

# Diagnostic Survey of Livestock Production in South Kivu/DR Congo



by  
Brigitte L. Maass, Dieudonné Katunga Musale, Wanjiku L. Chiuri and Michael Peters

Nairobi, Kenya

November 2010



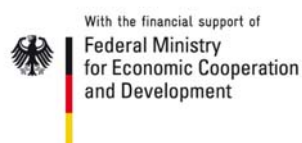
# DIAGNOSTIC SURVEY OF LIVESTOCK PRODUCTION IN SOUTH KIVU/DR CONGO

CIAT Working Document No. 210

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Nairobi, Kenya – November 2010



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## TABLE OF CONTENTS

<b>Summary</b> [English]	<b>1</b>
<b>Resumé</b> [French]	<b>2</b>
<b>Resumen</b> [Spanish]	<b>4</b>
<b>Report</b>	<b>5</b>
Photographic documentation I	5
Background	7
Materials and methods	8
Results	11
Discussion and conclusions	21
Photographic documentation II	27
References	29
<b>Appendix</b>	<b>32</b>
1. Participants of the survey	32
2. Questionnaire used [English/French]	33

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## DIAGNOSTIC SURVEY OF LIVESTOCK PRODUCTION IN SOUTH KIVU/DR CONGO

–  
9-12 June 2009

**Project on ‘More Chicken and Pork in the Pot, and Money in Pocket:  
Improving Forages for Monogastric Animals with Low-income Farmers’**

### **PARTICIPANTS OF THE SURVEY<sup>1</sup>**

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### **SUMMARY**

For a survey on livestock production with emphasis on monogastric animals, 20 villages in seven so-called ‘*groupements*’ of South Kivu province in DR Congo were selected mostly along a North-South West axis, with the provincial capital town of Bukavu in the center. Most of the hilly agricultural land between the National Park of Kahuzi-Biega in the West and Lake Kivu in South Kivu province is located at above 1500 m asl. The survey took place in elevations extending from about 900 m asl. in Kamanyola to 1900 m asl. in Burhale. A diagnostic survey approach was employed to rapidly obtain in-depth knowledge of constraints and opportunities in a defined social, economic, and natural environment. From the responses of 112 informants, it was concluded that livestock is an integral part of the mixed farming systems in the region of South Kivu, despite their presently low numbers per household. Farmers largely concentrate on small livestock, such as poultry, swine, cobayes and rabbits. Overall, the livestock help families to accumulate household reserves that were heavily invested in children’s education. From the farmers’ views, the most important issues of animal husbandry appeared to be related to animal diseases and feed resources, particularly in the dry season. Major challenges faced by introducing new and more productive forages into the region will include (i) the agro-ecological adaptation of such plants in mid-elevations of above 1500 m asl.; (ii) prolonged growth into the dry season; (iii) provision of high biomass-producing species in order to not use too much space of small farm land; and (iv) adaptation of forage cultivation in order to reduce labor demand for forage scavenging. Three locations are proposed for forage research in South Kivu province in close collaboration with the CIALCA consortium, Kamanyola, Miti/Mulungu and the area of Mumosho/Nyangezi. CIAT’s Tropical Forages Program may have limited forage options available for Burhale because of its relatively high elevation. Other lowland areas towards Kasika, like Tubimbi, can only be targeted if security has improved.

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<sup>1</sup> Local participants are listed in Appendix 1

## RAPPORT D'UNE ENQUÊTE DIAGNOSTIQUE SUR L'ÉLEVAGE AU SUD-KIVU/RD CONGO

—  
9-12 de Juin de 2009

**Projet de 'More Chicken and Pork in the Pot, and Money in Pocket:  
Improving Forages for Monogastric Animals with Low-income Farmers'**

### PARTICIPANTS DE L'ENQUÊTE<sup>2</sup>

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### RESUMÉ

Dans le projet *'More Chicken and Pork in the Pot, and Money in Pocket: Improving Forages for Monogastric Animals with Low-income Farmers'* (i.e., 'Plus de poules et porcs dans la casserole, et plus d'argent dans la poche: Amélioration des fourrages pour les animaux monogastriques en faveur des fermiers aux faibles revenus'), nous avons mené une enquête sur l'élevage en mettant l'accent sur les animaux monogastriques. Vingt villages dans sept groupements de la province Sud-Kivu en RD Congo ont été choisis principalement le long d'un axe Nord – Sud-Ouest, avec Bukavu, la capitale provinciale, au centre. La plupart des terres agricoles de collines entre le Parc National de Kahuzi-Biega à l'Ouest et le lac Kivu de la province Sud-Kivu se situent au-dessus de 1500 m d'altitude. L'enquête a eu lieu entre 900 m d'altitude à Kamanyola et 1900 m d'altitude à Burhale. Une méthode d'enquête diagnostique a été utilisée pour obtenir rapidement une connaissance approfondie des contraintes et des opportunités en considérant le contexte social, économique, et de l'environnement naturel. D'après les réponses de 112 agriculteurs sondés, il a été conclu que le bétail est une partie intégrante des systèmes d'agriculture mixte dans la région du Sud-Kivu, malgré le nombre de bêtes actuellement faible par ménage. Les agriculteurs se concentrent principalement sur des petits animaux d'élevage, comme la volaille, les porcs, les cobayes et les lapins. Généralement, le bétail sert surtout à fournir des réserves financières pour les ménages qui ont fortement investi dans l'éducation scolaire des enfants. Du point de vue des agriculteurs, les problèmes les plus importants en rapport avec l'élevage semblent être liés aux maladies animales et à l'approvisionnement en nourriture, en particulier pendant la saison sèche. Les principaux défis à relever face à l'introduction de fourrages nouveaux et plus productifs dans la région seront (i) l'adaptation agro-écologique de ces plantes à des altitudes supérieures à 1500 m; (ii) une nécessité de croissance prolongée pendant la saison sèche; (iii) l'approvisionnement d'espèces fourragères hautement productrices afin de limiter l'espace utilisé surtout pour les fermes de faible superficie; et (iv) l'adaptation de la culture fourragère pour réduire la demande en main d'œuvre utilisée pour leur récolte. Trois sites ont été proposés pour la mise en place de programmes de recherche sur les fourrages dans

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<sup>2</sup> Les participants locaux se trouvent listés dans l'Appendice 1



le Sud-Kivu en étroite collaboration avec le consortium CIALCA: Kamanyola, Miti/Mulungu, et la zone de Mumosho/Nyangezi. Le Programme de Fourrages Tropicales du CIAT ne pourra offrir qu'un choix limité de fourrages pour Burhale en raison de son altitude relativement élevée. D'autres zones de plus basse altitude en direction de Kasika (comme Tubimbi) ne pourront être considérées que si la sécurité s'est améliorée.

## ENCUESTA DIAGNÓSTICA DE LA PRODUCCIÓN GANADERA EN KIVU DEL SUR/RD CONGO

—  
9-12 de Junio 2009

Proyecto de 'More Chicken and Pork in the Pot, and Money in Pocket:  
Improving Forages for Monogastric Animals with Low-income Farmers'

### PARTICIPANTES DE LA ENCUESTA<sup>3</sup>

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### RESUMEN

Dentro del proyecto 'Más pollo y cerdo en la olla, y dinero en el bolsillo: Forrajes mejorados para animales monogástricos de los agricultores de bajos ingresos', se ha llevado a cabo un Diagnóstico Rural Participativo (DRP) en los '*groupements*' (sub-condados) Miti-Mulungu (Territorio de Kabare) y Tubimbi (Territorio de Walungu) con la participación de un total de 165 miembros de la comunidad. Durante esta actividad, cinco herramientas se han utilizado para recopilar información; (i) el calendario estacional; (ii) el calendario diario considerando género; (iii) la clasificación de riqueza considerando género; (iv) el mapa de los recursos del pueblo; y (v) el diagrama de flujo de recursos. La posesión de ganado, especialmente los grandes animales como las vacas, es un criterio importante de riqueza para todos los participantes. A pesar de su gran abundancia, la gente aparentemente no está consciente del valor de sus pequeños animales (pollos, cuyes, patos y conejos), que con frecuencia se intercambian por otros más grandes, tales como cabras, cerdos y hasta vacas, lo que indica su potencial para ascender en la llamada 'escala de ganado'. Hubo una falta general de conocimientos y habilidades en la cría de animales. La falta de acceso a los medicamentos veterinarios adecuados y la ignorancia sobre su utilización son grandes retos de la ganadería en los dos sitios. La gente expresó las necesidades de alimentar a sus animales, sobre todo en la estación seca. Sin embargo, tradicionalmente no se practica el cultivo de forraje en los dos sitios. Un desafío adicional parece ser cultivar forrajes en un entorno tan volátil referente a la seguridad, la deforestación extrema y especies de ganado, que no tienen clase social. La diferencia más importante entre los dos '*groupements*' se percibió en su nivel general de riqueza. Debido a la inseguridad, los efectos de las guerras múltiples, la incidencia de enfermedades de los cultivos, y el apoyo gubernamental bajo al sector agrícola, Tubimbi ha sido privado de sus principales medios de supervivencia y se ha empobrecido. Por otra parte, la minería de oro realizada por los jóvenes ayuda a la comunidad para obtener dinero en efectivo. La gente de Miti-Mulungu parecía estar mejor, debido también a la mejor conexión con la capital provincial de Bukavu.

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<sup>3</sup> Los participantes locales se encuentran listados en el Apéndice 1

**Photographic documentation I**



Surveying farm households with livestock in Burhale (left) and Miti (right)



Digitizing and discussing data in the CIALCA office, Bukavu, after the day out in the field



Ruminants found during the survey in Mudaka: cattle, goats and sheep





Monogastrics found during the survey: pig feeding on cassava leaves in Burhale and free-roaming chicken in Mudaka



Monogastrics found during the survey in Burhale: cobayas feeding on *Galinsoga parviflora* (left), and a rabbit held in a cage, feeding on sweet potato leaves (right)



Swine stable in Burhale (left) with a bee-hive in the front, and tethered goats at a homestead in Mudaka feeding on shade-tolerant herbs like *Galinsoga parviflora* or *Commelina* spp. (right)

## REPORT

### BACKGROUND

Most of the hilly agricultural land between the National Park of Kahuzi-Biega in the West and Lake Kivu in South Kivu province of DR Congo is located at above 1500 m asl. The seven so-called '*groupements*'<sup>4</sup> selected for the present survey of livestock production with emphasis on monogastric animals are mostly situated along a North-South axis, with the town of Bukavu in the center. This is one of the ten mandate areas chosen in 2005 by the Consortium for Improving Agriculture-based Livelihoods in Central Africa (CIALCA) to represent diverse agricultural production conditions, demography and access to markets (Farrow et al. 2006). After a participatory rural appraisal (PRA) with almost 900 farmers in South Kivu, CIALCA has initiated research at identified 'action sites', where bananas and grain legumes form an integral part in farming systems (CIALCA 2008; Cox 2008; Farrow et al. 2006). CIALCA aims at identifying researchable issues, constraints, opportunities, and entry points; providing information that assists in the selection of communities, associations and farmers that will participate in research and development activities. In addition, technical solutions are sought in participation with farmers.

The action sites refer to *groupements* that are the lower administrative unit under a '*territoire*' and consist of a number of villages (Cox 2008). The region is being characterized in a comprehensive baseline study that has not yet been completed (P. Pypers, pers. comm. 2009). It was found that 84% of the households in South Kivu province of DRC predominantly pursue agriculture-based livelihood strategies by practicing subsistence agriculture. The sole dependence on subsistence agriculture as a livelihood strategy, however, may increase a household's vulnerability to shocks that are typical for agricultural activities, such as droughts or floods, pests and diseases. This vulnerability is expressed through a number of issues like a high level of food insecurity (>60% food insecure in South Kivu sites); the occurrence of human diseases, particularly in children under five; and little access to agricultural development agents, among others (CIALCA 2008). Poor food security, poor child nutrition, and poor access to markets were all strongly correlated (CIALCA 2008). In the PRA, about 30% of households in South Kivu stated that they could only afford one meal a day. Consumption of animal protein, fruits and vegetable with their high contents of micronutrients was found to be low. For example, less than 20% of the children are given meat, fish or eggs more than twice per week. Protein intake from legumes (mostly beans and soybean) is generally higher, but only about 30-40% of the children consume legumes on a daily basis (CIALCA 2008).

Small farm sizes, limited land availability, and poor soils tend to keep overall production level low in South Kivu. Different types of markets were identified in the sites, ranging from local village open air markets operating on specific days to large regional markets (CIALCA 2008). Farmers find bribes and taxes to access the market as the major constraint to commercialize their produce (legumes such as *Phaseolus* beans, soybean and groundnuts, but also cowpea and pigeon peas), followed by insufficient land availability.

Armed conflicts and weak provision of security by the central government have compounded the challenges faced by small-scale farmers in the region. Cox (2008) also

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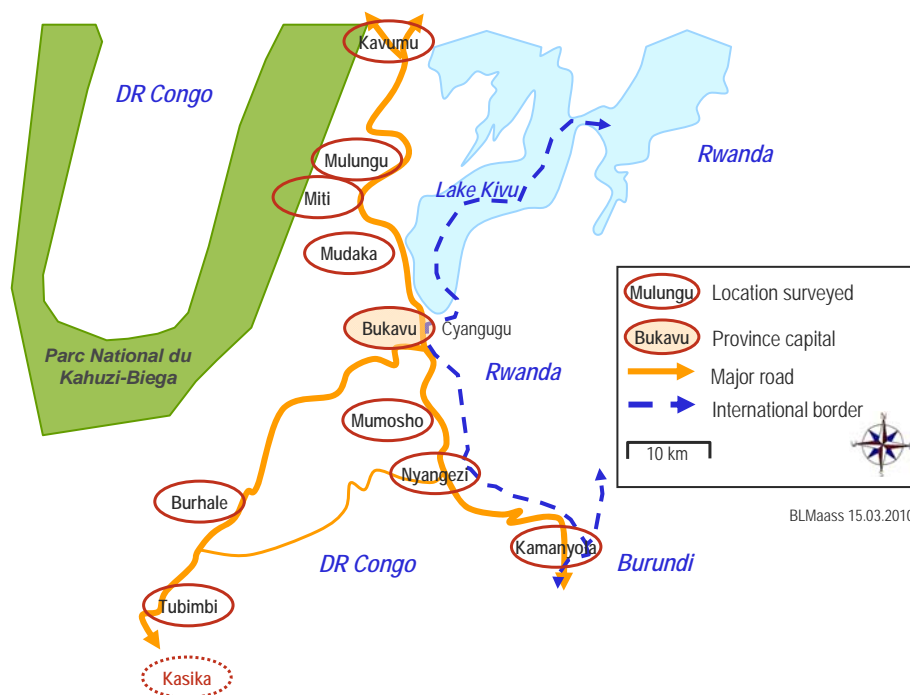
<sup>4</sup> In South Kivu, administrative units are, from superior to inferior, *Territoire* → *Collectivité* → *Groupement* → *Localité* → *Village*.

highlighted the profound effects that the insecurity due to war and post-war conflicts had on land management and sustainability of agricultural production since the mid 1990s. Under such conditions, livestock production is a major challenge. By hiding them in the bush or far away, large animals can be prevented from looting. As a coping strategy in such a volatile environment, farmers focus more on small stock. Nevertheless, livestock production may continue to be one of the few available opportunities of accumulating a certain level of wealth and ensuring the education of children, and it is an integral part of the culture and traditions in the region (Cox 2008).

## MATERIALS AND METHODS

### Region surveyed

Seven *groupements* have been surveyed that were between about 20 and 30 km North, 60 km South-West, and 20 and 60 km South of the town of Bukavu (Fig. 1, Table 1), comprising a total of 20 villages (Table 2)<sup>5</sup>. In some of the locations, CIALCA scientists together with local partners are developing technology options in so-called 'action sites'; whereas 'satellite sites' serve the partners to take up these options, adapt them to local conditions and extend them further (Table 1). The agricultural land of the seven *groupements* was mostly above 1500 m asl., except for Kamanyola that is located in the plains of the Rusizi river. In CIALCA's baseline survey, the region is labeled as 'Montane South Kivu' (CIALCA 2008). Population density is very high with more than 350 persons/km<sup>2</sup> (Farrow et al. 2006) and access to markets seems to be very limited (Moyroud and Katunga 2002). In general, (road) infrastructure is not much developed and/or maintained, the latter because of historic reasons, but especially due to the wars and post-war neglect of these parts of the country (Moyroud and Katunga 2002; Van Acker 2005; Ulimwengu et al. 2009).



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

<sup>5</sup> The location Kasika could not yet be surveyed due to insecurity in the area.

## Survey method applied

The diagnostic survey approach (Fujisaka et al. 2005) was employed for this study to rapidly obtain in-depth knowledge of constraints and opportunities in a specific social, economic, and natural environment. The objective was to understand smallholder livestock production systems, and identify the opportunities and constraints to substitute purchased (and possibly imported) feeds with forage-based protein feed produced by farmers specially for monogastric animals. Topics addressed beside general socio-economic information of the respondents included monogastric systems, markets, feeds, and organization of people. All guiding questions are listed in Appendix 2.

**Table 1.** Socio-economic data of the region, where interviews took place in South Kivu province, DR Congo. (Data from CIALCA Baseline Survey, 2008)

<b>Groupement (Main village/ Research center)</b>	<b>Distance from Bukavu (km and direction)</b>	<b>Altitude (m asl.)</b>	<b>Soils</b>	<b>Population (no. inhabi- tants)*</b>	<b>CIALCA site<sup>#</sup></b>
Bugorhe (Kavumu)	31 N	1700	Good	52,230	Satellite site
Miti (Mulungu)	25-27 N	1700	Recent volcanic	18,683	Satellite site
Mudaka	21 N	1650	Fair	34,452	Action site
Burhale	57 SW	1650	Poor	37,047	Action site
Mumoshu	20 S	1650	Poor	28,903	Satellite site
Karhongo (Nyangezi)	30 S	1650	Poor	39,784	Mid action
Kamanyola	60 SE	900	Good + dry	30,421	Mid action
Tubimbi	77 SW	1100		15,700	None

\* Population data 2007 from Rapport Annuel 2008 Administration du Territoire, Division Provinciale de l'Intérieur Sud-Kivu; Tubimbi from WFP<sup>6</sup>. [>250,000 people]

<sup>#</sup> Action site, where CIALCA scientists drive the development of technology options; Satellite site, where partners drive the adaptation of these technology options to local conditions; Mid action site, intermediate activities of both.

A total of 112 persons from seven *groupements* were interviewed during four days in early June 2009. Interviewers were 20 persons (Appendix 1) with some kind of interest for future research in the region, comprising 4 women and 16 men. Interviews along the semi-structured questionnaire took mostly place in Kiswahili language, occasionally mixed with French and the local language 'Mashi'.

At the end of every day, several key data gathered were collected in an Excel sheet and a short group discussion was held about whether there was a need to modify the questionnaire by deleting and/or adding any question. This has led to the fact that some of the data are unbalanced throughout the four days, however, it allowed to have a more comprehensive insight into smallholder monogastric production systems in South Kivu.

<sup>6</sup> WFP. 2006. Emergency Report No. 27/2006. Issued weekly by the United Nations World Food Programme – Date 07.07.2006. [Available 23.06.2010 online from: <http://idh.cidi.org:8080/humanitarian/wfp/06b/ixl0.html>].

When the area towards Kasika became accessible because security had improved, an additional survey was conducted in Tubimbi (Fig. 1) in February 2010. The method applied was modified in that individual interviewers conducted the interviews and not couples. This resulted in a significantly higher number of interviews (N = 39) during one day. Therefore, data were not analyzed together but included in most of the tables because the agricultural situation in Tubimbi differed substantially from the other *groupements* surveyed.

The number of animals was also converted into tropical livestock units (TLU). Initially, conversion factors were used according to Ghirotti (1993), where cattle are weighed with 0.7, sheeps/goats with 0.1, swine with 0.2, and chicken with 0.01. Additionally, ducks were assigned 0.02 TLU, double that of chicken, rabbits 0.01 TLU, and cobayes<sup>7</sup> 0.005 TLU due to their small sizes (a random sample of ten adult cobayes showed that they weigh about 500 g/animal). Finally, the overall TLU per respondent was adjusted to one TLU being equivalent to one cattle with a body weight of 250 kg (LEAD/FAO 1999).

All data were analyzed by descriptive statistics with MS-Excel.

**Table 2.** *Groupements* and villages, where interviews took place in South Kivu province, DR Congo in June 2009.

<b>Groupement (Main village/ Research center)</b>	<b>Villages surveyed</b>
Bugorhe (Kavumu)	Cireja, Combo Mululu, Kakenge, Kavumu
Miti (Mulungu)	Miti centre, Mulungu INERA
Mudaka	Kashungurhi, Konge, Cirhogole, Mudaka centre, Cinjoma, Murhala
Burhale	Mwegerera
Mumosho	Mumosho
Karhongo (Nyangezi)	Cijingiri, Cibimbi, Kalengera, Mulende
Kamanyola	Rubumba, Mulengezi
Tubimbi	Buzige, Luhundu, Mashulubwe, Mulugu

<sup>7</sup> The French name '*Cobaye*' is being used here instead of the English '*Guinea pig*' because the latter provides a wrong impression of a domestic animal that neither originates from Guinea nor is a pig (Morales 1994). In the scientific literature, it is sometimes called '*cavy*' if not the laboratory animal or pet is concerned. The common name used in South Kivu is '*Dende*' ('*D'Inde*'), which is the (French) Kiswahili version of '*Cochon d'Inde*'.



## RESULTS

### Socio-economic situation of the respondents

On average, about 40% of respondents were women except for Kamanayola, where predominantly men responded to the questionnaire. The overall mean age of respondents was above 40 years with differences among *groupements* (Table 3). Respondents had a mean of 5.5 children, ranging from none to 17 (the latter both in Mulungu and Nyangezi). Most parents had some years of primary education, the women usually fewer years than the men. Also more women were illiterate than men. In Kamanyola and Miti (Mulungu), an overall higher level of education was found together with a lower mean number of children per interviewee in the former, but not so in the latter. In Mumosho, Mudaka and Tubimbi, on the other hand, more illiterates were among the interviewees. Children were generally participating in primary education, and many of them were also pursuing secondary education, or even university studies.

The predominant occupation was farming. Land property was small with a mean of 1.5 ha, however, many respondents had scarcely one hectare available. On average, however, people in Mudaka and in Kamanyola, had access to more land.

**Table 3.** Socio-economic data of respondents to a survey in seven *groupements* of South Kivu province, DR Congo in June 2009.

<i>Groupement</i> (Main village/ Research center)	Inter-views (no.)	Women (no.)*	Men (no.)*	Mean age (yr)	Education level (mode)	Children (no.)	Land area available (ha) <sup>#</sup>
Bugorhe (Kavumu)	21	8+	6+	38.5	Primary	5.2	0.83
Miti (Mulungu)	21	10	11	41.9	Secondary	6.0	1.21
Mudaka	25	11	12	37.2	Illiterate	5.6	2.52
Burhale	14	6+	9+	50.5	Primary	5.4	1.46
Mumosho	5	1	4	43.0	Illiterate	6.5	0.01
Karhongo (Nyangezi)	13	3	6	45.3	Primary	6.2	1.13
Kamanyola	13	2+	12+	36.2	Secondary	4.2	1.71
<b>Total / Mean</b>	<b>112</b>	<b>41+</b>	<b>60+</b>	<b>40.9</b>		<b>5.5</b>	<b>1.48</b>
SE				0.15		0.04	0.03
Tubimbi	39	14	25	42.2	Illiterate	4.9	1.45

\* In some *groupements*, of many interviewees the 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>#</sup> This question was not provided everywhere in Mumosho and Karhongo *groupements*.

**Table 4.** Proportion (%) of respondents growing certain crops on their land in seven *groupements* of South Kivu province, DR Congo.

<i>Groupement</i> (Main village/ Research center)	Interviews (no.)	Beans ( <i>Phaseolus</i> )	Cassava	Banana/ plantain	Maize	Sweet potato	Sorghum	Sugar-cane	Ama-ranthus	Taro ( <i>Colocasia</i> )	Soy-bean
Bugorhe (Kavumu)	21	76.2	61.9	66.7	52.4	38.1	4.8	19.0	9.5	9.5	0.0
Miti (Mulungu)	21	76.2	81.0	52.4	55.7	47.6	4.8	9.5	19.0	9.5	9.5
Mudaka	25	68.0	76.0	76.0	48.0	48.0	8.0	36.0	32.0	16.0	16.0
Burhale	14	92.9	92.9	78.6	42.9	92.9	50.0	0.0	7.1	28.6	28.6
Mumoshho	5	100.0	80.0	80.0	60.0	40.0	0.0	0.0	0.0	20.0	0.0
Karhongo (Nyangezi)	13	84.6	92.3	100.0	84.6	69.2	76.9	7.7	0.0	7.7	7.7
Kamanyola	13	84.6	38.5	15.4	100.0	38.5	38.5	0.0	0.0	0.0	7.7
<b>Total / Mean</b>	<b>112</b>	<b>79.5</b>	<b>74.1</b>	<b>66.1</b>	<b>62.5</b>	<b>52.7</b>	<b>23.2</b>	<b>14.3</b>	<b>13.4</b>	<b>12.5</b>	<b>10.7</b>
Tubimbi	39	20.5	97.4	30.8	25.6	84.6	2.6	5.1	5.1	28.2	2.6

**Table 5.** Mean animal numbers (no.) per respondent who raised the specific type of livestock and proportion of livestock keepers in seven 'groupements' of South Kivu province, DR Congo in June 2009.

<i>Groupement (City/ Research center)</i>	<b>Interviews (no.)</b>	<b>Cattle (no.)</b>	<b>Goats (no.)</b>	<b>Sheep (no.)</b>	<b>Swine (no.)</b>	<b>Chicken (no.)</b>	<b>Ducks (no.)</b>	<b>Cobayes (no.)</b>	<b>Rabbits (no.)</b>	<b>Livestock spp. (no.)</b>	<b>TLU<sup>#</sup></b>
Bugorhe (Kavumu)	21	1.0	2.6	0.0	2.6	3.6	3.3	7.6	3.8	2.5	0.44
Miti (Mulungu)	21	3.0	5.4	0.0	1.1	6.4	20.0	8.8	4.5	2.7	0.91
Mudaka	25	5.6	6.2	7.0	1.3	4.2	1.0	3.9	2.0	2.4	1.69
Burhale	14	3.0	2.9	2.0	2.3	4.8	0.0	13.8	4.3	4.1	1.36
Mumosho	5	0.0	4.3	0.0	1.3	3.0	1.0	17.0	0.0	3.4	0.63
Karhongo (Nyangezi)	13	4.0	2.7	3.4	2.0	7.4	10.0	9.7	4.5	3.3	1.18
Kamanyola	13	8.3	4.9	0.0	7.4	12.3	5.0	0.0	10.0	2.8	2.82
<b>Total / Mean</b>	<b>112</b>	<b>4.5</b>	<b>4.4</b>	<b>4.0</b>	<b>2.8</b>	<b>6.1</b>	<b>5.3</b>	<b>9.4</b>	<b>4.7</b>	<b>2.89</b>	<b>1.29</b>
SE		0.25	0.05	0.41	0.08	0.07	0.78	0.13	0.18	0.01	0.02
Tubimbi	39	2.2	1.6	1.7	1.7	4.7	1.0	5.7	2.8	2.9	0.89
<b>Livestock keepers with certain animals (%)</b>		<b>Cattle (%)</b>	<b>Goats (%)</b>	<b>Sheep (%)</b>	<b>Swine (%)</b>	<b>Chicken (%)</b>	<b>Ducks (%)</b>	<b>Cobayes (%)</b>	<b>Rabbits (%)</b>		
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	–	–
Mumosho	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	–	–
<b>Total / Mean</b>	<b>112</b>	<b>19.6</b>	<b>66.1</b>	<b>5.4</b>	<b>46.4</b>	<b>70.5</b>	<b>7.1</b>	<b>50.5</b>	<b>21.4</b>	–	–
Tubimbi	39	15.4	43.6	7.7	74.7	79.5	2.6	48.7	10.3		

\* n.r., not recorded. <sup>#</sup> TLU, Tropical Livestock Unit, equivalent to 250 kg animal life weight. Conversion factors were used according to Ghirrotti (1993), where cattle are weighed with 0.7, sheeps/goats with 0.1, swine with 0.2, and chicken with 0.01. Additionally, ducks were assigned 0.02 TLU, double that of chicken, rabbits 0.01 TLU, and 0.005 TLU; aquaculture was not counted. Subsequently, the overall TLU was adjusted to 250 kg body weight.

**Table 6.** Critical features of animal husbandry according to 112 respondents from seven '*groupements*' of South Kivu province, DR Congo in June 2009.

<i>Groupement</i> (City / Research center)	Interviews (no.)	Major problems for animal husbandry (%)			Time applied for herding or fetching forages (h/d)	Herding animals by (%)	
		Diseases	Lack of forage/feeds	Theft		Children	Herdsmen
Bugorhe (Kavumu)	21	33.3	33.3	42.9	2.8	61.9	9.5
Miti (Mulungu)	21	76.2	42.9	28.6	3.0	57.1	38.1
Mudaka	25	88.0	8.0	4.0	2.5	76.0	8.0
Burhale	14	92.9	64.3	35.7	3.1	50.0	21.4
Mumoshho	5	100.0	60.0	0.0	n.r.	100.0	0.0
Karhongo (Nyangezi)	13	92.3	38.5	23.1	n.r.	84.6	15.4
Kamanyola	13	84.6	23.1	0.0	3.7	46.2	23.1
<b>Total / Mean</b>	<b>112</b>	<b>76.8</b>	<b>33.9</b>	<b>21.4</b>	<b>2.8</b>	<b>65.2</b>	<b>17.9</b>
Tubimbi	39	74.4	12.8	20.5	1.8	28.2	10.3

**Table 7.** Forages and feeds provided to livestock according to 112 respondents in seven 'groupements' of South Kivu province, DR Congo in June 2009.

Forage/feeds in general	Grasses ('local name' if available)	Broad-leaved forage plants (forbes) (family; 'local name')	Feeds from crop residues or by-products	Crop products as animal feeds
	<i>Tripsacum andersonii</i> (Guatemala grass)	<i>Galinsoga parviflora</i> (Asteraceae; 'Ragara')	Cassava leaves	Maize grains
	<i>Pennisetum purpureum</i> (Napier grass; 'Cibingo/u', 'Matete')	<i>Bidens pilosa</i> (Asteraceae)	Sweetpotato leaves	Taro ( <i>Colocasia</i> )
	<i>Digitaria</i> sp. (cf. <i>vestita</i> ; African couchgrass)	<i>Tithonia diversifolia</i> (Asteraceae)	Papaya leaves	Cassava flour
		<i>Commelina</i> sp. (cf. <i>diffusa</i> )* (Commelinaceae)	Cassava peelings	
		'Igoka' <sup>#</sup>	Rice straw	
		'Nchungululu' <sup>#</sup> (Asteraceae)	Banana/plantain stems	
			Straw (in general)	
			Sugarcane bagasse	
			Sugarcane tails/tips	
Forage/feed for particular animals	Swine	Goats	Chicken	Rabbits
	Kitchen left overs	<i>Setaria</i> , <i>Digitaria</i> ,	Sorghum and maize grains	Banana/plantain peelings
	Palm kernel cake	<i>Tripsacum andersonii</i> ,	Soybean grains	Sweet potato leaves
	Groundnut cake	<i>Tithonia diversifolia</i> ,	Palm kernel cake	Palm kernel cake
	Brewer's grain ('drêche de boisson')	<i>Calliandra calothyrsus</i> ,	Groundnut cake	
	Residues of maize, sorghum, soybean, cassava, banana/ plantain	<i>Leucaena leucocephala</i>	Brewer's grain	<b>Cobayes</b>
	Avocados + avocado nuts	Maize leaves	<i>Leucaena</i> leaf meal	
	Papaya	Sorghum leaves	Small fish ('fretin'), fish heads	<i>Bidens pilosa</i> , <i>Digitaria</i> ,
		Sweetpotato leaves		<i>Galinsoga parviflora</i> ,
		Banana/plantain peelings		Banana/plantain leaves
		Bean hulls		Sorghum leaves

\* , at least two morphologically different species of *Commelina* were found; # , local names not yet identified.

## Crop production

Typical crop production was based on *Phaseolus* beans, cassava, banana/plantain and maize; these crops were reported from two thirds and more of the respondents (Table 4) across all *groupements* surveyed. About half of the farmers would also cultivate sweet potatoes. Only in Kamanyola, maize was grown by all respondents without exception. On the other hand, there were much less banana/plantain, sweet potato and cassava cultivated in Kamanyola than on average. In general, there was also much less crop diversity in Kamanyola, and production appeared more market-oriented. Similarly, only limited crop diversity was found in Tubimbi, however, this reflected the impoverishment and a lack of interest by the villagers. Their crop production was mostly based on cassava and sweet potato.

Almost every fourth respondent mentioned to grow sorghum, whereas between 14 and 11% of them also cultivated sugarcane, amaranth, taro (*Colocasia*) and/or soybean. While sorghum was cultivated more towards the West and South of Bukavu, sugarcane and amaranth were more abundant in the northern region (Table 4). Rarely people had fruits and/or vegetables, such as potatoes, passionfruit, pineapple, tomatoes, cabbage, and onions, which were mostly cultivated for sale at the local market. Only few legumes other than *Phaseolus* beans were grown, for example groundnuts in a few occasions in Nyangezi, in addition to individual farmers in Miti, Kavumu and Kamanyola. In Mudaka, some people also cultivated coffee for sale. Every fourth respondent from Tubimbi had oil palms.

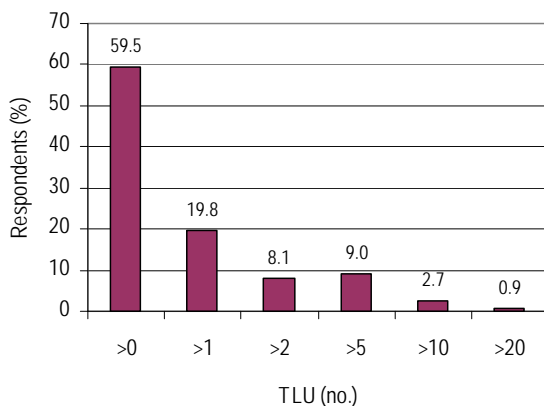
## Animal husbandry

Small animals, such as goats (*Capra aegagrus*: Bovidae), swine (*Sus* spp.: Suidae), chicken (*Gallus gallus*: Phasianidae), rabbits (various genera: Leporidae) and cobayes (*Cavia porcellus*: Caviidae) were the basis of livestock production, while cattle (*Bos* spp.: Bovidae) were rare, although more abundant than sheep (*Ovis aries*: Bovidae) (Table 5). Across all seven *groupements* surveyed, about two thirds of the farmers with livestock raised chicken and/or goats; approximately every second held cobayes and/or swine; and more than 20% had rabbits. Except for Nyangezi/ Mumosho, Mudaka and Burhale with small holdings, sheep were essentially non-existent in the other areas. Only a few respondents had ducks, fish, or bees. Concerning regional differences (Fig. 2), the most swine and highest number per household were found in the lowland *groupement* of Kamanyola, however, also more than 80% of the farmers in Burhale and Mumosho raised swine, but in much smaller number per farm. On average, there were also double to triple as many chicken per respondent in Kamanyola as in the other *groupements*. Cobayes, on the other hand, were most abundant in Mumosho, Burhale and Nyangezi, while they were absent in Kamanyola. On the other hand, highest rabbit numbers per household were found in Kamanyola. In Tubimbi, 7.7% of all respondents had fish ponds.

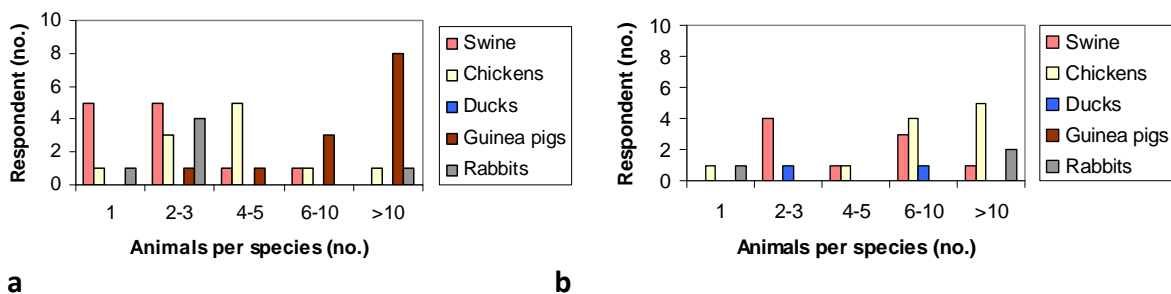
On average, there were relatively few animals held per livestock species. A mean of only 1.84 tropical livestock units (TLU) were reported per livestock-keeping household ranging from 0.03 to 23.0; however, 60% of respondents possessed up to one TLU only, while 12% had more than five TLU (Fig. 2). Nevertheless, in some cases substantial livestock numbers were available, e.g., up to 28 chicken and up to 25 swine both in Kamanyola; up to 15 goats each in Miti and Mudaka; up to 35 cobayes in Burhale; up to 17 rabbits in Kamanyola; and a maximum of 21 cattle in Kamanyola. Figure 3 shows different frequencies of monogastric animals available in two of the *groupements*, Burhale and Kamanyola. While in the former,

there was a relatively low number of swine, in the latter it was higher. On the other hand, the cobaye stock was relatively high in Burhale, while they did not exist in Kamanyola. The highest numbers of livestock in Tubimbi were found with smallstock (cobayes, chicken and rabbits).

Most animals were held in or around the homes. A few stables were observed, particularly for swine and rabbits, but occasionally also for goats and cattle. Cobayes, on the other hand, usually roamed freely in the houses and especially in the kitchens. Chicken and duck were almost exclusively kept in free-ranging systems to scavenge for their food. Goats were said to be either walked to feed them in the bush, along the roadside or they were tethered. Also swine were taken to the bush, but more to defecate in order to have no bad smells around the house, as some interviewees stated.



**Fig. 2.** Proportion of 112 respondents (%) that possessed a number of animals assessed as tropical livestock units (TLU) in South Kivu province, DR Congo in June 2009. One TLU corresponds to one cattle of 250 kg body weight.



**Fig. 3.** Frequency of monogastric livestock (number of animals per species) according to respondents in South Kivu province, DR Congo in June 2009; examples from (a) Burhale and (b) Kamanyola; guinea pigs are cobayes.

Production of small livestock species was mostly described as a family activity involving women, men and children. Nevertheless, animal production has gender, children and youth development implications, as in about almost two thirds of the cases, on average, children were responsible for herding livestock and/or fetching forage mostly alone (Table 6). But also women were in charge of gathering forage. About 18% of interviewees employed herdsmen to look after their animals, especially cattle. Occasionally, like in Mulungu, herdsmen were only in charge of goats and sheep.

Issues raised in livestock production were particularly animal diseases by more than 75% of respondents (Table 6). Several respondents had lost considerable numbers to up to all their swine due to African Swine Fever (ASF). According to respondents, ASF seemed to

regularly occur about every six or so years and then cause the death of most animals. Chicken suffered from diseases like the Bird (Avian) Flu. Interviewees attributed these challenges to poor and/or expensive veterinary services. Theft, particularly by the military, was still an issue for more than 20% of the livestock keepers, especially in Burhale and Kavumu. Overall, about 5% complained that large birds or dogs preyed on small livestock like chicken and cobayes, but in Tubimbi this was almost double (8%). Except for Mudaka and Tubimbi, high proportions of interviewees in all *groupements* complained about the lack of dry season feed (Table 6). Also 11% drew attention to a lack of space or appropriate housing for their animals.

All livestock was largely targeted for sale in case of an arising need. One of these cases would be an illness of a family member, but also special occasions like weddings, burials, or an unexpected visitor that would require an animal to be sold or slaughtered. Strikingly, a large part of the livestock was used to pay the school fees of children. Meat consumption at household level could, therefore, not be very high. Most interviewees indicated that they consumed about 20 to 40% of their livestock; some reported about 1 rabbit per family per month, or one goat per year. However, swine and goats were mostly sold, while cobayes, chicken and eggs were about half for consumption and half for sale. The timing of sale, however, was strongly dictated by the need of cash, especially, to pay school fees.

Only few respondents stated that particular livestock races were kept or bred. An exception was a farmer/herbalist from Miti who was raising improved chicken, and he was very conscious about the better prices that his eggs could fetch if he sold them to chicken producers, particularly in the dry season. However, most livestock kept in the region has already had some interbreeding with improved races, such as laying breeds in chicken, the Belgian landrace for swine, or wool sheep.

### Feed supply

Feed supply depended largely on crops and crop residues, for example banana stems, sweet potato vines or maize stalks. Specific forage plants gathered were named, such as *Galinsoga*, *Bidens* or *Commelina* (Table 7). Frequently, people stated that they purchased by-products from beer-brewing, or palm kernel or groundnut cake for improved feeding of their animals, especially swine. But also chicken received special attention; they were often given maize or sorghum grains, or small fish<sup>8</sup>. In a few cases, people reserved a plot for growing forages or even cultivated some particular forage species like Guatemala grass (*Tripsacum andersonii*), Napier grass (*Pennisetum purpureum*) or multi-purpose shrubs, such as *Leucaena leucocephala* and *Calliandra calothyrsus* (Table 7).

Zero-grazing was the most widely distributed way of feeding animals. Mostly women and children spent between about 1 and 4 hours daily to fetch forage for the livestock (Table 6), either by walking them to any grazing areas or by collecting forage along roadsides or in lowland, swampy areas. Several informants stated that children had to look after the animals in the afternoon because they largely served to cover their school fees.

### Markets

Generally, subsistence agriculture dominated in the seven *groupements* surveyed. In most cases, about 50-80% of the plant products were consumed by most of the households. On

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<sup>8</sup> Not specified whether dried, as meal, or in which form.



average, however, about 60% of the interviewees stated that they also sold some of their produce (Table 8), while the remainder consumed most of what they produced. In Tubimbi, however, not even 10% stated to sell produce from their crops. Portions of some of the staple crops, like maize, beer bananas, *Phaseolus* beans, and cassava were also sold. On the other hand, none of the interviewees stated that he or she had ever sold or bought ‘forages’ anywhere. Concerning the purchase of feeds, they would have to go directly to the brewery in order to buy brewers’ grain, or to the oil mill for palm kernel and groundnut cake.

Across all interviewees, about 40% to 85% reported that they occasionally sold one or more animals and/or eggs (Table 8); however, in Kavumu, Mumosho and Nyangezi, this was substantially lower. Most of animal products were sold to either a local market or the neighbor. Some farmers in Miti stated that they preferred to sell animals to neighbors in order to avoid administrative issues and expenses that they would have to bear in the market. Some farmers stated that swine gave higher returns in shorter time than goat, and this may partly be the reason why farmers continued to raise swine despite all the problems they face.

**Table 8.** Sales and markets of agricultural produce according to 112 respondents from seven ‘groupements’ of South Kivu province, DR Congo in June 2009.

<b>Groupement (City / Research center)</b>	<b>Interviews (no.)</b>	<b>Respondents selling crops (%)</b>	<b>Respondents selling animal products (%)</b>
Bugorhe (Kavumu)	21	38.1	9.5*
Miti (Mulungu)	21	66.7	71.4
Mudaka	25	36.0	40.0
Burhale	14	71.4	85.7
Mumosho	5	60.0	20.0
Karhongo (Nyangezi)	13	84.6	15.4
Kamanyola	13	76.9	61.5
<b>Total / Mean</b>	<b>112</b>	<b>58.0</b>	<b>43.8</b>
Tubimbi	39	7.7	30.8

\* mostly not reported.

Paying school fees was considered very important, hence, livestock prices apparently reflect the school year. Unanimously, all respondents stated that prices were lowest in September, when the school year starts and, usually, many livestock owners sell their animals. On the other hand, they were high during the Christmas/End of the year season in December because of increased demand for livestock products.

### **Organization of people**

Across *groupements*, about one third of all respondents were members of one or several of the about 40 associations or other organizations (Table 9). Some of them are related to agricultural production, such as the Association for Maize and Tomato Producers in Kamanyola or a Livestock Producers’ Association (*‘Association des Eleveurs’*) in Mudaka, and

CIALCA in Burhale. The diversity of associations or groups was strikingly high, and almost none of them occurred in more than one *groupement*. A number of respondents belonged to more than one association, while some clearly stated that they did not want to be a member of any association.

**Table 9.** Organizations that 112 respondents belonged to in seven '*groupements*' of South Kivu province, DR Congo in June 2009.

<b>Groupement (City/Research center)</b>	<b>Interviews (no.)</b>	<b>Organized respondents (%)</b>	<b>Organizations named (no.)</b>	<b>Name of organization (full name, if available; number of mentions)</b>
Bugorhe (Kavumu)	21	28.6	7	ADI Kivu (1); ASDR (Association des Jeunes Catholiques, 1); BIKA/IRS (1); Coupe couture NCA 8e CEPAC Kavumu (1); CR UMOJA (1); Réseau Communautaire pour la Protection d'Enfant (1); Shirika (Catholic Women Group, 2);
Miti (Mulungu)	21	17.4	6	AFJP de CIM (2); AFVPA (1); AMUS (1); Cataliste (1); Muzusangabo/Cirigole (1); Rhudosanye/Miti (2);
Mudaka	25	40.0	8	Anti-Bwaki (2); Association des Eleveurs (1); Bazire (Pisciculteurs, 2); Buzigire (1); IADEL (2); Muzusangabo (1); Tuungane (1); Zukacikala (2);
Burhale	14	42.9	5	CIALCA (4); Rhucihangane (3); Malteser (1); CAB (1); PAD (1);
Mumosho	5	20.0*	1*	UFF (Union fait la force, 2)
Karhongo (Nyangezi)	13	30.8*	5*	Shirika (1); CAB (1); Mper'okuhyani (1); Association des agriculteurs et éleveurs de Nyangezi (1); Addiction d'eau potable de Lwakonzi (1)
Kamanyola	13	61.5	7	ACDSEM (1); APSK (Progres Social, 1); AREF (crédit, 1); Assoc. des Tailleurs (1); IPLSI (2); Producteurs de Mais et Tomate (1); VRE (Vision de Restauration de l'Environnement, 2);
Tubimbi	39	35.9	10	AJTS (Association des jeunes de Tubimbi dans la lutte contre le sida, 4); CFGL (Comité des facilitateurs des grands lacs, 3); CMPS (1); CODESO (1); ODERU (1); Majambere (2); Ngeso (1); PDAPS (2); Tuungane (1); Voder (1)

\* This question was not provided everywhere in Mumosho and Karhongo *groupements*.

## DISCUSSION AND CONCLUSIONS

In the following discussion, issues around livestock, especially the production of monogastric animals, their feeding and marketing, will be emphasized that came to the attention during the survey.

### Issues of livestock production

With a few exceptions, livestock numbers per household were very low in the area surveyed. As Cox (2008) points out, cattle were once the measure of prosperity and livelihood security in South Kivu. Numbers have decreased drastically due to the wars since 1996 and protracted conflict thereafter. Nowadays, small monogastric species, such as chicken, cobayes and rabbits apparently play a more prominent role than ruminants, except goats (Table 5). Also swine occurred with a relatively high frequency compared to cattle, but they had low mean numbers, except in Kamanyola (Fig. 2). These figures reflect Cox' (2008) observations that the traditional mixed farming of the region that involves cattle husbandry under grazing has almost been given up; however, cattle have partly been replaced by goats. Traditionally, cattle were part of a transhumance system, while nowadays they mostly stay in the same area year-round. On the other hand, for generations small livestock have been an integral component of Kivutien livelihoods and, highly likely, they play a central economic role in many households, particularly the poorest (Cox 2008).

Three main issues of livestock production were raised by informants to the survey, livestock diseases, lack of feed and animal theft.

**General insecurity.** Due to the wars and post-war conflicts, the general situation of security is not relaxed for most farmers (Van Acker 2005). Theft appears to be quite common (Table 6). And in *groupements* like Burhale, more than one third of the households experienced looting of either cattle or goats (Cox 2008). However, Cox (2008) also recognized that there was no particular advantage or disadvantage of either small or large animals regarding their potential to be stolen. Small animals like cobayes or chicken can easily be carried away together with the people who have to flee. While large animals like cattle or goats can only be hidden in the bush from potential thieves. Certainly, livestock populations have decreased like in other conflict areas of Sub-Saharan Africa (Brück 2003, cited by Cox 2008) or in South America, for example in the Andean foothills of Peru during the active time of the 'Shining Path' guerilla movement (Loker 1993). Moyroud and Katunga (2002) state that, in addition to the existing high level of food insecurity, armed groups that steal the available food, crops or livestock pose another problem to communities, already struggling to survive. This environment of insecurity challenges any new initiative, particularly those related to research. On the other hand, farmers in the region are more than ready to initiate new livelihood strategies (Cox 2008), to reclaim their 'stolen' livelihoods.

**Feeding systems and fodder resources.** Generally, animal numbers per household were so low in the areas surveyed that feed availability should not have been an issue. Nevertheless, a third of the interviewees expressed their concerns about the lack of feed, particularly dry-season feed (Table 6). This shortage is related to relatively recent changes in animal husbandry because stable raising and zero-grazing have only recently been introduced (Cox 2008).

Some of the plant species named as forages by the farmers (e.g., *Galinsoga parviflora*, *Bidens pilosa* or *Commelina diffusa*) are regarded weeds elsewhere (Hillocks 1998) that are

associated with rather fertile soils (Mulangwa 2005; Mairura et al. 2007). Nevertheless, in many smallholder farming systems these species are being harvested together with grasses as forages for livestock (e.g., Bindelle et al. 2007; Ingratubun et al. 2000; Lanyasunya et al. 2008). Therefore, Bindelle et al. (2007) investigated the nutritive value of such species fed by farmers as fresh forages to cobayes in peri-urban rearing systems of Kinshasa. They found that *Commelina diffusa*<sup>9</sup> had a rather low daily voluntary intake, being moderately ingested by cobayes and, therefore, concluded that the species was not suitable as forage for cobaye, as opposed to leaves of *Amaranthus hybridus* or sweetpotatoes. They also highlighted that fresh forages are important to feed in order to supply the required vitamin C to cobayes. When studying the potential of *Commelina benghalensis*<sup>1</sup> as forage for ruminants, Lanyasunya et al. (2008) concluded that it could well be regarded as an acceptable supplement for fibrous low quality ruminant diets. Also the forage quality of *Commelina diffusa*<sup>1</sup> could compare well with that of several commonly used fodder crops, such as Sudan grass (*Sorghum halepense*) and Napier grass (*Pennisetum purpureum*) (Lanyasunya et al. 2006).

The wild sunflower, *Tithonia diversifolia*, on the other hand, has been shown to be a useful fodder species for different animal species. From a feeding trial with increasing proportions of wild sunflower leaf meal (WSLM; from 0 to 20%) and decreasing percentages of maize and corn bran (from 25 to 15 and 20 to 10, respectively) for weaner pigs, Olayeni et al. (2006) concluded that the diet could include up to 20% WSLM without any adverse effects on the swine. However, feeding pullets would not be recommended beyond 5% WSLM of the diet (Togun et al. 2006). Mahecha et al. (2007) found that cows' diet could contain up to 35% of chopped fresh *Tithonia* replacing concentrate without adversely affecting milk production. Crude protein (CP) contents ranged from 16.7% (Mahecha et al. 2007) to 21.4% (Tun 2004, cited by Bolio-Osés et al. 2006) of *Tithonia* cut every 7 to 4 weeks, respectively, while CP was 18.9% in WSLM when plants were harvested before flowering (Olayeni et al. 2006).

A number of respondents to the survey used planted grasses such as *Digitaria*, Guatemala and Napier (Table 7) grass. Some of them also had multipurpose trees like calliandra and leucaena; however, it is not known how much use they really made of the latter as feed resources.

In conclusion, some of the unconventional forage plants may provide a certain value; however, they may not be as productive as others that are similarly adapted to the agro-ecological and production systems conditions. For example, the perennial groundnut *Arachis pintoi* is well adapted to shaded areas under banana and other plantations, like in Central America (Cruz et al. 1994). In southeast Asia, *A. pintoi* has also been fed to swine and poultry (Stür et al. 2000). Apparently, any new forage species may have to fulfill more than one purpose as outlined under soil fertility below. As Adjei and Muir (2000) stated, "the wide range of animals that utilize forages in tropical Africa requires a careful selection of the equally large variety of cultivated forages available for introduction. That may mean working with animals such as rabbits or swine as well as the more traditional forage end-users."

**Livestock diseases.** Livestock diseases seemed to be a more important issue to many interviewees than feed supply (Table 6). This concurs with Cox' (2008) observations that

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<sup>9</sup> No evidence for the proper taxonomic identification of the *Commelina* species is given in any of the references. Specific names may have been assigned haphazardly, i.e., different species according to the references may as well be the same.

livestock numbers lost due to disease were very high. He blamed the disappearance of extension services and the extremely high prices of medicine, if available at all. Our survey supports this statement as hardly anybody had access to any extension service and farmers were too poor to afford any medicine, except herbal preparations from local herbalists. However, such herbal medicines have traditionally been applied in the region because diseases have long caused high livestock mortality (20-35%) as reviewed by Chifundera (1998). According to respondents, the most devastating disease for livestock farmers in the region is the cyclic African Swine Fever (ASF), closely followed by the Avian Flu. In southern Africa, where outbreaks regularly occur, ASF is a highly lethal and economically significant disease of swine (Babalobi et al. 2007; Boshoff et al. 2007). Both these transboundary diseases require action if swine and poultry husbandry is to be an important activity of farmers in the region. The devastation potential of these diseases, especially for the poor, challenges to care for any investment in livestock development programs (FAO 2002; Perry et al. 2002).

**Small livestock species.** So-called minor livestock species in Africa have not attracted much research, as yet, and almost nothing is known about their distribution, productivity or traditional management, as Blench (2000) stated for cobayes, despite their relatively wide distribution over a belt from Senegal in West Africa to Tanzania in East Africa (Ngou-Ngoupayou et al. 1995; Nuwanyakpa et al. 1997). Bindelle et al. (2007) reported that about 30% of the families in peri-urban areas of Kinshasa reared cobayes on the basis of grasses and forbes harvested daily in the backyards, along roads or nearby rivers. They also stated that the actual contribution to food security of cobayes as one of the unconventional livestock species has been greatly ignored. Peru, the major producer and consumer country worldwide, has an annual consumption of about 116,500 tons of meat from more than 65 mio. slaughtered animals; the overall Andean cobaye population is estimated to be 36-42 mio. (Morales 1994; Chauca de Zaldívar 1995). In the Andean countries, major advances have been made in breeding and managing cobayes (Morales 1994); for example, 5.5 animals per year per female are produced under conventional and 10.8 under improved management (Chauca de Zaldívar 1995). Manjeli et al. (1998) reported the annual reproductive rate to range from 5.4 in primiparous to 11.8 in multiparous animals from the western highlands of Cameroon. However, essentially nothing has been done to increase their productivity in central Africa despite their apparently widespread distribution in the region (Ngou-Ngoupayou et al. 1995). Geerts (2006) suggested that the high level of inbreeding in traditional African cobaye production would impede their extraordinary productivity potential. It is also highly likely that, under traditional husbandry, feed is not sufficiently made available as cobayes usually “eat day and night, and the amounts they eat are surprising” (Martin 1991). This means that feed has to be continuously made available to cobayes.

There is a great potential of cobayes to contribute to reducing food insecurity in developing countries (Lammers et al. 2009). This is especially so under the insecurity due to wars and armed conflict prevalent for the past decades in the Kivu region, where cobayes have helped rural people to not completely lose their livestock populations due to pillage; and they have also served for some cash income; finally, they were most valuable for paying school fees (Metre 2005). Hence, the cobaye is a livestock species very suitable for smallholders for a number of advantages, as summarized in Box 1, also over rabbits that may escape and, thus, become feral (Lammers et al. 2009). Cobayes, like village poultry, most

likely serve as the first step for their owners to ascend on the 'livestock ladder', leading to larger livestock species such as goats and cattle (Perry et al. 2002).

**Child labor and education.** The survey found that a large proportion of children have to either herd livestock or fetch fodder for them. The amount of time children spend is a concern. Nevertheless, several informants stated straight forward that children would also benefit from the cash income of the livestock as it will be used for paying their school fees, uniforms and other school supplies required.

**Box 1. Advantages of cobayes**

1. Help women (and children) to obtain cash income
2. Produce low-fat and high-protein meat
3. Do not compete with humans for their food
4. Grow and reproduce on a flexible diet
5. Are prolific animals
6. Adapt to a wide range of climates
7. Respond favourably to husbandry and management
8. Have a size that is easy to manage
9. Are healthy and productive animals
10. Provide security from disease and other risks such as pillage

The importance of schooling given by communities was high. It seems that families prioritize education above nutrition. Cox (2008) also highlighted the fact that he found an extraordinary high rate of school participation in the two *groupements* investigated. He also indicated that, on average, a household with children in school would pay US\$ 22.50 per year. During the present survey, even higher figures were perceived because some informants said that they paid US\$ 2.00 per child per month in primary school and between US\$ 3.00 and up to US\$ 10.00 per child per month in secondary school. This is definitely a difficult task for parents that hardly have cash income. Nevertheless, some of them may accept poverty in order to pay school fees (Cox 2008). This phenomenon of parents' sacrificing, even on food quality or quantity, in order to maintain their children in school has been described for poor rural regions in China (Unger 2002, cited by Brown 2006). Cox (2008) concluded that farmers would rather invest in education of their children than in cattle and, hence, on-farm productivity, as an attempt to participate in a modernity that exists outside the context of war. This can be seen as a strategy for risk diversification that, ultimately, will lead to a new livelihood strategy.

The situation of child labor, however, demonstrates an opportunity for introducing more productive and higher value forage crops that should reduce the burden of animal husbandry for both children and women. If forage is cultivated and proper feeding regimes adopted, animal production will increase. This will reduce the time spent by women and children scavenging for forages. When animals are fed with better feeds, their health and reproduction regimes will greatly improve. Consequently, children will have more time for their school work, play and other engagements, and there will be enough meat for their diet without jeopardising what needs to be sold to cater for school expenses. Women, on the other hand, will have more time for other chores.

**Organization of people**

According to CIALCA (2008), most sites included in the PRA generally had local associations and farmers organizations, with a mean of 10 per village, most of them agriculture-based, with some involved in health and nutrition as well as education. In the present survey, about every third person was involved in such an association (Table 9). This shows a striking capacity for collective action and self-organization, which may be the most important resource for building resilient livelihoods (Cox 2008). On the other hand, most of these

associations may be NGO-dependent and the local people may have few or no plans for their continuance. This highly diverse landscape of associations and organizations could also make access to farmers very difficult. Larger associative bodies like the CIALCA consortium should, therefore, be looked for in order to reach farmers with both improved germplasm and information in a system's perspective.

### Other issues of agriculture

**Cropping patterns and soil fertility.** Due to a traditional system of land tenure and management but also by differences of geology, major differences in soil fertility can be found in the region. The plants close to the homestead, often referred to as 'kitchen garden', receive more nutrient inputs due to residues from the homestead, from livestock, which is kept close to the homestead, and from harvest residues of annually cropped fields that are left close to the homestead after processing (CIALCA 2008). These fields can be regarded as 'infields', while the traditional cropping system also included 'outfields' that were farther away from the homestead and mostly managed in shifting cultivation as developed for western Kenya by Tittonell et al. (2005). In South Kivu, the 'infields' were classically around the homestead on tenured land, while the 'outfields' were given on a limited rental basis ('*bwasa*' land). Although the '*bwasa*' system has been formally abolished, the way of managing fields traditionally still continues, only that an exchange of crops has happened in that cash crops like beer bananas are now grown around the homestead, while staple crops are now often cultivated on more distant land usually of low fertility (Cox 2008).

In the past, cattle were responsible for a greatly reduced dependence on fallowing in main fields near the homestead (Cox 2008). Different from cattle dung that used to be a major pillar of the traditional agricultural system, goat dung is not yet considered a valuable resource (Cox 2008). And neither goat nor cobaye or rabbit manure occur in sufficient quantity to make up for soil fertility loss during cropping.

CIALCA has endeavored to reduce soil erosion and improve soil fertility. On-farm trials with a number of species have been established as hedgerows or grass strips (e.g., *Tripsacum*, *Pennisetum*, *Setaria* and *Brachiaria ruziziensis*) in order to assess their ability to retain soil. Farmers did not only prefer those species that have capacity to reduce soil loss by good rooting, but they also chose those that can serve as a green manure and are a good forage, like *Tithonia*, *Tripsacum* and *Calliandra* (CIALCA 2008). This shows obvious interest of farmers for plants that can be used as forages for their livestock. And it could also help to introduce new improved forage germplasm options to the region.

**Crops and crop residues in South Kivu.** Crops cultivated in the region reflected those mentioned by Cox (2008) for the areas of Burhale and Luhihi. Bananas and legumes (*Phaseolus* beans in particular) are primary staple and cash crops in the CIALCA mandate areas (CIALCA 2008). As both crops and crop residues largely also serve to feed animals, it would be useful to monitor feed values of improved germplasm introduced by CIALCA, in order to not forget the livestock needs while improving the overall agricultural production systems. In addition, treating straw and residues with Urea might be considered for improved livestock feeding, however, agro-chemicals are scarce and expensive in the region. If available, the direct application of Urea to crops could be more economical.

**Prospects and research needs.** It is indispensable to document the feed calendar in the different *groupements* throughout the year for an improved understanding of feed surpluses

and shortages. This could help to not only introduce new forage germplasm, but also conservation techniques that may be new to the farmers of the region. While CIALCA has strongly focused on improving cropping systems and soil fertility, also plants have been introduced to farmers that can serve as forages. Within the new initiative on 'Improved Forages for Monogastrics', additional forage germplasm with higher feeding value will be made available to farmers. Main objectives of the project are to evaluate the agro-ecological adaptation of improved forage grasses and legumes in participation with farmers and their associations, to assess the nutritional quality of these forages, and to link fodder and livestock production to markets. Apparently, there is a great need for such new germplasm and, probably, also for improved management techniques. One of the major challenges for CIAT's Tropical Forages Program (TFP) is to identify forage species and accessions of high nutritional quality suitable for monogastrics and other livestock that will produce high biomass in an altitudinal level slightly above the common ecology so far addressed by the TFP. Moreover, specific spatial and/or temporal niches need to be identified for the evolving crop-livestock systems.

The survey indicated that the most promising regions for interventions are Kamanyola because of the overall relatively larger animal populations already maintained, and Burhale, with similarly abundant livestock, however, much lower numbers per household (Fig. 2). Finally, also the area of Mumosho/Nyangezi may be targeted due to its high livestock abundance and the needs for forages expressed.

## Conclusions

Livestock is an integral part of the mixed farming systems in the region of South Kivu, despite their presently low numbers per household. Multi species farming is often driven by risk avoidance; consequently, the most important livestock species may not easily be singled out (Sones et al. 2002). From the farmers' point of views, the most important issues of animal husbandry appear to be related to animal diseases and feed resources, particularly in the dry season. Major challenges faced by introducing new and more productive forages into the region are especially towards their agro-ecological adaptation with regard to mid-elevations of >1500 m asl., prolonged growth into the dry season, and high biomass-production in order to not use too much space of small farm land. These forages need to integrate into the existing crop-livestock systems, i.e., both spatial and temporal competition with crops should be minimal. An example for this principle in a spatial niche could be *Arachis pintoi* in banana/plantain plantations, which will not negatively interfere with banana production. Another possibility for a temporal niche for the dry season would be sowing short-lived forages after crop harvest. High biomass-producing forage species that can grow on small (so far unproductive?) land may substantially lighten the burden put on children and women, who are mostly responsible to herd the animals and/or fetch feed for them.

Based on the findings of this diagnostic survey on livestock production, three *groupements* are proposed for forage research to feed monogastric animals in South Kivu province in close collaboration with CIALCA: Kamanyola, Miti/Mulungu, and Mumosho/Nyangezi. If improving security towards Kasika allows, also the region of Tubimbi should be targeted. Because of the abundance of monogastric animals, Burhale is also proposed to be an experimental site, however, the available options from CIAT's Tropical Forages Program are limited at these relatively high elevations.



## Photographic documentation II



A participant in Miti, feeding his improved chickens (left), feeding un-chopped banana pseudostems to goats in Mudaka (center), and planted grass to stabilize field bunds and provide forage in Burhale (right)



Typical forage collected to feed livestock (left) and a plot in Burhale left to grow forages (right)



*Tithonia diversifolia* grown along a path in Burhale (left) and Napier grass at a shady, moist location in Mudaka (right)





Field in Mudaka with mixed cropping of bananas, sweet potato and amaranth (left); homestead surrounded by bananas and recently planted sweet potato in Nyangezi (right)



Banana plantations in Burhale (left) and grazed, frequently burnt hills near Nyangezi (right)



Children returning from school in Burhale (left) and the village of Mulungu hidden in the banana plantation (right)

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## APPENDIX

### Appendix 1. Participants of the survey in South Kivu, DR Congo in June 2009

No.	Name	Sex	Function	Institution*
1	Kilamwaka Ndalihazi	M	Rural Extensionist	Centre de Santé, Kamanyola
2	Bahati Venant	M	Facilitator	CIALCA, Burhale
3	Kapinga Shahidi	M	Enseignant	ISDR, Bukavu
4	Isaac Nshokano	M	Research Assistant	IITA REAFOR, Bukavu
5	Sudy Simulilo Nyange	M	Work Leader	ISDR, Bukavu
6	Vital Kulimushi	M	Rural Extensionist	IADEL, Bukavu
7	Vanny Musimbi K	M	Rural Extensionist	Independent, Bukavu
8	Erick Linolirhanzi	M	Rural Extensionist	Independent, Bukavu
9	Ngabo Thomas	M	University Assistant	UEA, Bukavu
10	Yves Mitima Muhima	M	Agronomist	Independent, Bukavu
11	Olivier Ntamwira	M	Agronomist	Independent, Bagira
12	Eulalie Zahinda	F	Rural Extensionist	Independent, Bukavu
13	Esperance Mpinga	F	Rural Extensionist	Independent, Kadutu
14	Janvier Bashagaluke	M	University Assistant	UCB, Bukavu
15	Rugarabura Deo	M	Research Technician	INERA, Mulungu
16	Innocent Lofoli	M	Research Assistant	INERA, Mulungu
17	Dieudonné Katunga Musale	M	Research Technician	CIAT-Bukavu
18	Michael Peters	M	Scientist	CIAT-Cali, Colombia
19	Brigitte Maass	F	Scientist	CIAT-Nairobi, Kenya
20	Wanjiku Chiuri	F	Scientist	CIAT-Kigali, Rwanda

\* IADEL, Initiative d'Action pour le Développement d'Élevage; IITA, International Institute for Tropical Agriculture; INERA, Institut National pour l'Étude et la Recherche Agronomique; ISDR, International Strategy for Disaster Reduction; REAFOR, Programme for Relaunching Agricultural and Forest Research in DRC; UEA, Université Évangélique en Afrique; UCB, Université Catholique de Bukavu.

**Appendix 2.** Questionnaire used for the survey in South Kivu, DR Congo in June 2009**Key questions for the rapid diagnostic on monogastric systems, DRC June 2009****Questions clés sur le diagnostic rapide du système d'élevage des monogastriques, RDC juin 2009**

Objective: Understand monogastric production systems in South Kivu, DRC, and identify possibilities for alternative forage based feeds

*Objectif: Comprendre les systèmes d'élevage des monogastriques dans le Sud Kivu et identifier une alternative d'une bonne alimentation fourragère*

**General questions // Questions générales**

1. Do you have animals? Why do you have them, why do you have small animals (e.g. goats, sheep)  
*Avez-vous des animaux? Pourquoi les avez-vous, pourquoi avez-vous des petits animaux (exemple: chèvres, moutons)*
2. Do you have monogastric animals? (Poultry, swine, guinea pigs, rabbits, fish...)? Which ones?  
*Avez-vous des animaux monogastriques? (Poules, porcs, cobayes, lapins, poissons...)? Lesquels?*
3. Animal races if possible? Why did you choose these?  
*Si possible, donnez la race des animaux. Pourquoi les avez-vous choisis?*
4. Where do you hold your animals (free range, in the compound, cage, stable ....)? Why?  
*Comment élevez-vous vos animaux (divagation, dans la ferme, en cage, en stabulation...)? Pourquoi?*
5. From where did you bring the male for your husbandry?  
*D'où provient le mâle que vous utilisez dans votre élevage?*
6. Why do you have monogastric animals? Why did you start to raise these? Since when do you have them? How many animals do you have? Why don't you have more/less? Did you increase or decrease the number of animals? Are you satisfied? What are the problems?  
*Pourquoi avez-vous des animaux monogastriques? Pourquoi faites-vous cet élevage? Depuis quand les avez-vous? Combien d'animaux avez-vous? Pourquoi n'en avez-vous pas plus/moins? Avez-vous augmenté ou diminué le nombre d'animaux? Etes-vous satisfaits? Quels sont les problèmes?*
7. Do you have other animals? Do you have cattle? How many? Why do you have different animal types?  
*Avez-vous d'autres animaux? Avez-vous les bovins? Pourquoi avez-vous différents types d'animaux?*
8. Who handles the animals? Who sells the animals?  
*Qui garde les animaux? Qui les vend?*
9. How big is the farm (ha, m<sup>2</sup> or any other measure)?  
*Quelle est la superficie de votre exploitation (ha, m<sup>2</sup> ou autre mesure)*
10. Since when are you living on the farm?  
*Depuis quand vivez-vous dans la ferme?*
11. What crops do you have?  
*Quelles sont les cultures que vous faites?*
12. Are you selling crops?  
*Vendez-vous les cultures?*
13. Are there any animal health problems?  
*Y a-t-il des problèmes de santé des vos animaux?*  
Comment: If you are invited always good to see the animals, how they are held, which animal species there are, how they are fed.....  
*Commentaires: Si vous êtes invités, il est préférable de visiter les animaux, voir comment ils sont élevés, quelles sont les espèces animales élevées, comment sont-ils nourris.....*

**Market // Marché**

14. Where are you selling the animals?  
*Où vendez-vous les animaux?*
15. Are there many people who sell?  
*Y a-t-il beaucoup des gens qui les vendent?*
16. Are there Price differences during the year?  
*Y a-t-il une variation des prix pendant l'année?*

17. Are you paid for the quality of the meat/egg?  
*Etes-vous payé pour la qualité de la viande/des oeufs?*
18. At which age and weight are you selling the animals?  
*A quel age et poids vendez-vous les animaux?*
19. Are you buying animals for fattening? When do you buy them and at which age?  
*Achetez-vous les animaux pour l'engraissement? Quand les achetez-vous et à quel age?*
20. How much cost a fattened animal? How many animals did you sell last year?  
*A quel prix se vend un animal engraisé? Combien d'animaux avez-vous vendus l'année passée?*
21. How many eggs are getting per chicken per day or week?  
*Combien d'oeufs recevez-vous par poule par jour et par semaine?*
22. How much cost an egg?  
*A quel prix se vend l'œuf?*
23. What percentage of the animal production is sold and how much consumed in the household?  
*Quel pourcentage de la production animale est vendu et combien se consomme par le ménage?*

### **Feeds // Alimentation**

24. What are giving as feed? Are you using vegetative materials? Which ones?  
*Quelle nourriture donnez-vous aux animaux? Utilisez-vous les herbes? Lesquelles?*
25. Are you buying/selling feed?  
*Vendez-vous ou achetez-vous les aliments?*
26. Do you have sufficient feed? The whole year? If not, why not? When in the year is your feed limited? What are you going to do about it?  
*Avez-vous suffisamment de nourriture pour vos animaux? Pendant toute l'année? Si non, pourquoi? Quand avez-vous carence d'aliments durant l'année? Que faites-vous pour combattre cette carence?*
27. How is the quality of the feed? Of the purchased feed, is the quality varying during the year?  
*Quelle est la qualité d'aliments? Des aliments achetés, la qualité varie-t-elle durant l'année?*
28. Are you buying concentrates/feed? What type are you buying (comment: there could be different feeds for stable/free range, young and old animals) Where are you buying the feed? At which price? Comments on concentrates? Changes during the year in prices, quality?  
*Achetez-vous les concentrés/aliments? Quel type achetez-vous (commentaire : il peut y avoir différents types d'aliments pour la stabulation/pâturage libre et ou divagation, jeunes et vieux animaux)? Où achetez-vous les aliments? A quel prix? Commentaires sur les concentrés? Variations des prix durant une année, qualité?*
29. Who is producing the feed? Who is buying the feed?  
*Qui produit les aliments? Qui vend les aliments?*
30. With what are you feeding the animals? What feed are you offering? What quantities are you giving? Are you changing quantities for different types of animals? For which animal are you giving which feed? (Comment: It is important to know that the quantity is sufficient and that there is a balanced diet; one can ask for a concentrate bag noting energy and protein. Even if useful take a sample)  
*Avec quoi nourrissez-vous les animaux? Quelle nourriture offrez-vous? Quelles quantités donnez-vous? Changez-vous les quantités d'aliments selon les types d'animaux? Pour quel animal donnez-vous quel type d'aliments? (Commentaire : il est important de savoir que la quantité est suffisante et qu'il y a un équilibre des nutriments, on peut demander pour un concentré d'aliment la notice sur l'énergie et les protéines? même s'il est utile de prendre un échantillon).*

### **Organization // Organisation**

31. Are you participating in/belong to associations or groups? Which ones?  
*Appartenez-vous à un groupe ou une association? Laquelle?*
32. Do you have technical assistance? From whom? Is it sufficient?  
*Recevez-vous une assistance technique? D'où vient elle? Est-elle suffisante?*
33. Is there lack of capital/credit?  
*Y a-t-il une carence de capital/crédit?*





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