# Impact of Zero Grazing Practices on Livestock Production Among Smallholder Farmers in Rwanda: A Case Study of Burera and Gicumbi Districts

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**Abstract:** Livestock plays a crucial role in household and national economies of Rwanda and contributes to the national Gross Domestic Product (GDP). The aim of this study was to assess the impact of zero grazing on livestock production among smallholder farmers in Rwanda. A case study of Burera and Gicumbi districts. A Cross-sectional data from rural households and communities were collected using survey methods. Twenty (20) farmers were selected from each of the eight sectors making one hundred sixth (160) do livestock zero grazing farmers system. The findings of the study indicated that main and first feeds used by farmers in zero grazing in study area is nippier grasses (*Pennisetum spp*) with 100%. The result of the regression analysis in (table 3) showed that eight variables out of thirteen were positively influenced production of zero grazed livestock in study area. Gender, farming experience, land size, source of feeds, and yield were statistically significant at ($P \leq 0.01$) level. The findings in table 4 showed that, the four sectors namely income generation, quick accumulation of manure, infrastructure facilities, and animal high yield produce have statistically and significantly affected by zero grazing system at ($P \leq 0.01$). The findings of this study showed that the most common constraints for zero grazing system is small and fragmented land holdings, lack/poor animal housing with (100%). The shortage of water/quantity/quality of fodder was the second constraints in study area with (90.3%). The findings also showed that there was no good and separate houses for the livestock in study area while most of the livestock raised without housing. The number of veterinaries and extension service should be increased as well as to control the problem of poor quality and low quantity of livestock products, disease, and death of animal raised. Proper animal housing and proper animal feeding both in quality and in quantity should be increased in order to improve animal health and increase livestock production.

**Keywords:** Impact, Zero Grazing Practices, Livestock, Production, Smallholder Farmers

## 1. Introduction

Agriculture is a central component of the economic development of the country; it employs 70% of the workforce [40] and generates 35% of the GDP [28]. In sub-Saharan Africa Livestock represents on average 30% of the Agricultural Gross Domestic Product (GDP) and about 10% of the national GDP and up to 250 million poor people depend on livestock for their income and livelihoods. However, the sector is seriously constrained by animal diseases and

inadequate investments to enhance its contribution to the development of the African Continent, despite its great advantage potential [7].

Growth in agricultural production and productivity is needed to raise rural incomes and to meet the food and raw material needs of the fast growing populations. Livestock have an important part to play, as they provide high-quality protein to consumers and regular income to producers. To fulfil their potential sustainably, livestock must be managed with efficiency [8]. The demand for livestock products in the world is fast increasing due to a rapid increase in world population leading to growing demand for meat, especially in developing countries. This trend is expected to rise the number of livestock reared worldwide, a setting which is threatened by climate change [4].

Other studies have shown that the reductions in the number of cattle are due to death caused by lack of green pasture during extreme drought events, disease and starvation, as herders do not have enough fund to buy processed food for the cattle [29, 31]. The livestock industry contributes significantly to physical and economic growth by providing nutritional and food security for a productive and healthy living on a worldwide scale [6].

Livestock production performs several functions primarily as source of household income, food and animal drought power for livestock producers. The livestock sector also supports and sustains enterprises and interest groups which are linked and associated with the livestock value chains such as the livestock traders, transporters, slaughter facilities / processors, feed manufacturers, government (veterinary/animal husbandry departments), local authorities, veterinary drug suppliers, etc. who also generate employment opportunities [7].

Livestock provide income, create employment opportunities and provide food and nutrition security across different production systems and along different value chains. As poor livestock-keeping households tend to be net sellers of livestock products, they benefit from rising livestock prices. Moreover, vulnerable groups, particularly women and the landless, frequently engage in livestock production, thus highlighting the multifaceted virtues of livestock promotion as a pathway out of poverty [10]. Livestock provide a safety net, helping keep poor households from falling into poverty. They are often the only asset women can own/control and can be sold to meet emergency and family health needs.

Livestock, therefore, is a major source of sustainable employment for many people and supports rural development initiatives along the value chain. Value added activities, especially meat and milk processing, has the capacity to create higher employment opportunities along the value chain and should be encouraged in addition to marketing the primary products. Meat processing has a value added multiplier effect of 11.7, suggesting that processing of beef into assorted meat products creates more jobs, followed by livestock feeds and dairy products [7].

Livestock plays a crucial role in household and national economies of Rwanda and contributes 8.8% to the national Gross Domestic Product (GDP) [14]. The dairy subsector contributes 15% to the Agricultural Gross Domestic Product and 6% to the Gross Domestic Product [20]. Rwanda has 1.33 million head of cattle, of which 28% are improved dairy cows that produce 82% of the total milk output. The estimate of the annual milk output is 445,000,000 liters with a value of US$ 115.3 million [20].

Livestock provides food and manure, draft power for crop cultivation, a store of wealth for rural people, and the main source of export revenues [5]. The country earned US$23,679,907 from export of live animals in 2014/2015 [32]. Rwanda does not have a livestock master plan, but there is a National Dairy Strategy (NDS) of which the main stakeholders are the Ministry of Agriculture and Animal Resources and the Ministry of Trade and Industry. The NDS developed targets for milk production (by 2017 and 2020), a marketing system, and policy environment and institutional framework [20].

In Rwanda, the predominant livestock production system is a smallholder crop-livestock mixed farming system with average land holding of 0.76 ha for the majority of farmers [25]. Smallholder farmers keep one to three cows [13]. The dominant breed of cattle raised in Rwanda is Ankole, a local zebu breed [25]. Improved dairy cows account for 28% of the total cattle population and produce 82% of milk in the country [20].

Challenges that face animal feed industry include; improving quality of feedstuffs, reliable supply of raw materials; improving knowledge on feed formulation, regulating animal feed industry; increasing investment in animal feed production; and formulating and strengthening animal feeds manufacturer associations [39]. Challenges facing milk production and productivity of dairy animals include increase availability of quality dairy animals, consistent supply of quality feed resources, control of livestock diseases, and provision of technical support services, establishment and strengthening of dairy farmer organizations. Others are improving accessibility to credit facilities, increasing processing capacity and increasing domestic demand through milk consumption promotion [39].

IFAD [11] showed that inadequate livestock nutrition and poor feeding practices are the primary reasons for low animal production, and a major factor affecting the development of viable livestock industries in developing countries. Adequate quantities of high-quality feed are necessary for profitable livestock production. There are forage technologies such as grass-legume mixtures, cereal-legume intercrops, fodder trees, silage and hay making [12], whose use can help in mitigating feed shortages. Inadequate availability of feed, both amount and quality was found to be the single most significant issue causing livestock production to be poor [37].

Rwanda as one of the most densely populated country in Africa, agricultural landholdings are very small, with 60% of agricultural households, farming on less than 0.7 hectares [19]. The total arable land is about 1.4 million hectares, which is 52 per cent of the total surface area of the country. However, the actual area cultivated has exceeded 1.6 million ha in recent years. Another 0.47 million ha is under permanent pasture, so

well over 70 per cent of the country's total land surface is exploited for agriculture [30].

Generally, landholdings are very small with more than 60 per cent of households cultivating less than 0.7 ha, 50 per cent cultivating less than 0.5 ha, and more than 25 per cent cultivating less than 0.2 ha [30]. This constraint is aggravated by the fact that most farms have multiple, scattered plots, many of them very small. This should also be an important limiting factor of doing an open livestock grazing or pastoral grazing in Rwanda.

The Government of Rwanda (GoR) encourages zero grazing because it avoids over-grazing and subsequently reduces land degradation. The main feed available for dairy cattle under this system is Napier grass [27]. The zero-grazing system is characterized by keeping animals in a shed and feeding by cutting and carrying forage and crop residues to the cows. This production system is increasing in proportion due to the shrinkage of grazing land, which has been widely turned over to crop cultivation in response to increasing population [27].

The major available feeds are pasture or grasses, crop residues, improved fodder, and nonconventional feeds like leaves of banana plants and kitchen leftovers [16, 26]. Crop residues such as maize and sorghum Stover and rice, wheat, and sugar bean. Straw are mainly fed to animals during dry seasons. Nonconventional feeds like leaves of banana, pulp and hulls of coffee, tops of cassava, and vines of sweet potatoes are also fed to dairy cattle [13].

Based on a survey that was carried out in 19 out of Rwanda's 30 districts, the main feeds used during rainy and wet seasons are Napier grasses verities, roadside grasses, maize Stover, banana peels, and sweet potato vines [27]. The use of conserved feed such as hay and silage is low among small dairy holders and higher among dairy holders in peri-urban and urban areas. During the dry season and cropping season, there is a severe lack of feed supplies, and its nutritional content is inadequate to sustain essential functions, resulting in decreased livestock production. One of the recommended livestock farming system and most profitable option to overcome this challenge is improved forage production using strategies suitable for a given farming system [2]. Therefore, the current study sought to assess the impact of zero grazing on livestock production and productivity among smallholder farmers in Rwanda. A case study of Burera and Gicumbi districts. The specific objectives were to identify the social economic factors influencing livestock production, to analyse the social economic impacts of zero grazing on smallholder farmer's livelihood, and to determine the constraints facing by smallholder farmers on zero grazing of livestock in study area.

*Objectives:*

1. To identify the main types of feeds in zero grazing livestock in study area.
2. To identify the social economic factors influencing livestock production in study area.
3. To analyse the social economic impacts of zero grazing on smallholder farmers livelihood in study area.
4. To determine the constraints facing by smallholder

farmers on zero grazing of livestock in study area.

# 2. Materials and Methods

## 2.1. The Study Area

The study was conducted in two districts (Burera and Gicumbi) of Northern Province of Rwanda. The choice of these two districts was purposive based on the good agricultural practices especially benches terraces are in abundant and should facilities fodders production in smallholder households farming in this agro-ecological zoning [28]. His average altitude is 2100 meters and his relief is characterized by steeply sloping hills connected either by valleys steep sided or by flooded marshes. It receives the annual precipitation reaching 1400mm depending on elevation. The temperature varies between 9°C and 29°C, according to the places and the season. Agriculture (Maize, beans, wheat, sorghum, banana, Irish potato, sweet potao, and vegetables) livestock farming (cows, poultry, sheep, goat, pig, and rabbits) dominate its rural economy [28].

## 2.2. Data Collection, Sampling Procedure and Sample Size

A Cross-sectional data from rural households and communities were collected using survey methods. The study was carried out in Northern Province of Rwanda, in Burera and Gicumbi districts. Northern Rwanda especially two districts were selected among five due to availability of livestock farmers who have been producing high quantity of livestock products particularly milk. The choice of sectors was purposive based on the number of farmers having at least two cows and other small animals in zero grazing farming system. A list of farmers in both districts were received from district and sector veterinary officers in selected areas. Gicumbi and Burera distcis were chosen due to higher cattle population and milk production target in 2015 [28].

Data was collected between November-December 2021 through personal interviews using pretested questionnaires. Data were collected with the use of structured questionnaires. The information collected included bio-data and information relating to the farming system, feeds used and constraints facing in study area. Twenty (20) farmers were selected from each of the eight sectors making one hundred sixth (160) do livestock zero grazing farmers system. The common market price and market availability were used to value the quantities of livestock products as well as social economics impact on farmer livelihoods in study area.

***Table 1.*** *Distribution of Sample Frame and Sample Size.*

| District | Sector | Sample frame | Sample size |
|---|---|---|---|
| Burera | Cyanika | 150 | 20 |
|  | Kagogo | 150 | 20 |
|  | Butaro | 150 | 20 |
|  | Bungwe | 150 | 20 |
| Gicumbi | Manyagiro | 150 | 20 |
|  | Miyove | 150 | 20 |
|  | Rutare | 150 | 20 |
| Total | Nyankenke | 1200 | 160 |

## 2.3. Data Analysis

The descriptive statistics analysis that were employed using percentages and diagrams to characterize the zero grazing livestock farmers. Factors influencing livestock production and the impact of zero grazing on livestock farmers' livelihoods were analyzed using regression analysis model to determine the relationships between dependents and independent variables. The data was coded and entered in Statistical Package for Social Scientists (SPSS). Descriptive analysis was done using SPSS version 20 and regression using STATA version 14.

# 3. Results and Discussions

## 3.1. Characteristics of the Respondents

Table 2 presents general characteristics of the respondents. The findings indicated that out of the 160 zero grazing livestock farmers interviewed, the proportion of males to females is 64.4% and 34.6% respectively, indicating more males than females included in livestock farming system activities in study area. The mean age range is between 36-50 years represented by 42.5% followed by the range of 51-65 years represented by 26.3% 47 years showing that farmers doing zero grazing of livestock are relatively mature people. The results indicated that 56.9% of had between 4-7 members of household, followed by 27.5% that eight and above members of household. This shows that a vast majority of the respondents of more members of family enabled farmers to engage more in livestock farming production because of the labor force available in the household.

The findings showed that, 67.5% have land less than 0.25ha, followed by 18.1% have the land between 0.26-0.5 ha to do different agricultural activities. Few livestock farmers have greater than 0.6 ha and above. These indicate that most farmers in study have small and fragmented land-holdings indicating a small-scale farming system for the majority in study area. The study further indicated that most of the respondents had only basic education and very few of them have university level of education. The findings revealed that 41.2% of respondents relatively have not attained school followed by those attained primary education with 34.4%. This indicates that education plays a role in livestock farming through easy understand of new technologies and innovations.

*Table 2. Demographic Characteristics of Respondents.*

|  | Frequency | Percentage |
|---|---|---|
| Gender |  |  |
| Male | 103 | 64.4 |
| Female | 57 | 35.6 |
| Age |  |  |
| 21< | 10 | 6.2 |
| 21-35 | 19 | 11.9 |
| 36-50 | 68 | 42.5 |
| 51-65 | 42 | 26.3 |
| 66 and above | 21 | 13.1 |
| Family size |  |  |
| 4< | 25 | 15.6 |

|  | Frequency | Percentage |
|---|---|---|
| 4-7 | 91 | 56.9 |
| 8 and above | 44 | 27.5 |
| Land size |  |  |
| <0.25 | 108 | 67.5 |
| 0.26-0.5 | 29 | 18.1 |
| 0.6-1 | 15 | 9.4 |
| 1.1 and above | 8 | 5 |
| Education level |  |  |
| Illiterate | 66 | 41.2 |
| Primary | 55 | 34.4 |
| Secondary school | 23 | 14.4 |
| Vocation | 11 | 6.9 |
| University | 5 | 3.1 |

## 3.2. Main Feeds Used in Zero Grazing of Livestock in Study Area

The results pertaining to the different feeds are presented in figure 1. The findings of the study indicated that main and first feeds used by farmers in zero grazing in study area is nippier grasses (*Pennisetum spp*) with 100%. This indicate that nappies grasses grown along the terraces are used in different activities especially soil erosion control, fodder for livestock, stakes for climbing crops, and buildings. A large number of zero grazing livestock farmers showed that banana peels and leaves straw (wheat, beans, peas) are used in this farming system with (89.6%) and (71.8%) respectively. In this area, others feeds and maize and sorghum stoves are used in zero grazing system respectively with (69.4%) and (57.7%). This indicates a possible relationship between zero grazing of livestock in smallholder farmers households and feeds availability.
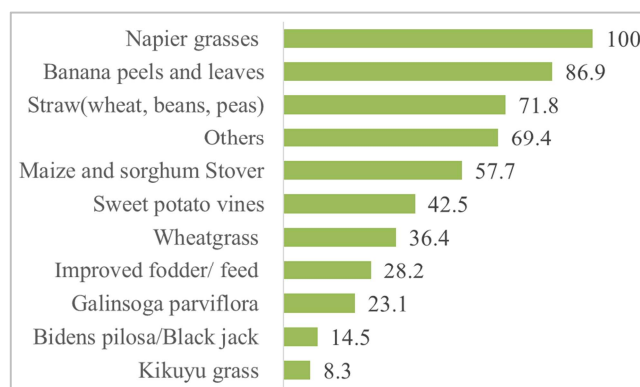


*Figure 1. Main feeds used in zero grazing of livestock in study area.*

## 3.3. Social Economic Factors Influencing Zero Grazing Livestock Production

A logit regression model was fitted using the binary dependent variable that takes the value of 1 if the respondent use zero grazing farming system and 0 if otherwise. The results of the model shows that the data fitted well (R-square = 0.8766 and p-value < 0.0001) as results are presented in table 3. The result of the regression analysis in (table 3) showed that eight variables out of thirteen were positively influenced production of zero grazed livestock in study area. Gender, farming experience, land size, off farm income, and yield were

statistically significant at ($P \leq 0.01$) level. Females are still expected to cook and perform house chore duties while males are expected to do jobs that require lots of energy such as certain farm operations involved in herd management [21].

Pests and disease control, and favorable climate were significant at ($P \leq 0.05$) level, and labor at ($P \leq 0.10$). This showed that some of the household members were likely to provide family labor for farm activities. This was supported by Majekodunmi [18] indicated that successful herd management for maximum profit requires family labor from certain members of household. However, age, education level, off farm income, and lack of stable market were negatively influenced production of zero graze livestock in study area.

This implies that, a unit increment in the land size should increase production of zero grazed livestock by 4.8% holding other factors constant. This suggests that farmers accessing larger plot of land are likely to set aside part of their land for agriculture production and fodder. Milk production depends on the on the level of intensification [22]. The differences in milk production is a result of high quality feeds in different production systems which are determined by the agro ecological zones and the differences in the type of breeds kept by the farmer [23]. It should also implying that a 1% increase in off farm income, 1 year increase in farming experience and 1% increase in source of fodder would increase the production of zero graze livestock by 7.7; 8.7% and 6.9% respectively. It

was supported by Afande and Wachira [3] who showed that in the developing countries if farmers obtain formal financing, the productivity from application of additional inputs would increase.

Lack of stable market showed a negative significance with production of zero graze livestock in study area at ($p < 0.10$). This implying that 1 year increase in education level and 1% increase in lack of stable market in study area would reduce the production of zero grazed livestock by 6.2% and 5.3% respectively. However, the effect of lack of the stable market is negative indicating that the further a farmer is from the market reduces the likelihood of using zero grazing system in livestock farming. Farmers further from the market could attribute this to low price of produce and less access to information. Farmers who perceive stable market and good price as beneficial are likely to use zero grazing system when holding other factors constant. This was supported by kibiego *et al* [15] indicated that milk production cost increases with the level of intensification with profits per litre of milk decreasing with increased level of intensification. Education has a negative influence on production of zero grazed livestock. Holding other factors constant, increase in education by one year reduces the production of zero grazed livestock by 62%. Farmers who are more educated are likely to be investing in other businesses like commercial and government lobar.

*Table 3. Logit regression of the factors influencing zero grazing livestock production.*

| Variables | Coefficient | Standard Errors | P-value |
|---|---|---|---|
| Gender | 0.031 | 0.011 | 0.004 |
| Age | -0.019 | 0.001 | 0.000 |
| Education level | -0.062 | 0.041 | 0.816 |
| Farming experience | 0.087 | 1.356 | 0.000 |
| Plot size | 0.048 | 2.085 | 0.000 |
| Off farm income | 0.076 | 0.734 | 0.000 |
| Labor | 0.510 | 1.836 | 0.081 |
| Stable market | -0.053 | 0.394 | 0.012 |
| Price of product | 0.397 | 0.654 | 0.544 |
| Quantity of Yield | 0.085 | 0.039 | 0.000 |
| Source of fodders | -0.069 | 0.502 | 0.000 |
| Favorable climate | 0.052 | 6.313 | 0.046 |
| Pests and disease control | 0.027 | 0.475 | 0.015 |
| Constant | 4.627 | 6.446 | 0.000 |
| Number of obs =160 Prob > F = 0.0000 | | | |
| F(13, 146) = 148.71 R-squared = 0.8766 | | | |

## 3.4. Social Economic Contribution of Zero Grazing on Smallholder Farmer's Livelihood

The result of tobit regression analysis in table 4 indicated that zero grazing system contributed positively to eight social economic sectors of smallholder livelihood such as (income generation, quick accumulation of manure, employment opportunities, malnutrition control, infrastructure facilities, reduce pests and diseases spread, animal high yield produce, and reduce conflict). The findings in table 4 showed that, the four sectors namely income generation, quick accumulation of manure, infrastructure facilities, and animal high yield produce have statistically and significantly affected by zero

grazing system at ($P \leq 0.01$). This was supported by the result of (Godber and Wall, 2014) indicated that livestock production is an important contributor to sustainable food security for many nations, particularly in low-income areas, and marginal habitats that are not suitable for crop production. According to Umrani [38], livestock contributes to the production of organic fertilizer and fuel; dung from livestock can be used to supply household energy. The two sectors such as employment opportunity and conflict control have been affected by zero grazing system in study area. However, Poverty reduction, reduction of pests and disease spread and malnutrition control have been affected positively by zero grazing system in study area at ($P \leq 0.10$).

This implies that, a unit increase in zero grazing system

should increase income generation should by 9.7% holding other factors constant. This suggests that farmers adopted zero grazing in their household are likely to increase their income 9.7% than those have not adopted. This should due to different products sold especially milk, egg, meat, animal manure sold at local and district market. This was supported by Musemwa *et al* [24] reported that Livestock farming has great potential to alleviate household food insecurity and poverty in communal areas of the world, including South Africa.

This also implies that, a 1% increase in zero grazing system in study area should increase quick accumulation of animal manure by 445.2% holding other factors constant. This is because livestock also contribute to the food supply by providing manure in contributing to land preparation, providing ready cash to buy planting materials or fertilizer, or to hire labor for planting, weeding, or harvesting. This also due to the good management of all animal dung and manure collected at home where those do not practiced zero grazing loose it along the hills and mountains. The results was also supported by Thornton [34]

who showed that Keeping livestock is an important risk-reduction strategy for vulnerable communities, and livestock are important providers of nutrients and traction for growing crops in smallholder systems.

In addition, 1% increase in zero grazing system adoption in study area should increase infrastructure facilities by 5.4%. Feed roads, milk collection centers, therefore, should explain infrastructures constructed to facilitate zero grazing livestock farmers study area. With this construction of these new infrastructures, there was a huge provision of new jobs to different level of people of rural community both educated and non-educated especially Labor Day and workforce. The contribution of zero grazing system should also be explained by reduction of conflict between agriculture farmers and livestock farmers. For example, 1% increase in zero grazing system in study area reduce conflict by 3.8%. Respondents indicated that zero grazing system reduced pests and diseases spread in study area. Where 1% increase in zero grazing system should reduce pests and disease spread by 6.9%.

*Table 4. Social economic contribution of zero grazing on smallholder farmer's livelihood.*

| Variables | Coefficient | Standard Errors | P-value |
|---|---|---|---|
| Food supply | -0.043 | 0.328 | 0.189 |
| Income generation | 0.097 | 3.317 | 0.003 |
| Poverty reduction | 1.214 | 1.365 | 0.074 |
| Quick accumulation of manure | 4.452 | 0.528 | 0.000 |
| Employment opportunity | 0.197 | 1.152 | 0.041 |
| Food security control | 3.126 | 7.876 | 0.550 |
| Malnutrition control | 0.027 | 0.414 | 0.067 |
| Social security | -0.761 | 0.002 | 0.087 |
| Infrastructure facilities | 0.054 | 4.589 | 0.000 |
| Reduce diseases spread | 0.069 | 1.796 | 0.066 |
| Animal high yield produce | 0.045 | 0.807 | 0.005 |
| Reduce conflict | 0.038 | 0.665 | 0.032 |
| Constant | 12.349 | 9.735 | 0.041 |
| Number of obs = 160 Prob > F = 0.0000 | | | |
| F(12, 147) = 81.85 R-squared = 0.8163 | | | |

### 3.5. Constraints Facing by Smallholder Farmers on Zero Grazing of Livestock

The results as presented in the study areas pertaining to the constraints facing smallholder farmers in zero grazing are presented below in figure 2. Despite the role of livestock and its products, the findings of this study showed that the most common constraints for zero grazing system is small and fragmented land holdings, lack/poor animal housing with (100%). This was supported by Teshome Kidanie [33] reported that providing proper housing for the cattle is one of the most important husbandry practices that are needed to protect the animals against the vagaries of nature and thefts and predators alike. Housing has to be so if it is well ventilated and well drained [17]. The results showed that shortage of water/quantity/quality of fodder was the second constraints in study area with (90.3%). This is because inadequate quantity and quality of animal feed in Rwanda, compounded by seasonal fluctuations in water availability, is a key factor preventing dairy cows from reaching the potential milk productivity that could be expected. High costs of vaccines

and medicines with (84.9%), low productivity (80.6%), lack of stable market (76.5%), inadequate storage facilities (69.5%). Price fluctuation and lack of specified livestock manager with (67.2%) and (60.8%) respectively.

The findings also showed that there was no good and separate houses for the livestock in study area while most of the livestock raised without sufficient feeds and proper housing. This is similar to the case of livestock production in the tropics, where lack of available feed for livestock production is said to have resulted from overgrazing and poor-quality and reduced forage from natural veld during the dry season [1]. The study further indicates that the livestock were not provided with specified managers in most of these two Districts where feeding and other proper activities are not well controlled. Few of respondents indicated that theft of fodder, pests and diseases and lack of marketing infrastructures are also the challenges for zero grazing system in study area. This because, high cost of vaccines and medicines reduce the number of farmers enter domain as well as reduction of quantity and quality of zero grazed livestock products especially milk.

The different respondents indicated foot and mouth disease (FMD) as main diseases observed in their farming system. This should increase quantity of products loosed at farm level. In a study in Ethiopia, Tibbo [35] indicates feed shortages, livestock disease, low genetic potential of indigenous livestock, lack of marketing infrastructure and water shortages as the factors affecting cattle and sheep farming in the area.

The respondents further showed that it very expensive for private veterinaries because it requires a long time and distance to meet them or to visit the veterinary clinics that are many times in towns or cities. They also revealed that most of them depended on the government veterinaries and clinics to get their cattle treated as they wish. However, these government veterinaries are in little number because are found at sectors and district level while farmers are dispersed all over the villages as unit of local government. This was supported by the study of Folasade Temitope Ogunkoya [9] conducted in South Africa showed that poor veterinary services, no access to credit, lack of extension services, lack of advice and training are the main important factors reducing livestock production. He concluded that lack of camp systems, drought prevalence, increased feed costs, poor veterinary interventions, insufficient breeding stock, the high cost of fuel and transportation, lack of equipment, disease, stock theft and pilfering, and lack of suitable grazing land.
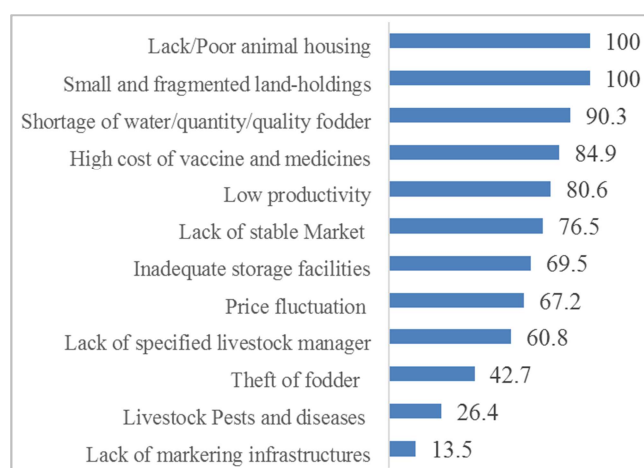


**Figure 2.** *Constraints facing by smallholder farmers on zero grazing of livestock.*

## 4. Conclusion and Recommendations

The findings of the study indicated that main and first feeds used by farmers in zero grazing in study area is nippier grasses (*Pennisetum spp*) with 100%. The result of the regression analysis in (table 3) showed that eight variables out of thirteen were positively influenced production of zero grazed livestock in study area. Gender, farming experience, land size, source of feeds, and yield were statistically significant at ($P \leq 0.01$) level. The findings in table 4 showed that, the four sectors namely income generation, quick accumulation of manure, infrastructure facilities, and animal high yield produce have statistically and significantly affected by zero grazing system

at ($P \leq 0.01$). The findings of this study showed that the most common constraints for zero grazing system is small and fragmented land holdings, lack/poor animal housing with (100%). The shortage of water/quantity/quality of fodder was the second constraints in study area with (90.3%). The findings also showed that there was no good and separate houses for the livestock in study area while most of the livestock raised without housing. As recommendations:

1. Livestock products especially milk; meat and egg should be enhanced through increased number of inseminated cattle, establishment and strengthening of livestock farmer organizations; and facilitation of linkages to markets and dairy value chain actors.
2. Small and medium local conservation system (cold chain) facilities reducing degradation of animal products especially milk should be focused on as well as to reduce production losses for farmer.
3. Organized and dynamic marketing for animal products should be enhanced to increase income generated to farmer in order to improve livelihoods, food security and nutrition of farmer.
4. Proper animal housing and proper animal feeding both in quality and in quantity should be increased in order to improve animal health and increase livestock production.
5. The number of veterinaries and extension service should be increased as well as to control the problem of poor quality and low quantity of livestock products, disease, and death of animal raised.
6. RAB and other researchers should focus on other varieties of nappies grasses and agroforestry shrubs that should increase fodder for smallholder farmers as well as to increase for zero grazing system production especially for cattle, goat, and sheep.
7. Worthwhile to overcome the problems of lack of feeds/fodder particularly during the dry season, farmers should be trained on the systems helping them to know how to conserve fodder in case of surplus.

## Acknowledgements

## References

[1]   Abdulrazak, S. A., Muinga, R. W., Thorpe, W. and Orskov, E. R. (1997). Supplementation with Gliricidia Sepium and Leucaena Leucocephala on voluntary food intake, digestibility, rumen fermentation and live weight of crossbred steers offered zea mays stover. *Livestock Production Science*, 49 (10): 53-62.

[2]   Adugna. (2012). "Potential for development of alternative feed resources in Ethiopia," Tech. Rep., Addis Ababa, Ethiopia, 2012, Report prepared for ACDI/VOCA.

[3] Afande, O. F. and Wachira, J. I. (2015). Constraints to profitability of small-scale dairy farmers in Nyeri South Sub-County, Kenya. *Developing Societies, 5 (7).*

[4] Banik, S., pankaj, P., Naskar, S., Malik, P., Bhatta, R., Takahashi, J., Kohn, R. & Prasad, C. (2015). Climate change: impacts on livestock diversity in tropical countries. *Livestock Production and Climate Change,* 6, 162.

[5] Bazarusanga, T. (2008). The epidemiology of theileriosis in Rwanda and implications for the control. PhD Dissertation. Ghent University.

[6] Behnke, R, Metaferia, F, (2015). The contribution of livestock to the Ethiopian economy– Part II. IGAD Livestock Policy Initiative Working Paper No. 02-11.

[7] COMESA. (2015). Regional Livestock Policy Framework. Lusaka, Zambia 2015.

[8] FAO. (2011). World Livestock 2011- Livestock in food security. Rome, FAO.

[9] Folasade Temitope Ogunkoya. (2014). Socio-economic factors that affect livestock numbers: a case study of smallholder cattle and sheep farmers in the Free State province of South Africa.

[10] Heffernan, C. and Misturelli, F. (2000) *The Delivery of Veterinary Services to the Poor: Preliminary Findings from Kenya*. Report for DfID. Reading: Veterinary Epidemiology and Economics Research Unit, University of Reading.

[11] IFAD. (2007). Livestock and rangelands; livestock feeding [www page]. URL http://www.ifad.org/lrkm/theme/production/feeding.htm

[12] Kabirizi, J. M. L. (2006). Effect of integrating forage legumes in smallholder dairy farming systems on feed availability and animal performance. Unpublished Ph. D thesis, Makerere University, Uganda.

[13] Kamanzi, M. & Mapiye, C. (2012). Feed inventory and smallholder farmers' perceived causes of feed shortage for dairy cattle in Gisagara district, Rwanda. Tropical Animal Health and Production. 44 (7): 1459-68. doi: 10.1007/s11250-012-0087-3.

[14] Karenzi, E., Mashaku, A., Nshimiyimana, A. M., Munyanganizi, and Thonart, P. (2013). Kivuguto traditional fermented milk and the dairy industry in Rwanda, A review. Biotechnology, Agronomy, Society and Environment (BASE). 17 (2): 383-391.

[15] Kibiego, B. M., Langat, K. J., and Bebe, O. (2015). Competitiveness of small-scale milk production systems in Uasin Gishu County of Kenya. *Journal of Economics and Sustainable Development, 6 (10).*

[16] Klapwijk, C. J., Bucagu, C., Van Wijk, M. T., Udo, H. M. J., Vanlauwe, B., Munyanziza, E., and Giller, K. E. (2014). The 'One cow per poor family' programme: Current and potential fodder availability within smallholder farming systems in southwest Rwanda. Agricultural Systems. 131: 11-22. doi: 10.1016/j.agsy.2014.07.005.

[17] LeeKim. (2014). The major reproductive problems of dairy cows in and around ASELLA town, central Ethiopia. Available online at www.advancedscholarsjournals.org.

[18] Majekodunmi, A. (2011). *Pastoral livelihoods and the epidemiology of emergent trypanosomiasis on the Jos plateau, Nigeria*. PhD thesis. University of Edinburgh.

[19] MINAGRI. (2009). Strategic Plan for the Transformation of Agriculture in Rwanda – Phase II (PSTA II). Kigali, Rwanda.

[20] MINAGRI. (2013). Rwanda national dairy strategy. Final Report Kigali, Rwanda.

[21] Moyo, B. H. Z. (2010). The use and role of indigenous knowledge in small-scale agricultural systems in Africa: the case of farmers in northern Malawi. PhD thesis. University of Glasgow.

[22] Mugambi, D. K., Maina, M., Wambugu, S. K., Gitunu, A. M. (2014). Evaluation of technical efficiency of dairy farms in Eastern Central Highlands, Kenya. *International Journal of Development Research and Innovation.*

[23] Muia J. M. K., Kariuki J. N., Mbugua P. N., Gachuiri C. K., Lukibisi L. B., Ayako W. O., Ngunjiri W. V. (2011). Smallholder dairy production in high altitude Nyandarua milk-shed in Kenya: Status, challenges and opportunities. Livestock Research for Rural Development.

[24] Musemwa, L., Mushunje, A., Chimonyo, M., Fraser, G., Mapiye, C. and Mchenje, V. (2008). Nguni cattle marketing constraints and opportunities in the communal area of South Africa. *African Journal of Agricultural Research*, 3 (4): 239-245.

[25] Mutimura, M. (2010). Evaluation of improved Brachiaria grasses in low rainfall and aluminium toxicity prone areas of Rwanda. MSc Thesis. University of KwaZulu-Natal.

[26] Mutimura, M., Ebong, C., Rao, I. M., and Nsahlai, I. V. (2015). Nutritional values of available ruminant feed resources in smallholder dairy farms in Rwanda. Tropical Animal Health and Production. 47 (6): 1131-7. doi: 10.1007/s11250-015-0839-y.

[27] Mutimura, M., Lussa, A. B., Mutabazi, J., Myambi, C. B., Cyamweshi, R. A., and Ebong, C. (2013). Status of animal feed resources in Rwanda. Tropical Grasslands - Forrajes Tropicales. 1: 109. doi: 10.17138/TGFT(1)109-110.

[28] NISR. (2016). Rwanda poverty profile report: integrated household living conditions survey 2013/2014. Kigali, Rwanda.

[29] Ojima, D., Togtokh, C., Galvin, K. A., Hopping, K., Beeton, T., Ulambayar, T., Narantuya, B. & Myagmarsuren, A. (2017). Coping With Climate Extremes in Mongolian Pastoral Communities. *Making Climate Compatible Development Happen*, 182.

[30] REMA. (2009). Rwanda state of environment and outlook report.

[31] Roever, C., Delcurto, T., Rowland, M., Vavra, M. & Wisdom, M. (2015). Cattle grazing in semiarid forestlands: Habitat selection during periods of drought. *Journal of animal science,* 93, 3212-3225.

[32] SYB. (2015). Rwanda Statistical Yearbook 2015. Republic of Rwanda, National Institute of Statistics of Rwanda, Kigali. http://www.statistics.gov.rw/publication/statistical-yearbook-2015

[33] Teshome Kidanie, Dessalegn, Endeshaw Terefe, Ashebir Kifle, Abebe Tafa, Weldegebrial G. Aregawi, Workinesh Seid & Woldegebriel T/ Mariam.(2016). Cattle management and marketing practices in Afar region, 7: 55-65.

[34] Thornton, P. K. (2010). Livestock production: recent trends, future prospects. *Philosophical Transaction: Biological Sciences*.

[35] Tibbo, M. (2002). *The opportunities and challenge of enhancing goat production in East Africa.* Proceedings of a conference held at Debub University, Awassa, Ethiopia.

[36] Tonamo, A., Tamir, B., Goshu, G. (2015). Assessment of cattle feed resources; chemical composition and digestibility of major feeds in Essera district, southern Ethiopia. Sci. Technol. Arts Res. J. 4, 79–88.

[37] Ulfina, G., Zelalem, B., Jemal, D., Gemeda, D., Chala, M., Jiregna, D., Diriba, G., Lemma, G., Workneh, A., Adam, D. (2005). Survey of Cattle Production and Marketing Practices in Danno District, Western Ethiopia, Using PRA Tools. PRA Report.

[38] Umrani, A. P. (2000). Role of livestock production in economy. *Pakistan Economic Review* (05318955), 31 (2): 27.

[39] United Republic of Tanzania. (2011). Livestock Sector Development Programme.

[40] World Bank. (2016b). Rwanda economic update: Rwanda at work. Kigali, Rwanda: The World Bank. (Available from: http://documents.worldbank.org/curated/en/2016/03/26010807/rwanda-economic-update Rwanda-work) (Accessed on 15 July 2016).