

# Challenges and opportunities for smallholder livestock production in post-conflict South Kivu, eastern DR Congo

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**Abstract** A survey on smallholder livestock production with emphasis on monogastric animals was conducted in 20 villages of seven so-called ‘*groupements*’ of South Kivu province in DR Congo, situated along a north to south-west axis with the town of Bukavu in the center. This land adjacent to Lake Kivu is located at elevations ranging around 900–1900 m asl, experiencing tropical highland climate. A diagnostic survey helped to rapidly obtain in-depth knowledge of constraints and opportunities in this environment. Correspondence analysis and multiple regression analysis were used to investigate the association of production constraints with particular livestock species and to understand the factors that govern the number of livestock that people owned

(converted to tropical livestock units [TLU]), respectively. Responses of 112 informants demonstrated that livestock is an integral part of the region’s mixed farming systems. Low livestock numbers per household at present reflect the poverty as a consequence of recent violent conflicts. Currently, farmers focus on small livestock, like poultry, swine, cavy (i.e., Guinea pigs) and rabbits. Families keep livestock to accumulate household reserves that are strongly invested in children’s education. Major issues of animal husbandry were related to animal diseases and lack of feed resources, particularly in the dry season. Lack of feed or forages were unrelated to a particular livestock species. Livestock holdings depended on animal diversity, location, land size available and respondents’ education level. The potential introduction of improved forages is challenged by their dry-season tolerance, compatibility with cropping on small farms; and people’s readiness to cultivate forages.

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**Keywords** Cavy · Food security · Guinea pig · Livelihood · Monogastric · Poultry · Small livestock · South Kivu · Swine · Tropical forages · Tropical highlands

## Abbreviations

ASF African swine fever  
DRC Democratic Republic of the Congo  
m asl Meters above sea level  
PRA Participatory rural appraisal  
TLU Tropical livestock unit

## Introduction

In the South Kivu province of the Democratic Republic of the Congo (DRC), armed conflicts and weak provision of security by the central government have compounded the challenges faced by smallholder farmers in this tropical highland region

since the mid-1990s (Vlassenroot et al. 2003; Van Acker 2005; Cox 2011). The peasant population suffers from extreme poverty and an alarming nutritional status with high incidence of food insecurity (Rossi et al. 2006; Kandala et al. 2011). Agricultural production in general has decreased in the past decade of turmoils (Vlassenroot et al. 2003) setting of a vicious cycle of food and nutritional insecurity (Kandala et al. 2011), low food production and subsequent extreme poverty (Rossi et al. 2006). This situation has been aggravated by limited access to land and markets (Vlassenroot et al. 2003; Ulimwengu et al. 2009). Demographic pressure on the land is highly due to unequal distribution. Infrastructure is neither much developed nor maintained, especially due to the wars and post-war government neglect of these parts of the country (Van Acker 2005; Ulimwengu et al. 2009).

Subsistence production is based on maize (*Zea mays*), *Phaseolus* beans, bananas/plantains (*Musa* spp.) and cassava (*Manihot esculenta*). About 50–80% is produced for household consumption, and only few crops are exclusively aimed for sale, like certain fruits and vegetables (Maass et al. 2010b). Subsistence agriculture, predominantly pursued by 84% of the households as a livelihood strategy, increases their vulnerability. This is reflected by constraints like food insecurity (>60% of people) in South Kivu; human diseases, particularly in children under the age of 5; and little access to agricultural development agents, among others (CIALCA 2008). In CIALCA's (2008) participatory rural appraisal (PRA) reaching almost 900 farmers, 30% of households in South Kivu stated that they can only afford one meal a day. Consumption of animal protein, fruits and vegetables with their high contents of micronutrients was found to be low, especially for children. Kandala et al. (2011) point at the fragile nutritional status of children under 5 years old from South Kivu, shown by their very high prevalence of stunting (46.1%).

In such a volatile environment, livestock production is a major challenge as large animals are a special target of looting (Cox 2011). Farmers, therefore, focus more on small livestock as a coping strategy (Maass et al. 2010b; Zozo et al. 2010; Cox 2011), including pigs, rabbits and domestic cavy (i.e., Guinea pigs). In the region, most development agents and family nutrition advocates have not paid much attention to small monogastrics as yet. Bindelle et al. (2007) similarly state that the actual contribution to food security of cavy in the peri-urban environment of Kinshasa, DR Congo has been greatly ignored. Other authors (e.g., Lammers et al. 2009) emphasize the great potential of cavy to contribute to reducing food insecurity in developing countries, due to various advantages for smallholders. Cavy, like village poultry, most likely serves as the first rung for their owners to ascend on the so-called 'livestock ladder', resulting in larger livestock species (Perry et al. 2002). Livestock production in South Kivu may, consequently, continue to be one of the few opportunities available to smallholders to accumulate a certain level of

wealth (Cox 2008). However, the environment of enduring insecurity and poverty challenges any new research initiative.

This study was conducted in order to (1) assess the current status of smallholder livestock production and its different roles and (2) find entry points for forage research with the aim of advancing the production of small, monogastric livestock species to improve the livelihoods of smallholder farmers in South Kivu. While Maass et al. (2010b) have published a detailed report of survey findings, this article aims to synthesize the results and pave the way ahead.

## Materials and methods

### Region surveyed

The seven *groupements*<sup>1</sup> surveyed are along a north to south-west axis, with the provincial capital town of Bukavu in the center (Fig. 1, Table 1), and comprising a total of 20 villages. Their agricultural land is primarily above 1,500 masl, except for Kamanyola which is located on the Rusizi river plains at about 1,000 m asl, hence, experiencing tropical highland climate.

### Survey method applied

A diagnostic survey approach (Fujisaka et al. 2005) was employed as a powerful tool to rapidly obtain in-depth knowledge of constraints and opportunities in a specific social, economic, and natural environment. Topics addressed beside general socio-economic information of the respondents included monogastric systems, markets, feeds, and the organization of people (Maass et al. 2010b).

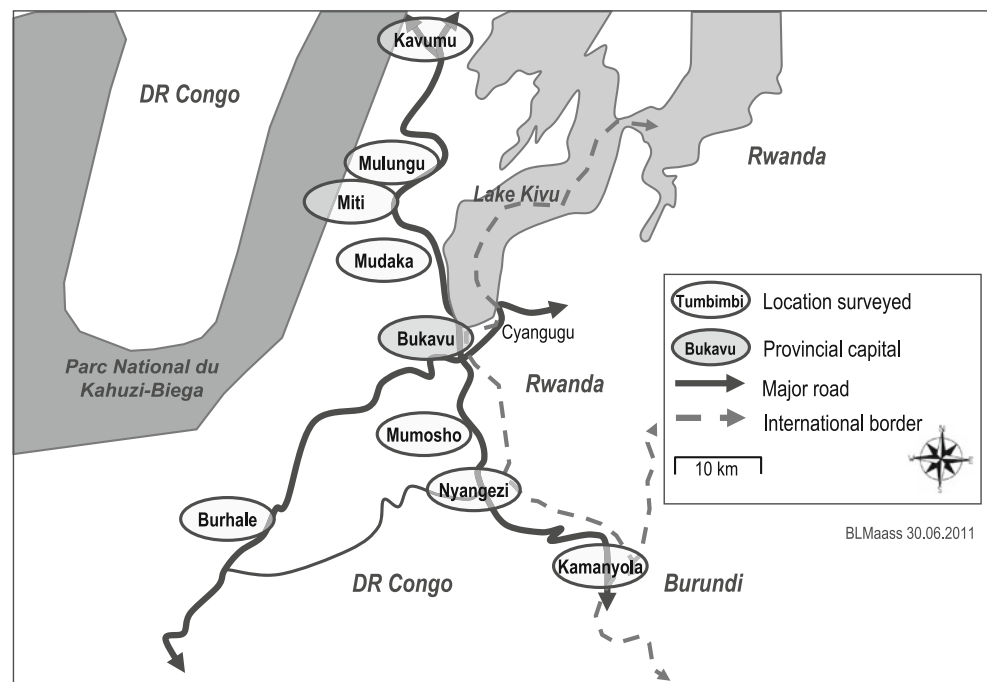
A total of 112 persons from seven *groupements* were interviewed during 4 days in early June 2009 by 20 interviewers comprising four women and 16 men (Maass et al. 2010b). Interviews along a semi-structured questionnaire mostly took place in Kiswahili, occasionally mixed with French and the local language 'Mashi'.

### Data analysis

The number of animals was converted into tropical livestock units (TLU). Conversion factors were first used according to Ghirotti (1993), where cattle are weighed with 0.7, sheep/goat, swine, and chicken with 0.1, 0.2 and 0.01, respectively. Additionally, duck was assigned 0.02 TLU, double that of chicken, rabbit 0.01 TLU, and cavy 0.005 TLU (in a random

<sup>1</sup> In South Kivu, administrative units are, from superior to inferior, Territoire, Collectivité, *Groupement*, Localité, Village.

**Fig. 1** Location of *groupements* surveyed in South Kivu province, DR Congo, in 2009



sample of ten adult cavies they weighed about 500 g/animal).<sup>2</sup> The overall TLU per respondent was then adjusted to 1 TLU being equivalent to one cattle with a body weight of 250 kg (LEAD/FAO 1999).

After analyzing data by descriptive statistics, correspondence analysis was applied to investigate the association of categorical variables, especially that of production constraints with particular livestock species. Animal numbers were converted into indicator variables and all data transformed into Euclidean distances. Correspondence analysis was carried out by using the non-metric multidimensional scaling routine in SPSS (version 18.0).

To investigate the question whether there is a difference in household characteristics between households with a high number of livestock and those with a low number of livestock, a multiple regression analysis was performed with log-transformed TLU values as dependent variable. Explanatory variables were pre-selected by dividing respondents into two TLU groups, with subsequent *t*-test for numerical variables and chi-square test for categorical variables. As TLU showed a strongly skewed distribution, the two groups were defined by the 75th percentile of TLU, whereby respondents with TLU above the 75th percentile were grouped as high and

those with TLU below the 75th percentile as low. Only variables that were found to be significantly different between the two groups were entered into the regression analysis. Wald test was used to drop non-significant terms. The analysis was conducted in Genstat, 12th Edition.

## Results

### Socio-economic profile of respondents

On average, about 40% of respondents were women except for Kamanayola, where predominantly men were interviewed. Respondents' mean age was 40.9 years, varying little among *groupements*, and they had an average of 5.5 children (Table 2). Most parents had several years of primary education, women usually fewer years than men. Also, more women were illiterate than men. Children generally participated in primary education, and many were pursuing secondary education, or even university studies.

Respondents were predominantly crop–livestock farmers (77%), while another 8% were livestock keepers only. Land property was small with a mean size of 1.5 ha and an extremely skewed distribution, as many respondents (45%) had less than half a hectare available, and only 9% had more than 3 ha.

About one third of all respondents were members of at least one of the 36 associations listed during the survey (Table 2), some of which are related to agricultural production. Several respondents belonged to more than one association, while some refused to be involved in any. Though, only about one third of the interviewees had access to

<sup>2</sup> The term 'Cavy' is being used throughout the text instead of the colloquial 'Guinea pig' because the latter provides a wrong impression of a domestic animal that neither originates from Guinea nor is a pig. We follow the scientific literature, where 'cavy' is considered the appropriate naming if neither the laboratory animal nor the pet is concerned. In South Kivu, domestic cavies are either named 'Cobaye' or 'Dende', the latter being the (French) Kiswahili version of 'Cochon d'Inde'.

**Table 1** Socio-economic data of the region, where interviews took place in South Kivu province, DR Congo (data from CIALCA Baseline Survey, 2011, in press)

Groupement (center/research center)	Villages surveyed (no.)	Distance from Bukavu (km and direction)	Latitude	Longitude	Altitude (m asl)	Soil fertility	Population (no. inhabitants) <sup>a</sup>
Bugorhe (Kavumu)	4	31 N	2.30°S	28.82°E	1,700	Good	52,230
Miti (Mulungu)	2	25–27 N	2.19°S	28.47°E	1,700	Recent volcanic	18,683
Mudaka	6	21 N	2.38°S	28.78°E	1,650	Fair	34,452
Burhale	1	57 SW	2.70°S	28.63°E	1,650	Poor	37,047
Mumosho	1	20 S	2.37°S	28.52°E	1,650	Poor	28,903
Karhongo (Nyangezi)	4	30 S	2.88°S	27.03°E	1,650	Poor	39,784
Kamanyola	2	60 SE	2.01°S	29.01°E	900	Good	30,421

<sup>a</sup> Population data 2007 from Rapport Annuel 2008 Administration du Territoire, Division Provinciale de l'Intérieur Sud-Kivu

technical assistance or extension service, of which many complained that it was not adequate to meet their needs.

#### Description of livestock holdings

Small animals like goats, chicken, swine, cavies, and rabbits were the basis of livestock production (Table 3). Cattle were rare (only about 20% of interviewees), although more frequent than sheep (5%). Across all seven *groupements* surveyed, about two thirds each of the livestock farmers raised chicken or goats. Approximately every second household each had cavies or swine, and more than 20% had rabbits. Cavies, were most frequent in Mumosho, Burhale and Nyangezi, but absent in Kamanyola.

Households in the lowland *groupement* of Kamanyola showed, on average, the highest number of swines per household (mean 7.4). While more than 80% of the farmers in Burhale and Mumosho raised swine, on average the numbers

per household were much smaller than in Kamanyola. In Kamanyola households were also found to have double or triple the number of chicken when compared to the other *groupements*, and also the highest number of rabbits per household. Most livestock kept in the region has already had some interbreeding with improved breeds, such as laying breeds in chicken, the Belgian landrace for swine, or wool sheep. Only a few respondents indicated the presence of pure breeds in the locality.

The large majority of households (94%) held more than one livestock species, with a mean of about three species (Table 3) and little variation among *groupements*. Total numbers of livestock species held were generally very low. Only in a few cases were substantial livestock numbers available, e.g., up to 28 chicken, 25 swine, 17 rabbits and 21 cattle in Kamanyola; up to 15 goats each in Miti and Mudaka; up to 35 cavies in Burhale. The locations showed similar livestock holdings based on TLU means (Fig. 2), except for Kamanyola with a slightly

**Table 2** Socio-economic data, organizations belonging to and access to extension service of respondents to a survey in seven *groupements* of South Kivu province, DR Congo in 2009

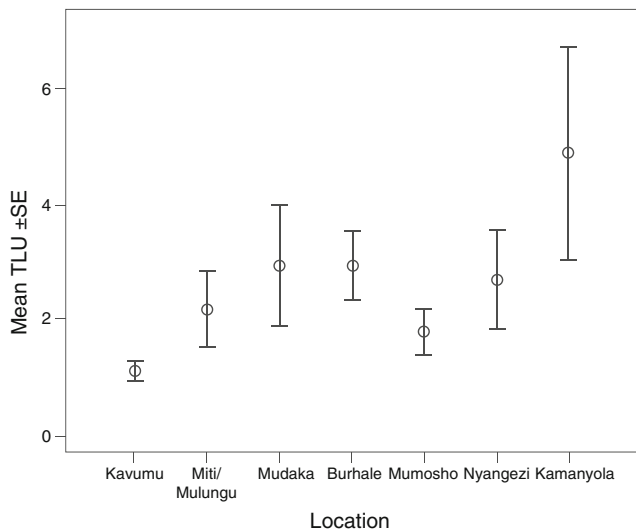
Groupement (center/research center)	Interviews (no.)	Women (no.) <sup>a</sup>	Men (no.) <sup>a</sup>	Mean age (years)	Education level (mode)	Children (no.)	Land area available (ha) <sup>b</sup>	Organized respondents (%) <sup>b</sup>	Organizations named (no.) <sup>b</sup>	Access to extension (%) <sup>b</sup>
Bugorhe (Kavumu)	21	8+	6+	38.5	Primary	5.2	0.83	28.6	7	9.5
Miti (Mulungu)	21	10	11	41.9	Secondary	6.0	1.21	17.4	6	33.3
Mudaka	25	11	12	37.2	Illiterate	5.6	2.52	40.0	8	32.0
Burhale	14	6+	9+	50.5	Primary	5.4	1.46	42.9	5	42.9
Mumosho	5	1	4	43.0	Illiterate	6.5	0.01	20.0	1	0.0
Karhongo (Nyangezi)	13	3	6	45.3	Primary	6.2	1.13	30.8	5	7.7
Kamanyola	13	2+	12+	36.2	Secondary	4.2	1.71	61.5	7	61.5
Mean (Total)	(112)	(41+)	(60+)	40.9		5.5	1.48	38.1	(36)	33.3
SE				1.47		0.41	0.25			

<sup>a</sup> In some *groupements*, many interviewees' sex was not recorded. When a '+' is added to the number, both women and men were present in the interview, and the total may be lower than the added individual numbers

<sup>b</sup> This question was not provided everywhere in Mumosho and Karhongo *groupements*

**Table 3** Mean animal numbers (no.) per respondent who raised the specific type of livestock and proportion (%) of livestock keepers from seven *groupements* of South Kivu province, DR Congo, in 2009

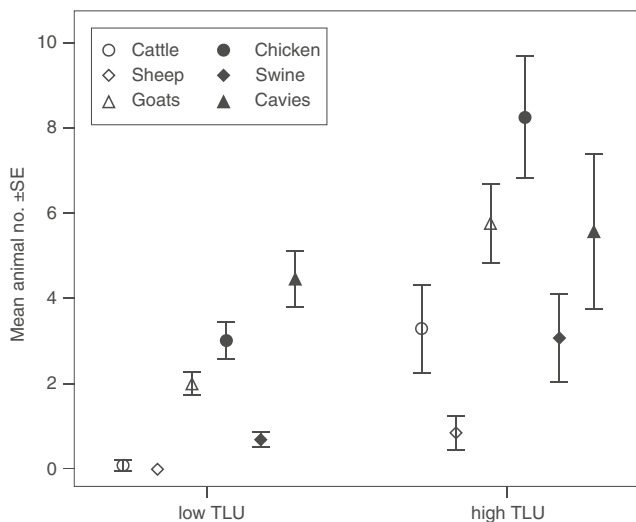
<i>Groupement</i> (center/research center)	Interviews (no.)	Cattle (no.)	Goats (no.)	Sheep (no.)	Swine (no.)	Chicken (no.)	Ducks (no.)	Cavies (no.)	Rabbits (no.)	Livestock spp. (no.)
Bugorhe (Kavumu)	21	1.0	2.6	0.0	2.6	3.6	3.3	7.6	3.8	2.5
Miti (Mulungu)	21	3.0	5.4	0.0	1.1	6.4	20.0	8.8	4.5	2.7
Mudaka	25	5.6	6.2	7.0	1.3	4.2	1.0	3.9	2.0	2.4
Burhale	14	3.0	2.9	2.0	2.3	4.8	0.0	13.8	4.3	4.1
Mumoshoh	5	0.0	4.3	0.0	1.3	3.0	1.0	17.0	0.0	3.4
Karhongo (Nyangezi)	13	4.0	2.7	3.4	2.0	7.4	10.0	9.7	4.5	3.3
Kamanyola	13	8.3	4.9	0.0	7.4	12.3	5.0	0.0	10.0	2.8
Mean (Total)	(112)	4.5	4.4	4.0	2.8	6.1	5.3	9.4	4.7	2.89
SE		1.17	0.39	1.00	0.55	0.62	2.22	0.96	0.90	0.11
Livestock keepers with certain animals (%)		Cattle (%)	Goats (%)	Sheep (%)	Swine (%)	Chicken (%)	Ducks (%)	Cavies (%)	Rabbits (%)	
Bugorhe (Kavumu)	21	9.5	42.9	0.0	38.1	66.7	4.8	61.9	19.0	–
Miti (Mulungu)	21	14.3	76.2	0.0	52.4	76.2	4.8	23.8	19.0	–
Mudaka	25	28.0	60.0	8.0	24.0	52.0	4.0	48.0	12.0	–
Burhale	14	28.6	78.6	7.1	85.7	78.6	0.0	92.9	42.9	–
Mumoshoh	5	0.0	80.0	0.0	80.0	80.0	20.0	80.0	0.0	–
Karhongo (Nyangezi)	13	23.1	84.6	23.1	15.4	76.9	7.7	69.2	30.8	–
Kamanyola	13	23.1	61.5	0.0	69.2	84.6	15.4	0.0	23.1	–
Mean (Total)	(112)	19.6	66.1	5.4	46.4	70.5	7.1	50.5	21.4	–



**Fig. 2** Mean animal holdings recorded according to location surveyed in South Kivu province, DR Congo, in 2009, expressed in tropical livestock units (TLU,  $\pm$ SEM)

higher mean due to relatively high cattle or goat numbers. Only respondents from Kavumu had noteworthy less livestock, which probably reflects a higher theft incidence (see below).

Respondents with high TLU (more than 2.6) had significantly more swine, goats and chicken than households with low TLU (lower than 2.6). Sheep and cattle were only found in households with high TLU values. Interestingly, the number of cavies did not differ between these two groups (Fig. 3). The order of mean animal number per species changed from cavies > chicken > goats to chicken > goats > cavies when comparing the group of low TLU to that of high TLU values.



**Fig. 3** Mean number of livestock species ( $\pm$ SEM) according to overall low (<2.6 TLU) or high (>2.6 TLU) animal holdings expressed in tropical livestock units (TLU), recorded during a diagnostic survey in South Kivu province, DR Congo, in 2009

## Animal husbandry

Most animals were held in or around the homestead. The few pens observed were for swine or rabbits, but occasionally also for goats or cattle. Cavies usually roamed freely in the houses, especially the kitchens. Poultry was almost exclusively kept in free-ranging systems to scavenge for their food. Goats were either walked to feed them in the bush, along the roadside, or they were tethered near the homestead. Swine were also taken to the bush, but more to defecate in order to avoid bad smells around the house, as interviewees stated.

Small livestock production was mostly described as a family activity involving women, men and children. In about two thirds of the cases, children were responsible for herding livestock or fetching forage mostly alone (Table 4); women also gathered forage. About 18% of interviewees employed herdsmen to look especially after cattle and goats.

## Markets and commerce

Subsistence agriculture dominated in all seven *groupements* surveyed; however, portions of some of the staple crops were also sold in the nearby markets or to collectors (Table 5). In contrast, none of the interviewees stated that he or she had ever sold or bought ‘forages’ anywhere. Depending on cash availability, supplementary feeds from crop by-products like brewers’ grain, or palm kernel and groundnut cake were purchased directly from the brewery or the oil mill in Bukavu, respectively.

Respondents kept animals as an asset and for cash income generation, while meat consumption at household level was of low priority. Most interviewees consumed about 20–40% of their livestock production. Swine and goats were mostly sold, while cavies, chicken and eggs were about half for consumption and half for sale. The need for cash dictated strongly the timing of sale, especially, to pay school fees at the beginning of the school year in September.

From 40% to 85% of interviewees reported that they occasionally sold one or more animals or eggs (Table 5) either on a local market or to a neighbor. Some farmers preferred to sell animals to neighbors to avoid administrative issues and expenses that they would have to bear in the market. Other interviewees stated that swine gave higher returns in shorter time than goats, which could partly explain why farmers continued to raise swine despite all the health and disease challenges they faced.

Paying school fees was considered very important, hence, livestock prices reflect the school year. Prices were higher during the Christmas/end-of-the-year season in December because of increased demand for livestock products and low supply as most animals were sold 3 months earlier for school fees and supplies.

**Table 4** Critical features of animal husbandry according to 112 respondents from seven *groupements* of South Kivu province, DR Congo, in 2009

Groupement (center/research center)	Interviews (no.)	Major constraints for animal husbandry (%)				Time for herding or fetching forages (h/day)	Herding animals by (%)	
		Diseases	Lack of feeds (forage)	Lack of money	Theft		Children	Herdsmen
Bugorhe (Kavumu)	21	33.3	42.9 (33.3)	28.6	42.9	2.8	61.9	9.5
Miti (Mulungu)	21	81.0	71.4 (42.9)	33.3	28.6	3.0	57.1	38.1
Mudaka	25	88.0	52.0 (8.0)	12.0	4.0	2.5	76.0	8.0
Burhale	14	92.9	92.9 (64.3)	35.7	35.7	3.1	50.0	21.4
Mumosho	5	100.0	60.0 (60.0)	0.0	0.0	n.r.	100.0	0.0
Karhongo (Nyangezi)	13	92.3	46.2 (38.5)	30.8	23.1	n.r.	84.6	15.4
Kamanyola	13	84.6	61.5 (23.1)	46.2	0.0	3.7	46.2	23.1
Mean (Total)	(112)	77.7	59.8 (33.9)	27.7	21.4	2.8	65.2	17.9

### Challenges to livestock production

Major issues in animal production raised by interviewees (Table 4) were, in decreasing order of importance, animal diseases (78%) and lack of feed (60%), followed by lack of money (28%), animal theft (21%), and animal housing/space (13%), while lack/cost of transportation and predators (5% each), lack of veterinary products (4%) and time to search forages (2%) were named less frequently. This reflects the general situation of extreme poverty of the people who cannot afford to procure supplementary feeding or health services for their livestock.

According to respondents, African swine fever (ASF) seemed to regularly occur about every 6 years or so, and then causes the death of most animals. Chicken regularly suffered from bird (Avian) Flu and Newcastle disease. Interviewees attributed disease challenges to poor and expensive veterinary services. Theft, particularly by armed groups, was still an issue for many livestock keepers, especially in Kavumu and Burhale.

Feeding constraints concerned largely the lack of dry season feed, but also unaffordable prices for by-products or concentrates. Feed supply depended mostly on crops and crop residues, such as cassava and papaya leaves, cassava peelings, rice straw, sugarcane tails/tips, banana stems, sweet potato vines and maize stalks. Some people reserved small areas to grow forage grasses or multipurpose shrubs. To improve swine feeding, by-products of beer-brewing and oil-and-cereal milling were sourced. Chicken also received special attention by feeding them maize or sorghum grains, or small fish.<sup>3</sup> Mostly women and children spent about 1–4 h daily to fetch forages (Table 4), either by walking the

animals to any grazing areas or by collecting forage along roadsides, fields or in lowland, swampy areas.

Some production constraints were clearly associated with particular livestock species by correspondence analysis (Fig. 4). Dimension 1 associates animal diseases and lack of feed with the presence of chicken and goats, whereas lack of veterinary services and products, housing/space and money as well as animal theft were associated with cattle, rabbits and ducks. The latter group of respondents appears to be slightly better off, while the former could be defined as extremely poor. Dimension 2, on the other hand, separates more commercially oriented respondents with cattle, goats and chicken that complained about the lack of money and animal diseases, however, they belonged to associations, had high TLUs, had herdsmen at their disposal and sold their livestock. In contrast, the more subsistence-oriented respondents were those who kept cavies and swine. Lack of feed or forages was not closely associated with any livestock species.

### Determinants for livestock holdings

While the diagnostic survey clearly reflected the extreme poverty of most of the respondents, differences in livestock numbers were also evident. Therefore, the question arises what makes some respondents more successful livestock farmers than others? The subsequent multiple regression helped to identify the most important factors ( $R^2=0.56$ ) that led people to have more livestock (in TLU) (Table 6). While land size, animal diversity and location (Kamanyola) were positively related to higher TLU, illiteracy of respondents had a negative relationship. Interestingly, none of the voiced constraints, such as lack of feed or forages, threats by animal diseases, theft, or lack of money and appropriate housing were significantly related to TLU.

<sup>3</sup> Not specified whether fed dried, as meal, or other form.

**Table 5** Sales and markets of agricultural produce according to 112 respondents from seven *groupements* of South Kivu province, DR Congo, in 2009

<i>Groupement</i> (center/research center)	Interviews (no.)	Respondents selling crops (%)	Respondents selling livestock (%)
Bugorhe (Kavumu)	21	38.1	9.5 <sup>a</sup>
Miti (Mulungu)	21	66.7	71.4
Mudaka	25	36.0	40.0
Burhale	14	71.4	85.7
Mumoshosho	5	60.0	20.0
Karhongo (Nyangezi)	13	84.6	15.4
Kamanyola	13	76.9	61.5
Mean (Total)	(112)	58.0	43.8

<sup>a</sup>Mostly not reported

## Discussion

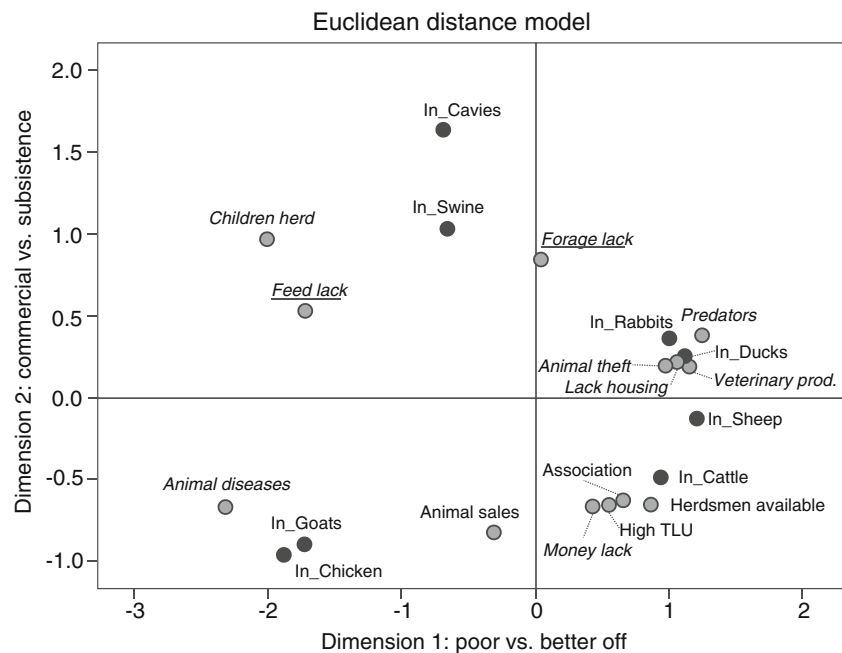
### Out of poverty – livestock as an asset

Enduring insecurity and the overall extreme poverty of peasants is reflected in low inventories of livestock assets in the current survey (Table 3). Most livestock species, especially cattle, are traditional rural assets in South Kivu (Zozo et al. 2010; Cox 2011) and, therefore, not intended for regular consumption. They are also symbols for peasants' social status, and their possession reflects the wealth class that people belong to according to their self-perception (Zozo et al. 2010). Survey respondents corroborated that during the past decades of war and protracted conflicts, livestock have been and continue to be a pillage target for armed groups (Table 4). This resulted in severely reduced livestock numbers per household (Vlassenroot et al. 2003; Cox 2011) and, consequently, in steeply decreasing wealth in productive assets. In *groupements* like Burhale, more than one third of the households

experienced looting of either cattle or goats (Cox 2008). Although small animals like caviés or chicken are also targets, they can easily be carried as people flee (Metre 2011); while large animals like cattle or goats can only be hidden in the bush, and fleeing families expect that looters will not find them before they return for their animals.

Except for goats, small monogastric species, such as chicken, caviés and rabbits nowadays play a more prominent role than ruminants (Table 3). Swine rearing occurred with a higher frequency compared to that of cattle, but with low abundance, except in Kamanyola. This is an interesting shift in livestock given that the Rusizi plains are a traditional cattle raising area. Respondents who were better off, also had few animals (Fig. 3) and had not further specialized in particular species, as reflected in animal diversity being a significant factor for higher TLU (Table 6). Poor smallholder farmers often keep multiple species to avoid risk (Perry et al. 2002). The relationships of TLU with both education level and land size available (Table 6) point at multidimensional

**Fig. 4** Ordination of presence of livestock species (In\_ indicator value), production characteristics and constraints recorded during a diagnostic survey in South Kivu province, DR Congo in 2009, using non-metric multidimensional scaling





**Table 6** Multiple regression estimates for determinants of tropical livestock units (using log-transformed TLU), recorded during a diagnostic survey in South Kivu province, DR Congo, in 2009

Parameter	Estimate	Standard error	<i>t</i> Value	<i>F</i> value
Constant	-1.262	0.400	-3.16	0.002
Animal diversity (no.)	0.5131	0.0840	6.11	<0.001***
Illiterate	-0.428	0.202	-2.12	0.038*
Land size (ha)	0.0930	0.0371	2.50	0.015*
Location Kamanyola	0.725	0.284	2.55	0.013*
Location Kavumu	-0.519	0.374	-1.39	0.170 ns
Location Miti	0.254	0.282	0.90	0.371 ns
Location Mudaka	0.068	0.291	0.23	0.817 ns
Location Mulungu	0.420	0.327	1.28	0.204 ns
Location Mumosho	0.107	0.703	0.15	0.879 ns
Location Nyangezi	0.490	0.360	1.36	0.179 ns
Lack of forage	-0.324	0.195	-1.66	0.102 ns
General feed lack	0.221	0.203	1.09	0.280 ns
$R^2$	0.557			
Model test ( $F_{(12, 112)}$ )	8.74***			
Number of observations ( <i>n</i> )	112			

ns, no significance

\*Significance at 5% level

\*\*\*Significance at <1%, level

poverty restricting livestock husbandry. Alkire and Santos (2010) suggest that the incidence of poverty — the proportion of multidimensionally poor population — is higher than 73% in rural areas of DRC. This condition is probably even more severe in eastern DRC, where armed conflicts persisted longer than in the rest of the country (Vlassenroot et al. 2003; Rossi et al. 2006; Kandala et al. 2011). After having lost their livestock during the past decades of turmoils, small livestock may help people to eventually recover their assets by ascending the ‘livestock ladder’.

#### Food and nutrition security — small livestock for consumption

Extreme poverty and general insecurity has led to dramatic levels of food insecurity in eastern DRC (Vlassenroot et al. 2003; Rossi et al. 2006). The consumption of animal-source food is not common due to the chronic poverty of the population. In particular, children suffer from the lack of animal protein, reflected in the very high stunting prevalence in children under 5 years old (Kandala et al. 2011). As animal-source food is critical for children’s appropriate growth and cognitive development (Grillenberger et al. 2006), regular consumption of eggs, milk, or meat from small animals, such as covies would, consequently, impact on their nutritional status. Covies were held by every second interviewee independent of total livestock possession (Table 3, Fig. 3). As these small, prolific, robust animals have excellent meat quality, they can play an important role in fighting food insecurity in the region (Lammers et al. 2009; Metre 2011).

#### Sustainable crop production — livestock as a systems component

In the traditional mixed farming of the region, soil fertility of main fields near the homestead used to be maintained by available cattle manure (Cox 2011). Interestingly, none of the interviewees raised lack of manure or declining soil fertility as a livestock-related issue. This survey supports the view that, for generations, small livestock have been integral constituents of livelihoods in South Kivu and are economically very important in many households, particularly the poorest (Cox 2011). Different from the self-perception of wealth (Zozo et al. 2010), our results, however, underline that cavy husbandry is not restricted to the poorest (Fig. 3) but seems to be part of the regional culture. Given the present stocking rates, neither goat nor cavy or rabbit manure occur in sufficient quantity to make up for soil fertility losses during cropping. In the absence of agro-chemicals on the market or the lack of sufficient financial resources to purchase them, the integration of livestock into the production systems remains crucial for soil fertility maintenance and nutrient recycling (Cox 2011).

#### Regular income generation — livestock for gender equity and education

Unlike large ruminants, the production of small livestock such as poultry, covies and rabbits is primarily controlled by women and children (Maass et al. 2010a). Importantly, covies can be consumed any time in South Kivu, depending on a woman’s decision, whereas a chicken is slaughtered

only for extraordinary events, and this decision has to be made by the male household head (T.K. Metre, personal communication, 2011). Therefore, the contribution of covies to household diets may be substantial. On the other hand, they serve to obtain cash for recurring needs, such as school fees, indicating the important role that these small animals play for the education of children (Maass et al. 2010a,b; Zozo et al. 2010).

A large proportion of children have to either herd livestock (Table 4) or fetch fodder for them. The amount of time children spend for this is a concern. However, several informants maintained that children benefitted from the cash income from livestock as it covers their school fees and other required school supplies. It seems that families prioritize education above adequate nutrition. This phenomenon of parents' sacrificing on food quality or quantity, in order to maintain their children in school, is similarly known from poor rural regions in China (Unger 2002, cited by Brown 2006). This presents an opportunity for introducing more productive and higher value forages that should reduce the burden of animal husbandry for both children and women. By adopting forage cultivation together with adequate feeding regimes, livestock production will increase through both improved animal health and reproduction. Forage cultivation has been demonstrated to reduce the time spent by women and children scavenging for feed (Stür et al. 2002).

#### Prospects for forage research

Besides animal diseases, lack of feed/forages was perceived as main challenge for the majority of interviewees (Table 3). Contrary to expectations, lack of feed/forages was neither related to any particular livestock species (Fig. 4) nor to the overall livestock holding (in TLU) of a respondent (Table 6). Nevertheless, more commercially oriented livestock farmers with higher TLUs appear to suffer less from lack of feed as seen from Dimension 2 in Fig. 4, possibly because they have more land available. By improving the feeding situation, disease incidences usually decrease. However, the devastation potential of highly lethal and economically significant diseases, such as ASF (Babalobi et al. 2007), Newcastle or Avian Flu, is a challenge to be faced by any investment in livestock development especially for the poor (Perry et al. 2002).

Incipient forage research has shown that some improved legumes are agro-ecologically adapted to the region. Major challenges are (1) to find spatial and temporal niches within the cropping system(s) considering small land sizes available, and (2) to encourage people to cultivate forages for animal feed. The chance for adoption will be substantially higher if food-/feed crops, such as *Lablab purpureus*, are promoted to farmers given their current situation of chronic food insecurity. Under the conditions of South Kivu, research for development with the active participation of the

peasants concerned has the highest probability of success. Within the new initiative on 'Improved Forages for Monogastrics' coordinated by CIAT's Tropical Forages Program (TFP), additional forage germplasm with high feeding value is made available to farmers, emphasizing women and young farmers with small livestock.

The agricultural sector in South Kivu has a huge potential to develop both crop and livestock production for a rapidly expanding urban market (Van Acker 2005). The majority of respondents sold their products either on the local market or to neighbors (Maass et al. 2010b), thus, missing out on better prices. However, they had to incur the extra cost of travelling to town to purchase supplementary feed like brewer's grain. The agricultural production region investigated is contiguous to the Bukavu markets with an urban population estimated at between 0.7 million and more than 1 million inhabitants. Due to the incipient recovery of security and advances in repairing and building of road and other infrastructure, the OECD (2009) predicts agricultural production in South Kivu to both maintain and speed up its growth. Consequently, great opportunities emerge for livestock farmers in South Kivu.

#### Conclusions

Livestock is an integral part of the mixed farming systems in the region of South Kivu province, despite their presently low numbers per household. Current livestock production is based on a variety of animal species without significant specialization. From the farmers' views, the most important issues of animal husbandry are related to animal diseases and feed resources, particularly in the dry season. This study has demonstrated that TLU is a useful indicator for relative wealth between the extreme poor and the slightly better off livestock farmers in South Kivu. In the current post-conflict situation, small livestock play a more important role for wealth recovery than large animals, however, emphasizing those that do not compete with humans for food, such as covies and rabbits. However, husbanding rabbits seems to be more delicate under the conditions of extreme poverty prevalent in South Kivu resulting in advantages for covies as a small, prolific and robust animal (Lammers et al. 2009; Metre 2011). Chauca de Zaldívar (2000) in South America has shown that enhanced feeding substantially improved the productivity of covies. In conclusion, there are good arguments to invest in further feed and forage research of monogastric animals. Challenges for the introduction of high-quality forages are agro-ecological adaptation for mid-elevations of >1,500 masl, prolonged growth into the dry season, and high biomass production to use small space of highly limited farm land resulting in minimal competition with crops. Such improved forages may substantially lighten

the burden put on children and women, who are mostly responsible to feed the animals.

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**Ethical standards** The research performed complies with the current laws of the Democratic Republic of the Congo.

**Conflict of interest** The authors declare that they have no conflict of interest.

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