Journal of Geography and Regional Planning Vol. 3(9), pp. 234-239, September 2010
Available online at http://www.academicjournals.org/JGRP
ISSN 2070-1845 ©2010 Academic Journals

Full Length Research Paper

Options for adapting to climate change in livestock-dominated farming systems in the greater horn of Africa

An Notenbaert[1]*, Andrew Mude[1], Jeannette van de Steeg[1] and James Kinyangi[2]

[1]International Livestock Research Institute (ILRI), P. O. Box 30709, 00100, Nairobi, Kenya.
[2]Alliance for a Green Revolution in Africa (AGRA), Mbabane, Swaziland.

Accepted 2 September, 2010

The greater horn of Africa is one of the least developed regions in Africa. Livestock are an important economic resource and an essential asset for poor farmers in this region. Climate variability, population growth, low economic development, limited market integration, and low fertilizer use, amongst others put serious pressure on livestock production. The sustainability of the livestock production in the rangelands and the integrated crop-livestock systems is further jeopardised by climate change. The uncertainties associated with climate change impacts call for interventions that empower communities to effectively cope with current climatic variability and to adapt to unexpected future consequences. Risk management and climate-robust development both appear to be promising approaches. Index-based livestock insurance, for example, offers innovative opportunities for protecting farmers' assets, while diversification in the arid- and semi-arid regions might turn into economically viable livelihood strategies. These adaptation options will only be adopted if the right systems of incentives and policies are put in place.

Key words: Climate change, livestock, diversification, insurance, farming systems, greater horn of Africa.

INTRODUCTION

The greater horn of Africa (GHA) is home to about 220 million people, and is among the poorest regions in the world. The human development index for all countries of the GHA falls far below 0.4, the cut-off point used by UNDP to describe "abysmal human conditions" (UNDP, 2008). As a whole, the human development record of the GHA compares unfavourably with that of sub-Saharan Africa. Poverty levels are especially high in the rural areas, where most people depend on agriculture for their livelihood. Between 1980 and 1990 the percentage of the rural population living in absolute poverty was 85% in Sudan, 70% in Djibouti and Somalia, and 63% in Ethiopia (The InterAfrica Group, 1995).

In this region, agricultural production is performed in a myriad of different farming systems (Figure 1). The largest human and livestock populations are supported by mixed systems. Rainfed cropping is practised in the relatively wet highlands of Ethiopia, Kenya, Uganda, Rwanda and Burundi. This is often integrated with livestock keeping. Also in large parts of the arid to semi-arid regions of Tanzania and Sudan integrated crop-livestock farming is practised. Although rainfed food production dominates in the GHA, extensive irrigation can be found in Sudan and to a smaller extent along the river in Somalia. The largest land area of the GHA is, however, under rangelands (about 65%). They support substantial populations in their livelihoods and contribute considerable amounts to the national budgets through livestock production, but also wildlife and eco-tourism (Notenbaert et al., 2009).

Throughout the GHA, livestock production is a vital component of the economy. In Eritrea and Sudan, for example, 57 to 62% of the agricultural GDP respectively is coming from livestock. In Somalia this share goes up to 88% (Knip, 2004). For poor farmers, livestock are recognized as essential assets for their livelihoods. There are many reasons for which poor people keep livestock, including for food, income, manure, traction, status and as savings. This means that the role these animals play

*Corresponding author. E-mail: A.Notenbaert@cgiar.org. Tel: 254-20-422 30 00. Fax: 254-20-422 30 01.

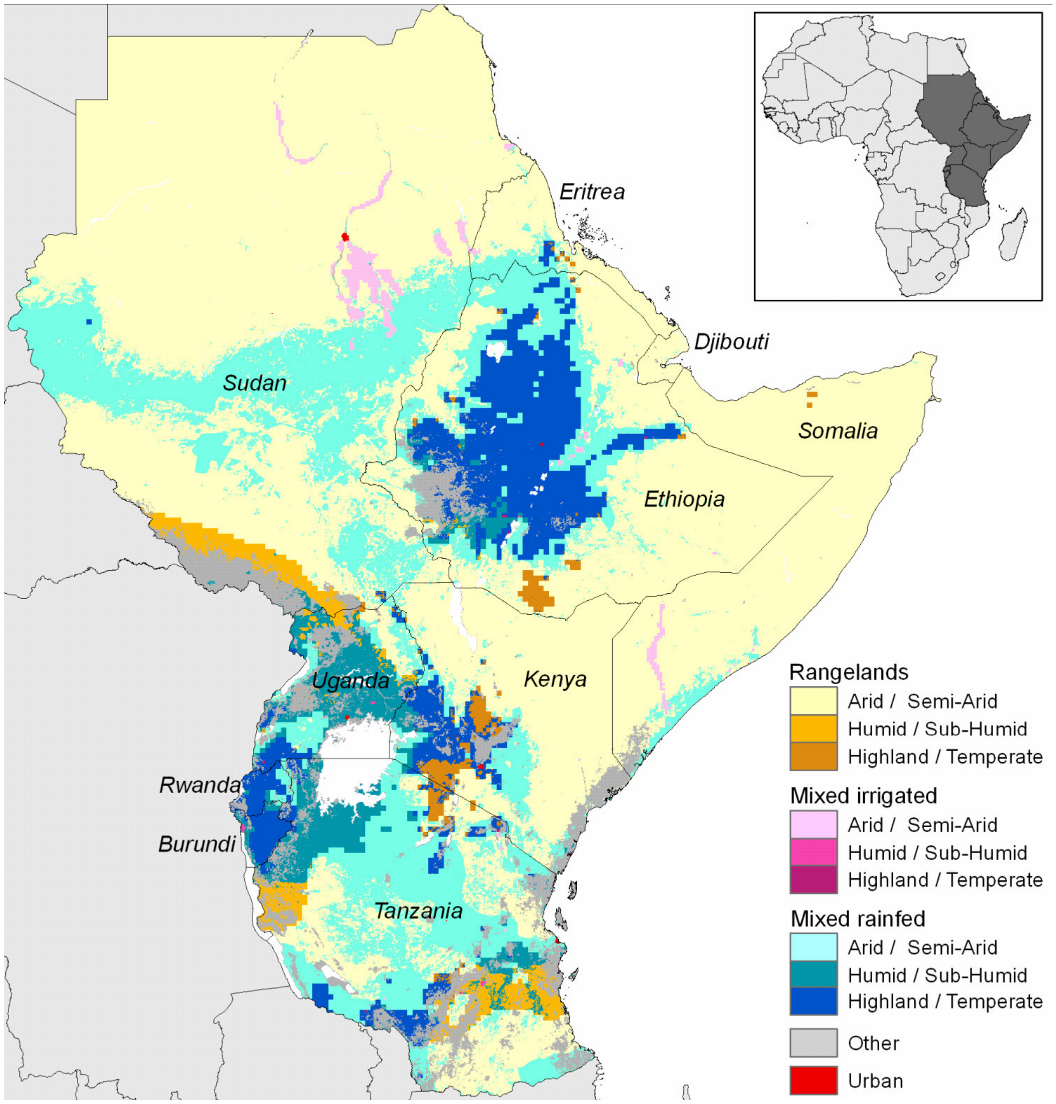

Figure 1. The varied livestock production systems in the Greater Horn of Africa.

in households' well-being is highly complex (LID, 1999). The International Livestock Research Institute (ILRI, 2005) has identified three main strategies by which livestock-based livelihoods can be used to pull households out of poverty. Termed "pathways out of poverty", the first pathway focuses on how livestock help to secure the household's asset base by providing access to more reliable flows of the benefits noted above. This capacity may help buffer the household, allowing it to bear risks associated with developing other income generating strategies. The second pathway represents the livestock development scenario in which specialization and intensification increase the productivity of livestock, in turn increasing household incomes and promoting accumulation of other assets. The final pathway involves improving access to market opportunities (e.g., opening new markets, getting better prices) that increase the profitability of livestock activities and create incentives to increase production and sales.

Important constraints to sustainable and profitable livestock production include feed availability, access to water, markets and capital, unfavourable pricing policies, poor infrastructure, lack of output processing technologies, weak institutional research-extension-farmer linkages, resource degradation, climatic variations and animal health (LID, 1999). The matters mentioned above are all critical issues that will have an impact on the manner in which different communities across the range of farming and livestock systems are making a living through agricultural production. In addition to that, some of these already daunting constraints become even more challenging as a result of climatic changes. Temperatures are rising and rainfall patterns are expected to become even more erratic. Although in some areas total rainfall is projected to increase, this will most likely not compensate for the increased evapo-transpiration caused by increasing temperatures (Mude et al, 2007). Moreover, an increase in extreme climate events, such as droughts and floods, is anticipated (Christensen et al., 2007; KNMI, 2006). An increasing uncertainty of the onset and duration of seasons leave livestock farmers in the GHA susceptible to extreme climate events. They are often unable to appropriately plan their livestock management. A good example is the El Niño episode of 1997/1998 which caused severe flooding and extensive destruction of property, infrastructure and livestock deaths (Little et al., 2001). It triggered unprecedented interest in and created awareness about the significance of early warning systems for preparedness and disaster management.

Expected impacts of the observed climatic trends include reduced agricultural productivity (of food, feed and livestock products), higher disease prevalence (within crops, livestock and humans alike) and reduced fresh water availability (Thornton et al., 2009a, b). Since ground water recharge capacity is likely to decrease with lowering of the water table, a reduction in the production of borehole water can be expected (IPCC, 2001). In the arid and semi-arid lands, where groundwater is the main water resource, this scenario increases the possibility of conflict over water sources for livestock keepers. In addition, wetlands, which represent critical dry season grazing areas for livestock herders, are projected to shrink drastically in size or disappear altogether across climate change timescales (Kinyangi et al., 2009).

The combination of high poverty levels and farming systems already under pressure leaves a significant number of small holder farmers in the GHA extremely vulnerable to the impacts of climate change. Livestock herders and crop-farmers alike will have to prepare for, cope with and adapt to their changing environment. Adaptation strategies, whether they are spontaneous farmer initiatives or policy-driven actions, will need to deal with the existing pre-conditions and the anticipated changes.

However, the application of climate change science to address these impacts is still not fully developed and prone to uncertainties. Most climate models, and especially those for Africa, operate at a very coarse spatial resolution (Christensen et al., 2007; Hulme et al., 2001). Typically, global circulation models (GCMs) project future climate at a spatial resolution of a degree and more. They can predict general trends in countries or regions but are, unless downscaled, not relevant to local situations. Moreover, the climate projections have time frames of several decades, not exactly the time crop farmers, livestock keepers or policy makers consider when taking decisions.

In short, a spatial as well as temporal disconnection exists between the current climate change science and the reality on the ground. Projected changes in terms of temperature, amount and timing of rainfall are hampered by uncertainties, even less is known about the impacts of these changes (Kabubo-Mariara, 2009). It is therefore crucial to keep the design and development of adaptation options very flexible, enabling small-holders to adjust to the local context and unknown future climate variability. This will only be possible if local communities are equipped with the necessary resources (financial, physical, social, and human) to cope and adapt, while at the same time an effective institutional capacity and supportive policy context is put in place. Together, these can provide a conducive environment for continuous innovation, hopefully leading to effective livelihood strategies and sustainable resource use.

In this paper, we review a number of adaptation options currently promoted amongst resource-poor farmers and livestock keepers in the GHA. We conclude by highlighting the supportive measures that need to be put in place for these options to work.

ADAPTATION OPTIONS TO CLIMATE-RELATED SHOCKS

The aim of climate change adaptation is to reduce the climate-related vulnerability and empower the community to effectively cope with current climatic variability and to adapt to the unexpected consequences of climate change. The emerging consensus on how best to do so is to follow a two-pronged approach. Improving the provision of climate risk management services which comprises traditional early warning services, more innovative weather insurance products, as well as community based risk mitigation through seasonal climate forecasts, contingency planning, training etc., defines one prong. Climate-robust development interventions, which includes introducing and supporting the adoption of enhanced livelihoods and development of an enabling economic infrastructure defines the other.

RISK MANAGEMENT THROUGH LIVESTOCK INSURANCE

Pastoralists frequently migrate with their animals in search of pasture and water. Research in the horn of Africa on how livestock herders cope with climate variability demonstrates that the average distances trekked tripled in drought years (Ndikumana et al., 2000). Livestock herders also manage the composition, size and diversity of animals in order to cope with variable feed resources and as a traditional form of insurance against livestock deaths during drought. Other coping mechanisms include slaughtering livestock and preserving the meat, preservation of grazing areas for times of extreme drought, division of large herds into smaller units and species, stock loaning between relatives and friends, collection of wild fruits and bartered cereals, and begging for food (ILRI, 2006).

Over the past years, ILRI in collaboration with various partners has pursued a substantial research program aimed at designing, developing and implementing market mediated index-based insurance products. This innovative insurance scheme intends to protect livestock keepers, particularly in the drought prone arid and semi-arid regions, from the drought related asset losses they face. The studies are generating useful insights that can improve the design of relevant insurance products and improve how they are targeted to the various needs of the expected clientele. Extensive discussion and survey work has indicated a strong demand and willingness to pay. A planned pilot should demonstrate its feasibility and effectiveness in helping to manage drought related risks in a commercially sustainable way (Chantarat et al., 2009).

Index-based insurance products represent a promising and exciting option for managing the climate related risks that vulnerable households are exposed to (Hellmuth et al., 2007, Barrett et al., 2007, Hellmuth et al., 2009). Like any insurance product, the purpose of index-based insurance is to compensate clients in the event of a loss. Unlike traditional insurance, which assesses losses on a case by case basis and makes payouts based on individual client's loss realizations, index-based insurance offers policy holders a payout based on an external indicator which triggers a payment to all insured clients within a geographically defined space. For index-based insurance to work there must be a suitable indicator variable (the index) that is highly associated with the event being insured but is not prone to manipulation by either the insured or insurer. For example, if one is insuring against livestock mortality, then an indicator such as rainfall or forage availability may be suitable. The rationale here is that rain failure during the rainy season, shortage of available forage, or a combination of the two will result in some level of livestock mortality. Having sufficiently modelled this relationship, one can then write an insurance contract based on a rainfall or forage indicator to protect against various degrees of livestock losses.

Because index-based insurance is based on the realization of an outcome that cannot be influenced by insurers or policy holders, it has a relatively simple and transparent structure. This makes such products easier to understand and consequently less complicated to design, develop, and trade. Indeed the success of several crop-related pilot programs conducted in India, and various countries in Africa and Latin America, has proven the feasibility and affordability of such products (Barnett and Mahul, 2007).

An index-based insurance product has significant advantages over conventional insurance. Conventional insurance requires that the insurer monitor the activities of their clients and verify the truth of their claims. For relatively small clients in infrastructure deficient environments, the costs of such monitoring are often overly prohibitive. With index-based insurance products, all one has to do is monitor the index. Furthermore, by using an index based on variables that cannot be influenced by the insured, index-based insurance products overcome the key problems with conventional insurance contracts of an individual's experience: that more (less) risk-prone individuals will self-select into (out of) the contract and that insured individuals have an incentive to take on added risk phenomena known respectively as "adverse selection" and "moral hazard".

DIVERSIFICATION THROUGH DRY-LAND COMMODITIES

Research within livestock and crop-livestock farming systems has resulted in a growing awareness that -in combination with improved production and marketing technologies- traditional livelihoods must be complement-ted by new sources of income. It has been demonstrated that households place an increased value on agricultural extension, savings and credit groups as well as alternative income generating activities (Ellis, 1998; Mude et al., 2007; Ouma et al., 2008). This is further proof of the realization that improved welfare is to be found not only in increasing the return to traditional livestock farming, but also in pursuing novel and promising opportunities.

Dryland commodities are one example of a non-traditional livelihood option that could potentially catalyse growth and offer high returns in the arid and semi-arid regions. Numerous NGOs and CBOs are increasing community awareness in the commercial wealth that exists in a variety of tree crops and shrubs that grow naturally and in abundance in these areas, especially in the more arid areas. Communities are waking up to the wealth they have been squandering by exploiting the resources to produce charcoal and firewood. The interest in perceived benefits of dryland commodities derived from various plant species such as *Acacia senegal (gum Arabic), Aloe* species*, Jatropha curcas, Azadirachta indica*, among others, is fast growing. Natural resource experts value the soil fixing and regenerating value of these trees. Environmentalists concur and also see growing opportunities for propagating such trees to tap into the increasing demand for carbon trading and payments for ecosystems services. And more recently there is a growing interest for the Jatropha tree in the search for bio-fuels. Development agencies, on their part, see significant potential in the income generating capacity of these products (Mude et al., 2007; Ouma et al., 2008).

While preliminary research has highlighted the considerable promise of these commodities and showcased instances in which they are successfully providing dry-land communities with a sustainable source of alternative income, more rigorous efforts to understand how to unlock their full potential is needed. Such efforts recognize that evolving dynamics of climate change, demographics, market integration and land tenure require researchers, development agencies and communities to investigate non-traditional opportunities that can provide an adaptation advantage to vulnerable populations.

CONCLUSIONS AND RECOMMENDATIONS

Households will be forced to adapt to the changing circumstances by introducing new production technologies, embracing sustainable natural resource management practices and even diversifying their livelihood portfolio to include higher yielding, more stress-resistance crop and livestock varieties. On the other hand, research institutions, policy-makers and development practitioners need to investigate and introduce new innovative products and programs that provide smallholder farmers and livestock keepers with a supportive institutional and infrastructural environment to manage their risks and engage in sustainable but remunerative production.

Producing the required change calls for an enabling policy environment that is directly informed by available scientific expertise and should be guided by local successes. It also requires consultation and involvement of local communities in the design and testing of new practices to create a feeling of ownership among land managers and to tap into practical traditional experience and expertise. The international community of development organizations and donors need to support this process so that, in partnership with local institutions, informed, coherent and integrated policies can be developed, implemented, and continually improved through a process of assessment.

We briefly introduced two examples of research for development programs with a focus on reducing the vulnerability of small-holder farmers in the GHA. The first example explores innovative opportunities for protecting farmers' assets. It illustrates how an un-usual consortium of partners (researchers, donors, government agencies, financial institutions and insurance companies) can come together and provide modern risk management strategies to traditional farmer families. The second example focuses on climate-robust development. It is a clear illustration of how the perceptions about arid and semi-arid livestock production regions are rapidly changing. As noted by Sere et al. (2008), it is increasingly recognised that these are ecosystems with many functions and some alternative development options. Some of these options might turn into economically viable livelihood strategies if the right systems of incentives and policies are put in place. For poor households this will mean alternative income-generating activities beyond traditional livestock production such as the payments for ecosystems good and services like water, carbon sequestration and others, tourism, bio-fuel production and the development of niche markets. An increased number of options might make these regions more attractive for public and private investment. This could in turn lead to better services and infrastructure in these regions.

REFERENCES

Barnett JB, Mahul O (2007). Weather Index Insurance for Agriculture and Rural Areas in Lower Income Countries. Ame. J. Agric. Econ., 89(5): 1241-1247.

Barrett CB, Barnett JB, Carter MR, Chantarat S, Hansen JW, Mude AG, Osgood DE, Skees RJ, Turvey CG, and Ward MN (2007). "Poverty Traps and Climate Risk; Limitations and Opportunities of Index-Based Risk Financing" IRI Technical Report No. 07-02.

Chantarat S, Mude AG, Barrett CB (2009). Willingness to Pay for Index Based Livestock Insurance: Results from A Field Experiment in Northern Kenya. Working Paper, Cornell University.

Christensen JH, Hewitson B, Busuioc A, Chen A, Gao X, Held I, Jones R, Kolli RK, Kwon WT, Laprise R, Magaña Rueda V, Mearns L, Menéndez CG, Räisänen J, Rinke A, Sarr A and Whetton P (2007). Regional Climate Projections. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Ellis F (1998). Household strategies and rural livelihood diversification. J. Dev. Stud., 35(1): 1-38.

Knip V (2004). Review of the livestock sector in the Horn of Africa (IGAD countries). Livestock sector report Horn of Africa. Livestock Information, Sector Analyses and Policy Branch (AGAL), Food and Agricultural Organization of the United Nations. p. 39.

Hellmuth ME, Moorhead A, Thompson DE, Williams J (2007). Climate Risk Management in Africa: Learning from Practice. Climate and Society No. 1. International Research Institute for Climate and Society (IRI), Columbia University, New York, USA.

Hellmuth ME, Osgood DE, Hess U, Moorhead A, Bhojwani H (2009). Index Insurance and Climate Risk: Prospects for development and disaster management. Climate and Society No. 2. International Research Institute for Climate and Society (IRI), Columbia University, New York, USA.

Hulme M, Doherty RM, Ngara T, New MG, Lister D (2001). African climate change: 1900-2100. Climate Res., 17(2): 145-168.

International Livestock Research Institute (ILRI) (2005). Livestock – a pathway out of poverty. ILRI's strategy to 2010.

International Livestock Research Institute (ILRI) (2006). Assessment of the impacts of the drought response program in the provision of emergency livestock and water interventions in preserving pastoral livelihoods in northern Kenya. Report of an ILRI Multidisciplinary Scientific Team of Consultants Assessing the Emergency Drought Response Project in Northern Kenya.

Intergovernmental Panel on Climate Change (IPCC) (2001). The Regional Impacts of Climate Change: An Assessment of Vulnerability. http://www.ipcc.ch

Kabubo-Mariara J (2009). Global warming and livestock husbandry in Kenya: Impacts and adaptations. Ecol. Econ., 68(7): 1915-1924.

Kinyangi J, Herrero M, Omolo A, van de Steeg JA and Thornton PK (2009). Scoping Study on Assessment of Vulnerability to Climate Change and Climate Variability in the Greater Horn of Africa. Mapping Impacts and Adaptive Capacity. IDRC/DFID–CCAA. International Livestock Research Institute (ILRI), Nairobi, Kenya. Available at: http://www.research4development.info/.

KNMI (2006). Climate change in Africa. Changes in extreme weather under global warming, Royal Netherlands Institute of Meteorology, http://www.knmi.nl/africa_scenarios/.

Little PD, Mahmoud H, Coppock DL (2001). When deserts flood: risk management and climatic processes among East African

pastoralists. Climate Res. 19: 149–159.
Mude A, Ouma R, Van de Steeg JA, Kariuki J, Opiyo D, Tipilda A (2007). Kenya Adapatation to Climate Change in the Arid Lands. ILRI 2007.
Ndikumana J, Stuth J, Kamidi R, Ossiya S, Marambii R, Hamlett P (2000). Coping mechanisms and their efficacy in disaster-prone pastoral systems of the Greater Horn of Africa. Effects of the 1995–97 drought and the 1997–98 El Niño rains and the responses of pastoralists and livestock. ILRI Project Report. A-AARNET (ASARECA-Animal Agriculture Research Network), Nairobi, Kenya, GL-CRSP LEWS (Global Livestock- Collaboratve Research Support Program Livestock Early Warning System), College Station, Texas, USA, and ILRI (International Livestock Research Institute), Nairobi, Kenya. p. 124.
Notenbaert A, Herrero M, Kruska R, You L, Wood S, Thornton P, Omolo A (2009). Classifying livestock production systems for targeting agricultural research and development in a rapidly changing world. ILRI Discussion Paper 19. ILRI (International Livestock Research Institute), Nairobi, Kenya. p. 41.
Ouma R, Mude A, Radeny M, Kariuki J (2008). Identifying livestock-based risk management and coping options to reduce drought-related vulnerability to in agro-pastoral and pastoral systems in East Africa (With Evidence from Samburu and Kajiado). Report for the System-wide Livestock Programme.
Seré C, Ayantunde A, Duncan A, Freeman A, Herrero M, Tarawali S, Wright I (2008). Livestock production and poverty alleviation – challenges and opportunities in arid and semi-arid tropical rangeland based systems. In: Multifunctional Grasslands in a Changing World. Proceedings of XXI International Grassland Congress / VII International Rangelands Congress, Hohhut, China. 1: 19-26.
The InterAfrica Group (1995). Social Development in the Horn of Africa: Challenges and Prospects. Paper prepared for the World Summit on Social Development. March 1995, Copenhagen, Denmark. African Studies Center, Center for Dialogue on Humanitarian, Peace and Development Issues in the Horn of Africa.
Thornton PK, Jones PG, Alagarswamy G, Andresen J (2009). Spatial variation of crop yield response to climate change in East Africa. Global Environ. Change, 19(1): 54-65.
Thornton PK, van de Steeg JA, Notenbaert A, Herrero M (2009). The impacts of climate change on livestock and livestock systems in developing countries: a review of what we know and what we need to know. Agric. Sys., 101: 113–127.
UNDP (2008). Human Development Report 2007/2008.