Emergency management of disasters involving livestock in developing countries

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Summary

Different disasters have similar consequences on the health and welfare of livestock. Numerous geophysical disasters can exacerbate epizootics, resulting in the deaths of many animals and the reduction of production efficiency. These disasters also present a considerable threat of spoilage of processed foods, endangering public health. Furthermore, large-scale disasters involving animals can modify the long-term stability of national economies, the environment and social structures.

The authors discuss the vulnerability of the livestock industry to natural disasters and the impact of floods, droughts and transboundary diseases and pests on national economies. Examples are given on how some losses can be avoided, evaluated and compensated. The role of the veterinarian is presented in relation to work conducted by other relief organisations in cases of emergency.

In developing countries, mitigation programmes should focus on strengthening global animal health services. Preparedness needs to be community based, with education provided in a timely manner. Effective recovery from disasters should be based on mitigation programmes, including international trade and mutual aid agreements between neighbouring countries to supply appropriate goods and environmentally and culturally appropriate breeds of livestock.

Disaster relief for the care of livestock should be recognised as a form of humanitarian assistance, given the benefits to be derived for public health and the socio-economic implications of successful intervention.

Keywords

Animal health – Developing countries – Disaster relief – Economic impact – Emergency management – Food safety – Food supply – Natural disasters – Preparedness – Public health – Response.

Introduction

The two major causes of disasters which occur in developing countries are epizootics and geophysical events (3, 4, 5, 6) Throughout history, epizootic diseases have killed large populations of animals and reduced the production efficiency of many animals. In addition to epizootics, and sometimes exacerbating these, numerous geophysical disasters affect livestock agriculture every year. These geophysical events can also cause considerable loss of animal life and spoilage of processed foods for humans (1, 6, 21).

In many ways, the same threats of disaster face developed countries The difference lies in the frequency and relative magnitude of impact that disasters have in the two types of countries (Tables I and II) (9). Industrialised countries are usually capable of compensating losses rapidly through insurance programmes, government assistance, access to credit and activation of business reserves By contrast, over 60% of the entire livestock industries of some developing countries may be at risk of geophysical disasters in cases where these safety nets do not exist (Tables III and IV) (5, 16). Furthermore, the frequency and magnitude of disasters,

Table I
Average number of people affected by natural disasters in different regions of the world (1970-1994)

Impact	Africa	Americas	Asia	Europe	Oceania	Total
Killed	76,485	8,988	55,922	2,240	94	143,728
Injured	1,017	15,180	37,288	3,475	135	57,096
Affected	11,450,827	4,481,691	111,473,882	561,580	653,827	128,621,807
Homeless	256,871	308,359	4,334,807	64,965	14,77	4,979,080
Total	**11,785,200**	**4,814,216**	**115,901,899**	**632,260**	**668,133**	**133,801,711**

Source: International Federation of Red Cross and Red Crescent Societies *World Disasters Report, 1996* (9)

including war, is higher in developing countries than elsewhere. As a result, many disasters in developing countries bring with them the potential for serious long-lasting impacts on animal agriculture and, therefore, also on the economic and public health of the country in question (4, 18)

Tending to livestock in developing countries employs many more people than in developed countries (18). Consequently, animal husbandry systems contribute significantly to the economic and political strength of developing countries, and represent a large portion of the gross national product (GNP), cultural heritage and identity of many countries. In many areas, the long-term stability of the environment also depends heavily on sustainable agriculture which is based on traditional livestock husbandry systems and social structures. Growing population pressures and certain forms of development are a constant threat to this stability and these pressures on the environment substantially modify the impact which results from disasters involving animals

The economic consequences of disasters reflect some of the fundamental differences between the rearing of livestock in developed and less developed countries. In developing countries, livestock may be kept as units of production but are also just as likely to be kept as repositories of wealth and an important means of draught power for cultivation and transportation (22). Disasters that affect animals can, therefore, also affect the infrastructure of a country, thereby hindering the distribution of food and goods, and in addition, reducing an important source of employment, revenue and wealth in rural countries. Greater numbers of livestock in a country also mean an increase in disposable income for farmers (5)

Table III
The risks of natural disasters to the cattle industries of Central America (1995) (5)

Disaster type	Cattle at risk (percentage of total industry, by region)[a]	Land areas at risk (percentage of entire country, by region)[a]	Replacement value at risk (US$ million)[b]
Floods	64	62	1,635
Droughts	58	36	1,482
Earthquakes	55	62	1,405
Volcano	44	40	1,124
Landslides	36	38	920

(a) Data based on Costa Rica hazard analysis maps
(b) Figures based on industry value statistics supplied by the Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA) (The replacement value of the cattle industry in Central America is approximately US$2 6 billion)

The heavy dependence of populations on agriculture in developing countries means that following a disaster normal agricultural activities must be resumed as rapidly as possible and long-term changes must be made to the structure of the livestock sector to reduce the impact of future disasters

Table II
Average number of people affected by natural disasters, by types of disaster in the world (1970-1994)

Impact	Earthquake	Drought and famine	Flood	High wind	Landslide	Volcano	Total
Killed	21,593	73,606	12,361	28,194	1,560	1,014	138,329
Injured	30,952	NA	17,910	7,668	247	280	57,56
Affected	1,768,695	58,622,156	52,543,433	11,107,110	137,613	94,030	124,273,037
Homeless	232,406	22,270	3,502,014	1,111,092	107,434	14,764	4,990,430
Total	**2,053,646**	**58,718,482**	**56,075,718**	**12,542,064**	**246,854**	**110,088**	**129,458,852**

NA Not applicable
Source: International Federation of Red Cross and Red Crescent Societies *World Disasters Report, 1996* (9)

Table IV
Number of large-scale natural disasters in the world, by region (1970-1995)

Type of disaster	Africa	Americas	Asia	Europe	Oceania	Total
Earthquake	41	137	245	166	85	674
Drought and famine	278	52	91	16	15	452
Flood	184	390	665	155	139	1,523
Landslide	12	91	101	22	10	236
High wind	85	452	703	218	200	1,658
Volcano	9	33	45	16	6	109
Other	220	103	198	100	8	629
Total	**829**	**1,258**	**2,048**	**693**	**463**	**5,281**

Source: International Federation of Red Cross and Red Crescent Societies *World Disasters Report, 1996* (9)

Examples of disasters involving the livestock industry

Geophysical disasters

In 1970, the East Bengal cyclone killed approximately 60% of the entire cattle population within an area of >5,000 km^2 (20). Throughout this extensive area 30%-80% of farmers lost cattle due to drowning. Six months later a survey revealed that as a result of the cyclone the amount of land being cultivated had decreased from over 20% to approximately 6%. The most common explanation given by farmers was the lack of bullocks and buffalo to plough the fields To return the area to pre-cyclone production levels would have required an estimated 123,000 cattle (12.8 cows per 100 acres) and 127,000 ploughs. The fishing industry was also severely affected; nearly 90% of all fishermen were unable to fish because of the loss of essential equipment (20).

In 1991, Mount Hudson erupted in southern Chile. Volcanic ash was blown as far south as the Falkland Islands and covered areas of Chile and Argentina where approximately 2 5 million sheep grazed As the ash was deposited on pastures, thousands of these sheep died due to starvation as the ash prevented access to forages and wore down their teeth (17)

In 1992, droughts in Zimbabwe resulted in a 12% decrease in the national economy, principally due to reduction in productivity of the agricultural sector.

The severe winter of 1996 caused the death of 700,000 cattle and yak in the People's Republic of China. As a result, farmers were unable to plough large areas of fields the following spring (12).

Over 20,000 cattle drowned in floods which affected the Pacific coast of El Salvador in 1996 Later, the damp soil conditions caused by flooding favoured the growth of parasites, which resulted in increased mortality and morbidity in livestock (5)

In 1998, an extremely harsh winter in northern Tibet resulted in the death of over 10 million buffalo and sheep, most of which belonged to nomads. Many people also died (12)

Epizootics

In 1978, an outbreak of African swine fever in Haiti and the Dominican Republic necessitated the slaughter of most of the swine on the island The indigenous black pigs were replaced with 'improved' white breeds. Farmers continued to lose income because the new breeds were not hardy enough to walk long distances to market for sale.

In 1997, 3 85 million pigs on 6,147 farms in Taipei China died from foot and mouth disease (FMD) or were slaughtered as part of the disease control programme For a period of one year following the outbreak, the export of swine from Taipei China to Japan was banned and as a result the United States of America (USA), took over from Taipei China as the primary provider of swine to Japan.

In 1998, outbreaks of Rift Valley fever (RVF) were associated with heavy rains in north eastern Kenya, southern Somalia and Tanzania The rains were thought to have been associated with *El Niño*. Several hundreds of thousands of livestock were affected, with mortality rates of between 50% and 75% recorded in the early stages of the outbreak. Over 89,000 human cases of RVF occurred and resulted in over 300 deaths

On average, human cases of rabies in Indonesia total 70-80 each year, and over 1,300 dogs are affected by the disease In 1998, the government of Indonesia decided to implement a control programme against rabies by killing 150,000 dogs, 100,000 cats and 170,000 monkeys Concerns arose over methods used for carcass disposal and the possible emergence of diseases that would normally have been controlled by predation by cats

Natural disasters associated with epizootics

In 1979, Hurricane David was suspected of contributing to the introduction of the *Amblyomma* tick and subsequent infection of cattle on Dominica with cowdriosis (infected cattle were probably imported after the hurricane) (8).

In the thirty years between 1950 and 1980 three major *El Niño* events were recorded. More recently, in the period between 1984 and 1998 (14 years), four such events have occurred. With an increasing understanding of weather patterns, it has been possible to associate increases in diseases and disease outbreaks with increased rainfall or droughts. Associations between diseases and the *El Niño* years have been demonstrated for pneumonic plague in Ecuador, and rabies and leptospirosis in Cuba and the Caribbean, respectively (4).

Technological disasters

Ten years after the Chernobyl nuclear disaster in 1986, sheep farmers in parts of Wales still could not sell any sheep for human consumption due to excess radioactivity on Welsh pastures.

Vulnerability of the livestock industry to natural disasters

In developing countries the animals of prime economic importance are livestock, including poultry and equines (horses, donkeys and mules). These animals are essential as a source of wealth, food and power for work and transportation. The principal issues that arise in disaster situations in developing countries are a shortage of food for the human population, spoilage of food and a loss of economic viability and employment in the agricultural sector (1, 3, 6, 15, 21).

Estimation of the number of animals at risk

Estimates of approximate numbers of livestock populations in disaster-prone areas can be made in most countries by overlaying maps with agricultural census data and geographic distributions of hazards. This estimation method has been used in Central and South America (5). These simple methods are useful in estimating the impact of mitigation and preparedness programmes but not for the assessment of damage following a disaster. Methods used for assessment of damage after a disaster are described below. However, these methods can be susceptible to inaccuracies as they are based on estimates of numbers of animals which are obtained by taking averages over large geographic areas.

Estimation of the number of animals affected by a geophysical disaster

The first method of estimation is based on knowledge of the extent of the area affected by the disaster. To assess the total number of animals affected, the area affected (number of hectares) is multiplied by the average number of animals in that area.

The second method requires estimates of the number of people in the region. These figures are usually available. To estimate the number of animals affected, the ratio of animals to people in a representative area is calculated. Once the number of people affected by the disaster is known, the number of animals can be estimated by multiplying the number of people affected by the ratio of animals to people. Often the number of livestock in rural areas exceeds the number of people.

However, in many disasters shelters are used only by a small proportion of those people affected; for example, in the drought of 1984 in the Sudan, primarily sedentary farmers entered displacement camps, whereas others moved to urban centres and formed squatter settlements, or stayed with extended family. Transhumant and nomadic populations moved with their surviving livestock to other areas, frequently across national boundaries.

Economic impact

Added value of livestock

Measurement of the impact of disasters on the livestock industry and national economy is difficult because the value of livestock is greater than the market value of the animals or their pastures (18). For example, a cow is most valuable as a producer of milk, additional calves and manure, a chicken is most valuable as a source of eggs and fertiliser, pigs provide a source of piglets, remove garbage and keep land free from snakes. In both cases, an estimate of the loss suffered due to a disaster should take into account not only the replacement value of the animal, but also the loss of production, power, and alternative uses, each of which accrue until the replacement animals become productive again.

The use of cattle in a variety of production systems to control weeds and reduce the need for herbicides and fertiliser is another prime example of the added value of livestock. In Malaysia, for example, cattle graze in palm and rubber plantations and reduce the cost of weed control by 40%. Similar programmes in Colombia in sugar cane plantations reduce costs of weed control by up to 50% (18).

In nomadic and transhumant societies, the income generated by livestock populations may appear low. As animals in such societies represent wealth, the number of animals that are owned are an important insurance against disaster, and a certain minimum number of animals is required to maintain the nomadic existence. In these societies, loss of livestock strikes at the structure of society in ways which cannot be quantified monetarily.

Loss of income

Livestock are an essential component of sustainable agriculture systems. Owners of livestock gain income from sales of live animals and animal products, fees for services (draught, transport) and sales of raw products that are processed on and off the farm (18). Livestock are the principal source of agricultural power in many developing countries

The livestock industry is more labour intensive than many other sectors of agriculture. Therefore, any given disaster may affect relatively more people in the livestock industry than other sectors of agriculture. Estimating the impact of disasters on the livestock industry should also take this aspect into account (5, 18)

Animal health concerns that result from disasters

The most important causes of a deterioration in animal (livestock and equines) health in disasters are poor nutrition and subclinical disease which result from contagious disease and geophysical events (Table V) The combination of exposure to waterlogged pastures and malnutrition predisposes animals to many infectious diseases. In tropical climates, some of these diseases can have a rapid and devastating impact. Malnutrition results in loss of body weight, energy and mineral imbalances, all of which can increase susceptibility to disease, decrease reproductive efficiency and can even be fatal.

Both malnutrition and infectious disease can be responsible for reduced reproductive efficiency. Fewer calves will be born and those that are born will be weaker and are more likely to die A reduction in reproductive efficiency is an important cause of decreased economic performance of livestock, as it interrupts the cycle of sustainability in pastoral agriculture systems Prolonged flooding can reduce the reproductive efficiency and viability of the calf crop so that the value of the entire herd decreases by as much as 25%-40%.

Impact of floods on animal health

Flooding occurs in two ways flash-floods and cresting floods Flash-floods occur following heavy rainfalls in low-lying and drainage areas and in areas where irrigation is not adequate

Common sites for flash-flooding are where rivers merge. Flash-floods often pose the greatest immediate threat to lives as animals and people can be trapped and drown. Cresting floods usually arrive after a warning of several days or weeks Cresting floods often rise slowly, trapping animals on islands without feed and threatening hypothermia and drowning (Fig 1). Cresting floods are a common problem along low-lying coastal areas, where overflowing rivers cannot drain into the sea. All flooding results in displacement of livestock and other animals and their owners

Prolonged flooding of pastures kills vegetation, therefore reducing the nutritional value of pasture to grazing animals Flooding also removes organic matter from the soil which reduces the water-holding capacity of the soil. Soils that have a low content of organic matter are more prone to droughts and landslides, and are less productive for plant growth.

The average grazing density for cattle in wet tropical climates is approximately one cow per ha per year. Pastures are used on a rotational basis every 60 to 70 days The nutritional quality of grasslands that have been flooded is reduced because of decreased soil fertility, decreased organic matter in the soil, and because of parasites that destroy plant roots. As a result, pastures can only maintain cattle for 20 to 30 days per rotation This increased rate of rotation increases the need for grazing land approximately four- to five-fold.

If grazing is continued at the same density as before a flood or on pastures that flood repeatedly, a vicious cycle is created of flooding, decreased soil quality, overgrazing and increased susceptibility to erosion, which may continue for many years. In some cases flood-leached pastures that have been overgrazed may only be repaired by leaving the land free of livestock and other crops for several years.

Subsistence farmers may move animals to higher ground when floods are imminent or, in rare cases, build rafts for minor species (pigs, chickens, sheep, goats, guinea-pigs) to float on when waters rise However, most subsistence farmers take their animals with them when they are displaced. This means that city shelters for displaced subsistence farmers are

Table V
Animal and public health concerns that result from natural disasters

Disease	Examples
Protein energy malnutrition, mineral deficiencies	Loss in economic value, decreased economic efficiency (fewer calves) In addition, cattle seek and eat carcasses to compensate for mineral imbalances Botulism can result, killing the animal
Respiratory disease	*Pasteurella, Mycoplasma* pneumonias
Gastro-intestinal parasites	Helminth, cestode and trematode infestations protozoal diarrhoea
External parasites (vector-borne diseases)	Tick and leech infestations
Blood-borne parasites	Babesiosis, leishmaniosis
Bacterial diseases	Dermatophilosis
Vector-borne diseases	Rift Valley fever, Venezuelan equine encephalomyelitis, heartwater, babesiosis, anaplasmosis, theileriosis

Photo courtesy of C A Zepeda Sein, Organismo Internacional Regional de Sanidad Agropecuaria

Fig. 1
Cattle trapped in a newly created island after Hurricane Mitch, Honduras, 1998

often inundated with animals, thereby presenting considerable public and animal health problems

Floods also deposit large amounts of debris in pastures which can be hazardous to grazing animals (for example, puncture wounds to the feet and skin) Following floods, livestock and equines are particularly prone to these injuries because their hooves are weakened through continual exposure to water and mud Damaged hooves and skin of livestock and equines can become infected, resulting in severe lameness and generalised illness Lame cattle and equines can no longer plough fields or carry loads; the resulting lack of animals for transport increases the cost of crops, such as citrus and cacao, that need to be transported from terrain that may only be accessible on foot Debris also reduces the effective grazing area of pastures. Debris can often be contaminated with hazardous chemicals that may affect the health of grazing animals, and may endanger humans who later consume contaminated meat or milk products.

Floods are often predictable events to farmers Producers with large herds, who have substantial economic commitments to raising livestock are generally aware of common weather-related problems For example, producers know the areas that flood regularly and how to prevent extensive losses when flooding occurs In addition during the winter months cattle herds are usually moved to higher pastures, where they are not threatened by floods and where replenished grasslands can be found As cattle are being moved, producers also provide preventive health care to their cattle This includes vaccination, deworming and treatment against clinical disease

Cattle exposed to floods suffer from a number of ailments that can affect their health, economic value, and can prevent movement of cattle (Table VI) The detrimental impact of disasters on the health of a herd may reduce the value of the herd by between 30% and 70%. Income is lost through death of animals, weight loss, reproductive losses and additional health care expenditures The greatest problems that producers report in flood-affected cattle are foot rot (infection of the foot with *Fusobacterium necrophorum*), viral and vesicular diseases, including FMD, blackleg (*Clostridium chauvoei*), and other contagious diseases such as internal and external parasites, respiratory infections (*Pasteurella* spp and *Mycoplasma* spp) and skin diseases (*Dermatophilus* spp.). Public health concerns may also arise due to outbreaks of zoonotic disease, including vector-borne diseases (10), hydatidosis and visceral larva migrans.

Impact of droughts on livestock production

Susceptibility to drought is associated with low rainfall but droughts also commonly occur in previously flooded areas, where soils have been leached of organic matter. During droughts, livestock experience a rapid reduction in weight and reproductive efficiency. Both of these concerns result in considerable economic loss, and a reduction of the food supply for humans. As cattle seek food and water in drought-affected areas they are more likely to consume unsuitable feeds and water, which may exacerbate other diseases, cause further loss of weight, and kill the animals Wells and water-holes that are nearing empty may have increased salt and other noxious solutes in them, making them unpalatable or dangerous to drink.

Farmers wanting to protect their animals from starvation and dehydration will move them long distances to areas where feed and water may be found On these journeys, animals may be exposed to unfamiliar diseases and predation, and consume energy that would otherwise be available for growth, reproduction and milk

Drought-affected areas are often at increased risk of fire. Increased amounts of dead vegetation present a fire hazard which, once burning, may be very difficult to control.

An investigation into the impact of drought in Somalia in the early 1970s showed that it took many years for the livestock industry to recover (7) The immediate losses experienced by farmers and the country as a whole were the deaths of many thousands of animals. Additional losses included reduced fertility for several years after the drought and the failure of the livestock industry to regain the same size as before the drought occurred. It took three years after the drought for cattle to return to their normal reproductive capacity Herds still did not return to their original size for several more years because farmers were forced to slaughter animals at a younger age as a source of nutrition and extra income.

Transboundary diseases and pests

In the USA, many of the diseases responsible for reduced productivity of livestock are referred to as 'foreign animal diseases' (FADs), indicating that they have been eradicated or are exotic to the USA. However, FAD is a paradoxical term, as it includes vesicular diseases (e.g. vesicular exanthema of swine) that occur principally in the USA Therefore, to be consistent with other countries, the preferred and less ambiguous term is 'transboundary' diseases. This term also truly reflects the potential of these agents to cause disasters. The Office International des Epizooties (OIE) is the one of the most important organisations that monitors transboundary diseases Many books describe these diseases and their epidemiology, such as those produced by the OIE (11) and the United States Animal Health Association (2).

The economic implications on international trade of a diagnosis of a transboundary disease in a country are massive The diagnosis of transboundary diseases in a country may be accompanied by a complete ban on the exportation of animals

Table VI
Some typical problems that arise in floods with animals raised by subsistence farmers

Species	Disease	Treatment
Poultry (chickens turkeys ducks)	Abscesses	Antibiotic supplemented feed
	Respiratory diseases	Antibiotic supplemented feed
	Mites	Topical treatment with parasiticide
Swine	Cholera	Kill and remove affected animals
	Scabies	Topical treatment with parasiticide
	Foot rot	Pare foot and treat with penicillin
Cattle, goats, camelids	Foot rot	Pare foot, wrap with copper sulphate bandage, treat with penicillin
	Respiratory tract infections	Treat with long acting tetracycline
	Vector-borne diseases (Rift Valley fever)	Quarantine
Horses	Vector-borne diseases (Venezuelan equine encephalomyelitis)	Vaccination
Dogs	Rabies	Kill all aggressive dogs and those suspected of being infected Vaccinate all other dogs
	Scabies	Topical treatment with parasiticide

and animal products, and an increased dependence on imported goods. For example, the loss in revenue from FMD in South America exceeds US$500 million a year. It has been estimated that an outbreak of FMD in the USA would incur losses of US$7 billion

Transboundary diseases are also costly because they cause increased morbidity and mortality in animals Consequently, productivity and the economic value of the livestock industry are reduced, and indigenous sources of food for a nation are difficult to obtain. Some transboundary diseases are zoonotic and consequently pose an additional direct threat to public health.

Therefore, the impact of transboundary diseases is very similar to other (geophysical) types of disasters. The greatest impact is due to animal death and decreased productivity, with the predictable result that the human food supply is compromised. Transboundary diseases are an important contributory factor in human malnutrition

Increased awareness of the vulnerability of the world to these diseases has developed as wars in Europe have shown that boundaries are easily changed and disease control along borders has been insufficient to prevent the spread of contagious disease. Increased international movement of livestock and food of animal origin has introduced an increased risk of spread of disease. Nine of fifteen major epidemics in recent years have occurred in 'developed' countries

An increased incidence of contagious disease appears to correlate well with years in which other natural disasters occur. For example, in years of increased rainfall due to *El Niño*, there are often increased numbers of reports of infectious disease Examples are RVF in Africa, FMD in South America, mongoose and human rabies in Cuba, and human leptospirosis in the Caribbean In these years and when vector control efforts break down, the incidence of vector-borne diseases, such as Venezuelan equine encephalomyelitis, also appears to be increased (4).

A role for veterinarians

For many years veterinarians have been the pioneers of animal health throughout the world The veterinary profession has been responsible for the eradication of many diseases from many countries, the development of vaccines, disease surveillance and intervention programmes (13) Veterinarians have also responded to the needs of countries affected by geophysical disasters on many occasions (3) However, it has been non-veterinary organisations that have led the field in an organised approach to disasters

Much of the involvement of veterinarians in disasters in developing countries has suffered from the perception that programmes for the control of epizootics are exclusively veterinary in nature. Veterinarians have also placed a disproportionate emphasis on the response phase to disasters, and have failed to adopt an 'all-hazards' approach (see below) to disasters involving livestock. These actions may have alienated other disaster-relief agencies and professionals active in developing countries A regrettable consequence of such alienation is the increasingly prevalent point of view that veterinarians are merely technicians, rather than professionals who have a tremendous amount to contribute to societal well-being, including public and animal health

Further, the disproportionate emphasis given to the response to disasters involving the livestock industry, in comparison with preventive measures (mitigation), has done little to dispel the traditional and costly vicious cycle of damage and repair.

The solution to this dilemma starts with an all-hazards appreciation of disasters. All-hazards emergency management is based on the concept that, regardless of the impact of many different types of disasters, the socio-economic consequences of disasters on a country are usually similar, including those on animal agriculture. Therefore, the responsibility of veterinarians is to participate as members of the emergency management team and to work within integrated programmes dealing in all types of disaster reduction. This can probably only be accomplished by being present in a country before a disaster strikes (14).

The role of the veterinarian in this integrated programme of emergency management should be clear, and is no different from other aspects of veterinary disaster management: the care of animals is an effective method to provide better care for people In the case of national disasters in developing countries, the attention to animal agriculture is an effective method to improve public health, the environment and the economy of the country.

International veterinary disaster management is an effective form of humanitarian assistance. The Food and Agriculture Organization (FAO) of the United Nations and several other organisations have recognised this (3). The FAO is potentially able to co-ordinate the needs for agricultural relief through the United Nations Development Program, the principal body entrusted with the coordination of humanitarian assistance.

Applying the four phases of emergency management

Mitigation

The most effective mitigation of any disaster in developing countries is to strengthen the animal health services of those countries A strong Veterinary Service is one that is well