

7

Livestock against Risk and Vulnerability:

Multifunctionality of Livestock Keeping in Burundi

E. Vandamme^{1,2}, M. D'Haese², S. Speelman² and L. D'Haese^{2,3}

¹ Department of Veterinary Medicine, Institute of Tropical Medicine, Antwerp, Belgium

² Department of Agricultural Economics, Ghent University, Ghent, Belgium

³ Department of Applied Biological Sciences, University of Antwerp, Antwerp, Belgium

Abstract

Although poor households in developing areas are generally seen as highly vulnerable, they actually do have coping mechanisms through which they deal with risks. In essence, they cope by adapting their income- and food-generating activities. The focus of this chapter – livestock keeping as a livelihood strategy in a risky environment – explores whether resource-poor households use livestock to overcome risks. A study of the reasons for livestock keeping and the multifunctionality of livestock within the sustainable livelihoods framework identified the use of livestock as insurance against risk and as the base from which to diversify economic interests. The study obtained information on 288 households in Burundi, including demographic, socio-economic, food security and agricultural characteristics. Recognising that food security is probably the most important and valid measure of livelihood outcome in resource-poor areas, the level of food insecurity was analysed by asking questions regarding availability, accessibility and diet quality. The second part of the analysis studied characteristics of livestock keepers and how livestock contribute to their household risk-coping abilities. The majority of households are food insecure and involved in wage labour. The more food-secure households are involved in livestock keeping and more likely to be involved in food and cash crop markets. Although average animal production is very low, involvement in livestock keeping is significantly linked to better food security. Livestock was used to overcome vulnerability through income from animal products and distress sales, provide opportunities to obtain credit and facilitate investment by serving as insurance. These results support the hypothesis that livestock can play a role as insurance and increase the risk-bearing capacity of resource-poor households, especially for risky investments that have higher returns.

Key words: risk, vulnerability, food security, insurance, investments, resource-poor households, Burundi

1. Introduction

It is generally recognised that poor households in developing areas are highly vulnerable to risk. Risk is the exposure to events with uncertain and potentially unfavourable consequences (Hardaker *et al.*, 1997). The two main negative events identified are shocks and stresses. Shocks are large, unpredictable, irregular disturbances, while stresses are smaller, predictable, regular and sometimes continuous disturbances (Pearce *et al.*, 1989). A household is said to be vulnerable to risk when it is prone to food insecurity and experiences a high degree of exposure to shocks and stresses (Chambers, 1989 and Davies, 1996). This refers both to external threats to livelihood security and internal coping capabilities determined by assets, food stress, support from kin or community amongst others (Ellis, 2000). Faced with external threats, a household will adapt its income and food-generating activities in the best possible way to minimise risk and achieve food security. The focus of this chapter is to explore how important it is for households in resource-poor areas to keep livestock in order to overcome vulnerability and surmount risk.

Measuring and conceptualising vulnerability and resilience to risk is complex. On the one hand, the large variety of risk factors makes it difficult to isolate specific causes. The ability to cope also depends on which livelihood strategies are practiced. With regards to the former, different risk factors result in different types of risk: i) environmental factors such as droughts or floods; ii) socio-economic factors such as gender discrimination or a lack of efficient resource management; iii) natural and man-made hazards such as conflict, insect plagues, malfunctioning markets and high prices; and iv) political factors such as civil unrest and policies that affect entitlements and access to resources (Collier and Gunning, 1999). This chapter does not consider these types of risk, but instead focuses on livestock keeping as a livelihood strategy in a risky environment.

Ellis (2000) makes a clear distinction between *ex ante* and *ex post* risk management strategies. *Ex ante* strategies or adaptive strategies are long-term adaptations aimed at improving livelihood security. *Ex post* strategies or coping strategies describe households' attempts to manage limited resources to ensure survival and protect assets in the hope of recovery after a shock or threat (Ellis, 2000). Consumption smoothing is a very important *ex post* coping strategy, and refers to a uniform way of consumption between income generating periods to prevent lack of money towards the end of non-income generating periods. An important instrument for consumption smoothing is the distress selling of assets in times of crisis. The main assets used for distress sales are livestock and food crops (Ellis, 2000). For livestock to assume a role in consumption smoothing, Dercon (1998) identified some necessary economic and geographical conditions that must be in place: i) livestock markets should be well developed, ii) prices should be relatively stable and reasonable, and iii) there should

be risk management strategies for disease management or moving cattle in case of a life-threatening drought.

This chapter presents a case study undertaken in a northern province of Burundi to i) identify the contributions of livestock keeping to rural livelihoods and ii) determine the role of livestock keeping in risk-management strategies. Results are based on data from 288 households interviewed about their farming practices in 2007.

2. Literature overview

An estimated two-thirds of resource-poor rural households worldwide keep some type of livestock (LID, 1999). Six different reasons for livestock keeping can be distinguished: i) food production; ii) income generation; iii) provision of manure; iv) draught power; v) financial instruments; and vi) enhancing social status (Moll, 2005 and Randolph *et al.*, 2007). The first four result in the direct-use value of livestock (Shackleton *et al.*, 2001) while the last two are more related to development settings and their cultural, social and economic context and create indirect-use value (Shackleton *et al.*, 2001). Livestock serve as financial instruments in rural settings because of the persistent absence of credit and financial markets in rural areas of developing countries. According to Moll (2005), investment in livestock is seen as creating a savings account or insurance, which can provide an instrument of liquidity and consumption smoothing in times of need. The sixth reason refers to widely-found social implications of livestock keeping. In fact, livestock keeping does not only induce cultural and social advantages, in many cases it also translates into access to or authority over a broader base of resources which provide opportunities to obtain higher income (Randolph *et al.*, 2007).

To understand and identify the contributions of livestock to the general well-being of rural households, the conceptual framework of livelihoods can be used (Randolph *et al.*, 2007). Chambers and Conway (1992) defined livelihoods as the capabilities, assets and activities required for a means of living. According to Ellis (2000) the most important feature of this popular livelihood definition is that it directs attention to the link between assets and the options people possess in practice to pursue alternative activities that can generate the income level required for survival. Assets are the starting point for livelihood analysis, the basic building blocks upon which households are able to generate their means of survival. Scoones (1998) distinguished five types of capital households may possess in the sustainable livelihood framework, namely; natural capital, human capital, physical capital, financial capital and social capital.

Natural capital comprises the land, water and biological resources that are utilised by people to generate means of survival.

Physical capital refers to infrastructure such as roads, electricity and water supply, irrigation canals, machines.

Human capital comprises the labour available to the household: their education, skills and health.

Financial capital refers to any stock of money to which the household has access. Generally these can be savings or access to credit in the form of loans.

Social capital attempts to capture community and wider social claims which contribute to individuals' and households' means of survival.

Randolph *et al.* (2007) identified specific contributions of livestock to each type of capital. Animal manure can increase natural capital by increasing soil fertility. It also indicates a linkage between herd size and physical capital, because an increase in herd size results in an increase in physical capital. Animal products and proteins are important contributors to human nutrition and health status and therefore provide a means to empower human capital. Animal production is a means of income generation and therefore increases financial capital. The clear linkage between livestock keeping and social status indicates the positive implications livestock keeping has on social capital.

A DFID study by Heffernan and Misturelli (2000) in Kenya provided evidence of the major importance of livestock keeping in household economic security. Using a ranking exercise, they found that rural households identify livestock keeping as their most important income source. Kristjanson *et al.* (2004) found that livestock played a key role in pathways both into and out of poverty. Dercon (1998) found that in Sukumaland, Tanzania, households that owned cattle had significantly higher income than those households that did not own cattle. Assuming that keeping cattle has highly positive effects on livelihood outcomes, one might wonder why not all households are involved in cattle keeping. Dercon (1998) stated that some households were excluded from the economic activity of cattle keeping due to low asset and resource endowments. This suggests the presence of entry barriers for the involvement in cattle keeping.

Reardon *et al.* (1992) showed that larger livestock holdings in Burkina Faso were linked to greater diversification, which resulted in risk reduction strategies and identified three different activities leading to risk reduction:

- i Livestock can be used as collateral for loans to start non-farm enterprises. Ellis and Freeman (2004) described livestock as a substitutable asset that can be sold in order to invest in land or small businesses and vice versa. Non-farm income can be used to build up herds and obtain the necessary inputs.
- ii Income can be gained from selling animals and by-products.

- iii Households with larger livestock holdings seem to be less risk averse and thus perhaps more willing to invest and diversify outside agriculture in off-farm activities.

Ellis (2000) found that households would only engage in economic activities with high perceived risk when they could compensate for this risk by having contingency income sources or fallback positions of social support in place, in case of failure. Dercon (1996) showed that in Tanzania, households with relatively low livestock holdings allocated significantly more of their land to sweet potatoes – which are considered a low risk and low return crop – than households with large livestock holdings. These findings suggest the possibility that livestock holdings influence the household's farm-management decisions.

These studies lead to the conclusion that livestock can be used to overcome vulnerability both directly through income from animal products and distress sale and indirectly through providing opportunities to obtain credit and facilitating investment by serving as insurance and thereby increasing risk-bearing capacity.

3. Case study: Livestock keeping among poor households in Ngozi Province, Burundi.

General information of Burundi

Burundi is among the poorest countries in Africa. Its annual gross national income (GNI) per capita (PPP) is only US\$320, five times less than the average sub-Saharan African GNI. Burundi was ranked 167 out of 177 countries in the last United Nations Development Program's (UNDP) Human Development Index (HDI), which measures human development by combining life expectancy at birth, education level and standard of living. Burundi has a population of 8 million and average population density of 273 persons/km². Agriculture is by far its most important economic activity, with 90 percent of the population involved in agricultural activities. The most important staple crops are beans, sweet potato, cassava and banana, with coffee as its only important cash crop for export. Despite high population growth, Burundi was food self-sufficient until the beginning of its 1993 civil war (Cochet, 2004). Currently, the political environment in Burundi is relatively stable but widespread insecurity and uncertainty still prevails.

Rural households in Burundi are exposed to high levels of different risk factors. Climatic risks related to a fluctuation in rainfall and temperature result in crop yield uncertainties. Economic risks and political conflicts cause widespread price uncertainty due to market instability and unreliable institutions and infrastructure. Increasing population pressure and land scarcity create great uncertainty on yields

and hence on income derived from the agricultural sector. In this context of high risk and uncertainty, rural households develop coping mechanisms and risk management strategies to ensure a sustainable income or, in the worst case scenario, to survive.

Data collection

The data used in this case study was gathered during August and September of 2007 in Ngozi province of northern Burundi. This province is characterised by a high population density (475 persons/km²) resulting in land scarcity and high levels of food insecurity. Information obtained on 288 households included demographic, socio-economic, food security and agricultural characteristics.

Methodology

The data is used to identify how livestock contributes to rural livelihoods and what characterises livestock keepers in the sample. It is worth noting that an estimated 90 percent of the households in Burundi depend on agriculture for their survival. Food security, probably the most important and valid measure of livelihood outcome in resource-poor areas, can be assessed using various indicators such as daily caloric intake. However, this study uses a more subjective measure, namely the Household Food Insecurity Access Scale (HFIAS) developed by USAID (Coates *et al.*, 2007). Using this method, the answers to a specific set of questions on availability, access and diet quality, result in a score for each household indicating the level of food insecurity. The score ranges from 0 (household is food secure) to 27 (household is highly food insecure). The HFIAS score can be divided further into four different categories ranging from category one for food-secure households to category four for highly food-insecure households. The relative importance of livestock is analysed for each of these categories.

The second part of the analysis studies different characteristics of livestock keepers and how livestock contributes to the household's risk-coping abilities.

Results

Contribution of livestock to food security

In order to analyse food security for livelihood outcome and sustainability, households with different food security levels and livelihood activities were compared to reveal how differences in the uptake of economic activities resulted in a better or worse food security status. The original distribution of households for Ngozi in four different food security categories (highly food secure, mildly food secure, moderately food insecure, and severely food insecure) is shown in Figure 1.

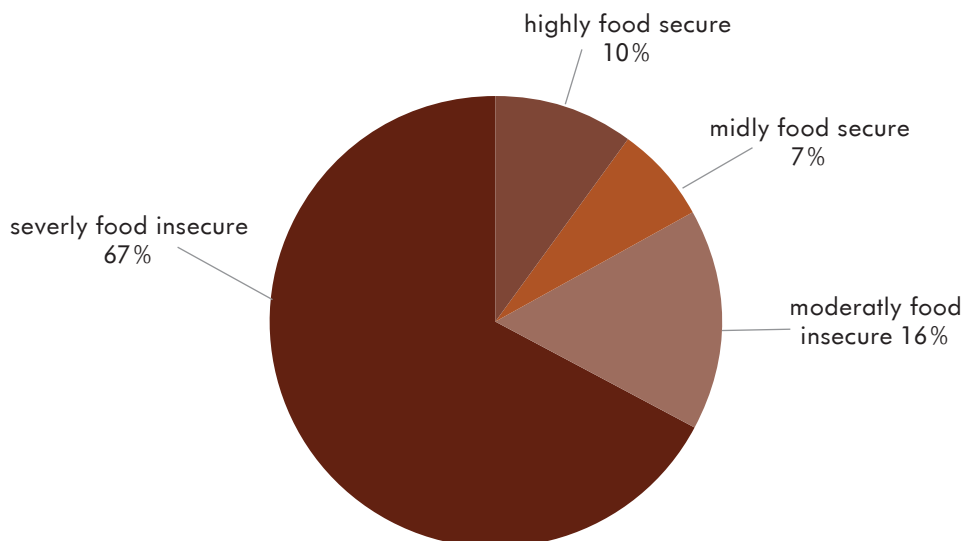


Figure 1: Food security status of households in Ngozi in 2007 (N=288)

For further analysis, the two food secure categories were merged to create a larger category for statistical reasons, resulting in three different categories; i) food secure households; ii) moderately food insecure households; and iii) severely food insecure households. For these three categories, the share of households involved in different livelihood activities was compared with a Pearson Chi-squared test. The results are presented in Table 1.

Table 1: Livelihood activities of households (hh) with different food security status in Ngozi, 2007 (N=288)

Share of households (%) involved in	Food secure hh (N=47, 16.5%)	Moderately food insecure hh (N=47, 16.5%)	Highly food insecure hh (N=194, 67%)	Test (Chi-squared)
Food crop sales	91.5	91.5	74.4	11.19**
Cash crop sales	91.5	61.7	69.6	11.85**
Wage Labour	12.8	29.8	41.8	14.65**
Trade	46.8	46.8	30.4	7.41**
Livestock	66.0	42.6	31.4	19.28**
Poultry keeping	17.0	27.7	18.0	2.45
Goat keeping	51.1	38.3	35.1	4.11
Cattle keeping	40.4	25.5	12.4	20.78**

Households with a food-secure status were more likely to be involved in food crop and cash crop sales, and livestock keeping. A significantly larger share of households with high food-insecurity levels were involved in wage labour. Being involved in livestock keeping in general, and specifically cattle keeping, was significantly linked to a better food-security level which suggested that cattle keeping and livestock keeping in general had a positive effect on household food security levels.

Contributions of livestock to livelihood strategies

Table 2 shows the distribution and characteristics of livestock keeping in Ngozi. Goats were the most popular livestock species while an equal share of households were involved in cattle and poultry keeping. Other livestock species were less common.

Table 2: *Characteristics of livestock keeping in Ngozi, 2007 (N=288)*

	Number of households (N)	Share of households (%)	Maximal	Mean number of animals (SD)
Cattle	56	19	13	2.38 (1.93)
Goats	110	38	40	3.48 (4.13)
Poultry	56	19	46	6.84 (6.87)
Pigs	27	9	9	1.56 (1.78)
Sheep	22	7.5	5	2.59 (1.29)

Table 3 shows the households that kept cattle or poultry, the share of households that actually obtained animal products from their livestock and the quantities obtained. Approximately one-third of the households keeping cattle or poultry actually obtained milk or eggs from their animals. The average animal production was low, which implied a low production value. These findings suggested that the sales of animal products such as milk or eggs were probably not the main reason for livestock keeping.

Table 3: *Animal production in Ngozi, 2007*

	Share of households (%)	Minimal	Maximal	Mean (SD)
Milk production (l/week)	25.5	1	42	14.47 (12.75)
Egg production (eggs/week)	35.7	3	20	9.30 (5.03)

Livestock were partially integrated in the farming system through the specific use of manure as fertiliser for the purpose of nutrient cycling. A similar study in the same

study area, performed in 1996, found an increase in the use of manure over the previous ten years. This implied a certain, albeit more indirect, importance of animal products in rural livelihoods.

Figure 2 gives an overview of the distribution of the most valuable livestock assets owned by households. Different livestock keeping strategies were distinguished: i) households keeping cattle and possibly also smallstock (goats, sheep and pigs) and poultry; ii) households keeping smallstock and possibly poultry; iii) households keeping poultry; and iv) households without livestock. More than half of the households in the sample kept some type of animal, mostly smallstock. This was partly explained by a government project that introduced goats. One-fifth of the households kept cattle. Since only very few households were solely involved in poultry keeping, they were merged with households involved in smallstock keeping for further analysis. This resulted in three livestock keeping strategies: i) no livestock; ii) keeping only smallstock, i.e. poultry, goats, sheep or pigs; and iii) keeping cattle and possibly other livestock species.

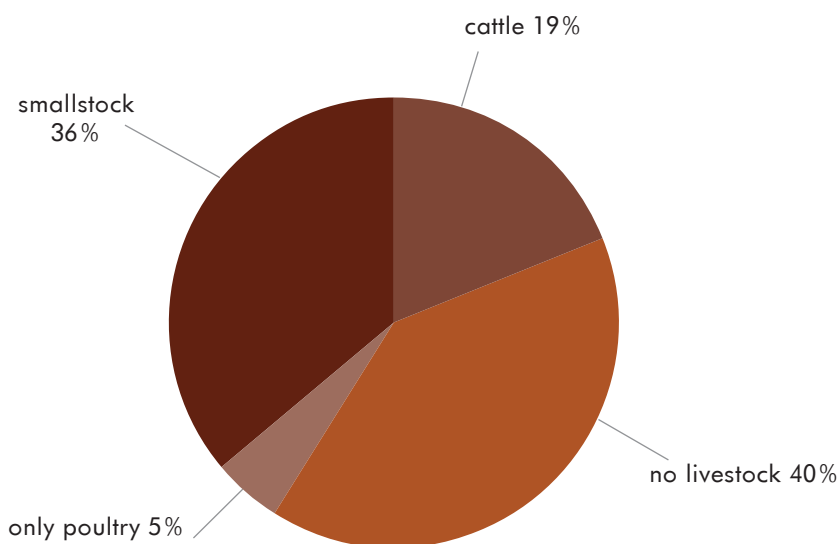


Figure 2: *Distribution of different livestock keeping strategies of households in Ngozi, 2007 (N=288)*

As stated, livestock can be used to overcome vulnerability both directly, through income from animal products and distress sale, and indirectly by providing opportunities to obtain credit and facilitating investment by serving as insurance and thereby increasing their risk-bearing capacity. The low productivity and production levels of livestock in Ngozi indicated that income from animal products as an outcome

of livestock keeping would not be a major contributor to households' risk-coping mechanisms. Although distress sales had potential to be another possible coping strategy, a lack of information on the functioning of local livestock markets and access to those markets prevented drawing clear conclusions on the contribution of distress sales to coping strategies and insurance possibilities in Ngozi.

According to Table 4, only 12.5 percent of all respondents had access to credit. A Pearson Chi-square test, used to determine whether there was significant difference in access to credit for households involved in different livestock keeping strategies, allowed a comparison of the share of households that had access to credit for each livestock keeping strategy. It found that households owning cattle had significantly higher access to credit.

Table 4: *Access to credit for households involved in different livestock keeping strategies in Ngozi, 2007*

	Share of all households having access to credit (%)
General dataset (N=288)	12.5
Hh not involved in livestock keeping	7.1
Hh keeping only smallstock	11.8
Hh keeping cattle	25
Chi-Square test: 11.09**	

The last indirect contribution that livestock keeping might have had to risk and uncertainty management was providing a type of insurance that would increase risk-bearing capacity. Households owning livestock assets might have been more willing to invest in more risky farm and non-farm activities because they had livestock assets to fall back on in case the investment went wrong. This hypothesis was examined by comparing farm management decisions and activity choices for households involved in different livestock keeping strategies.

► Farm management decisions

For rural resource-poor households, farm-management decisions are crucial. These households try to allocate the limited resources they have as efficiently as possible in order to increase income security, food security and risk-coping ability. The different farm-management decisions studied included cropping choices, input investments and the level of investment in conservation measures. For comparing cropping choices, less common products such as pineapple and passion fruit as fruit crops, and tomatoes, cabbages and onions as vegetable crops were also included in order to ascertain whether investments in these crops could be linked to differences

in livestock-asset holdings. The field-fragment share for food crops or cash crops indicated the percentage of field fragments cultivated with either food crops or cash crops. A higher share of field fragments cultivated with cash crops could indicate a higher preference to invest in cash crops. Table 5 compares the uptake of different management decisions for the different livestock keeping categories. Different tests were used to check whether there was a significant difference between households belonging to different livestock keeping categories.

Table 5: *Farm management decisions of households with different livestock keeping strategies in Ngozi, 2007 (Standard deviation between brackets for continuous variables)*

	Households not keeping livestock (N=113; 39%)	Households keeping only smallstock (poultry, goats, sheep, pigs) (N=119; 41%)	Households keeping cattle (N=56; 20%)	Test
Cropping choice decisions				
Number of different crops	5.52 (1.81)	5.97 (1.70)	6.25 (1.81)	F-stat: 3.64**
Share of households involved in vegetable cropping (%)	24.8	35.3	41.1	Chi-Squared: 0.07
Share of households involved in fruit cropping (%)	9.7	10.9	12.5	Chi-Squared: 0.30
Share of households involved in rice cropping (%)	7.1	7.6	23.2	Chi-Squared: 12.22**
Field fragment share food crops	0.71 (0.18)	0.65 (0.18)	0.69 (0.21)	F-stat: 2.43
Field fragment share cash crops	0.20 (0.16)	0.21 (0.14)	0.18 (0.16)	F-stat: 0.65
Input decisions				
Share of households using fertiliser (%)	42.5	52.9	48.2	Chi-squared: 2.55
Share of income invested in farm (%)	16.17 (13.38)	25.67 (18.15)	30.39 (20.68)	F-stat: 15.86**
Expenditure on inputs (\$/ha)	64 (118)	61 (77)	57 (77)	F-stat: 0.12
Conservation measures				
Share of households applying anti-erosion measures (%)	26.5	47.1	44.6	Chi-squared: 11.39**

The data provided some evidence of linkages between livestock holdings, and cropping and investment decisions. Households without livestock grew significantly fewer crops, were less involved in vegetable and fruit cropping (although not significantly) and were less involved in rice cropping. They invested a significantly lower share of their income in farming activities, although actual expenditures on inputs per landholding did not seem to differ significantly. In addition, a significantly larger part of livestock keepers invested in anti-erosion hedges, making them less vulnerable to erosion. These findings indicated that livestock holdings were related to farm management decisions and that the presence of livestock asset holdings might provide an incentive to diversify crop choices and invest in rarer crops and specific conservation measures.

► Activity choices

Table 6 shows the share of households from different livestock keeping categories involved in different livelihood activities. The study found significant differences in activity choices of households involved in different livestock keeping strategies.

Table 6: *Involvement in livelihood activities of households with different livestock keeping strategies in Ngozi, 2007*

Share of households involved in	Households not keeping livestock (N=113, 39%)	Households keeping only smallstock (poultry, goats, sheep, pigs, (N=119, 41%)	Households keeping cattle (N=56, 20%)	Test (Chi-squared)
Food crop sales (1=yes)	75.2	80.7	89.3	4.69
Cash crop sales (1=yes)	63.7	79	73.2	6.75**
Wage labour (1=yes)	45.1	28.6	28.6	8.27**
Trade (1=yes)	24.8	40.3	48.2	10.79**
Share of income from off-farm (%)	43.85	29.26	26.93	F-stat: 8.49**

A larger share of households involved in livestock keeping were involved in cash cropping while a larger share of households not involved in livestock keeping were involved in wage labour. Almost half of the households involved in cattle keeping were also involved in trading, while less than one-quarter of households not involved in livestock keeping were performing trading activities. However, comparing the share of income derived from the off-farm sector indicated that off-farm income was most important for households that did not have any livestock. Households not

involved in livestock keeping derived a larger share of their income from off-farm activities which indicated some kind of substitution between livestock and off-farm income.

4. Conclusion

Uncertainty is part of everyday life for most rural households in resource-poor areas. To deal with this risk and uncertainty, rural households develop different risk-coping strategies, adapt their farm management practices and invest in social ties and tangible and secure assets, such as livestock. This study focused on livestock keeping in a densely populated province of Burundi.

Literature describes the direct and indirect ways livestock keeping decreases vulnerability of rural households and controls risks. This can occur directly through the income gained from sales of animal products but also the distress sales of animals. Looking at the low animal production levels, however, indicated that this could not be the most important contribution of livestock to livelihoods of households in Ngozi. Limited information on livestock markets inhibited drawing a conclusion on the importance of distress sales of livestock as a risk-reduction strategy.

However, the obtained data did indicate that the indirect contribution of livestock keeping could be described either as facilitating access to credit or serving as insurance that, in turn, could provide incentives to engage in higher risk and higher return activities. In general, access to credit in Ngozi was very poor, as only 12.5 percent of households had access to credit. Results suggested that livestock keeping, especially cattle keeping, facilitated access to credit.

Studying the linkages among different livestock keeping strategies and on- and off-farm management decisions found that households with livestock were keener on risky investments such as vegetable, fruit and rice cropping and had a higher likelihood of investing in anti-erosion hedges to decrease erosion risk. Differences related to off-farm activity choices suggested that households involved in livestock keeping were also more involved in trading.

These results support the hypothesis of livestock playing the role of insurance and increasing the risk-bearing capacity of resource-poor households. Owning livestock gives households a sense of security and breathing space to invest in more risky crops and activities that have higher returns. It allows the conclusion that livestock are important contributors to households' capability to cope with risk and overcome vulnerability because they provide a reliable means of insurance in high risk, resource-poor areas such as Ngozi.

References

- Chambers, R. 1989. Editorial introduction: Vulnerability, coping and policy. *IDS Bulletin*, 20(2): 1-7.
- Chambers, R., and Conway, R. 1992. *Sustainable rural livelihoods: Practical concepts for the 21st century*. IDS Discussion Paper, No. 296.
- Coates, J., Swindale, A., AND Bilinsky P. 2007. Household Food Insecurity Access Scale (HFIAS) for measurement of food access. Indicator guide version 3, Food and Nutritional Technical Assistance Project (FANTA) USAID, Washington D.C., USA.
- Cochet, H. 2004. Agrarian dynamics, population growth and resource management: The case of Burundi. *GeoJournal*, 60: 111-122.
- Collier, P., and Gunning, J.W. 1999. Explaining African economic performance. *Journal of Economic Literature*, 37: 64-111.
- Davies, S. 1996. *Adaptable livelihoods: Coping with food insecurity in the Malian Sahel*. Macmillan Press, London, UK.
- Dercon, S. 1996. Risk, crop choice and savings: Evidence from Tanzania. *Economic Development Cultural Change*, 44 (3): 485-514.
- Dercon, S. 1998. Wealth, risk and activity choice: Cattle in Western Tanzania. *Journal of Development Economics*, 55: 1-42.
- Ellis, F. 2000. *Rural livelihoods and diversity in developing countries*. Oxford University Press, Oxford, UK.
- Hardaker, J.B., Huirne, R.B.M., and Anderson, J.R. 1997. *Coping with risk in Agriculture*. CAB International, New York, USA.
- Heffernan, C., and Misturelli, F. 2000. *The delivery of veterinary services to the poor: Preliminary findings from Kenya*. Report for DFID's Animal Health Programme. The University of Reading, Reading, UK.
- Kristjanson, P., Krishna, A., Radeny, M., and Nindo, W. 2004. *Pathways out of poverty in Western Kenya and the role of livestock*. PPLPI Working Paper No.14.
- Moll, H.A.J. 2005. Costs and benefits of livestock systems and the role of market and nonmarket relationships. *Agricultural Economics*, 32: 181-193.
- LID. 1999. *Livestock in poverty-focused development*. LID, Crewkerne, Somerset, UK.
- Pearce, D.W., Markandya, A., and Barbier, E.B. 1989. *Blueprint for a Green Economy*. Earthscan, London, UK.

- Randolph, T.F., Schelling, E., Grace, D., Nicholson, C.F., Leroy, J.L., Cole, D.C., Demment, M.W., Omore, A., Zinsstag, J., and Ruel, M. 2007. Invited review: Role of livestock in human nutrition and health for poverty reduction in developing countries. *Journal of Animal Science*, 85: 2788-2800.
- Reardon, T., Delgado, C., and Matlon, P. 1992. Determinants and effects of income diversification amongst farm households in Burkina Faso. *Journal of Development studies*, 28 (1), 264-296.
- Scoones, I. 1998. *Sustainable rural livelihoods: A framework for analysis*. Working Paper no. 72. Institute for Development Studies, University of Sussex, Brighton, UK.
- Shackleton, C.M., Shackleton, S.E., and Cousins, B. 2001. The role of land based strategies in rural livelihoods: the contribution of arable production, animal husbandry and natural resource harvesting in communal areas in South Africa. *Development Southern Africa*, 18: 581-604.