is also less than the estimated manure production of $6,000 \text{ kg of manure per year}$ for a local *ankole*, weighing 300 kg , reared in zero-grazing system (MINAGRI 1990). There may be many (and compounded) reasons why the Girinka beneficiaries in this region apply low or less-than-optimum levels of manure and future work will assess the association between low manure usage and various local factors (e.g., small and scattered plots of land, far distance of travel to plots, poor cow sheds and manure collection facilities, lack of manure handling and transportation tools, availability of extension services, and better understanding and knowledge of manure preparation and application practices).

A seasonal pattern emerged from the beneficiaries' manure application. Of all the manure used in the past year by the interviewed beneficiaries, 49% was used in season A, 34% in season B, and 17% in season C. In order to optimize the benefits of manure nutrients to plants' uptake in the dry-land conditions, it is best if manure is applied at the onset of the rains (Mkhabela 2006). Although most manure was applied during one of the rainy seasons, farmers stated that they also based their decision for when to apply manure upon crops and plot (34% and 21%, respectively). In

addition to these criteria, about 30% of farmers applied manure randomly.

Farmers' knowledge and attitudes of soil fertility and crop yield

One potential reason for the high use of manure by Girinka beneficiaries may be due to their belief that they have fertile soil (81%), of which 82% attributed their fertile soil to the application of manure. The remaining 19% who perceived their land not to be fertile referenced naturally poor soil characteristics (57%), not enough manure (32%), and continuous cultivation (26%) as main culprits of poor soil fertility.

Despite their differing perceptions on soil fertility and its attributes, the vast majority of surveyed beneficiaries believed that manure can bring a positive influence on their land (99%). The beneficiaries suggested that signs of improved soil fertility were increased crop production (92%), darker soil color (24%), and more humid soil texture (8%). Beneficiaries were further asked about their recollection of increased crop production after manure application. The survey data suggest that the yields of beans (*Phaseolus vulgaris*), maize (*Zea mays*), sorghum (*Sorghum sp.*), cassava (*Manihot exculenta*) and banana (*Musa sp.*) grown in the district doubled after manure use. However, future research is needed to quantify the percent increase in crop yield as a direct result of manure use. Nonetheless, this positive perception of manure use on crop yield is another potential reason why the majority of farmers in the Ngoma district may be using manure.

Implications and recommendations

Although the majority of beneficiaries are using manure on their fields, our data suggest that recommended management practices for collection, storage and application are not always being followed. Three main factors were suggested by Girinka farmers in the Ngoma district as being most problematic in their manure practices. These include lack of manure handling and transporting tools, distance to plots, and poor construction of cow sheds particularly the roofing (97%, 55%, and 26%, respectively).

Another potential reason why recommended management practices are not consistently used in the district may be because many of the

sampled farmers had low access to extension information and services. In total, 36% of surveyed beneficiaries have not yet received formal Girinka training, of which 40% claimed that they did not know that this training existed. Most of interviewed beneficiaries (86%) considered Girinka training as the sole source of information and learning in regards to rearing a cow. In fact, the surveyed beneficiaries revealed the usefulness of the training materials on manure practices. Of those who received the Girinka training (64%), 68% said that the manure topic was covered during their training and 59% of them practiced the knowledge that they acquired. Given local conditions and scarce resources available to district and sector-level extension agents, an expansion of services may be unfeasible at this time. However, we suggest that stronger emphasis be placed on best manure practices during the training, especially for those with no previous experiences in taking care of a cow (41% of respondents). For these farmers, extension services and training courses are vitally important. At the macro-program level, additional research to inform development is required to determine how best to promote the “best manure management practices” for one-cow farm system in Rwanda.

4. Conclusions

Our results show that over 90 percent of beneficiaries used manure in their farming system. Such high usage rate can be regarded as a first milestone accomplishment for Girinka beneficiaries. It is equally impressive to see near unanimous consensus amongst farmers who believe that manure can improve soil fertility and improve yields. This is testimony of Girinka farmers’ positive attitudes towards manure practice and accompanying results. However, this study also suggests that there are gaps in the current manure knowledge and practices of the surveyed beneficiaries. The low quantity of manure applied warrants further analysis, to determine the factors which influence less-than-optimum levels of manure usage. Future work will determine if linkages exist between low quantity of manure use and various other constraints affecting Girinka beneficiaries. As the Girinka program is entering its sixth year of implementation, it is timely to review the current program deliveries and outcomes to develop strategies for the program to reach its maximum potential over the next seven years. A gift of a cow can make a family happy,

but determining how to sustain the continual gifts a cow can offer (i.e., manure, milk, reproduced calves, social benefits, etc.) may truly transform a family.

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