THE ECONOMIC IMPACTS OF LOSING LIVESTOCK IN A DISASTER

Final report

Prepared for the World Society for the Protection of Animals
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economists | at | large |
ADDING VALUE TO SOCIETY

Report prepared by:
Economists at Large Pty Ltd
Melbourne, Australia
www.ecolarge.com
research@ecolarge.com
Phone: +61 3 9005 0154
Fax: +61 3 8080 1604

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Summary

This literature review investigates the "economic impact of losing livestock in a disaster". It covers a wide range of material relating to the role of livestock in development, the economics of disasters, the treatment of livestock in disaster recovery efforts, and case studies on particular disaster events.

The purpose of this research is to highlight the current state of the literature relevant to livestock and disasters and to suggest future research areas that would help to understand better the impacts of losing livestock in a disaster.

This review focuses in particular on low-income countries. This is because livestock are extremely important to economic development and welfare in most low-income countries. Animals represent more than food — they represent livelihoods. When people are affected by natural disaster, their animals (and thus their livelihoods) are also affected. As experts in this field have put it:

> *From a global perspective, one of the most pressing needs* [in disaster relief] *is to improve livestock relief programming with communities who rely heavily on livestock for their social and economic well-being.*
> Source: LEGS 2009 p2

As such, this report reviews literature that relates to livestock in economic development, and also to the way disasters impact on economies. Considerable research has focused on the role of livestock in economies, and at the economic effects of natural disasters. We review the main themes of this work in the two main parts of this report. In doing so, we hope to outline, explain and expand on the value of livestock and their role in disaster recovery, and to make this importance easier to demonstrate to a wider audience.

We begin in Section 1 by examining the role of livestock in all economies. We see that in high-income countries, livestock are mainly treated as a financial asset and one of many sources of food. This is in stark contrast to low-income countries, where livestock have a range of functions. Animals provide meat, milk and eggs; they assist with ploughing fields; they can be sold for cash and play a role in cultural identity. We see that livestock in low-income countries have direct and indirect values relating to food, agriculture, savings and cultural values. The results of Section 1 are summarised below.

Livestock and Food	
Direct values	Indirect values
Reduced quantity of food available due to livestock death and injuries during disaster.	Increased levels of malnutrition due to reduced consumption of animal-sourced foods.
Reduced quantity of food through reduced livestock productivity due to: ▪ Increased exposure to disease; ▪ Reduced availability of feed.	Effects of malnutrition on children's physical and mental development.
	Effects of malnutrition on worker productivity.

	Reduced food security due to lack of animal-sourced foods to smooth fluctuations in agricultural crops. Crop yields are also likely to be less stable following a disaster.

Livestock and Agriculture	
Direct values	Indirect values
Reduced availability of draft power.	Increased reliance on purchased fuels and fertilisers.
Reduced availability of manure.	Increased labour requirements.
Reduced agricultural output.	Reduced access to other markets through transport and haulage, further exacerbating food insecurity problems.

Livestock, Savings and Income	
Direct values	Indirect values
Lost savings in the form of livestock.	Increased vulnerability to future disasters through loss of insurance value of different species.
Lost income from: ▪ Reduced sales of ASFs; ▪ Reduced income from transport and draft power.	Increased variation in income due to lost ASF sales.

Livestock and cultural values	
Direct values	Indirect values
Reduced ability to use livestock for cultural obligations such as dowries.	The possibility that reduced herd size may force people to abandon pastoralism, losing livelihood base and the social support structures of herding communities.

When livestock losses occur due to a disaster, it is direct values – those that can be estimated using market prices – that are generally considered in evaluating the cost of the losses. However, such valuation rarely incorporates the indirect values of livestock, which can be more difficult to observe, but often more important than the direct financial loss incurred in a disaster.

All these factors are affected when livestock are lost in disasters. Our literature review suggests that these values are often not considered in economic and general literature. We believe that an understanding and acknowledgment of these indirect roles is crucial in understanding the role of livestock in developing economies, and in understanding why their loss in natural disasters is so damaging.

Section 2 examines disasters and the economics thereof. Again, we focus largely on low-income countries, as these countries are more exposed and vulnerable to natural disasters than their high-income counterparts, and they also recover more slowly than high-income countries. Factors that influence disaster exposure and vulnerability include:

- Levels of disaster preparedness and mitigation;
- Economic factors including savings, productivity and trade links;
- Public institutions and governance;
- Demographic factors including population density, health and literacy.

As with livestock loss, financial estimates of the cost of disasters tend to refer to direct impacts: the cost of physical damage to the factors of production (being people and animals, land and capital). Again, in addition to these direct costs, disasters also have indirect impacts. While these are often harder to estimate than direct costs, they can also be more important in understanding the full welfare impacts of disasters. Indirect impacts typically result from the damage caused to factors of production and the losses sustained until such time (if ever) that this damage can be repaired. The direct and indirect impacts of disasters are summarised below.

Direct Impacts	Indirect Impacts
Labour	
Death, sickness and injury.	Lost wages of workers.
Costs of treating the sick and injured and laying dead to rest.	Reduced productivity of workers and industries due to injuries and psychological trauma.
Capital	
Damage to roads, housing, infrastructure, factories, machinery, etc.	Lost income from capital assets. Reduced productivity in capital-intensive industries.
Costs to fix or replace damaged capital assets and infrastructure.	Reduced ability of governments and firms to provide services to the public.
Land	
Damage to crops	Reduced food security
Erosion, landslides, loss of nutrients.	Reduced agricultural productivity
Costs of engineering to repair and restore land stability and soil quality	Rising food prices

Economists have attempted to model the costs of disasters, both direct and indirect, using regression analysis. We examine the efficacy of such modelling, and find that as it tends to be limited to macroeconomic factors, it sheds little light on regional effects – such as the loss of livestock.

In Section 3, we combine the findings of Sections 1 and 2 to help readers understand the impacts of losing livestock in disasters. The summary table of this concluding section is below.

Direct Impacts	Indirect Impacts
Labour	
Loss of animal-sourced foods.	Loss of food security Loss of nutrition with short term consequences for worker productivity and long-term consequences for education, community development and worker productivity.
Loss of draft power, increasing demand for human labour.	Reduced labour availability.
Loss of income generating opportunities.	Loss of a productive use of labour, particularly for women, children and the elderly. Reduced income security.
Loss of culturally and socially important animals.	Reduced social/cultural opportunities, such as participation in weddings, funerals, etc. Loss of social support networks.
Capital	
Reduced availability of draft power leading to increased demand for machinery and fuel.	Dependence on borrowed assets, or borrowing to finance their use. Increased dependence on external inputs such as fossil fuel.
Loss of savings and investment.	Loss of investment income from animals. Inability to cover sudden expenses such as medical bills and school fees. Herd sizes may become unviable leading to relocation, loss of social status and poverty.
Loss of livestock as an input to ASF related industries.	Reduced income or substitution from dairies, markets, abattoirs, butchers, retailers and restaurants
Land	
Loss of draft power.	Reduced agricultural productivity, leading to reduced food security. Reduced crop residues leading to reduced livestock productivity and increased demands on other feed sources, such as communal grazing areas. Increased demands on these areas can lead to natural resource degradation.
Loss of manure.	Reduced agricultural productivity, as above. Increased demand for chemical fertilisers, which may be expensive or unavailable. Increased demand for alternative fuels, such as firewood, which can lead to degradation of forests and woodlands.

Section 4 presents three case studies — the 2010 Pakistan floods, the 2010 *dzud* (harsh winter) in Mongolia, and cyclone Nargis, which hit Myanmar in 2008 — and discusses the direct and indirect losses of livestock in each.

Structure of the report

This report is divided into four main sections.

Livestock in economies	To understand the impacts of losing livestock in a disaster it is necessary to understand the role livestock play in households and economies. This section looks at the livestock ownership in both high and low-income countries.
Natural disasters and economies	There are different definitions of disaster, different classifications and different ways of responding to them. This section also includes statistics on disaster occurrence and sources of information for disasters. This section looks at the various approaches to understanding the economic impacts of disasters, discussion of direct and indirect costs and economic modelling
Disaster impacts and livestock	This section summarises the economic impacts of losing livestock in a disaster referring to results in the earlier sections.
Case studies	Three case studies looking at disasters in Pakistan, Mongolia and Myanmar.

Introduction

Disasters are inherently economic events. They damage economies through the physical damage they do to people and to the things that enable those people to make their livelihoods. For many of the world's poorest people, this includes livestock.

This report examines the economic impacts of losing livestock in natural disasters, with a focus on low-income or developing countries. We focus on low-income countries for two reasons. First, low-income countries are more vulnerable to natural disasters, and less able to recover from such disasters. due to the nature of their economies. Factors that influence disaster exposure and vulnerability include:

- Levels of disaster preparedness and mitigation;
- Economic factors (including savings, productivity and trade links);
- Public institutions and governance;
- Demographic factors (including population density, health and literacy).

Second, livestock play a far more complex role in the economy of low-income countries than in high-income countries. As we write this report, the importance of livestock in disasters in low-income countries is being demonstrated in Horn of Africa:

> *[In] Ethiopia, 3.2 million people require humanitarian assistance. Pastoralist communities there have seen 80% of their livestock die in some places, according to Oxfam, with the lost income making it extremely difficult for people to buy food.*
> Source: Rice 2011

The importance of livestock in development and disasters is understood and acknowledged by experts in the field — organisations such as WSPA, Oxfam, LEGS and others. Most importantly, and most obviously, it is also understood only too well by the people affected by the disasters: the pastoralist and agricultural communities who have been subject to a drought, floods or other emergency. These people demonstrate this by the lengths to which they go to save their livestock:

> *Some of the refugees from Darfur who managed to reach camps in eastern Chad brought their livestock with them but found little water and pasture available. In interviews some refugees explained that they were using some of the food ration they received in order to keep their animals alive, as a vital source of milk and cash.*
> Source: LEGS 2009, p226

As we see in Section 1 below, livestock are used almost exclusively for food in high-income countries. This means that disaster-related losses of livestock in high-income countries are essentially financial ones. These losses can be huge – for example, in early 2011 the state of Queensland in Australia suffered from severe flooding, which caused billions of dollars' worth of damage and was one of the costliest natural disasters in the country's history (Reuters 2011), with huge livestock losses across vast areas that were still being calculated

months later (ABC 2011; Ockenden, Wilson, and Phillips 2011). However, while the impacts on some businesses and families were great, the losses of livestock were generally covered by insurance or government assistance schemes – losing livestock on Australian farms rarely results in families being unable to feed themselves or suffering from malnutrition.

In low-income countries, the situation is very different. To the rural poor, livestock are not merely direct, financial assets, but also an integral part of their livelihoods. Livestock fill a range of functions, including:

- Contributing to food security and nutrition;
- Draft power – ploughing, milling, transport of people, goods, water, etc;
- Provision of manure for fertilizer and fuel;
- A vehicle for savings in the absence of banks and other assets;
- A form of insurance against crop failure or other economic hardship;
- An indicator of social standing.

The different roles that livestock play in low-income countries mean that they have value beyond the direct value of their food or earning potential. Their contribution to development through nutrition, improved agricultural output, financial and social functions is enormous. These indirect values are often under-recognised and undervalued when attempts are made to understand the impact of disasters.

The direct economic impacts of disasters tend to be shockingly visible and are generally easily quantified. They include the physical damage done to the factors of production – to people and animals, to land, and to capital. Assessment of disasters, economic modelling and media attention all tend to focus on these more obvious and quantifiable aspects.

What do we mean by "livestock"?

This report is about livestock – domestically raised animals and poultry. Other terms used here and in the relevant literature include:

- **Ruminants:** animals such as cattle, sheep, goats and camels, which are able to ruminate. Rumination enables digestion of grasses and other plant matter through chewing, digestion in multiple stomachs and re-chewing.

- **Monogastric animals:** pigs and birds and any animal with only one stomach. Usually less able to digest grasses. More suited to eating a range of foods including grains, pulses, food scraps, etc

- **Equines:** horses, donkeys, mules, etc, generally used for draft power, but also for milk and meat in some cultures.

- **Poultry:** domestically raised birds, mainly chicken and ducks.

- **Small stock:** smaller livestock. This usually means sheep and goats, but the term may also refer to poultry, rabbits, etc.

However, it may be the indirect impacts of the disaster – the ongoing effects caused by damage to factors of production – that may prove more significant in the long run. In low-income countries, the indirect effects of lost livestock may well be a large part of this indirect damage. This means it is important to understand the less obvious impacts of the loss of livestock in disasters – especially because low-income countries are more exposed and vulnerable to natural disasters than high-income countries.

Due to the same factors that leave them vulnerable to disasters, low-income countries also find it more difficult to recover from disasters. As we will see, understanding how livestock are affected by disasters is crucial to disaster recovery efforts — meaning that while the indirect impacts of disasters are often harder to estimate than direct impacts, it is critical to understand them in order to understand how best to help a disaster-affected country recover from the event that has befallen it.

What is a disaster?

This report and wider literature refers to disasters, emergencies, and hazards. There are different interpretations of what defines a disaster, and also many different types of disaster. However, while definitions vary between sources, general definitions include:

A situation or event that overwhelms local capacity, necessitating a request to a national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering. Generally, any one of the following criteria qualifies an event as a disaster:

- 10 or more people reported killed;
- 100 or more people reported affected;
- The declaration of a state of emergency;
- A call for international assistance.

Source: (Guha-sapir et al., 2011, p.7)

Throughout this report, we discuss different types of disaster. Most broadly, a distinction is drawn between two main types of disasters, as follows:

- **Rapid-onset:** earthquakes, tsunamis, hurricanes, floods, etc.
- **Slow-onset:** drought, unusually harsh winters, etc.

Some authors refer to “complex” disasters, involving conflict or poor governance, further complicated by natural disaster. Some regions vulnerable to drought and political instability face these threats regularly and some relief agencies term their situation to be in “chronic disaster”.

Different sources of data on disasters have different estimates as to the number of disasters that occur around the world annually. Generally, it appears that the number of events reported as disasters has been increasing in recent years due to increased population in vulnerable areas and also improved communications and reporting. Despite this increase, the number of people killed in disasters has been declining – emphasising, as noted above, that disasters are first and foremost economic events.

SECTION 1

Livestock in economies

Section 1: Livestock in economies

The role of livestock

In high-income countries, livestock are kept almost exclusively for the direct financial benefits that come from the production and sale of meat, milk or eggs. To livestock keepers in low-income countries, however, animals have multiple uses – including direct and indirect values. These are listed in Table 1 below.

Table 1: The direct and indirect value of owning livestock in low-income countries

	Direct values	Indirect values
Animal-sourced foods	▪ Food for consumption ▪ Cash	▪ Contribution to year-round food security ▪ Nutrition – micronutrients that contribute to cognitive and physical development
Transport and draft power	▪ Cash earned or expenses and labour avoided	• Improved agricultural output ▪ Contribution to local connectivity, links to more distant markets
Manure	▪ Fertilizer ▪ Fuel	▪ Improved soil fertility ▪ Improved agricultural output
Financial aspects	▪ Cash income	• Vehicle for savings ▪ Form of insurance
Social roles	▪ Fulfilment of social and cultural obligations	▪ Reinforcement of social support networks

This divergence in the role of animals between high-income and low-income countries has not always existed, as Steinfeld, Schneider, and Neville (2010) point out:

> *"Throughout history, livestock have been kept for a variety of purposes, with the almost exclusive focus on food use of livestock in modern agricultural systems being a relatively recent development."*

To illustrate the difference between livestock in low-income and high-income economies – and why disasters tend to affect livestock in the low-income world – it is necessary to understand the changes that have occurred in high-income countries, and also in wealthier urban areas of low-income countries.

Livestock in high-income countries

Many authors refer to this change in the role of livestock – from having multiple purposes to being raised purely for food – as the "livestock revolution" (Delgado et al. 1999; Pingali and McCullough 2010; Steinfeld, Schneider, and Neville 2010). These authors draw parallels with the earlier "Green Revolution", where production of crops was intensified through technology, management techniques and infrastructure provision. These changes in both cropping and livestock have been driven by population growth, urbanisation and rising incomes.

While definitions of "the livestock revolution" vary between authors, all refer to the industrialisation of livestock production, whereby livestock are bred exclusively for food via intensive production methods – usually in feedlots – and are "delinked" from land. Rather than being a land-intensive activity, with stock being kept close to their sources of feed, industrial livestock production is now centred on areas where input costs are low, infrastructure is good, access to markets is easy and environmental and animal welfare standards are lenient (Naylor et al. 2005).

This new, mobile livestock sector seeks out and competes for resources with other industries. This is different to the situation in low-income countries, where traditional, smallholder livestock raising works to mobilise low-value resources – grass, scraps, crop wastes – that might otherwise be unusable (Delgado et al. 1999).

The livestock revolution is tied to large increases in trade of animal products. Traditionally meat and other animal-sourced foods (ASFs) were not traded widely, either internationally or within countries. Now up to 13% of poultry, 12% of beef and 8% of pork is traded internationally. Global poultry supplies are now dominated by Brazil and the USA (Gerber et al. 2010).

As trade in ASFs has risen, so too has the trade in their feed. Low-income countries with abundant labour or land have been able to establish themselves as major exporters of livestock feed products. Soy is a good example of this, with Brazil now exporting a large portion of the world's soy for animal feed. Up to 25% of soy is traded internationally (Gerber et al. 2010). Naylor et al. (2005) feel that the livestock revolution has been dependent on declining real feed prices, improved technology and trade liberalisation.

The livestock revolution has raised many concerns, particularly relating to:

- **Food security:** As livestock in intensive facilities tend to be raised on grains, they can have an impact on prices of human staple foods. This is particularly the case with monogastric animals – pigs and poultry – which eat more grains, legumes and protein-based foods that could be eaten by humans (Naylor et al. 2005). Ruminants – cattle, sheep, etc – eat grasses and crop residues that are inedible to humans, so offer less competition for human grain crops, particularly if grazed extensively, as is often the case in low-income countries (Delgado et al. 1999).

- **Environmental concerns:** Intensive production areas have become major point sources of pollution, with effluent entering waterways and feedlots potentially affecting air quality. The conversion of land to raise feed crops also has major implications for land management (Steinfeld, Schneider, and Neville 2010). The costs of pollution and land degradation are not incorporated into the costs of production or the final price of goods. Economists refer to such costs as external costs, or "externalities". Inter-regional and international trade in livestock and feed often results in a situation where the ASF importers are paying the direct financial costs of meat production, while the economic externalities of pollution are left in the production areas (Naylor et al. 2005).

- **Animal welfare:** Animal welfare is a growing concern in relation to industrial-scale livestock production (Delgado et al. 1999). Animal welfare groups devote great effort to improving the welfare of animals in industrial-style farming, see WSPA (2011) for an example.

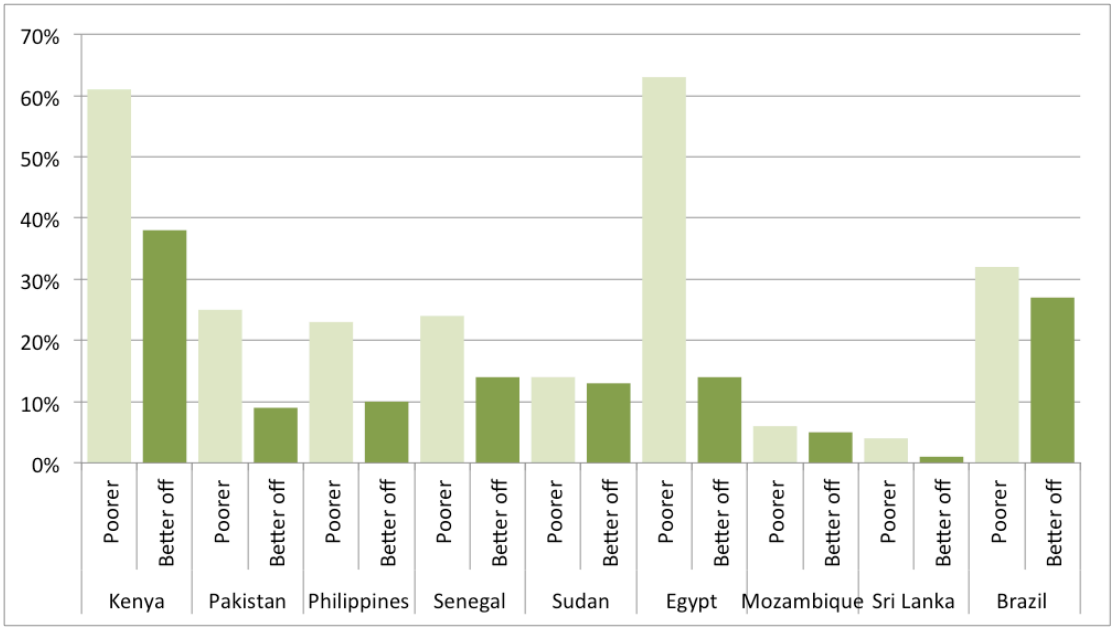
- **Human welfare:** Industrial livestock production and larger farms tend to be capital intensive, rather than labour intensive. From an employment perspective smallholder livestock often employs labour resources more efficiently, with little difference in economies to scale. Human health concerns are also associated with intensive livestock raising, particularly through exposure to zoonotic diseases and pollution of water sources (Livestock in Development 1999).

Livestock in low-income countries

Livestock are far more crucial to rural households in low-income countries than they are in high-income countries. They provide food, generate household cash income, contribute to agriculture, provide transport and play a major role in household finances.

The importance of livestock to people in low-income countries is shown by the high rates of ownership. Livestock are owned by 70% of the world's poor, and many of those who do not own livestock would like to do so – livestock is one of the most common investments by participants in microcredit programmes (Livestock in Development, 1999;FAO, 1999). A wide range of studies from all areas of the globe, over several decades, show a trend for the poorest parts of the population to have a proportionally higher part of their income derived from livestock (Delgado et al. 1999).

Chart 1: Income derived from livestock in rural areas - better off and poorer households



Source: adapted from Delgado et al. (1999) (p.41)

Delgado et al. note that where this trend is not observed, the situation is often that the poorest are unable to access grazing resources or credit to obtain livestock.

Livestock are particularly important for livelihoods in rural areas as they allow people to use the resources available to them, which are often resources that have no other uses – pasture, grass, shrubs, crop residues and food wastes (Delgado et al. 1999; UNHCR and IUCN 2005). These feed resources are available to smallholders of livestock at little or no cost, or as part of common grazing resources (FAO, 1999). Mobilising resources that have few other

uses is a main reason livestock are a large part of poor rural income (Hoffmann et al., 2003; Livestock in Development, 1999).

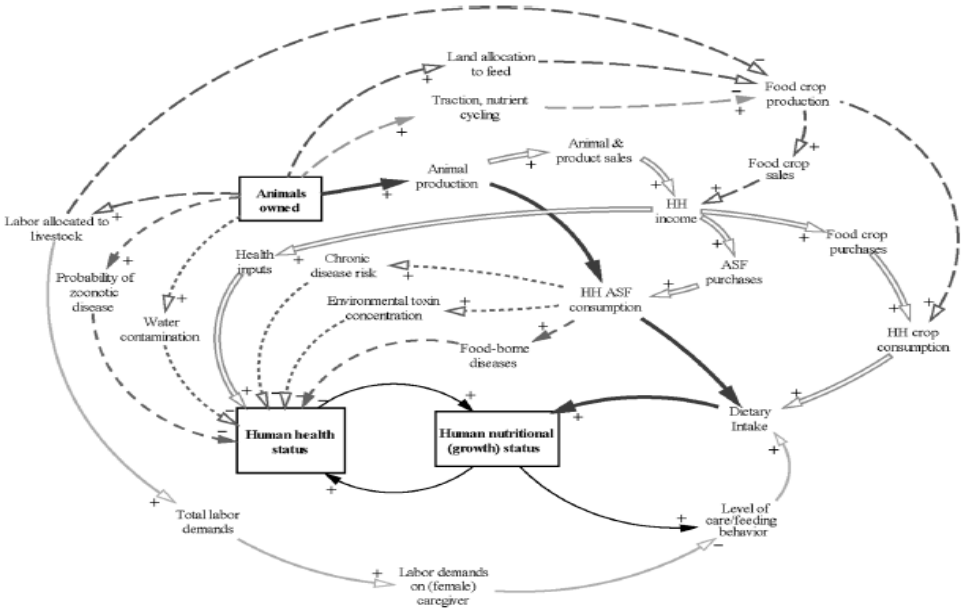
Many pastoralist communities live on rangeland with limited potential for cropping or industrial development – examples include the arid areas of the Sahel, the uplands of the Himalaya and the planes of Mongolia. Economists and aid organisations are increasingly recognising that in such areas, pastoralism not as a sign of backwardness, but rather an efficient system of resource mobilisation (Ogle 1997).

In addition to harnessing physical resources with little other use, raising livestock is a productive use of labour for people with little opportunity to participate in formal labour markets, particularly women, older people and children. In particular, the raising of small livestock assists women to enter the cash economy. Women in low-income areas are often unable to enter paid employment due to the need to look after children and family members, remoteness from employment opportunities, and/or social customs. Where cultural norms in prevent women from entering the workforce, they are often able to raise livestock, enabling them to produce food and cash income (FAO, 1999). Even if women are not earning a regular cash wage, Hoffmann, Riethmuller, & Steane, (2003) find that the ability to participate in informal trade of livestock products such as milk represents a very productive use of labour.

Livestock raising need not require large amounts of land or capital (Delgado et al., 1999). Often landless farmers are able to raise livestock in small pens attached to their homes, requiring little investment (FAO 1999).

Livestock play a more complex role in low-income economies than they do in the developed world. Randolph et al. (2007) show the complexity of the relationships between people, animals, agriculture, health and development in low-income countries. The linkages are both positive and negative, highlighting the complex role livestock play in decision making for the rural poor.

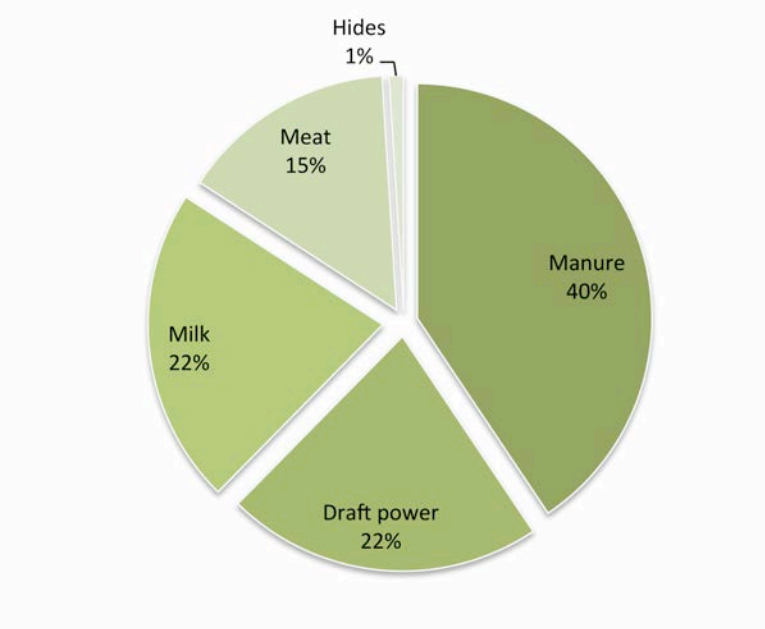
Figure 1: Roles of livestock in rural low-income economies



Source: Randolph et al., 2007 p2791, adapted from Nicholson et al., 2003. HH = Household, ASF = Animal Sourced Food.

The provision of food is only one of many economic roles played by livestock in low-income countries, and is in fact often one of the less important uses (Steinfeld, Schneider, & Neville, 2010). A good example of the diverse role livestock play in low-income economies comes from an FAO study in Bangladesh (FAO 1999). The study outlined the values of different aspects of livestock production. Most striking are the values from large ruminant production, shown in the chart below.

Chart 2: Different values of large ruminant production in Bangladesh



Source: adapted from FAO (1999)(p11)

We see here that the main uses of large ruminants are not for food, but for manure (used for fuel and fertilizer) and draft power. These values above are based on the financial values of the direct output of large ruminants, which still understate the indirect values livestock provide, by not considering the values these outputs add to other parts of economic development, for example the value milk and meat contribute to the economy through better nutrition, improved crop yields through manure application, or the role that livestock play in savings mechanisms.

As shown in Figure 1, not all aspects of livestock ownership are positive, particularly if animals are poorly managed. Some authors feel that the negative aspects of the livestock industry are emphasised in public discussion, with examples being greenhouse gas emissions and outbreaks of diseases such as SARS (Hoffmann, Riethmuller, and Steane 2003; Randolph et al. 2007). Publications like LEAD (2006) entitled "*Livestock's Long Shadow*" and the FAO's promotion of this report (FAO, 2006) show this tendency to cast livestock in a negative light.

Livestock *can* cause environmental degradation and health problems. But the positive effects of animal raising – improved nutrition, food security, increased agricultural output, financial stability and reinforcement of social support structures – mean that if managed well, livestock ownership is of great benefit to the rural poor (Livestock in Development, 1999). It is exactly because livestock play such a large role in the livelihoods of poor people that they are the focus of many development programmes, and why it is crucial to incorporate livestock into recovery efforts in times of disaster (LEGS 2009).

The following sections explore the many roles of livestock in low-income countries, showing why they are so important to economic development. We see that livestock don't only bring great benefit in terms of food provision, contribution to agriculture and as a form of savings – what we will call direct benefits – but also bring indirect benefits. Indirect benefits – also sometimes referred to by economists as "external" benefits – are often not included in the market price of animals or in financial evaluation of the role they play in an economy. They are, however, extremely important in understanding why livestock play such a great role in development and disaster recovery.

Livestock and food

One of the most basic reasons people keep livestock is that they provide food to their owners. Meat, eggs, milk and blood are important parts of livestock keepers' diets. These foods are often referred to as animal-sourced foods (ASFs) in development and nutrition literature. In pastoralist countries such as Mongolia, ASFs provide 48% of people's food intake, with even higher rates in rural areas (Internut 2010).

While the direct benefits of livestock in terms of food provision are clear – contributing to the energy requirements of their owners – there are also indirect benefits to the use of animals for food. Here we explore two of these indirect benefits – the way animal-sourced food can improve food security and the role they play in nutrition.

Food security

Livestock ownership can make a positive contribution to household food security. For people involved in mixed agriculture and livestock raising, livestock add to food security by providing an alternative or additional source of food in times of crop failure or cereal scarcity (Hoffmann et al., 2003; Livestock in Development, 1999). In addition to providing a buffer in a bad year, owning livestock can smooth out seasonal or cyclical differences in food availability. While agricultural crops may be available only in specific seasons, livestock products such as milk tend to be available throughout the year (Nicholson, Thornton, and Muinga 2004).

Some authors are concerned about the potential for livestock to reduce food security for people. This theme is also sometimes expressed in wider media, concerned that the raising of livestock is reducing the amount of grain available for human consumption, either through reduced area for grain crops, or more commonly, grain being fed to animals (Delgado et al., 1999).

The impact of feeding more livestock more grain does have the potential to impact grain markets and to reduce human food security. This is particularly the case at a local level if access to transport and wider markets is limited. However, such problems are generally driven by industrial-scale feedlot-based intensive livestock raising. This is quite different to the raising of livestock by smallholder farms or pastoralists, for whom livestock raising is generally positively linked to food security. Livestock raised by smallholders are often "opportunistic feeders" – they are fed items such as crop residues, food scraps, grasses, etc. that could not be used for human consumption (FAO, 1999).

Nutrition

Malnutrition is a problem for over 30% of people in the developing world (World Bank 2006; Neumann et al. 2010). Animal-sourced foods can play an important role in addressing malnutrition, particularly as predominantly cereal-based diets can lack micronutrients found in ASFs, causing many people to be chronically malnourished. Some of the micro nutritional benefits of ASFs include:

- Improved rates of pregnancy success;
- Child growth improvements;
- Stronger immune function;
- Improved health of breastfeeding women and their babies;
- Improved cognitive function and development in children;
- Higher rate of physical activity;
- Greater resistance to infection;
- Improved school performance.

Micronutrient deficiencies lead to:

- Poor brain growth;
- A huge impact on cognitive development;
- Physical stunting;
- Loss of motor skills.

  Sources: (Livestock in Development, 1999; Neumann et al., 2010; Randolph et al., 2007; World Bank, 2006)

Neumann et al. (2007) ran the world's first randomised controlled feeding study to examine the effect of supplementing primary school children's diets with ASFs. The study ran across four groups: a control group, and groups given snacks with small quantities of meat, milk and animal fats served as a snack during school recess. The groups that were given ASFs, particularly meat, showed stronger results in cognitive, physical and social tests.

Animal sourced food is particularly important for children, pregnant and breastfeeding women, and those with immune deficiency (such as HIV-positive people). ASFs are important for children as they have high-energy requirements relative to their gastric capacity, meaning that high-energy foods are essential. Anti-retroviral treatment drugs, for the treatment and management of HIV, are often ineffective without micronutrients that ASFs can provide (Neumann et al. 2010).

Nutrition and development

Due to the effects of malnutrition on long-term physical and cognitive development, worker productivity and demands on health services, nutrition is an important part of economic development (Demment, Young, & Sensenig, 2003). These effects of malnutrition can reduce the long-term GDP of developing countries by up to 10% (Neumann et al. 2010).

The role of nutrition in economic development has long been under-recognised (World Bank, 2006). Only in recent decades have development programmes and economists begun to realise the impacts and potential of nutrition for improving economic development (Demment et al., 2003). The potential for livestock to play a role in improving nutrition in disaster situations has been recognised by organisations such as LEGS (2009); UNHCR (1998); UNHCR and IUCN (2005).

A misconception that has hampered nutritional improvement and economic development is the idea that the best way to improve nutrition is through increasing income (World Bank 2006). However, this ignores the complex relationship between income, livestock ownership, ASF consumption and nutrition.

Demand for animal-sourced foods in low-income economies

There have been enormous increases in demand for animal-sourced food in low- and middle-income countries in recent decades, driven by rising incomes (Naylor et al. 2005; Pingali & McCullough 2010; Steinfeld, Schneider, & Neville 2010). While consumption of ASFs in low- and middle-income countries has risen dramatically, this has not been distributed evenly (Delgado et al. 1999; World Bank 2006). Statistics on ASF consumption need to be read with care, as the rising levels can mask inequality within regions and populations. While ASF consumption may be rising overall within a country, in poor areas such foods may still be unavailable and unaffordable (Neumann et al. 2010).

While some regions may have serious under-consumption of ASFs and chronic malnutrition problems, others may have problems with excessive consumption of ASFs such as obesity and heart disease. Rising demand and problems related to over-consumption have led to confusion about the role that animal sourced food should play in low-income economies (Randolph et al. 2007).

Problems associated with over-consumption of ASFs tend to be restricted to high-income countries, or wealthier, urban areas of low- and middle-income countries. Over-consumption tends to be a product of higher income and of relatively cheap ASFs available via processes associated with the livestock revolution. This review is focused on small-scale livestock owners in poorer areas, where malnutrition tends to be a problem, not excess consumption.

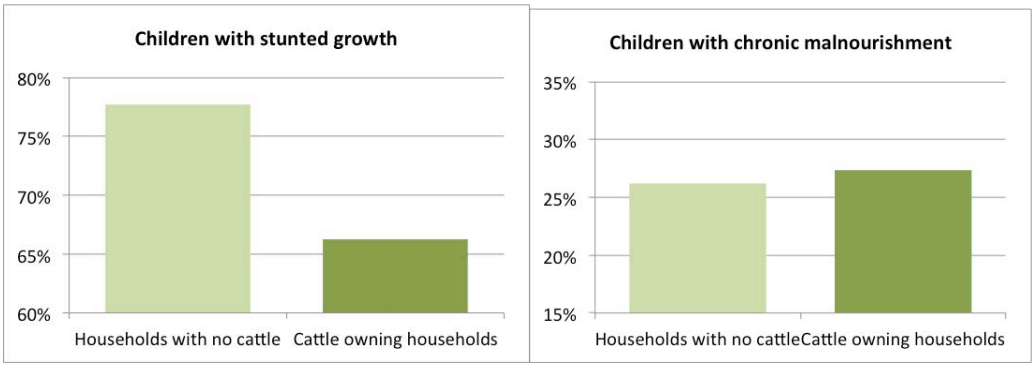
Livestock ownership and nutrition

While poor people who rear livestock tend to consume more ASFs than households with similar levels of income that do not have livestock, the relationship between livestock ownership, ASF consumption and nutrition is complex (Livestock in Development 1999; Nicholson et al. 2003). Even if people own livestock, they may be compelled by price to sell their ASFs for cash. Farmers often sell ASFs to realise their financial benefits, rather than retaining the nutritional benefits for their households (Livestock in Development 1999). As Randolph et al. (2007) put it, livestock keepers may not be livestock eaters.

Two interesting studies that have investigated this area empirically are Nicholson, Thornton, and Muinga (2004) and Nicholson et al. (2003). The former found that while ownership of improved breeds of dairy cattle in coastal Kenya improved household income significantly through sales of milk, there was only a marginal improvement in household consumption of dairy products.

Nicholson et al. (2003), meanwhile, found that while dairy cow ownership did improve growth in children, there appeared to be little effect on other indicators of nutrition. This study suggests that nutritional education could assist in realising the benefits that dairy cattle promotion programmes can provide.

Chart 3: Impact of cattle ownership on two indicators of childhood nutrition



Source: Adapted from Nicholson et al. (2003) (p.23)

Both studies highlight another poorly studied aspect of development and nutrition: intra-household allocation of food and nutrition. While there is limited empirical research on the topic, many authors and organisations are concerned that people who need the ASF most – pregnant women, breastfeeding women, children, people with immune deficiencies – often do not receive an adequate share (Hoffmann et al. 2003; Randolph et al. 2007; World Bank 2006). Social and cultural processes often result in food being allocated to older siblings, physical workers or men. In some societies cultural taboos relating to ASF consumption reinforce this pattern – for example, in parts of Africa taboos restrict pregnant women from eating meat and there are beliefs that children eating eggs leads them to become thieves (Neumann et al. 2010).

Income and nutrition

The above studies show that malnutrition affects the rural poor, but it is important to note that income and poverty predict malnutrition better than examining whether people live in a rural or urban setting. Kennedy et al. (2005) found that just as many urban poor suffer from malnourishment as their rural counterparts, while conversely, better-off rural residents had lower rates of malnutrition. They concluded that "simply living in an urban environment does not appear to confer any particular advantage"(p191). Interestingly, they found that while urban diets generally met energy requirements, often from fats and sugars, they often lacked micronutrients. If anything, the rural poor had better access to micronutrients through wild food, green leaves and other non-cereal foods. See also (Neumann et al., 2010).

Demment et al., (2003) argue that people need nutrition to be able to improve their incomes, at both an individual and economy-wide scale. They argue that poverty and malnutrition reinforce each other, a situation they term the "poverty-micronutrient malnourishment trap"(p3879). As pointed out above, improvements in average income do not always filter through to the rural poor, who often need nutritional assistance to break out of this trap. Demment et al urge the facilitation of access to ASFs, and building the capacity of smallholder livestock owners, as more sustainable ways to improve nutrition than the distribution of supplements or pills. This strongly echoes the livelihood-based approaches urged in disaster recovery by organisations such as LEGS (2009).

Livestock and agriculture

Livestock play an important role in agricultural systems. As shown in Chart 2 and FAO (1999), the contributions animals make to agriculture often outweigh their direct use for food, milk, hides, etc. The many ways livestock are integrated into agriculture relate to draft power and manure.

Draft power
Draft power is used for many purposes, many of which improve the productivity of crops:

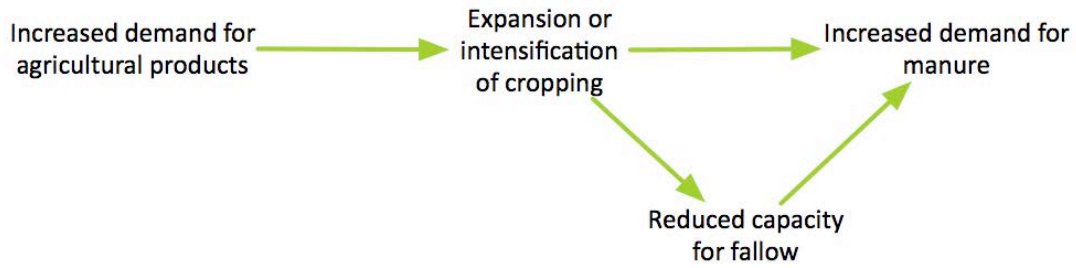
- Ploughing;
- Transport of people and produce;
- Transport of water and crop watering;
- Milling and threshing of grain.

The importance of draft power to agriculture is difficult to understate – 250 million draft animals provide power to farms in the developing world, covering 28% of the world's arable land (FAO 1999). In developing countries, 52% of arable land is farmed using draft power. In the highlands of Ethiopia, for example, access to a team of oxen for ploughing is one of the most important factors in reducing vulnerability to famine (Webb, von Braun, and Yohannes 1992).

Manure
Manure is used as a fertiliser and a fuel. Application of manure to cropland improves soil fertility and crop yields, and allows for more intensive cropping. In developing areas, manure can be one of the only ways to increase the fertility of land available to farmers, particularly as agriculture intensifies and the opportunity costs associated with leaving land fallow become too great.

As rural populations in low-income areas increase and farming intensifies, the need for manure and livestock integration becomes greater. Farmers collect manure to apply manually, or graze their livestock – or encourage others to do so – on crop residues following harvest (Ogle 1997).

Figure 2: Increasing demand for manure as agriculture intensifies



Source: Adapted from Ogle (1997) (p.7)

Fuel uses of manure/dung
Animal dung, particularly that of large ruminants, is used as a fuel in many areas. Dung can be dried and burned directly, or mixed with sawdust and other materials. It is a common fuel in pastoralist areas of Africa, India, Tibet and Central Asia (Randolf et al. 2007).
It can also be converted into biogas and used for cooking and lighting. Small scale biogas digesters are often used in the developing world – see BPP (2010) for an example.

Intensifying agriculture with livestock
Integrating livestock into agricultural systems has great potential to further improve agricultural yields and intensify agricultural production in low-income areas. Several studies

in Africa have shown that agricultural systems that use livestock are substantially more productive and profitable than simple subsistence cropping (see Ogle (1997) for examples).

Indirect values of livestock in agriculture

The indirect values of livestock in agricultural production stem largely from the lack of substitute inputs available to farmers in low-income countries. With little machinery available or affordable, livestock enable a higher level of agricultural production than would otherwise be possible with no draft power, or human labour alone. Without livestock, ploughing is less effective, harvests are difficult to transport, and less watering and fertilizer provision are possible. The use of livestock leads to greater agricultural output and food security, the benefits of which were discussed above.

In areas where substitutes are available in the form of farm machinery or chemical fertiliser, livestock still provide an insurance mechanism against swings in prices, availability of spare parts and maintenance. They provide a form of security and enable people to build their livelihoods without dependence on outside assistance.

Livestock, income, investment and insurance

Raising livestock is of great importance to rural incomes. Products such as milk, eggs, meat and manure are easily marketable, and can be sold readily in small, regular amounts. As much as 80% of people's cash income in poor areas is derived from livestock-related activities (Livestock in Development 1999). Indirectly, in the same way that ASFs can help smooth food consumption through seasons and years with poor harvests, the income from sale of livestock products can smooth out fluctuations in cash income. This in turn improves food security during non-harvest periods, or after crop failure (Livestock in Development 1999).

Livestock can also be used as a savings mechanism – they are accumulated in good times and sold later to cover large or unpredicted expenses such as school fees or medical expenses (Livestock in Development 1999). Used in this way, livestock are one of the few ways that poor people can save, due to a lack of access to banking and other investment opportunities. Livestock also have the advantage of being inflation-proof and productive assets (Livestock in Development 1999). FAO (1999) show studies that found investing in livestock delivered a 10% return to farmers over six years, while a bank deposit lost 10% due to inflation.

Ogle (1997) identifies areas in sub-Saharan Africa where livestock are being used as a direct mechanism for savings, rather than as productive assets. He observes wealthier farmers and even urban dwellers investing in large livestock herds due to lack of other savings mechanisms. These herds are then managed for survival rather than productivity, with larger numbers of males and less productive cows. Elsewhere, the savings value of livestock seems to be more indirect, with livestock being managed for productivity and direct uses as food or in agriculture, and their role in savings constituting a more indirect benefit (Livestock in Development 1999).

In the same way that they have little access to banking facilities, poor people often have little access to insurance. In these cases, livestock can function as a form of insurance against crop failure, drought, etc (Livestock in Development 1999). By keeping a range of livestock species, people can utilise different resources – for example, sheep and cattle tend to graze on grass, while goats and camels prefer shrubs and woodier plants. Different species can be grazed in different areas – goats in steep terrain, camels far from watering points, etc. (UNHCR, 2005). Keeping a range of livestock, and thus being able to utilise

multiple sources of feed, is an coping mechanism during times of drought and food insecurity (Webb, von Braun, and Yohannes 1992). The boxed text below provides an example of more conventional insurance for Mongolian herders.

Keeping livestock also comes with costs. Acquiring livestock can be expensive, and with little access to credit, many poor people who would like to own livestock are unable to acquire them (Livestock in Development 1999). Maintaining and rearing animals also carries costs, such as veterinary services and feed, which can be difficult to obtain and afford. Where livestock owners cannot afford to obtain and maintain herds in good condition there are often sub-optimal rates of ownership and low productivity (Livestock in Development 1999; Hoffmann et al. 2003).

Grazing is often dependent on communal resources, which have been declining due to grazing pressure, privatisation of land and exclusion of small graziers and intensification of rural land use (Livestock in Development 1999). Pastoralism and communal grazing is sometimes looked at as a "Tragedy of the Commons" type scenario, where open access to pasture gives each individual user incentive to overgraze, even when this leads to a worse outcome for the whole user group (Hardin 1968). However more recent thinking on rangeland grazing suggests that pastoralism is not out-moded – it remains a very efficient method of livestock production, and pastoral communities are efficient forms of communal rangeland management (UNHCR and IUCN 2005).

Livestock insurance in Mongolia

An exception to the lack of formal insurance for livestock holders is In Mongolia. The Mongolian Government, aid donors and insurance companies have been piloting an insurance scheme for semi-nomadic herders since 2005.

Mongolian herders often suffer very large losses as a result of "dzud" – harsh winters and springs that leave little fodder for livestock or prevent them from getting to it through thick snow. Insurance companies are normally reluctant to offer insurance policies to herders due to the difficulties involved with access, verifying losses and the small scale of the herders.

Some of these difficulties have been overcome by the Index-based Livestock Insurance Scheme. Under the scheme, compensation to policy holders is based on the adult livestock mortality rate across a county area, rather than an individual assessor's verification of the death of particular livestock. Different rates of compensation are triggered by different values of the county livestock mortality indices.

Although insurance has benefits for the owners of livestock, animal welfare organisations have suggested that caution needs to be taken in livestock insurance schemes to make sure they do not provide an incentive for owners to abandon their animals during disasters.

Sources: Mahul, Belete, and Goodland (2009); WSPA (2011b) personal communication.

NOTE: There is a case study on the Mongolian dzud later in this report.

Cultural roles of livestock

In many agricultural areas, and particularly pastoralist and herding societies, livestock are an integral part of culture. While difficult to value from an economic perspective, the cultural roles that livestock play influence decisions on herd size and composition, and these decisions in turn have an economic impact. The social functions of livestock are best illustrated by examples:

- In pastoralist areas of Kenya, dowry payments are customarily made in animals, usually consisting of at least 50 cows, hundreds of goats and often a number of camels. The necessity of livestock for such social situations often leads to theft and conflict, particularly if livestock numbers have been reduced by drought (IRIN 2011).

- In Ghana, cows are also important for dowries, while sacrifice of sheep and goats is important for funerals. These considerations are so important that families ration their own food consumption to avoid selling animals to allow for these future uses (Devereux 1993).

- In Zimbabwe, households sometimes have a ritual requirement to keep a bull that a medium instills with an ancestral spirit. These bulls are only slaughtered on special occasions (Barrett 1991).

The social benefits of livestock in herding and agricultural societies are most obvious when they are taken away – after disasters that have reduced herd sizes, pastoralists forced to move to urban areas often find themselves displaced from their social networks and unable to cope with their new surroundings and reduced to poverty. A good example comes from Aklilu and Wekesa's (2002) comprehensive analysis of the 1999-2001 drought in Kenya. Following calculations of the drought's financial impact, they write:

> *The social impact of these losses among pastoralists was equally severe. The drought undermined households' social position, caused families to break down and split and damaged social safety networks, friendships and borrowing capacities based on livestock ownership. In addition, it bred a sense of helplessness among its victims and increased households' vulnerability to future food insecurity as pastoralists and agro-pastoralists dropped out of the production system and moved off the land to settle near food distribution centres. This provided fertile ground for sedentarisation, environmental degradation, destitution and absolute poverty.*
> Source: Aliku and Weseka (2002) (p 2)

Strong pastoralist and agro-pastoralist societies have their own coping mechanisms to assist their people to survive drought and other disasters. Being integrated into such a society provides benefits through improved self-esteem and access to social support mechanisms. Herding societies also have their own coping mechanisms, such as people lending each other cattle, giving cattle to whoever has lost stock in a drought, sharing knowledge of how to manage pasture in lean years and areas saved from grazing for a poor season, etc.

Coping strategies employed by Kenyan pastoralist societies include:

- Migrating with herds to less stressed areas;
- Managing herds to maximise survival and later resilience, such as female-dominated herds, diversification of species, birth of livestock in all seasons to spread risk;
- Traditional disease management techniques;
- Social safety networks – giving, lending, etc (Aklilu and Wekesa 2002).

An example of social safety networks through giving and lending practices comes from the Borana and Degodia Somali cultures in the Horn of Africa. Under their traditions, group members who lose animals in drought, conflict or raiding have a right to assistance from their clan. Anyone left with fewer than five cows is can claim a minimum of five cows to ensure their herd remains of sustainable size (Gebru 2007).

SECTION 2

Natural disasters and economies

Section 2: Natural disasters and economies

Introduction

For a natural event to be a 'disaster' takes more than just physical processes. It requires people. As the philosopher Jean-Jacques Rousseau wrote of the Great Lisbon Earthquake of 1755:

> *You might have wished… that the quake had occurred in the middle of a wilderness rather than in Lisbon. ... But we do not speak of [those quakes], because they do not cause any harm to the Gentlemen of the cities, the only men of whom we take account.*
> *Source: As quoted in Stromberg 2007, p200*

Indeed, when an earthquake occurs in an uninhabited area, it is not considered a disaster and little attention is paid to it by anyone other than seismologists. Strong earthquakes of magnitude 7 and above often occur out to sea, but are not noticed by the public – see (USGS 2010) for a recent example in the Pacific Ocean off Vanuatu.

To be a disaster, an event needs to affect people. However, there do not need to be deaths for some definitions of disaster. For instance, although there's no suggestion that the droughts that hit parts of Australia in the late 20th century were directly responsible for any deaths, the Australian Government (2008) nevertheless considers them to be disasters due to their huge economic effects – including losses to agriculture, livestock holders, job losses and social change in country towns.

We begin this section by looking at some definitions and types of natural disaster. We discuss the factors that contribute to the scale of a disaster – the physical processes, the exposure of people and property to these processes, and also the vulnerability of populations to disasters in general. "Vulnerability to disasters" refers to how social and economic systems cope with and recover from disasters. We see that low-income countries are far more vulnerable to natural disasters than higher income countries.

Different sources have varying definitions of what constitutes a disaster, and collect different data. There are also wide variations in the numbers of disasters reported due to these differing definitions. While one disaster statistic – human deaths – requires little definition and shows little variation in different databases, the economic impact of disasters is also difficult to define, quantify or predict. This means that an economic study of disasters can be a difficult undertaking.

Most studies break down the economic impacts of disaster into direct and indirect impacts. Direct impacts are more easily quantified, often with market values, while indirect impacts require more investigation. Economists have attempted to model these impacts through regression analysis. Most modelling has focused on macroeconomic indicators.

What is a natural disaster?

Natural disasters disrupt lives, livelihoods and economies. Disasters cause "a significant negative impact on assets, production factors, output, employment and consumption", (Hallegatte and Przyluski 2010, p2). Disasters result in the destruction and degradation of the factors of production; people, land and capital.

The United Nations International Strategy for Disaster Reduction defines a disaster as:

> *A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources. … Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation.*
> UNISDR (2011)

The widely used EM-DAT international disaster database (see boxed text on p32) sets out empirical criteria to judge whether an event is a "disaster". To qualify as a disaster, one of the following must have occurred:

- 10 or more people reported killed;
- 100 or more people reported affected;
- The declaration of a state of emergency;
- A call for international assistance.
  Source: (Guha-Sapir et al., 2011, p.7)

Types of natural disaster

Through this report, we discuss different types of natural disaster. Generally disasters can be considered as being either slow-onset or rapid-onset, as follows:

Slow-onset disasters

Slow-onset disasters are usually droughts or unusually harsh seasons, such as the Mongolian "dzud". LEGS (2009) divide slow-onset disasters into four stages: alert, alarm, emergency and recovery.

Alert	Weather factors such as lack of rain, heavy snow, etc, lead to pasture and water resources not being replenished.
Alarm	Weather problems persist and feed and water resources are being depleted. Initial economic signs begin – eg increases in grain prices, decreases in livestock prices.
Emergency	Weather factors continue, significant depletion of pasture and feed. Price movements make food unaffordable. Transport constraints possibly affect food supply and price.
Recovery	Weather factors improve, livestock recover condition, livestock prices rise, cereal prices decline.

In terms of their impact on livestock, slow-onset disasters kill or reduce the productivity of livestock, along with causing a general reduction in agricultural output (Sayed 2010; LEGS 2011). These onset disasters reduce fodder and feed available to livestock, reducing their productivity and making them more vulnerable to disease. Animals in poor condition fetch lower prices and produce less milk and meat, reducing owners' assets, income and food security. In these situations, many livestock owners may be trying to sell livestock, further driving down their prices.

The resultant food shortages and insecurity can soon develop into a complete famine, as we are seeing in the Horn of Africa this year (Rice 2011).

Rapid-onset disasters

Rapid-onset disasters include earthquakes, tsunamis or flash flooding. LEGS (2009) divide these disasters into three general phases – immediate aftermath, early recovery and main recovery. Some disasters, such as flooding over an extended rainy season, may have a pre-disaster "alarm" phase:

Alarm	Weather such as heavy rain through a season gives some indication of risk, particularly in relation to flooding. Weather forecast of extreme events may allow for some preparation
Immediate aftermath	The period just after the disaster when the physical impact is most obvious. Lives still in danger.
Early recovery	Days and weeks after the physical impact and emergency responses have been initiated.
Main recovery	Months or years following disaster when lives and livelihoods are rebuilt.

In rapid-onset disasters, animals can be killed immediately, lost, or abandoned by owners in the aftermath of the disaster. Agricultural crops and livestock feed may be destroyed, leading to food shortages for humans and animals. The loss of livestock can reduce the agricultural output of subsequent seasons, compounding the effect on food supplies.

Complex and chronic disasters

A third category of disaster is complex or chronic disasters. These disasters are usually the result of conflict or poor governance, further complicated by either slow- or rapid-onset natural disaster. Some regions vulnerable to drought and political instability face these threats regularly and some relief agencies term their situation to be in “chronic disaster”. These disasters have great impact on livestock – displacement, theft, lack of services such as vets, agricultural extension, etc. Grazing is often restricted, communications and infrastructure are limited, making access to markets and decision making difficult (LEGS 2009).

Disasters and their impacts

In section 2 we focused on the role of livestock in low-income countries, examining the more complicated role that livestock play in these countries, because it is important to understand the role of livestock in such countries when planning disaster recovery programmes. This section, too, will focus on developing countries, as these countries tend to be more vulnerable to disasters and less able to recover from them. As we shall see, livestock play an important role in any recovery.

Three factors contribute to the impact of a disaster. First, there is the physical magnitude and duration the disaster, such as the height of a flood peak, the force of an earthquake or the duration of a drought. Secondly, there is the population exposed to the natural event – larger populations have more people in danger and more buildings, bridges, livestock and other assets that can be damaged. Last, but perhaps most important, is the vulnerability of the population to the impact of a disaster. It is this vulnerability to disasters, or resilience in recovering from them, that sets low and high-income countries apart (ADRC 2005; Strömberg 2007; Klieson 1994).

The ADRC (2005) defines "disaster vulnerability" as:

> *"A condition resulting from physical, social, economic, and environmental factors or processes, which increases the susceptibility of a community to the impact of a hazard."* (p5)

Similarly, the UNISDR defines "disaster resilience" as:

> *"The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions."* (UNISDR 2007)

Some of the social and economic structures and functions identified in other sources that separate low- and high-income countries in terms of being able to deal with disasters include:

Disaster preparedness/mitigation

- **Emergency services:** High-income countries have better developed ambulance, police and fire brigade services, along with hospitals and health care.
- **Adherence to building codes and standards:** Building codes and standards can be important in reducing cities' exposure to disaster impacts. Low-income countries are typically less able to implement and enforce such standards.
- **Land use planning:** Ensuring that land prone to disasters is used for appropriate purposes and is serviced by infrastructure that will mitigate disaster impact and facilitate recovery.

Economy

- **Capacity of sectors of the economy:** High-income countries have far greater capacity in sectors such as building and construction, health care and communications.
- **Savings and credit:** Countries with higher incomes have higher savings and access to credit on which survivors can draw during recovery stages.
- **Degree of openness to trade:** Low-income countries with fewer linkages to other markets and less trade infrastructure are less resilient in disaster recovery.

Public sector

- **Type of government:** Democratically elected governments will have a greater incentive to take strong action in the aftermath of a disaster, since they are more accountable to their voters.
- **Quality of institutions:** The quality and existence of institutions such as emergency response departments, health systems, public health and information services, has a large impact on the efficiency and effectiveness of recovery efforts.
- **Government financial position:** Governments' financial resources are can be stretched in disaster recovery, necessitating efficient tax collection, fiscal approval mechanisms, and access to credit and currency reserves. High-income countries typically have far stronger government financial positions.

Demographics and society

- **Population density:** Denser populations are more vulnerable to the effects of natural disasters.
- **Income and gender inequality:** More unequal societies tend to spend less on preventative measures against disasters.
- **Access to information:** The existence of newspapers, TV and radio stations, etc, facilitates news about disasters and improves transparency in recovery spending.
- **Literacy rate:** Higher literacy rates improve communication and access to information assisting with disaster preparedness, mitigation and recovery.
- **Health:** Less healthy populations find it difficult to recover from disasters due to reduced labour capacity. High rates of infectious diseases such as HIV, found in many low-income countries, can reduce labour capacity.

Sources: Cavallo and Noy 2010; Cavallo, Powell, and Becerra 2010; Hallegatte and Przyluski 2010; Neumayer and Plümper 2007; Noy and Vu 2010; Noy and Nualsri 2008; Noy 2009 and Klieson 1994.

As most of these structures and functions are weaker in low-income countries, those countries are generally both more vulnerable to disasters and less resilient in recovery.

Even within low-income countries, the people most vulnerable to disasters are the poor. They tend to be physically exposed to disasters, living on steep slopes, riverbanks, or low-lying neighbourhoods. Their buildings tend to be less well constructed, while services and infrastructure are minimal. Rodriguez-Oreggia et al. (2010) explored the impact of disasters on poverty in Mexico. They found that the impact of natural disasters on the poorest people is "similar to going back two years in human development" (p.17).

Gender inequality also has relevance for disaster recovery. In a study of 141 countries using data for years between 1981 and 2002, Neumayer and Plumper (2007) discovered that disasters had a disproportionately greater effect on the life expectancy of women than men. The greater impact a disaster had, the greater this disparity. However, in countries where women had higher socioeconomic status – typically high-income countries – this disparity was reduced. This has particular relevance for developing countries, as the nutritional status of children is closely linked to the status of their mothers (Hoffmann, Riethmuller, and Steane 2003b). Furthermore, disasters often increase women's labour burden and can reduce their key assets – which are often livestock (see section 1).

All in all, we can see that low-income countries tend to be the most vulnerable to natural disasters and the least resilient in recovery. Within these countries, women and the poor are most severely affected by disasters – and it is these people, as we saw in section 2, who are the most likely to be livestock holders.

Sources of disaster data

EM-DAT
The EM-DAT International Disaster Database (CRED 2011a)[1] is a freely available source of data on over 18,000 disasters dating back to 1900, and is commonly used in disaster research. EM-DAT is a project run by the Centre for Research on the Epidemiology of Disasters (CRED), an organization based in Belgium that promotes training and technical expertise on humanitarian emergencies.

Each disaster is then given a unique disaster number and data entered under various fields if relevant including:

- **Country:** Country or countries affected by the disaster.
- **Disaster group and type:** Groups are broad genres (natural, biological, complex, etc), while types are specific categories (such as earthquake, industrial accident, volcano, etc).
- **Date:** When the disaster began and ended.
- **Killed:** Number of people confirmed dead, and persons missing, presumed dead.
- **Injured:** Number of people suffering from physical injuries, trauma or an illness requiring medical treatment as a direct result of a disaster.
- **Homeless:** Number of people needing immediate assistance for shelter.
- **Affected:** Number of people requiring immediate assistance (such as evacuees or displaced people).
- **Estimated Damage:** Estimates of damage, given in US dollars.
- **Additional fields:** Often includes physical values of the disaster, e.g. Richter scale values for earthquakes, along with requests for assistance, aid contributions, etc.

Source:(Guha-Sapir et al., 2011, p.8)

NatCatService[2]
Maintained by reinsurance company Munich RE, NatCatService is a database of approximately 28,000 'natural hazard events' with about 1000 new events added per year between 2004 and 2010. Access to the database requires registration but is free. Originally developed for the insurance industry, the database is also used by researchers and governments (Munich RE 2011a).

Sigma reports[3]
Produced by reinsurance company Swiss RE, Sigma reports are published annually and discuss disasters and disaster impacts around the world. The reports are a useful catalogue of disasters and their costs to economies and insurers (Swiss Re 2011). A disaster is included in the Sigma statistics if insured claims, total economic losses or the number of casualties exceed a certain limit. In 2010, total economic losses had to exceed US$86.5 million for inclusion, and casualties also had to exceed 20 deaths, 50 injured or 2000 homeless (Swiss Re 2011).

Global Identifier Number (GLIDE)[4]
GLIDE is a numbering system and database promoted by the Asian Disaster Reduction

[1] http://www.emdat.be/
[2] http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/default.aspx
[3] http://www.swissre.com/sigma/
[4] http://www.glidenumber.net/glide/public/search/search.jsp?

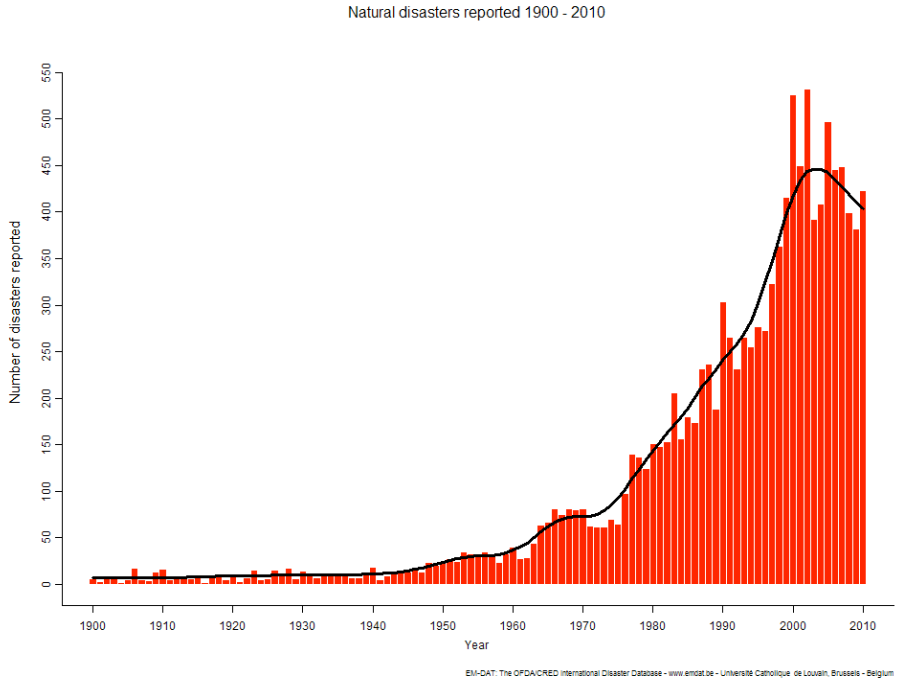
Center (ADRC). The system provides an index number, along with basic information about the disaster type, its location and magnitude, and a brief comment. It contains information on disasters from around the globe, not only Asia.

Desinventar[5]
Desinventar is a "Disaster Information Management System" that began with a focus on Latin American countries, but now includes data on disasters in low-income countries in all regions.

Measuring disasters – numbers, casualties, cost

The number of disasters reported in the EM-DAT database has been increasing strongly since the 1950s. This is due partly to changes in the level of exposure to disasters through population increase and urbanisation, and particularly these population increases in disaster-vulnerable areas, i,e. low-income countries (ADRC 2005).

Figure 3: Natural disasters reported (1900-2010)



Source: CRED 2011b

Another factor is improved reporting of disasters – disasters in remote areas that may have gone unnoticed by the rest of the world in the early twentieth century are now better reported. This process began with greater data collection efforts by the Office of US Foreign Disaster Assistance – beginning in 1960 and the founding of CRED in 1973 (Guha-Sapir, Hargitt, and Hoyois 2003).

[5] http://www.desinventar.net/

Improved transparency has also been important. Disasters that governments may have wished to hide are now made known to the outside world and recorded on international databases. For example, during the rule of Mao Zedong, China never reported more than one disaster per year, while it has reported at least six every year since the Deng Xiaoping era of the 1980s (Stromberg 2007).

Guha-Sapir et al. (2003) (p.23) state that disaster data for the 20th century "tends to emphasize … the evolution in telecommunications, humanitarian assistance availability and the active registering of natural disaster occurrences". They conclude, "reviewing the evolution of disasters over a shorter time span is better for identifying trends, both in the occurrence of events, as well as their impact on human populations."

While disasters have been increasing in number, we see in the table below that the actual number of disasters varies between different databases, due to differing definitions of "disaster" adopted by the source. For instance, the NatCatService recorded 960 events in 2010, while Sigma Reports recorded only 167:

Table 2: Reported disaster casualties and costs in 2010

Source	Number of disasters	Human deaths	Economic losses (costs) $ billion
EM-DAT	385	297,000	$124
NatCatService	960	295,000	$150
Sigma reports	167	297,000	$194[6]

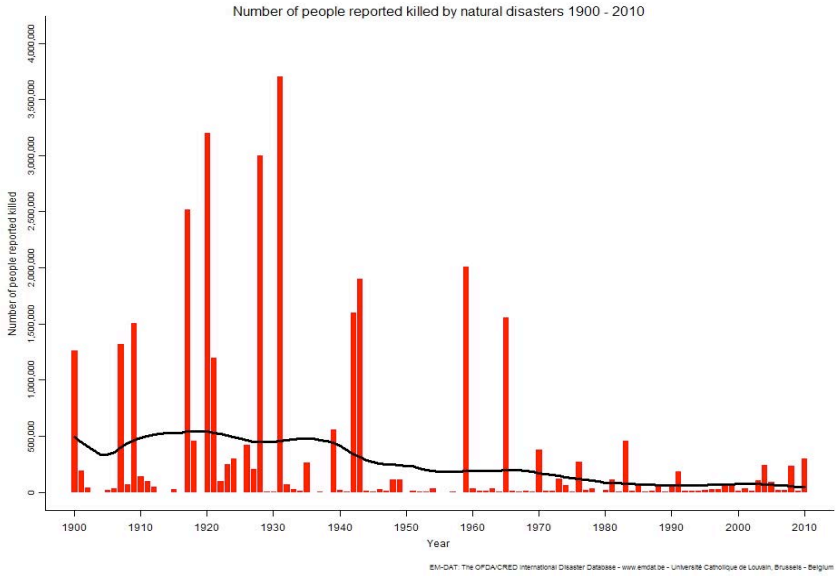
Sources: Guha-sapir et al. 2011; Munich RE 2011b; Swiss Re 2011

Despite this wide variation in the number of disasters, we see that estimates of human deaths are the same across databases, suggesting that the major events are included in all databases and many of the estimates used are the same.

Despite the increasing numbers of disasters reported, numbers of people reported killed by natural disasters has actually decreased over the twentieth century. This suggests that despite increasing populations exposed to disasters, fatalities have been reduced by improvements in emergency services, disaster response, infrastructure and medical treatment.

Figure 4: Number of people reported killed by natural disasters (1900-2010)

[6] Swiss Re (2011) does not clearly disaggregate natural from man-made disasters in reporting costs. Although on page 4 it is stated "Economic loss estimates from man-made disasters were more than USD 24bn". $194 is equal to $218 minus $24.



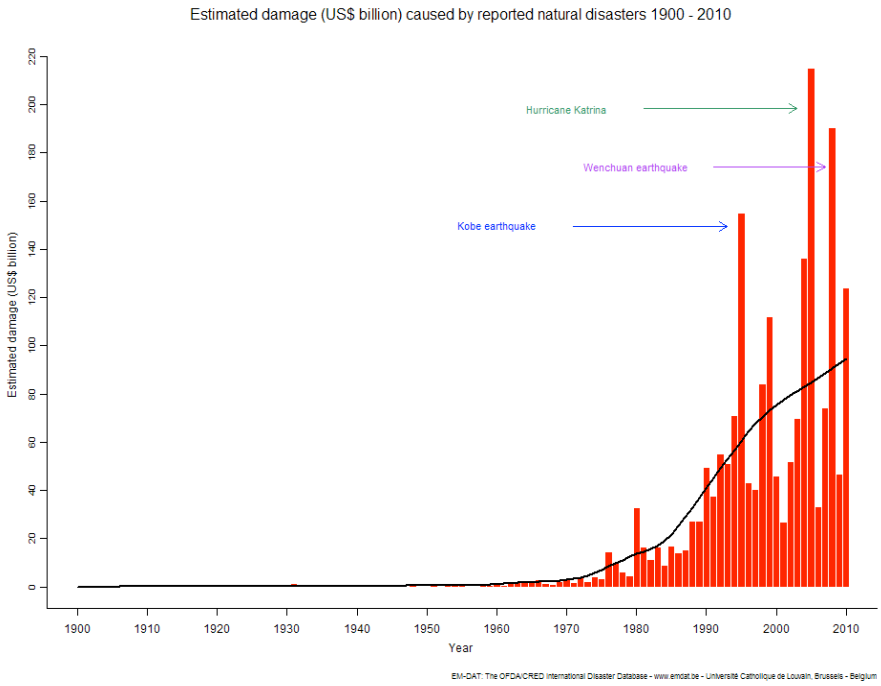
Source: CRED 2011b

While the number of deaths due to disaster shown in Figure 4 does not follow the trend of increasing disaster numbers shown in Figure 3, we see in the next section that the economic impact of natural disasters shows a similar trend to reported numbers of disasters.

Damages caused by natural disasters

The reported economic damages from natural disasters exhibit a similar trend to the number of disasters reported. The figure below shows estimated damage caused by reported natural disasters between 1900 and 2010. For similar reasons to the number of disasters reported – increases in exposed population and assets, improved reporting and communications – economic damages increase sharply after 1960

Figure 5: Estimated damages caused by reported natural disasters (1900 - 2010)



Source: CRED 2011b

As we have seen in Table 2, estimates of the costs of disasters vary considerably. Even estimated costs for the same disaster can vary wildly – for example, the USGS estimates the cost of the 1988 Spitak earthquake damage as $16.2 billion, while the ADRC (2005) publishes over $20 billion and internet sources commonly cite $3.5 billion[7]. Even experts in disaster economics use large ranges to estimate the costs. For example, Cavallo, Powell, and Becerra (2010) estimated the direct costs of the earthquake that struck Haiti in 2010 to be between $8 billion and $14 billion.

Some authors point out that "the cost" of a disaster varies depending on who is making the assessment. Insurance companies, international aid providers and other stakeholders will all make different estimates. While some more obvious, direct costs – such as reconstruction – are always included in such estimates, other "indirect costs" are more difficult to define, but can be ultimately more important in understanding the impact of a disaster (Hallegatte and Przyluski 2010).

[7] For example, http://healthcare.reachinformation.com.cws8.my-hosting-panel.com/1988%20Spitak%20earthquake.aspx

Direct and indirect economic impacts of disasters

Most discussion of disaster impacts includes discussion of direct and indirect impacts. Direct impacts tend to be more tangible, while indirect impacts involve a deeper understanding of a variety of factors – much like the direct and indirect benefits of livestock discussed in section 2. The EM-DAT database gives a basic definition of direct and indirect disaster impacts:

> *The economic impact of a disaster usually consists of direct (e.g. damage to infrastructure, crops, housing) and indirect (e.g. loss of revenues, unemployment, market destabilisation) consequences on the local economy.* (CRED 2011a)

While definitions of direct and indirect impacts vary, we suggest the following approach based on economic literature.

Direct impacts

Direct impacts relate to damages to the factors of production – labour, capital and land.

Damage to labour is a euphemism for human death, injury and sickness. The direct costs of this include the costs involved in treating the injured and/or laying the dead to rest. In some studies direct impacts include the cost of wages lost while the injured are recovering.

Damage to capital refers to the destruction of houses, roads, bridges and physical infrastructure (machinery, cars, trucks, factories, schools, etc). The direct costs of capital damage relate to the replacement or reconstruction of the assets affected. In developing countries, damage to livestock can form a significant proportion of capital damage – as we've seen in section 2, livestock play a large part in developing countries' capital base, contributing to farming, transport, savings, insurance and cultural practices.

Finally, disasters can damage land through erosion, landslides, loss of nutrients, etc. Repairing such damage may require extensive engineering and rehabilitation to enable the land to once again support buildings, agriculture or other productive activity.

Indirect impacts

Although direct impacts are visually obvious following a disaster, Hallegatte and Przyluski (2010) argue that estimating indirect impacts is actually more important to understand the welfare consequences of disasters:

> *…there are large uncertainties on indirect disaster costs, and these uncertainties arise both from insufficient data and inadequate methodologies. Considering the importance of unbiased estimates of disaster cost, for instance to assess the desirability of prevention measures, progress in this domain would be welcome and useful. To do so, much more research should be devoted to this underworked problem.*

The indirect impacts on labour in a disaster constitute the value of wages lost to workers, and also the production lost in industries that rely on the labour affected. This impact will persist until all affected factors of production return to normal – which may never occur. It's also important to consider the ramifications of lost earning and production potential of the

individual people killed or injured, including psychological trauma. A family that loses an income-earner has lost a stream of income that extends into the future. A badly injured worker may never again be able to produce to their full capacity, reducing their earning potential for the rest of their lifetime. Such impacts are greater in low-income countries because lower standards of emergency services, health care, and government support mean recovery is slower.

Indirect impacts on capital relate to the losses sustained while the capital items affected by the disaster are being repaired and/or replaced. Again, this takes longer in developing countries due to those countries' financial position and the generally lower capacities of their industries. The cost of indirect capital impacts includes the lost production and earning capacity of the capital affected, but also the losses related to the absence of those assets – for example, reduced transport linkages may mean that people are less able to travel for work or medical attention and have less access to markets. This, in turn, can drive up prices and cause shortages. Damage to capital also produces indirect impacts in the form of reduced government services – medical, educational, and (particularly relevant to livestock) veterinary care and agricultural extension.

Indirect impacts of land being damaged in disasters relate to its loss of productivity. This is particularly relevant to agriculture and pastoral areas, where reduced productivity means reduced crop yield and reduced fodder available for stock. In the case of slow-onset disasters such as drought, the loss of productive capacity of the land is felt throughout the economy as food prices rise. This has implications for the livelihoods of pastoralist communities in developing countries, and for food security in areas with low-income and little connection to outside markets LEGS (2009).

Treatment of direct and indirect impacts in economic literature

Most studies of the impacts of disasters fit broadly into this approach of distinguishing between direct and indirect impacts. While Hallegatte and Przyluski (2010) refer to a range of losses and impacts, their findings are generally in line with this approach. Their approach considers direct losses as being the immediate consequences of a disaster due to its physical impacts, while indirect losses arise from the consequences of those physical impacts. Hallegatte and Przyluski refer to "market" losses (for which there are observable prices – e.g. buildings, inventories, etc) and "non-market" losses (which lack easily observable market prices – e.g. health impacts, loss of lives, and damage to historical, environmental or cultural assets). They also distinguish between impacts within the area immediately affected by a disaster and impacts that occur outside that affected region (such as effects on a stock market or on government budgets). Lastly, they draw a distinction between monetary impacts (such as reduction in tax revenue and increases in national debt) and "non-monetary" consequences (such as impacts on poverty or inequality).

Similarly, Cavallo and Noy (2010) distinguish between direct and indirect damages from a disaster. They define "direct damages" as mortality, morbidity and damage to fixed assets, capital, raw materials and natural resources as a direct consequence of a natural disaster. Indirect damages, meanwhile, are defined as the loss of economic activity resulting from the direct damages or from spending on recovery from the direct damages. Cavallo and Noy also divide indirect damages into "short run" and "long run" damages.

Klieson (1994) also distinguishes between "costs" and "losses" arising from a natural disaster. Costs are defined as the spending that occurs to "replace, repair or reinforce" assets damaged by a natural disaster. Losses, meanwhile, are "the destruction of an

economy's wealth", as measured through lost income or the decline in the value of assets. Klieson distinguishes between "direct" and "indirect" losses in the same manner as other authors – direct losses are physical damage to assets, while indirect losses are lost productivity resulting from this damage. Klieson also distinguishes market effects that can be measured with market prices (such as asset values) and non-market effects that may not have market values, but still impact on welfare (such as leisure or commuting time). He also highlights that disasters can have redistributive and wealth impacts through distressed asset sales or through the permanent loss of savings due to a disaster.

Table 3: Direct and indirect impacts of disasters in economic literature

	Direct Impacts	Indirect Impacts
Hallegatte and Przyluski 2010	Direct Losses Market Losses Affected Region impacts	Indirect Losses Non-market Losses Outside affected region impacts
Cavallo and Noy 2010	Direct damages	Indirect damages Long run damages Short run damages
Klieson 1994	Direct costs Direct losses	Indirect costs Indirect losses

Modelling disaster impacts

As there are many definitions of disasters and their impacts, there have also been many different econometric models used to estimate disaster impacts. Many of these are reviewed and summarised in Cavallo and Noy (2010). These models typically rely on a form of regression analysis to estimate dollar value of the impacts of a disaster from data on natural disasters.

Regression analysis is a method for estimating one number (the dependent variable) based on a set of possibly related variables (independent variables). Regression analysis typically takes the form of:

$$Y = f(X, \beta)$$

where the dependent variable Y is a function of the independent variable X and the parameter β. Depending on the analysis, there may be several independent variables (taking the form X_0, X_1, X_2, etc) and corresponding parameters (β_0, β_1, β_2, etc). To estimate direct economic impacts of a disaster, Cavallo and Noy found that most literature uses models of the form shown below.

$DIS_{it} = \alpha + \beta X_{it} + \varepsilon_{it}$

where:
DIS_{it} is the direct variable, being a measure of the direct impacts of a disaster in country *i* at time *t*. It is measured either in dollar terms, or in the form of another numerical measure (such as casualties).

X_{it} includes a range of different independent variables. **X_{it}** generally includes a measure of the disaster's physical magnitude (e.g. a Richter scale value for earthquakes), along with variables that capture the exposure and vulnerability of the study area to disasters (such as measures of economic development, GDP per capita, rates of urbanisation, etc).

α is a constant. This is the value of ***DIS_{it}*** when dependent variables (**X_{it}**) have a value of zero. For disaster impacts, this value might often be close to zero, since if there if there was no earthquake (0 on the Richter scale), there would not be any disaster induced impacts.

β is the parameter that describes the relationship between the dependent and independent variables. For example, direct disaster costs (dependent variable) are likely to have a positive relationship with the strength of an earthquake as measured with the Richer scale. In other words, a stronger earthquake will typically result in more damages.

ε is an error term. The error term is indicative of how well the estimate fits the actual data. The error term is also sometimes considered to represent any independent variables not considered in the model.

Cavallo et al. (2010) used a simple regression model such as the one above to estimate the expected dollar value of direct damages caused by the earthquake that struck Haiti in January 2010. The dependent variable was the dollar value of expected damages, and the model included as independent variables the number of people killed; the Richter scale measurement of the earthquake; the country's population; its land area and its GDP. The

authors used data from the EM-DAT database to estimate the β parameters based on reported economic impacts in similar disasters in similar countries. The resultant estimated direct costs were US $8 billion, but the authors noted that the costs could potentially be as high as US $14 billion, depending on the final death toll, which was unknown at the time of research. Swiss Re (2011) reported that the direct cost of the Haiti earthquake was US $10 billion, suggesting that they used a similar regression model to Cavallo et al.

Indirect impacts

To estimate the indirect impacts of a disaster, much of the literature typically looks at the disaster's macroeconomic effects, with GDP or GDP per capita as the dependent variable (Cavallo and Noy 2010).

In examining the methods of estimating indirect costs, Cavallo and Noy (2010) distinguished between short run and long run macroeconomic impacts. They found that most literature looking at the short term indirect impacts on economic growth uses a model of the form shown in the box below:

$Y_{it} = \alpha + \beta X_{it} + \gamma DIS_{it} + \varepsilon_{it}$

Where:

$\boldsymbol{Y_{it}}$ is the direct variable referring to the indirect disaster impact in country *i* and time *t,* measured either in dollars or another numerical measure (such as per capita GDP).

α is a constant. This is the value of $\boldsymbol{Y_{it}}$ when dependent variables ($\mathbf{X_{it}}$) have a value of zero. For disaster impacts, this value might often be close to zero, since if there if there was no earthquake (0 on the Richter scale), there would not be any disaster induced impacts.

$\mathbf{X_{it}}$ is the range of direct variables that potentially affect *Y*, and their parameters β.

β is the parameter that describes the relationship between the dependent and independent variables. For example, direct disaster costs (dependent variable) are likely to have a positive relationship with the strength of an earthquake as measured with the Richer scale. In other words, a stronger earthquake will typically result in more damages.

$\boldsymbol{\gamma DIS_{it}}$ is a measure of the disaster's direct impact on country *i* at time *t,* as discussed above. The coefficient γ is of key interest, as it refers to how the direct economic impacts relate to indirect, long term impacts.

ε is an error term. The error term is indicative of how well the estimate fits the actual data. The error term is also sometimes considered to represent any independent variables not considered in the model.

Indirect impacts in the short-run

Using a similar approach to that above, Noy (2009) investigated the short-run indirect impacts of natural disasters by looking at macroeconomic impacts. He looked at the impact on a country's GDP, based on how past disasters had affected variables including GDP growth, institutional strength, literacy, stock market capitalisation and foreign exchange reserves. He examined a disaster's immediate impact by considering the direct damages it caused – i.e. the number of people killed and affected — along with measures of severity such as wind-speed for storms and a Richter scale magnitude for earthquakes. He

concluded that macroeconomic impacts can be correlated to the amount of property damaged. However, when indicators such as human casualties are used, there is no identifiable correlation with macroeconomic costs. The author did not suggest why this might be the case although the work of Noy and Nualsri (2008) – discussed below – indicates that human casualties are likely to have long run impacts.

Indirect impacts in the long run

Estimating the long-term macroeconomic indirect impacts of a natural disaster is more difficult. It is harder to isolate the impacts of a natural disaster from other factors. It is also difficult to estimate a baseline figure against which long-run impacts can be assessed (Cavallo and Noy 2010). Nevertheless, Noy and Nualsri (2008) looked at long-run growth (defined as the five-year average growth rate of real GDP per capita) in the aftermath of disasters, and found that in low-income countries, "a negative shock to human capital is significantly associated with the lower per capita output growth" (p.17). In other words, the loss of human lives, and the number of people affected by disasters, will have an impact on GDP in the long run in these countries. This contrasts with the work of Noy (2009) who looking at short run impacts, concluded that human casualties did not correlate with short term macroeconomic costs. This has potentially important ramifications for the loss of livestock in disasters since they are both physical property as well as productive assets to the people who keep them. This suggests that the loss of livestock may have short term macroeconomic costs as well as long term productivity costs. This area would require further exploration and is not covered extensively in the literature.

Most modeling of disaster impacts focuses on macroeconomic indicators, such as the impact of a disaster on GDP. However, these models are based on EM-DAT data, which itself lacks a consistent approach on estimating costs. We therefore feel that there is a gap in the literature addressing assessment of microeconomic and regional impacts of disasters. Such analysis could be of value to disaster recovery programmes – and as we have seen in section 1, it should include analysis of livestock when addressing low-income, rural areas.

SECTION 3

Disaster impacts and livestock

Section 3: Disaster impacts and livestock

Introduction

In Section 1 we saw that livestock play a very important role in the livelihoods of people in low-income countries. Animals bring direct benefit as a source of food, as well as providing input to agriculture, and playing a role in income and savings. Beyond this, we saw that livestock bring indirect benefits through improved food security, nutrition, savings and insurance functions, cultural factors and more. These indirect benefits are often less obvious, but play a very significant role in development. Understanding these indirect effects is important in planning for disaster recovery programmes and future development.

In Section 2 we saw that disasters affect economies, and their impacts are particularly strong in disaster-vulnerable, low-income countries. The impact of disasters in human terms is tragic but relatively easy to assess. More difficult is understanding the economic impact of disasters – dollar-value estimates of their impacts tend to vary widely, due to different interpretations of their direct and indirect impacts.

In Section 3, we review the impact of losing livestock in disasters in relation to the themes in Sections 1 and 2. The economic value of losing livestock in disasters is little considered or under-valued in general awareness. Specialists working in the fields of disaster recovery and livestock development, however, have long understood these issues – but have rarely expressed these in economic terms. We hope that this section will help guide future research and general readers on the impacts of losing livestock in disasters.

Direct and indirect values of livestock

In Section 1 we saw that livestock bring both direct and indirect values to their keepers in low-income countries. These benefits generally relate to their use for food, in agriculture, as a financial asset or as a provider of cultural value. Table 4 summarises the values of livestock presented in section 1 – values that are at risk following natural disasters.

Table 4: Direct and indirect values of livestock that can be affected by disasters

Livestock and Food	
Direct values	Indirect values
Reduced quantity of food available due to livestock death and injuries during disaster.	Increased levels of malnutrition due to reduced consumption of animal-sourced foods.
Reduced quantity of food through reduced livestock productivity due to: ▪ Increased exposure to disease; ▪ Reduced availability of feed.	Effects of malnutrition on children's physical and mental development.
	Effects of malnutrition on worker productivity.

	Reduced food security due to lack of animal-sourced foods to smooth fluctuations in agricultural crops. Crop yields are also likely to be less stable following a disaster.
Livestock and Agriculture	
Direct values	Indirect values
Reduced availability of draft power.	Increased reliance on purchased fuels and fertilisers.
Reduced availability of manure.	Increased labour requirements.
Reduced agricultural output.	Reduced access to other markets through transport and haulage, further exacerbating food insecurity problems.
Livestock, Savings and Income	
Direct values	Indirect values
Lost savings in the form of livestock.	Increased vulnerability to future disasters through loss of insurance value of different species.
Lost income from: ▪ Reduced sales of ASFs; ▪ Reduced income from transport and draft power.	Increased variation in income due to lost ASF sales.
Livestock and cultural values	
Direct values	Indirect values
Reduced ability to use livestock for cultural obligations such as dowries.	The possibility that reduced herd size may force people to abandon pastoralism, losing livelihood base and the social support structures of herding communities.

Direct and indirect impacts of disasters

As we saw in Section 2, the impacts of disasters can be divided into direct and indirect impacts. We discussed these impacts in terms of their affects on the factors of production, land, labour and capital. These impacts are summarised in Table 5.

Table 5: Direct and indirect impacts of disasters

Direct Impacts	Indirect Impacts
Labour	

Death, sickness and injury.	Lost wages of workers.
Costs of treating the sick and injured and laying dead to rest.	Reduced productivity of workers and industries due to injuries and psychological trauma.
Capital	
Damage to roads, housing, infrastructure, factories, machinery, etc.	Lost income from capital assets. Reduced productivity in capital-intensive industries.
Costs to fix or replace damaged capital assets and infrastructure.	Reduced ability of governments and firms to provide services to the public.
Land	
Damage to crops	Reduced food security
Erosion, landslides, loss of nutrients.	Reduced agricultural productivity
Costs of engineering to repair and restore land stability and soil quality	Rising food prices

The economic impacts of losing livestock in disasters

By combining the themes of sections 1 and 2, shown in the tables above, we can begin to understand the full impacts of losing livestock in disasters. Using the approaches outlined above, we attempt to summarise these impacts in Table 6 below.

Table 6: Direct and indirect impacts of losing livestock in disasters

Direct Impacts	Indirect Impacts
Labour	
Loss of animal-sourced foods.	Loss of food security Loss of nutrition with short term consequences for worker productivity and long-term consequences for education, community development and worker productivity.
Loss of draft power, increasing demand for human labour.	Reduced labour availability.
Loss of income generating opportunities.	Loss of a productive use of labour, particularly for women, children and the elderly. Reduced income security.
Loss of culturally and socially important animals.	Reduced social/cultural opportunities, such as participation in weddings, funerals, etc. Loss of social support networks.
Capital	
Reduced availability of draft power leading to increased demand for machinery and fuel.	Dependence on borrowed assets, or borrowing to finance their use. Increased dependence on external inputs such as fossil fuel.

Loss of savings and investment.	Loss of investment income from animals. Inability to cover sudden expenses such as medical bills and school fees. Herd sizes may become unviable leading to relocation, loss of social status and poverty.
Loss of livestock as an input to ASF related industries.	Reduced income or substitution from dairies, markets, abattoirs, butchers, retailers and restaurants
Land	
Loss of draft power.	Reduced agricultural productivity, leading to reduced food security. Reduced crop residues leading to reduced livestock productivity and increased demands on other feed sources, such as communal grazing areas. Increased demands on these areas can lead to natural resource degradation.
Loss of manure.	Reduced agricultural productivity, as above. Increased demand for chemical fertilisers, which may be expensive or unavailable. Increased demand for alternative fuels, such as firewood, which can lead to degradation of forests and woodlands.

Conclusion

In this report we have shown that livestock play an important and multifaceted role in low-income economies. Their many direct and indirect values make quantification of their contribution difficult, and their indirect values, in particular, are often overlooked. Natural disasters take a heavy toll on low-income countries due to those countries' exposure and vulnerability, part of which is their high dependence on livestock. Disasters also have direct and indirect impacts, which are difficult to quantify.

We conclude that the full value of livestock and the indirect economic impacts of disasters are inadequately understood in general discussion. We hope that our approach – of identifying the full values of livestock in low-income economies and applying this to the direct and indirect effects of disasters – can help future research in this area. We hope that livestock practitioners and economists will incorporate particularly indirect values into disaster recovery plans and general understanding of disasters and development. We suggest future research should focus on:

- Helping the public, organisations and donors understand the enormous role that livestock play in developing economies, and the way they are affected by natural disasters.
- Helping practitioners and the public understand whether economic valuation of a disaster incorporates indirect impacts.
- Better economic assessment of the indirect impacts of disasters.
- Assessing where modelling and economic analysis is possible or useful.
- Assisting with the development of economic modelling of livestock losses.

SECTION 4

Case studies

Section 4: Case studies

Case study 1 – Pakistan: floods (2010)

In 2010, severe monsoonal flooding in Pakistan killed 1,700 people and directly affected 14 million more. More than 1 million houses were destroyed, and affected households lost between 40% and 50% of their livestock due to the floods (World Food Programme 2010).

Arnoldy (2010) provides details of one individual who suffered losses in the floods:

> *Flood waters swept away Ghulam Hussain's house in Pakistan, [along with] $1,100 in jewelry, and $400 cash in a box set aside for his daughter's wedding. But the biggest financial blow to his family – and to many thousands of others – may be the damage to their herds of livestock.*
>
> *Mr. Hussain lost four cows (worth US$1,600) and four goats (worth US$465). The remaining animals are sick, stressed, and not producing much, he explains as he shows the meagre goat milk he just squeezed.*
>
> *"I am waiting for compensation from the government, then I will treat these animals and sell them when they are in better condition," says Hussain, sitting on the side of a road. If money doesn't come soon, however, he says he – like many others – will have to sell at a steep discount.*

Direct impacts

The Hussain household lost livestock worth US$2,065 (Arnoldy 2010). More broadly, over 1.2 million ruminants and 6 million poultry died in the flooding (World Food Programme 2010), worth US$562 million (U.S. Department of State 2011). In the aftermath a further 14 million animals were at risk due to fodder shortages and heightened risk of disease (FAO 2010). Table 7 shows the loss of livestock at a household level, averaged across the different provinces affected. We see that on average, households lost 51% of their livestock[8].

Table 7: Livestock owned per household before and after 2010 Pakistan floods.

Animal	Before (animals per household)	After (animals per household)	Change
Cows	2.2	1.4	-38%
Buffaloes	1.5	0.9	-40%
Sheep/goats	3.1	1.9	-39%
Poultry	4.5	1.3	-72%
Horses	0.1	0.0	NA
Oxen	0.1	0.1	NA
Donkeys/Mules	0.2	0.1	NA
Camels	0.1	0.1	NA
TOTAL	11.8	5.8	-51%

Source: (World Food Programme 2010) (p.6)

[8] World Food Programme (2010) reports that households lost on average 40% of their livestock. However, based on their figures the loss is 51%. Regardless, the loss is significant.

As we have seen in previous sections, simply measuring these direct losses — the number of livestock lost and their market value – tends to overlook the important indirect impacts of losing livestock in a disaster.

Indirect impacts of the floods

Food
Assessments of the floods made some consideration of lost livestock-related food resources – particularly poultry, eggs and milk. However, discussion of food security by relief agencies (for example World Food Programme 2010) centred around access to grains and pulses, and the changing prices of these resources. As is often the case after disasters, households were only able to attract low prices for their livestock, while prices of rice, flour and sugar were rising (World Food Programme 2010).

Nutrition is a large concern of the WFP and FAO in Pakistan, but in the immediate assessments following the floods, the impact of losing livestock on nutrition has not been considered. As we have seen, examining this would require considerable study.

Agriculture
The FAO (2010) emphasises the role of livestock in ploughing fields, and notes that the lack of fodder will impact on livestock. The FAO's assessment of agriculture, however, is focused on lost machinery, seed stocks and timing of sowing.

Income
Arnoldy (2010) likened the impact of the Pakistan flood on household assets to a stock market crash in a high-income country. The FAO, recognising the importance of livestock in the affected areas, pointed out:

> *The loss of livestock not only represents a loss of income for families, but also family savings and investment over many years. Livestock represents a safety net for many families and the loss of such productive assets will impact significantly on lives and livelihoods.*
> Source: FAO 2010

Social
The social value of livestock in Pakistan is difficult to incorporate into economic assessment, but represents a serious loss to the people affected:

> *"When a cow or a buffalo dies, the people of other villages come to his [owner's] home and mourn with him as they would the death of a son or a daughter."*
> *Source: Arnoldy 2010*

Conclusions

In order to fully understand the impact of the loss of livestock in the Pakistan 2010 floods, it is necessary to consider the indirect impacts discussed above. While such analysis is beyond the scope of the initial assessments quoted here, researchers should consider these impacts to better develop disaster recovery assistance.

Case study 2 – Mongolia: dzud (2010)

In 2010, Mongolia suffered from a severe dzud – a summer drought is followed by heavy snowfalls and unusually low temperatures in winter.

The dzud caused the deaths of between 11 million and 20 million animals (Gunchinmaa n.d.a). Monetary damages were estimated at over US$287 million. Little data is available on the 2010 dzud in disaster databases. EM-DAT has no data and the GLIDE number database has a small entry with no quantitative assessment, submitted by the International Federation of Red Cross and Red Crescent Societies (IFRC).

Exposure, vulnerability and direct impacts

The livestock sector is very important to Mongolia, accounting for over 84% of agricultural output. Approximately 44 million animals are kept as livestock and provide Mongolian herders with income from sales of wool or cashmere, hides and skin, live animals, milk products, winter clothing and heating from dried dung, (Gunchinmaa n.d.a).

As such, Mongolian herders are particularly exposed and vulnerable to natural disasters (see section 2). In addition to having their livelihoods exposed to the vagaries of physical conditions, they are also vulnerable through their high levels of debt (with over US$45 million of loans outstanding), along with pastures that are often overgrazed, poor livestock shelter arrangements and little machinery or expertise in fodder preparation (Gunchinmaa n.d.a).

Indirect impacts

Beyond the direct impacts of losing livestock and incomes, households can suffer from indirect impacts on nutrition, health, poverty, education, crime rates, gender equality and environmental stability, (Gunchinmaa n.d.a). Some of these impacts are best illustrated by quotes from victims of the dzud:

> *"We sell cashmere and wool to buy everything from petrol, clothes, food, school related expenses to cover pasture moving expenses. There are now no animals left for sale to generate income. This situation affects our livelihoods severely."*

> *"We preferred to get fodder for our animals rather than food for ourselves…Health wise we could not pay attention to ourselves although we had health problems during dzud. Animals are our life, so everything was dedicated to them."*

> *"Livestock is all we have, it is our entire livelihood. It is the single source of income to our family. We do not have any savings or cash. We would like to purchase more animals but we do not have the ability to do so."*

> *"We ourselves had suffered from cold and flu and related respiratory disease during dzud, but we did not seek medical help. There was no time to do so. Psychologically it was hard seeing so many animals die. We cried when around 50-60 animals died at once."*

"I cannot predict what future holds for us. If flour and rice are bought then, I guess, we at least can make meals with dried meat. But rice prices are too high now and we would not be able to purchase them. No milk and dairy product are possible as we only have one goat with a kid. If some other families come nearby to settle with several milking goats, maybe we can ask to milk one-or two of those."

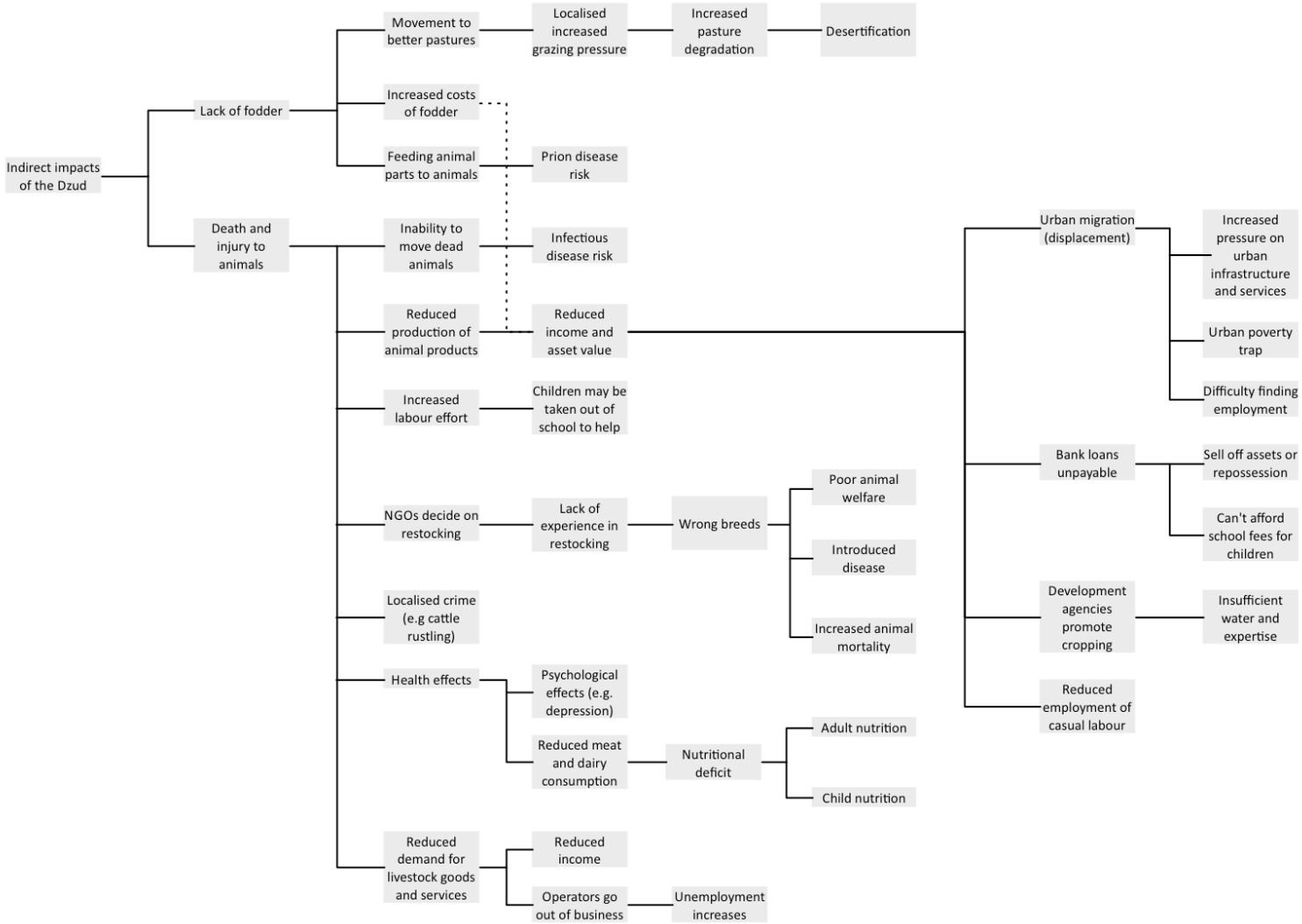
"If we move to soum centre, there is nothing for us to do there. We do not have any other skills. Also I think no one would be interesting in hiring us as we are relatively old now."

Sources: Interviews with Mongolian herders. (Gunchinmaa n.d.b; Gunchinmaa n.d.a)

Conclusions

The impact of the 2010 dzud goes far beyond the market values of animals lost, as reported. As can be seen from the comments of herders, the indirect impacts of the dzud are huge. Researchers and disaster assessment specialists should consider these impacts to better develop disaster recovery assistance. Figure 6 below shows some of these impacts.

Figure 6: Indirect impacts of Mongolian dzud



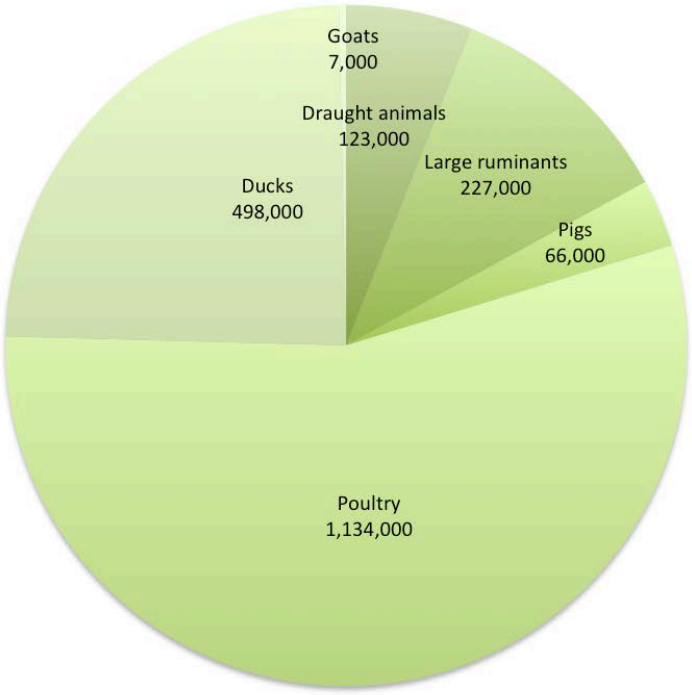
Source: Sawyer (2011)

Case Study 3 – Myanmar: Cyclone Nargis (2008)

In May 2008, cyclone Nargis struck Myanmar, causing nearly 140,000 deaths (CRED 2011c). The cyclone made landfall in the Ayeyarwady delta, Myanmar's foodbowl, and caused flooding across 63% of the farmland in the region affected. Direct damages were estimated at USD $4 billion and over two million livestock died. Stored food, animal feed, boats and equipment were also destroyed (Reed et al. 2009). In some coastal regions up to 94% of livestock were killed (WSPA 2010).

The chart below shows the reported livestock losses resulting from cyclone Nargis.

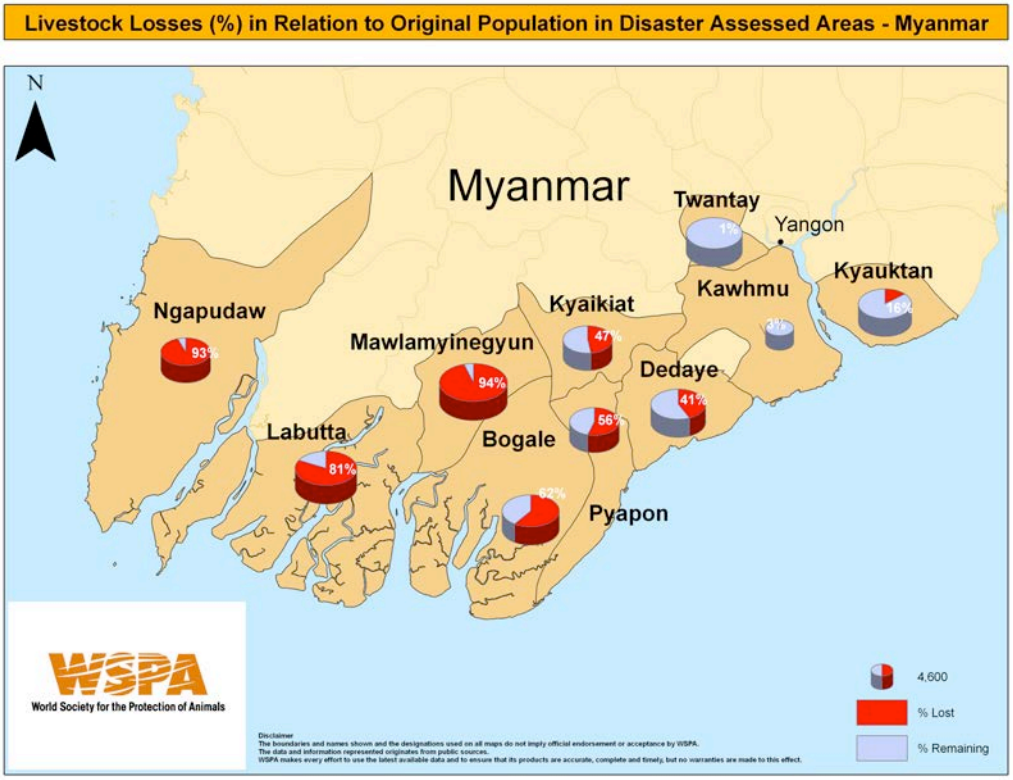
Chart 4: Number of livestock reported killed in cyclone Nargis



Source: (Reed et al. 2009)

Livestock losses can also be seen in the map below showing the percentage of livestock lost in each region.

Figure 7: Livestock losses (%) in relation to pre-Nargis population



All animals lost in the disaster have direct values, as discussed in section 1. The loss of livestock meant that meat production was reduced by a total of 32,000 tonnes and egg production reduced by 30 million eggs.

The loss of buffaloes was particularly important in this case, as they are an important source of draft power in Myanmar, a country where there are approximately 9 million draft animals and only 1,100 tractors. In Bogale, Ayeyarwady Division, 48% of draft animals were killed (Fang et al. 2009). This loss of draft power contributed to far lower yields post-Nargis:

> *The rise of input prices like fertilizer and other inputs (e.g. fuel), combined with low paddy prices and the shortage in draught power and labour, has caused the farmers to practice less intensified methods like changing from transplanting to broadcasting of paddy.*
> Source: Fang et al. 2009, p14

Attempts at restocking draft animals to boost agricultural production in the immediate aftermath of cyclone Nargis were constrained by funding. As of July 2008, three months after cyclone Nargis hit Myanmar, Reed et al. (2009) (p.42) reported that "livestock replacement remains low, with around 3% of buffalo, 3% of chickens, 23% of ducks and 19% of pigs replaced".

A 2009 WFP study conducted in Bogale and Laputta showed that poultry ownership rates had recovered, but ownership rates for cows and buffalo were well below pre-Nargis rates (World Food Programme 2009). The study concluded that replenishment of livestock, particularly large livestock, would be critical to household food security and resilience to further shocks.

Conclusions

The issues highlighted above reinforce the points made throughout this report: that livestock are stores of wealth, generators of income and sources of nutrition, and that as a result, losing livestock can lead to decreased ability to access credit, reduced agricultural output and reduced nutritional intake. Response and relief efforts need to better recognise and value the role of livestock play in recovering from a disaster such as cyclone Nargis.

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Appendices

Appendix I: Organisations and initiatives focused on Livestock in Disasters

Livestock Emergency Guidelines and Standards (LEGS)
LEGS is a handbook for livestock and disaster practitioners formed by a network of specialists in these fields, who recognised the need for a guidelines and a common approach to restoring livestock-related livelihoods in disaster recovery. Major contributions an funding come from Tufts University Feinstein International Centre, United Nations Food and Agriculture Organisation (FAO), USAID, Oxfam and others.

World Society for Protection of Animals (WSPA)
WSPA's Livestock in disasters programme has been in operation since??. The programme, part includes livestock interventions in developing countries, as well as assistance with companion animals following disasters, such as the recent earthquake and tsunami in northern Japan.

Society for Protection of Animals Abroad (SPANA)
SPANA has a history of assisting with animal welfare and development dating back to 1923. Their work focuses on livestock in developing countries through veterinary assistance, education and emergency livestock interventions. They are particularly active in Africa and the Middle East and also have operations in Asia, Eastern Europe and Latin America.

United Nations High Commissioner for Refugees (UNHCR)
UNHCR published its Environmental Guidelines for Livestock in Refugee situations in 1998. These guidelines were written after long experience with refugee situations relating to both natural disasters and conflict situations. Refugees often arrived with their livestock or were reluctant to take refuge in places where livestock could not be kept. Other situations saw people beginning to raise animals in refugee camps as a means of livelihood while displaced. Given the environmental implications of raising livestock in refugee situations, the UNHCR's guidelines were updated in 2005 with the assistance of the International Conservation Union (IUCN).

The Brooke
The Brooke is an international animal welfare organisation that deals with horses, donkeys and mules. The Brooke is active in Afghanistan, Egypt, Ethiopia, Gautemala, India, Jordan, Kenya, Pakistan, Senegal and Nepal.

The Donkey Sanctuary
The Donkey Sanctuary provides care, protection and or permanent security for donkeys and mules worldwide. Based in the UK, The Donkey Sanctuary has major projects in Egypt, Ethiopia, India, Kenya, Mexico, Cyprus, Italy and Spain. Smaller grants are also provided to other countries.