

# **FACTORY FARMING AND DEVELOPING COUNTRIES**

## **A Compassion in World Farming Trust briefing**

**January 2000**

**by**

**Joyce D'Silva**

**Director, Compassion in World Farming Trust**

Compassion in World Farming Trust  
5a Charles Street, Petersfield, Hampshire, GU32 3EH. UK  
Tel. +44 (0)1730 268070  
Fax. +44 (0)1730 260791  
Email: [compassion@ciwf.co.uk](mailto:compassion@ciwf.co.uk)  
[www.ciwf.co.uk](http://www.ciwf.co.uk)

# **Factory Farming and Developing Countries**

## **CONTENTS**

1.0 Introduction: the background scenario

2.0 Disadvantages of intensive livestock production

2.1 Animal health and welfare

2.2 Human health

2.3 The food/feed equation

2.4 Environmental effects

2.4.1 Direct effects: degradation and pollution

2.4.2 Use of fossil fuel energy

2.4.3 Indirect effects: water

2.4.4 Air pollution

2.4.5 Soil erosion and deforestation

2.4.6 Chemicalisation of agriculture

2.4.7 Genetic diversity

3.0 Economic power

4.0 The way forward

References

## FACTORY FARMING AND DEVELOPING COUNTRIES

### 1.0 Introduction: the background scenario

In 1999 the world's population passed the 6 billion mark. The U.N. predicts 4.6 billion more will be added to this in the 21st century. Not only is the overall global population increasing, but the increase is taking place in the developing countries. By 2050 another 600 million people will live in India, another 300 million in China. Nigeria's population is expected to be 339 million by 2050 – more than half the total population of the whole of Africa in the 1950's. <sup>(1)</sup>

Already 2 billion people are malnourished, and 840 million go hungry. <sup>(2)</sup> Unless the underlying inadequacies of our current and future systems of food production are addressed, these appalling figures may well increase.

#### Where will people live?

More and more people will live in urban centres. By 2010 it is estimated that half the global population will be urban. There are already 14 megacities with populations of over 10 million.

#### What will people eat?

Conventional wisdom says that as economic conditions improve, people demand more animal products in their diets. (We need to take account of marketing pressures and availability as contributory factors). Figures show that urban populations consume more meat per person than rural populations. The overall human demand for animal products is expected to triple or even quadruple in the next 30 years. <sup>(3)</sup>

In the last 20 years meat production in developing countries has increased by 127%, egg production by 331%. <sup>(4)</sup> Yet in these countries, only 22% of dietary protein comes from animal products. In the developed world, that figure is 60%. <sup>(5)</sup> There is obviously a huge question mark over whether it would be physically possible for all the world's estimated future population to eat animal products at the same level as, say, the USA today. It has been estimated that for 10 billion people to eat a 'US diet', we would need 4 planets the size of Earth to produce the extra 9 billion tons of grain required. <sup>(6)</sup>

Chinese meat production has doubled from 26.6 million tonnes in 1991 to 53.1 million tonnes in 1998.

<sup>(7)</sup> Already 1 in every 2 of the world's pigs lives in China. Poultry consumption in China increases by 14% p.a. By 1998, poultry production in China was 129 million tons (25% of global demand), making China the world's second largest poultry producer. <sup>(8)</sup>

### How will meat/eggs be produced?

Although pastoral grazing systems for ruminants (sheep, goats, cattle) will continue, as will mixed farms, where feed is grown largely on-site and livestock manure used on-farm as fertiliser, the fastest area of growth is in the intensive production of pigs and poultry – the monogastric animals, who often compete directly with humans for food. <sup>(9)</sup>

Backyard/household production of pigs and poultry in developing countries is losing out to the large intensive units. Backyard systems often utilise household scraps, etc. as feed. Intensive systems rely on manufactured (often imported) animal feeds.

By 1996, intensive farming produced over half the global pork and poultrymeat and 10% of global beef and mutton (from feedlot-type systems), and over two-thirds of eggs. <sup>(10)</sup> Although the industrialised countries dominate this sector at the moment, it is increasing rapidly in developing countries, especially in India, China and south east Asia. The 90's has seen a staggering growth rate of 9% p.a. in industrial pork and poultry production in Asia.

In spite of being aware of the environmental problems posed by intensive animal production, the FAO (Food & Agriculture Organisation of the United Nations) clearly supports further intensification.

*“The trend of further intensification and specialisation of demand-driven production is inescapable. Attempts to change the direction are doomed to fail. Rather it should be attempted to accelerate this development ....”* write two key FAO chiefs. <sup>(11)</sup>

### The perceived advantages of intensive livestock production

Governments in developing countries appear keen to promote factory farming. Pork, chicken and eggs are viewed as important and inexpensive contributors to dietary protein for the expanding urban populations. These operations are often located close to the large cities, e.g. around Beijing, Calcutta.

<sup>(12)</sup>

## **2.0 The Disadvantages of Intensive Livestock Production**

The disadvantages of intensive livestock production comprise:

### **2.1 Animal health and welfare**

Intensive factory farming-type production systems keep animals confined in isolation or at very high stocking densities in barren/overcrowded conditions which seriously impair the animal's ability to perform its natural behaviour. Animals are often mutilated to 'fit' the system (e.g. tail-docking, de-beaking) and are fed unnatural diets to promote growth or produce specialist products, e.g. veal. Most are genetically selected for rapid growth/high yield. This often results in serious health and welfare problems such as degeneration of the heart and lameness.<sup>(13)</sup> The animal welfare potential of these factory farming systems is very low indeed.

So, the cost in terms of animal welfare is high.

### **2.2 Human health**

- a) Intensive livestock production requires a range of inputs, including a host of veterinary products such as vaccinations and antibiotics, without which it would be impossible to rear animals indoors in such large groups (e.g. 60,000 chickens in one shed). Apart from the financial cost to the farmer, there are now serious concerns about the development of antibiotic-resistant bacteria as a result of overuse of antibiotics in animal farming. This antibiotic resistance poses a real threat to both human and animal health.

- b) Human health may also be adversely affected by the increased consumption of animal produce. Research has shown that red meat intake above a certain level probably increases the risk of colon and other cancers. There are associations between consumption of animal fats and heart disease also. The World Cancer Research Fund recommends eating a plant-based diet and recommends that governments should emphasise the production of foods of plant origin: vegetables and fruits, cereals, tubers, roots and pulses for human consumption. <sup>(14)</sup>

In other words, a completely different food policy from one that encourages intensive livestock production.

- c) Intensive livestock production provides fertile breeding grounds for bacteria and for the transmission of animal disease. In recent years the intensive livestock industry has witnessed massive (and expensive) outbreaks of serious animal disease which pose a threat to human health, e.g. swine fever in Taiwan and the Netherlands, salmonella in poultrymeat etc. etc. BSE is also more indirectly associated with this type of farming. In this case it was the use of the cheapest source of protein for animal feeds (other waste animal products) that apparently led to the rapid spread of the disease in animals and ultimately its spread to humans.

### 2.3 The Food/Feed Equation

The ratio of transformation of animal feed to human food (meat, milk, eggs) is close to 20:1. Half the weight of the animal (bones, feathers, hide and some guts) is not eaten. Concentrated feed rations are dried with a high input of energy to a maximum of 12% water. Meat is 80% water. Chicken convert feed most efficiently: 2.2 kg. of feed to 1 kg. live weight of chicken (half of which is food) so, 2.2:1 becomes 4.4:1. If you add the water content figure of the meat you end up with 19.36:1, i.e. nearly 20 kg. of feed to get 1 kg. of chicken flesh. <sup>(15)</sup>

Most statistics of feed conversion leave the water aspect of the equation out of their calculations and produce figures of around 4 kg. of grain to produce 1 kg. of weight gain for poultry and pigs, around 10 kg. of grain for 1 kg. of beef. <sup>(16)</sup>

Growing pigs excrete 70% of the protein in their feed, broilers 55% and beef cattle 80-90%. <sup>(17)</sup>

The accepted wisdom is that poultry and then pork are more efficient converters of feed, with beef cattle being the poorest converter.

The fact remains that you have to put much more protein and calories into an animal in feed than you can consume from it in edible produce.

The earth has enough arable land to sustain both its current and projected population (10 billion) on a vegetarian diet. Even Dennis Avery – arch exponent of intensification and genetic modification – admits that the alternative to the latter path is the creation of “five billion vegans”.<sup>(18)</sup>

Right now, livestock consume 32% of the world’s cereal production.<sup>(19)</sup> In the developed world, 65% of the agricultural land produces cereals for animal feed.<sup>(20)</sup> 144 million tons of animal feed come from oilseeds (e.g. soya), roots and tubers, 252 million tons are processing by-products (brans and oilcakes). The demand for soya beans has increased 9-fold since 1950, driven by the demand for animal feed (and vegetable oil).<sup>(21)</sup>

There is massive movement of animal feedstuffs across the globe. For example, the EU imports 45% of its oilseeds (soya) and, overall, imports 70% of its protein for animal feed (1995-96). As the European Commission admits “*Europe’s agriculture is capable of feeding Europe’s people but not of feeding Europe’s animals*”.<sup>(22)</sup> One-third of internationally traded commodities are livestock feed or products. This includes 3 million tons of plant nutrients shipped from nutrient-deficient areas to areas of nutrient surplus.<sup>(23)</sup> As one Amazonian activist explains, in southern Brazil they used to grow food “*for people, for children. Now they grow soya for the pigs in Europe*”.<sup>(24)</sup>

China has already turned, in the mid-90’s, from being a net exporter of grain to being an importer. Much of the imported grains are destined for the expanding farm animal population. As Lester Brown (World Watch Institute) writes, “*The question for China is not so much whether its land and other agricultural resources will enable it to feed 1.5 billion people, but whether it can feed 1.5 billion affluent people who are consuming larger quantities of livestock products*”.<sup>(25)</sup>

The US government became so worried about the potentially de-stabilising effect of Chinese grain demands (if its imports continue to rise, grain prices worldwide will go up which could produce unprecedented political instability, especially in third world cities), that it asked its National Intelligence Council, which oversees all US intelligence agencies, to review China’s food prospects.

It reported that it expects China to be importing 175 million tons of grain by 2025. (Current total global grain exports are only 200 million tons).<sup>(26)</sup>

To conclude: the production of meat, milk and eggs, especially in intensive systems, requires a greater input of feed/protein/calories than is contained in the end product. The increasing demand for cereals and oilseeds (e.g. soya) by Europe and in the future by central and eastern Asia has the potential to cause a major food disaster, with, literally, animals in factory farms being fed and people going hungry for lack of the same food.

## 2.4 Environmental effects of intensive animal production worldwide

Intensive animal farming produces direct environmental effects, e.g. excreta overload and air pollution. It also results in indirect environmental effects caused by the production of so many million tons of grains and oilseeds, which result in massive use of water, increased use of nitrates, pesticides and herbicides and, often, soil erosion.

### 2.4.1 Direct environmental effects: environmental degradation and pollution

Although correctly handled, animal manure can enrich the soil, the liquid slurry emanating from intensive factory farms often causes overload on the surrounding land, polluting plants, soil and water. There are references to 'structural surpluses of animal excreta' in some of the intensive livestock producing areas of Europe such as the Netherlands and northern Italy, where there is nitrogenous pollution of groundwater. This is because animals excrete much of the nitrogen in their diets – pigs and poultry excrete around 65% of their nitrogen intake and 70% of their phosphate intake.<sup>(27)</sup> This nitrogen becomes harmful to the surrounding environment as it can evaporate as ammonia, causing toxic, eutrophic and acidifying effects on the eco-system. Nitrates leach into the water causing a risk to human health. Soils saturated with phosphorus are subject to eutrophication.<sup>(28)</sup>

Of the 208,000 tons of ammonia emitted in the Netherlands in 1993, 181,000 came from animal manure.<sup>(29)</sup> Near-shore marine water can also become polluted as polluted waterways drain into it.<sup>(30)</sup>

There is also a global trade in animal waste and waste parts of animals. In 1998 the UK exported 62,600 tonnes of mammalian and poultry waste for rendering abroad.<sup>(31)</sup>

Animal feeds are often 'enriched' with metals such as copper, zinc, selenium and cadmium (which, in small quantities can aid growth). But only 5-15% is absorbed by the animal; the rest is excreted and can cause heavy metal accumulation in the soil and contamination of crops. <sup>(32)</sup>

#### 2.4.2 Use of fossil fuel energy

Intensive factory farming systems rely on automated feeding, heating, ventilation and waste removal systems, powered usually by electricity. This makes them particularly unsuitable systems for areas of the world where electricity supply is intermittent, and where they may compete directly with local human populations for an inadequate electricity supply.

#### 2.4.3 Indirect environmental effects: water

Recognition is growing that water scarcity may become a major factor in world food production in the near future. Water tables are falling in parts of the US, in north Africa and the Middle East, in most of India and in China on the flat land. In the north China plain (where 40% of China's grain is grown) the water table is dropping 1.5 m. p.a. Much of India shows a similar drop. In 1997, China's great Yellow River failed to reach the sea for 7 months of the year. Countries in the Middle East and north Africa now import wheat, as 1 ton of wheat is equal to 1,000 tons of water. In 1997, these countries imported grain and farm products roughly equal to the annual flow of the Nile river. <sup>(33)</sup>

Over 40% of the world's food production is from irrigated land (in China 70%, India 50%). <sup>(34)</sup> In 'the South', water scarcity may well be the biggest limitation on agricultural growth. <sup>(35)</sup>

Already, 22 countries suffer severe water scarcity and a further 18 have dangerously low water levels. <sup>(36)</sup>

The bulk of the water used to produce animal products is used in growing the crops to feed the animals. In the US in 1992, nearly half the water consumed was used for growing feed for livestock. <sup>(37)</sup> But the creatures themselves are considerable users of water. Overall, David Pimentel reckons it takes 100,000 litres of water to produce 1 kg. of beef, 3,500 litres to produce 1 kg. of chicken. <sup>(38)</sup>

#### 2.4.4 Air pollution

Animals and their excreta produce 23% of the world's methane. Methane is responsible for 15% of the greenhouse effect. <sup>(39)</sup> The manure from free-ranging animals or animals in more humane straw-based housing systems can be easily returned to nourish the soil. However, the liquid slurry from intensive livestock production produces acidifying effects associated with tree loss.

#### 2.4.5 Soil erosion/deforestation

Demand for animal products stimulates demand for animal feed crops and leads to intensive land use. Forests are cut down for logging, for slash and burn agriculture and for cattle ranches, but also for soya monocultures. In Brazil, the pressure to grow more soya has taken up more land, pushing cattle ranching yet further into the forest areas. Ironically, although Brazil is one of the world's largest feed exporters, one-fifth of its population (32 million) go hungry. <sup>(40)</sup>

Already the global area producing grain is shrinking – by 6% since 1981 - partly due to soil erosion, but also to non-farm use or diversion to soya beans (for animal feed).

In the long term, agriculture will only be sustainable if the soil is replenished at at least the same rate as it is eroded. Short term solutions such as multiple cropping cannot ultimately be viable if they rely on heavy inputs of fertiliser.

#### 2.4.6 Chemicalisation of agriculture

Chemical fertiliser input has risen phenomenally worldwide. In China alone it has risen from 2 million tons in 1965 to 36 million tons in 1995. <sup>(41)</sup> Although world grain production has doubled in the last 35 years, the increase in use of nitrogenous fertiliser has increased by 6.9 fold and of phosphorus fertiliser 3.5 fold. <sup>(42)</sup>

Since the second world war, the use of pesticides and herbicides has increased dramatically (their development being initially fuelled by wartime demand for insecticide to maintain troop health and for plant killers for use as 'weapons'). <sup>(43)</sup>

The 1960's 'Green Revolution' was chemical dependent. Already 10 companies control 85% of the global agro-chemical market. <sup>(44)</sup> Now the companies which produce these agro-chemicals are linking

up with seed companies. In the future we are likely to see more and more pesticide-resistant and herbicide-resistant genetically modified crops produced – both for animal feed and human food. The current row over genetically modified soya (genetically engineered to survive being sprayed with a herbicide) appears to be a ‘consumer’ concern. But the bulk of the world’s soya is fed to animals – and that appears to be the growth area for companies to invest in.

#### 2.4.7 Genetic diversity

Intensive animal production relies on a decreasing number of livestock breeds which have often been genetically selected for ‘adaptation’ to factory farm conditions. In practice this means fast growing animals, with good muscle to fat ratios or high milk/egg yield or good reproductivity rates. Currently 600 of 4,000 breeds of livestock are at risk of extinction.<sup>(45)</sup> This figure looks set to increase.

The same loss of genetic diversity is happening in the arable sector and may increase as the genetically modified crops come on stream.

As one senior FAO official concludes *“In practically no country in the world is the industrial system (of animal production) charged with the full environmental costs of production .... societies prefer the cheap supply of animal products over the functions of the eco-systems concerned”*.<sup>(46)</sup>

### **3.0 Economic Power**

Factory farming systems lend themselves to vertical integration, that is to ownership by a company (or group of companies) which produce the crops which are fed to the animals, dictate how the animals are reared, when (and often where) they are slaughtered and how and where they are processed and marketed. A prime example is UK broiler chicken production which is highly vertically integrated. This system is becoming established worldwide from China to Brazil.

It may make a profitable commercial enterprise but vertical integration takes power away from the farmer, who is little more than a contracted servant of the company and has lost all freedom to rear the animals in say, more welfare-friendly ways, or market the animal produce locally.

A recent article in Feed Tech explains how a ‘profitable’ enterprise in exporting US grain to southern Indian broiler and layer chicken producers is being established. It explains how the variability in the Indian maize crop coupled with high output from the chickens “*have made the US maize exporters and the (US Grains) Council exploit the Indian market ....*”.<sup>(47)</sup>

Worldwide, the big names in livestock breeding and pork and poultry production, the big seed companies and the agro-chemical giants are moving into the rapidly expanding intensive livestock industries in Asia and South America.

Governments - increasingly concerned about feeding their growing urban populations – appear more than willing to ease the way for such ventures.

This commercial drive will marginalise small farmers still further and favour large scale ‘factory farms’ near towns which “*may lead to a concentration of animals and production units near urban centres creating environmental and human health hazards*”.<sup>(48)</sup>

#### **4.0 The Way Forward?**

Organisations such as the FAO, whilst acknowledging the very real threats to the world food situation and the environment posed by industrial animal agriculture, seem myopic in their solutions. Their only way forward is a suggested movement of the animal units to areas close to where the grain is produced. In this way the pollution problems are removed from the urban areas and the animal wastes could be used on the crop land.<sup>(49)</sup>

Sadly this solution fails to deal with many of the problems of factory farming, not least the basic food/feed equation and the poor welfare of the animals.

Compassion in World Farming Trust believes that there is now sufficient evidence to campaign globally for a move away from intensive factory farming systems coupled with the adoption of a more plant-based diet.

Such an initiative would:

1. From the world food situation viewpoint, a move to direct human consumption of crops – leaving out the costly inefficient factory farmed animal “protein converter” – would release food straight into the human market and thus raise the potential for a better fed global population.
2. Improve human health: by reducing the consumption of fatty animal products and promoting the eating of vegetables and fruits, and by reducing the likelihood of further zoonoses (animal to human) diseases, and reducing the risk of antibiotic resistance spreading to humans.
3. Improve animal health and welfare. There is little potential for good welfare in factory farms. A move to less intensive livestock production on mixed farms would increase the potential for more humane, e.g. free-range farming with better health and welfare for the animals themselves. Such systems have fewer adverse effects on the environment.
4. Reduce the environmental degradation associated with intensive crop rearing produced in order to feed intensively reared animals. Pollution would also be greatly reduced as wastes from the animals in mixed farms would be used on-site.

JOYCE D’SILVA

Director

## REFERENCES

- (1) State of the World 1999. Ed. Lester Brown. A Worldwatch Institute Report on Progress Toward a Sustainable Society. Earthscan Publications Ltd. London.
- (2) Timothy G. Reeves. Intensification for the nine billion. Nature Biotechnology. Vol. 17 Supplement 1999.
- (3) Cees de Haan, Henning Steinfeld & Harvey Blackburn. Livestock & the Environment. Finding a Balance. Page 63. Report of a Study sponsored by the Commission of the European Communities, the World Bank and the governments of Denmark, France, Germany, The Netherlands, United Kingdom and United States of America. 1996.
- (4) Louise O. Fresco, Henning Steinfeld. A Food Security Perspective to Livestock and the Environment. Pages 5/6. Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997, organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.
- (5) Ibid.
- (6) State of the World 1999. Ed. Lester Brown. A Worldwatch Institute Report on Progress Toward a Sustainable Society. Earthscan Publications Ltd. London.
- (7) Worldwide production set to grow over next decade. World Meat Congress Report. Meat Trades Journal, 26/5/99.
- (8) Growing market for poultry meat in China. World Poultry – Elsevier. Vol. 15, No. 4. 1999.
- (9) Henning Steinfeld. Livestock and Global Change. Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997, organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.
- (10) Cees de Haan, Henning Steinfeld & Harvey Blackburn. Livestock & the Environment. Finding a Balance. Page 53. Report of a Study sponsored by the Commission of the European Communities, the World Bank and the governments of Denmark, France, Germany, The Netherlands, United Kingdom and United States of America. 1996.
- (11) Louise O. Fresco, Henning Steinfeld. A Food Security Perspective to Livestock and the Environment. Page 11. Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.
- (12) Henning Steinfeld. Livestock-Environment Interactions in Industrial Production Systems. Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.
- (13) Philip Lymbery. Campaigning for Change in the European Union. The Meat Business – Devouring a Hungry Planet. Compassion in World Farming Trust. Pub. Earthscan 1999.
- (14) Geoffrey Cannon. World Cancer Research Fund Report - Food, Nutrition and the Prevention of Cancer. WCRF/AICR 1997. American Institute for Cancer Research, Washington D.C..

- (15) José A. Lutzenberger & Melissa Halloway. *The Absurdity of Modern Agriculture: From Chemical Fertilizers and Agropoisons to Biotechnology. The Meat Business – Devouring a Hungry Planet.* Compassion in World Farming Trust. Pub. Earthscan 1999.
- (16) Alexander McCalla, Cees de Haan. *An international trade perspective on livestock and the environment.* Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.
- (17) Henning Steinfeld. *Livestock and global change.* Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.
- (18) Dennis T. Avery. *Intensive Farming and Biotechnology: Saving People and Wildlife in the 21st Century.* The Meat Business – Devouring a Hungry Planet. Compassion in World Farming Trust. Pub. Earthscan 1999.
- (19) Cees de Haan. *Balancing Livestock and Environment; The Study Framework.* Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.
- (20) J. Slingenbergh, W. Wint. *Livestock geography and land use.* Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.
- (21) *State of the World 1999.* Ed. Lester Brown. A Worldwatch Institute Report on Progress Toward a Sustainable Society. Earthscan Publications Ltd. London.
- (22) European Parliament. *Europe's Deficit in Compound Feedingstuffs and Agenda 2000.* 1999.
- (23) Alexander McCalla, Cees de Haan. *An international trade perspective on livestock and the environment.* Page 13. Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.
- (24) Andrew Simms. *Christian Aid Report 10/5/99. Selling Suicide – farming, false promises and genetic engineering in developing countries.*
- (25) *State of the World 1999.* Ed. Lester Brown. A Worldwatch Institute Report on Progress Toward a Sustainable Society. Earthscan Publications Ltd. London.
- (26) *Ibid.*
- (27) Cees de Haan, Henning Steinfeld & Harvey Blackburn. *Livestock & the Environment. Finding a Balance.* Page 54. Report of a Study sponsored by the Commission of the European Communities, the World Bank and the governments of Denmark, France, Germany, The Netherlands, United Kingdom and United States of America. 1996.
- (28) Henning Steinfeld. *Livestock-Environment Interactions in Industrial Production Systems.* Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997.

Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.

(29) Ibid.

(30) David Tilman. University of Minnesota, U.S.A. *Nature*. Vol. 399, 6/5/99.

(31) Jeff Rooker MP. *Hansard*. 16/4/99.

(32) Henning Steinfeld. *Livestock-Environment Interactions in Industrial Production Systems*. Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.

(33) *State of the World 1999*. Ed. Lester Brown. A Worldwatch Institute Report on Progress Toward a Sustainable Society. Earthscan Publications Ltd. London.

(34) Ibid.

(35) Timothy G. Reeves. *Intensification for the nine billion*. *Nature Biotechnology*. Vol. 17. Supplement 1999.

(36) Cees de Haan, Henning Steinfeld & Harvey Blackburn. *Livestock & the Environment. Finding a Balance*. Report of a Study sponsored by the Commission of the European Communities, the World Bank and the governments of Denmark, France, Germany, The Netherlands, United Kingdom and United States of America. 1996.

(37) Jeremy Rifkin. *Beyond Beef*. Pub. Dutton, New York, USA. Page 219. 1992.

(38) David Pimentel et al. *Water Resources: Agriculture, the Environment, and Society*. *BioScience* Vol. 47, No. 2. Feb. 1997.

(39) Hugo Li Pun et al. *Global consultation on balancing livestock, environment and human needs*. Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.

(40) Andrew Simms. *Christian Aid Report 10/5/99*. *Selling Suicide – farming, false promises and genetic engineering in developing countries*.

(41) Ke Bingsheng. *Industrial livestock production, concentrate feed demand and natural resource requirements in China*. Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.

(42) David Tilman. University of Minnesota, U.S.A. *Nature*. Vol. 399, 6/5/99.

(43) José A. Lutzenberger & Melissa Halloway. *The Absurdity of Modern Agriculture: From Chemical Fertilizers and Agropoisons to Biotechnology. The Meat Business – Devouring a Hungry Planet*. Compassion in World Farming Trust. Pub. Earthscan 1999.

- (44) Andrew Simms. Christian Aid Report 10/5/99. Selling Suicide – farming, false promises and genetic engineering in developing countries.
- (45) Cees de Haan. Balancing livestock and environment; the study framework. Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.
- (46) Henning Steinfeld. Livestock-Environment Interactions in Industrial Production Systems. Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.
- (47) Swineetha Wickramanyake, TANS, Sri Lanka. US Grains Council targets India's poultry units. Feed Tech. Vol. 3. No. 2.
- (48) Louise O. Fresco, Henning Steinfeld. Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.
- (49) Louise O. Fresco, Henning Steinfeld. Proceedings of the International Conference on Livestock and the Environment, 16-20 June 1997. Organised by World Bank, Food and Agriculture Organisation & International Agricultural Centre, Wageningen, The Netherlands.