Centre for Agricultural Strategy

Farm Animal Care Trust

Sustainable livestock farming into the 21st century

Edited by B J Marshall

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6 Alternative strategies for achieving sustainable livestock production

H Vogtmann

NATURE AS A BATTLE FIELD

Today's industrialised agri-business has little in common with an agriculture that seriously commits itself to 'the cultural duty for care and protection of the earth' (Markl 1986). Agri-business in its most developed form is a consequent realisation of the paradigm of modern natural sciences. Based upon Darwin's theory that 'nature is a product of chance and fight, and humans are an isolated, intelligent mutation which has to fight for survival' (Angros & Stancin, 1988), modern agri-business has developed 'strategies for fighting'. How else could one otherwise explain the sonorous names like 'Colt', 'Lasso', 'Combat', 'Exterminator'? Only a dead bug is a good bug. This is clear and simple, and calls for clear action, namely the merciless fight of humans against the inclemency of nature.

This understanding of nature revives the old conflict between Darwin's theory and the principles of ethics, recognised by Huxley (1896) one hundred years ago. The exercise of what is best in ethical terms, and what we might call virtue or good will, leads to behaviour contrary to that which will result in success in the cosmic battle for survival. In place of unfeeling dominance it asks for self-restriction; instead of pushing aside or trampling down all competitors it asks from each individual not only respect, but help for fellow creatures. This behaviour is not so much geared towards the survival of the fittest, but to make as many as possible fit for survival, thus rejecting the gladiatorial view of existence. This throws up the question which has already occupied two conflicting philosophies in the 17th century – especially in England – the hermetic and the mechanistic philosophies. In the hermetic tradition nature was penetrated with a godly spirit; accordingly, an understanding of nature required a combined and harmonious working

together of heart, hand and intellect. In contrast, the mechanistic philosophers tried to separate matter from spirit, and hand and intellect from heart (Fox-Keller, 1986).

Modern natural sciences were developed as a consequent continuation of the realisation of the mechanistic view, which called for the ever greater polarisation of spirit and nature, intellect and feeling, objective and subjective. Fox-Keller (1986) sees in this the reason for the development of values in modern sciences which support the kind of knowledge which leads to superiority, control and domination over nature. This monopoly of the dominance of mankind over nature deduced from Genesis I, 28 was regarded as a misunderstanding by Krolzik (1989) and can therefore, no longer be used by politicians and scientists as an excuse in today's dealings with nature. A new translation of Genesis I, 28 (Anonymous, 1986) no longer speaks of domination over, but rather caring for, the earth and all living beings.

THE NARROWNESS OF MIND IN TODAY'S BIOLOGY

The reductionist approach in modern biology however, has led to a narrowness of mind which the physicist Paul Davis (1986) describes as follows: 'It is ironic that physics, which once prepared the way for all other natural sciences, today again very deeply strives for mind, whereas biology follows the path of physics of the last century and seems to want to give up mind altogether'.

Matile (1978) rightly points out that 'the problem of reductionism already shows the lowest level of life at which the specialities of multicellular organisms are not present. Already at the cellular level a non-reducable principle occurs which is absolutely necessary for cell metabolism. The numerous biochemical interrelations and the wealth of science, hamper the support for this acausal principle, which cannot be explained by molecular elements. The cell is an independent, qualitative principle, which cannot be determined by biogenic substances or cell metabolism. This is illustrated by the fact that parts of certain cell structures are not the product, but the requirement of cell metabolism'. As little as the principle of a cell results from metabolism, the principle of an ecosystem emerges from its metabolism. The analogy for agriculture is that the analytical determination of major and even minor nutrients in the soil neither clarifies the plant-soil system, nor the plant-animal system, including human beings as part of an ecosystem. In this respect the performance of farm animals is frequently and incorrectly used as an indicator of well-being, for example egg production in laying hens (Fölsch & Vestergaard, 1981).

ANALYSIS OF THE PROBLEM

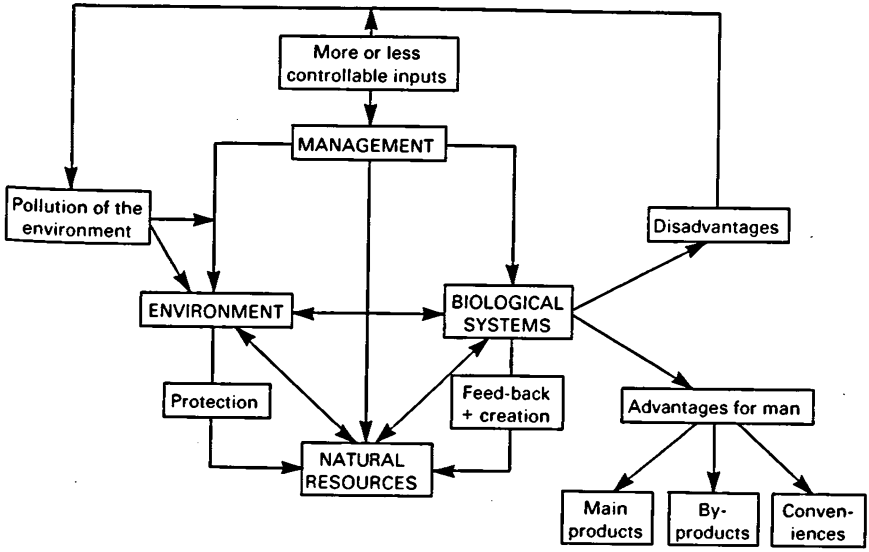
Since the introduction of industrial production methods into agriculture the farmer has been and is, more and more obliged to ignore ecological points of

view if he is to keep his farm on an economic footing. Because of the pressure to keep food prices low the industrialisation of agriculture was hurried along in the hope of improving the farmer's financial position. The means of doing this were based on the industrial practices of rationalisation, mechanisation and intensification. The number of people working in agriculture, like the number of farms, dropped sharply and thus had to be compensated for by the increased use of chemical/technical processes. In addition, the opportunity of importing cheap foodstuffs made possible a one-sided but, at least in the short term, financially acceptable intensification of specialist branches of production. The increase in disparity between individual groups of farms – and in the wider sense even between different agricultural regions – was an unavoidable phenomenon accompanying this process.

All the hard work and technical know-how, the excellent performance of science and technology, and the many reforms and gigantic structural changes in agriculture combined with an almost inconceivable increase in production, have not been enough to achieve the main objective of improving agricultural incomes. On the contrary, structural changes have resulted in fewer farms producing more and more. The increase in production achieved by neglecting ecological considerations has meant that there are constant reports of under-production on the one hand and over-production on the other. Every year the European Community destroys thousands of tons of food, including large quantities of fruit. This fruit must have been produced in large plantations, using a lot of chemicals. How much non-renewable energy was consumed in producing it? How great was the environmental pollution associated with its storage, transport and destruction? When we read of 'mountains' of barley, butter, meat, milk powder etc, amounting to hundreds of thousands of tons, we are justified in asking how the loss of raw materials and the stress on the environment associated with this production can be tolerated in the long term.

A change in development strategy to provide plenty of room for the maintenance, improvement and restoration of the environment is therefore urgently needed in agriculture (Figure 1). The tortuous paths of present agricultural policy have led to faults which it will be difficult to eradicate. In developing countries the problem is even greater because this trend is in many cases encouraged by our development policies, and ecology is an unattractive subject if the population is living at or below the minimum required for existence. Also agro-ecological development is not likely to produce dramatic results reflected in any measurable development (cost/profit analysis) in the short term. But only an ecologically acceptable system can also be economic in the long term. The decisive criterion of the economic viability of a method or system is its ability to survive, an ability which it develops because it is self-supporting.

Figure 1
Interaction of agricultural inputs and the environment



Man interferes in biological systems by more or less controllable inputs – in the case of agriculture by the use of synthetic mineral fertilizers and pesticides – in order to gain some advantage for himself. At the same time he causes unavoidable indirect and direct disadvantages to the environment, natural resources being consumed in the process. The protection of the environment and biological feed-back mechanisms as well as the creation of new equilibria must be given increasing priority in order to reduce these disadvantages and maintain natural resources. It is an open question whether and to what extent man will have to do without some of the advantages.

Source: Vogtmann

In developing countries traditional agricultural methods which are said to have been successful so far could serve as a starting point for the concept of modern agro-ecological development. Ecological development of this kind would support the production potential of populations in need of development. The most effective way of encouraging a development of this kind is by an understanding of the internal processes of an ecosystem and by a willingness to listen and to learn. 'Learning together' on the basis of ecological rules should be the first premise for any agricultural development aid. Our aims – and this applies equally to developing countries and to industrial ones – should not be linked to scientific inquisitiveness or to purely short-term economic standards, but to the needs and ideas of a society living in an evolved culture.

THE SITUATION IN ANIMAL HUSBANDRY

Teutsch (1983) has shown that the two conflicting philosophies in the Western World have, and still do, influence the relationships between humans and farm animals. On one side, there is the view that the exploitation of farm animals by man is natural behaviour. From this point of view productivity is the most important criterion for the judgement of the success of animal production systems. On the other side is the ethical point of view, which includes impairment of the welfare of farm animals. More recently ecological considerations have been taken into account (Kiley-Worthington, 1986), with questions being asked about environmental damage due to intensive animal production (eg manure disposal, ammonia pollution). In addition social questions are being asked in the field of feed imports from developing countries and the influence of animal-derived foodstuffs (meat and sausages in particular) on human health (Mühleisen, 1988). These last three points have led to the question of the social costs of agriculture in general (Vogtmann, 1985; v Weisäcker, 1991) and of animal production in particular.

Ethics and intensive livestock

Man has used animals for different purposes for a long time. Since publication of the books by Harrison (1964) and Singer (1976) intensive livestock farming has caused criticism, not least because of the ethical aspects which generally include impairment of welfare of cows, pigs, hens, etc under the specific housing conditions that accompany such farming practices. According to the Dutch Study Committee on Intensive Farming (1990) the public debate appears to be distinguishable at three different levels:-

(i) the fundamental level, on which the question is raised as to whether animals have a moral status or moral value and if so, what kind of status (ie instrumental value, intrinsic value);

(ii) the level on which, in the event of a conflict, the interests of man are (or should be) weighed against the use of animals for certain purposes. If the conclusion is that animals do have an intrinsic value, then such weighing-up is deemed to be necessary;

(iii) the level on which conditions are defined for the treatment, housing etc of animals, where the weighing-up on the second level has come to the conclusion that animals may be used for a certain purpose.

Unfortunately, a conscious weighing-up on the second level rarely takes place and ethical aspects are interpreted as questions of welfare. Discussions about purposes for animal use are avoided as this poses a threat for existing order and established interests. Therefore the debate is usually restricted to the third level, where it is much easier and less of a threat to discuss ventilation of buildings, size of cages etc. This approach presupposes that the discussion is based upon decisions at the second level, which were clearly never made. The idea that animals have intrinsic value is finding

more and more acceptance not only in the moral consciousness of Western society but also in jurisprudence. In Germany for example in the past, animals were regarded as objects in accordance with Roman Law. More recently however, they are considered as living beings, which gives animals or their advocates a much stronger position. In Holland the intrinsic value of animals is recognised in the following special Note by the Ministry of Culture, Recreation and Welfare (1981), (which was later reflected in the Animal Health and Welfare Bill):-

> 'Animal protection policy should be developed from the basis of recognition of the intrinsic value of the individual animal. The policy should be aimed at protecting the animal as far as possible from human actions which may affect its physical and ethological welfare. In practice this means that people will constantly have to take into consideration the acceptability of their actions in relation to animals. The animals' own interest should be included in a conscious weighing-up process . . . . The choice in favour of the intrinsic value of the animal as a starting point has the consequence that the functional use of the animal for man (economic use, educational or recreational function etc) may become secondary to it, or, in some cases, have to be weighed against it.'

Other European countries already have or are in the process of recognising the intrinsic value of animals. This means that it is morally unacceptable to regard an animal merely as an object, but that man has an obligation towards animals on the basis of their intrinsic value which they preserve despite their instrumental use by man. The question still remains open – the issue for consideration under practical conditions is whether it is permissable to impair the welfare of animals if a reasonable purpose exists for doing so, or whether it is not permissable to impair the welfare of animals, unless there is a necessary purpose for man to do so.

Health aspects of intensive livestock husbandry

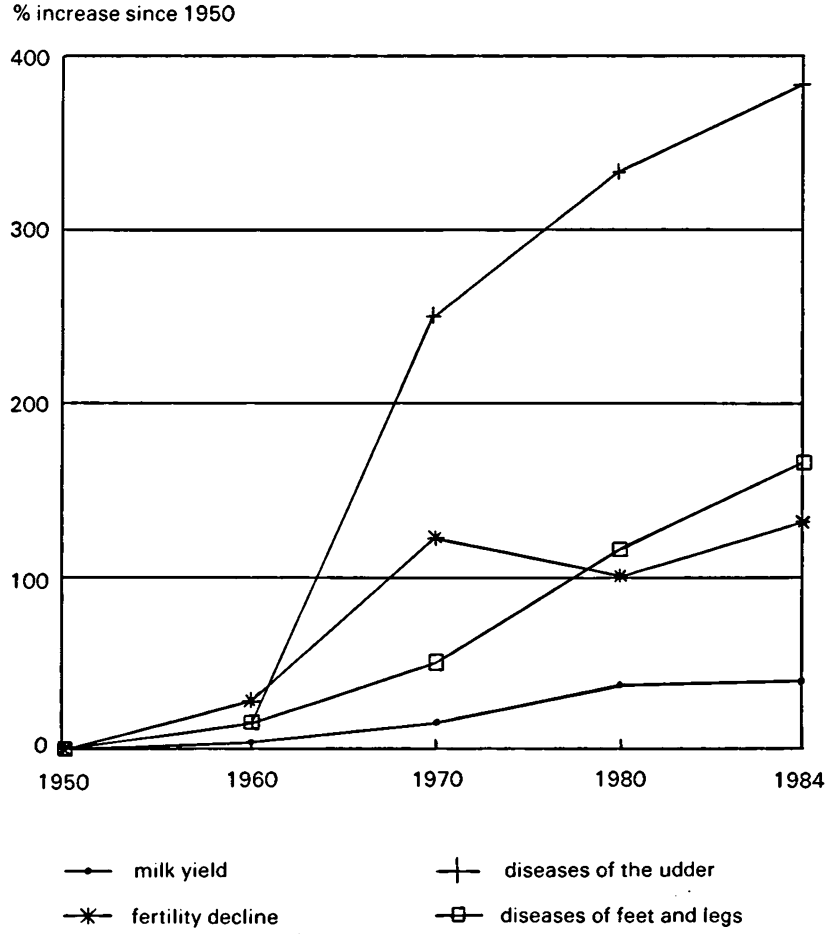
Discussion about health aspects in the context of intensive livestock production falls into three different categories:-

- the health of farm animals in intensive livestock systems
- the health of people working in such systems
- the health of consumers of animal products.

The health of farm animals

Like human medicine, veterinary medicine has also successfully defeated some of the so-called classical animal epidemics like tuberculosis, brucellosis and foot and mouth disease. Nowadays however, multi-factorial diseases are spreading. Bacteria, viruses and fungi, together with additional risk factors like extreme demands on performance, one-sided nutrition and housing conditions that lead to injuries and/or mental stress, can result in animal illnesses. These additional risk factors are solely attributable to man, who is much more responsible for the occurrence of illness in farm animals now than three or four decades ago (Boehncke *et al,* 1991). The influence on animal health by humans was clearly demonstrated by Sommer (1986). In dairy cows he showed a very close positive correlation between increased

Figure 2
The development of causes of death in correlation to milk yield in dairy cows (in Germany)

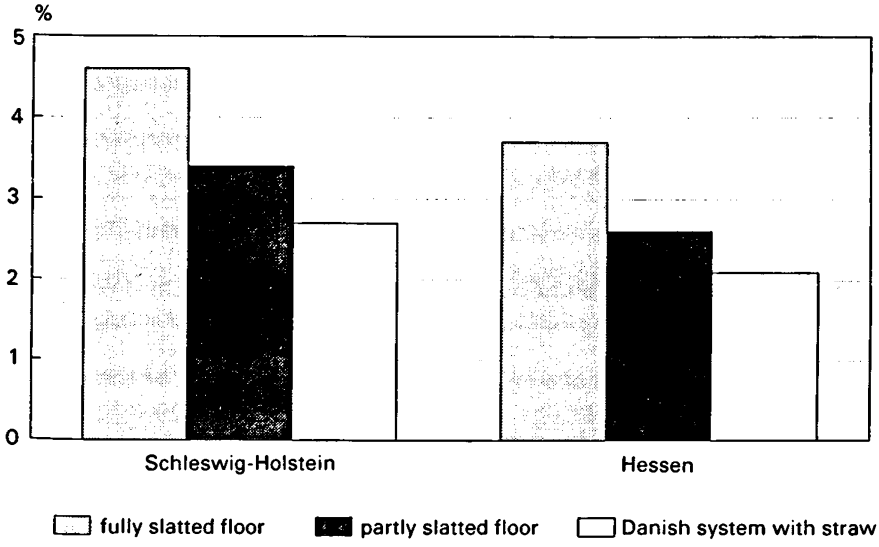


Source: Sommer (1986)

milk yield and impaired fertility, disease of the udder as well as of feet and legs (Figure 2). This leads to a much reduced 'working' life-span of dairy cows in Germany (2 to 3 lactations). That this depends not only upon the demand on performance, but also on other factors as well as intensification like housing systems, was illustrated by Knippenberg (1983). It is not clear how far breeding for extremely high milk yields plays a part in the increase in some diseases, because the feeding of a high yielding cow on roughage alone is extremely difficult and a number of diseases are closely related to

nutrition. Very similar situations can be found in pigs where increased performance or the kind of housing system (Figure 3) are closely correlated with animal losses or behavioural disturbances.

Figure 3
Losses of fattening pigs in different housing systems



Source: Sommer (1986)

Health of farm workers
Working conditions in intensive animal husbandry systems have recently become an issue because they are considered to be stressful for the farm workers, and hygienic aspects have been researched. Danuser *et al* (1988) found significant symptoms of lung malfunction in workers at intensive poultry units. Folsch (1991) pointed out that these aspects need much more attention because the quality of human labour as well as the satisfaction derived from it, will play an increasing role in the future.

Health of consumers of animal products
In Germany the consumption of meat and meat products has increased considerably over the last few decades and has recently reached approximately

100 kg per person per day. This consumption is considered far too high from a nutritional point of view, and a number of metabolic malfunctions and health problems are associated with it (DGE, 1984). In West Germany the surplus of total protein intake over daily requirement is 51% for males and 53% for females – 65% of this has an animal origin. In the USA with a yearly per capita consumption of 273 kg of foods of animal origin (Pond *et al,* 1980) this situation must be worse.

In addition, meat based products like sausages generally contain considerable amounts of fat. Besides its high energy content, there is a general concern about its content of toxic agents, derived either from agricultural practices in feed production (pesticides) or from environmental pollutants (heavy metals, dioxins); and under some circumstances even from bad feeding practices or chemical treatments of the animals (contaminants and residues). The various food scandals associated with meat production, like the hormone scandal, have led to a decline in meat and meat product consumption in Germany, despite very major advertising campaigns by the meat industry under the slogan 'meat is part of life-force'.

Recent consumer surveys (FORSA, 1988; Burda, 1988) have clearly shown a growing consumers' concern in the field of food quality in general, and for meat and meat products in particular. If one looks at consumers' food habits (Burda, 1988) it becomes clear that there is a considerable interest in good food quality (20%) and in addition a significant group of consumers (20%) take ecological aspects into consideration in connection with food as follows:

17% do not take food quality into account (food only has to taste well)

14% are not interested in food quality (do not think about food)

29% use convenience products (food has to taste good, with easy preparation in the minimum of time)

20% look for good quality (price, delicacy, food with few residues)

20% are interested in the organic/ecological aspects (have regard to energy, reduced meat consumption, food from organic farming, and take account of food preparation standards and of food additives).

The FORSA survey (1988) quite clearly showed that there is a general fear of residues in food, which depending on the circumstances, will lead to dramatic alterations in food buying patterns – the level of this concern about residues is 79%. Because of the perceived danger of residues some 59% of consumers say they would not buy certain foods – the level of consumer resistance is veal (64%), beef (14%), fish (12%), pork (7%), poultry/game (5%), sausage (4%).

It seems throughout practically all food consumer surveys that some people (57%) say they are prepared to spend more money on food without residues or from organic farming systems. A significant proportion of consumers however (21%) would rather cut down on the consumption of certain foods, especially meat. This illustrates that foods of animal origin have received, and will continue to receive in the future, a great deal of

publicity in relation to the substances they contain, their place in the diet, and their role in relation to health and disease. The consumer trends in awareness of food quality, and in buying as well as eating habits, need to be taken seriously into account when looking into sustainable livestock farming into the 21st century.

Social considerations of intensive livestock animal husbandry

Looking at animal production worldwide, there tends to be stagnation in per capita meat consumption in the industrialised countries. The growth in per capita income in developing countries, though slow, will increase the demand for meat in these areas. Judging by the very recent National Food Consumption Study (1991) in Germany it seems that with increasing levels of education, and therefore income, people tend to consume less meat (22.3% for males and 28.8% for females) from the lowest to the highest level of education, but consume more vegetables instead. This stagnation or even decline in meat consumption could lead to an alteration in the pattern of supply of cheap foodstuffs, like soyabeans or cassava/maniok, from developing to developed countries. It could also take the pressure off some of the agricultural land presently used for feed production for export and make it available for home food production. In addition, some of the marginal land on steep slopes (such as in Thailand for cassava production) could be taken out of use and thus reduce environmental damage to the land.

Ecological considerations of intensive livestock farming

The trend in intensive animal production systems is toward concentration in large facilities despite the necessity for long-distance transportation of feed and products. In Germany for example, the largest animal production units are concentrated around the great harbours in the north, because imported feed, to a large extent from developing countries, is readily and cheaply available with no further cost for transportation. The mechanisation and automation of feeding and animal handling has helped in this development. Under these conditions even ruminants are made more or less monogastrics, because of the extremely high input of concentrates. In Holland, for example, inputs of up to 18 kg of dry matter and concentrates in the ration of dairy cows are no longer exceptions.

These intensive animal farming systems have not only inflicted discomfort and pain in the animals, but have also caused considerable environmental damage. Everyone who realises that livestock husbandry cannot be fully understood without taking into account the many interrelated processes, both inside and outside the farming system, will readily understand the large number of environmental problems associated with this energy and resource dependent type of animal husbandry. These problems are of two main types:-

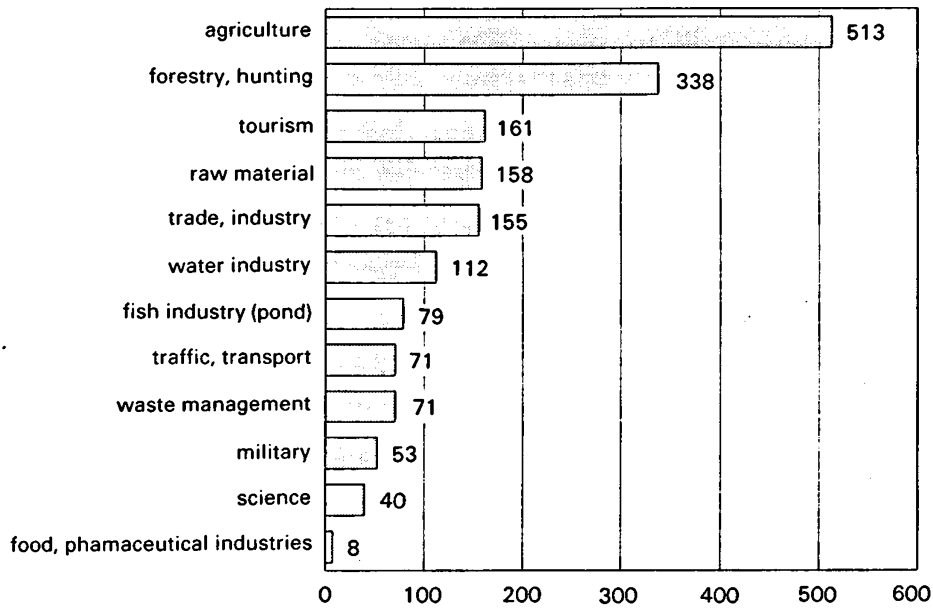
(i) the *direct* type of problem related to manure (mainly slurry), disposal, and air pollution including:

- odour problems (manures, exhaust from buildings)
- release of waste ammonia into the air
- oversupply of nutrients to soils and crops
- pollution of surface (N, P) and ground table water (N, pesticides);

(ii) the *indirect* type of problem that is a consequence of intensive agriculture, and which is also inevitably associated with intensive livestock husbandry, of which the following are the key examples:

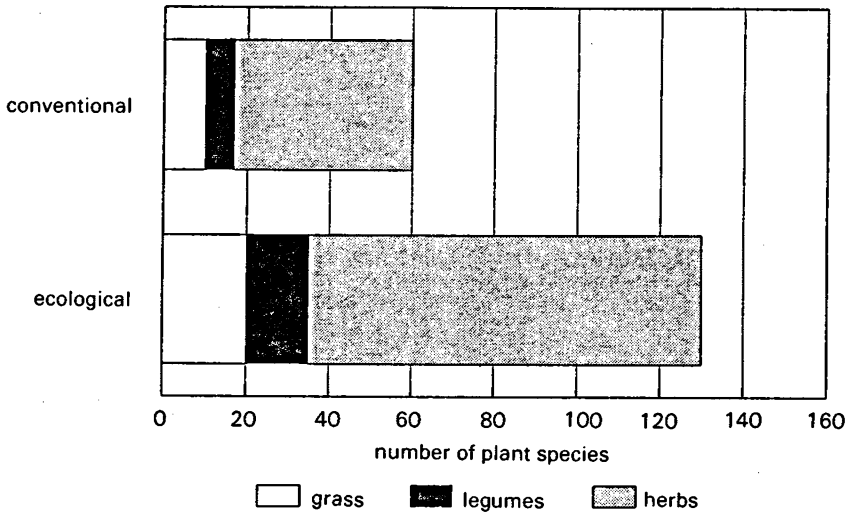
- reduced spectrum of plants produced (narrow crop rotations or even monocropping)
- reduced number of plant species present on farms (Figures 4 and 5)
- soil compaction, soil erosion, soil degradation
- alteration of the landscape
- inefficient use of resources: air, water, land and energy
- environmental pollution due to increased transport of feed etc.

Figure 4
Reason for plant species reduction



Source: Weizsäcker (1990)

Figure 5
Number of plant species in different agricultural systems



Source: Haiger *et al* (1988)

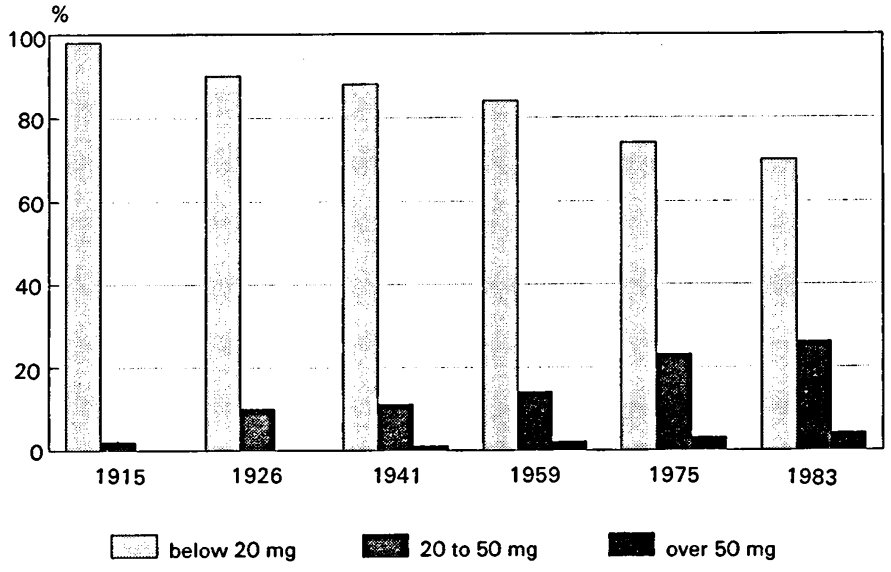
The agricultural policies of a number of European countries try to overcome these problems of intensive livestock husbandry through special bills and regulations. In Switzerland for example not only the carrying capacity of animals per ha has been set, but also a maximum size per livestock production unit. In Germany regulations are established at the State level that fix maximum amounts of animal manure applied per ha of grass or cropland and also the time of application (only during plant growth periods, when the applied nutrient can be utilised by a crop), thus indirectly setting a maximum number of animals per ha, but not per livestock production unit.

Social costs of intensive livestock farming

The main area of discussion centering around intensive livestock husbandry is the question of social costs involved in that type of agricultural or even agri-business production. The pollution problem caused by agriculture with increasing levels of nitrates (Figure 6) and pesticides in drinking water (and nitrates also in vegetables), seems to be unavoidable unless changes in

agricultural production systems as a whole take place. This is especially true in industrialised countries, and also to a large extent in developing countries.

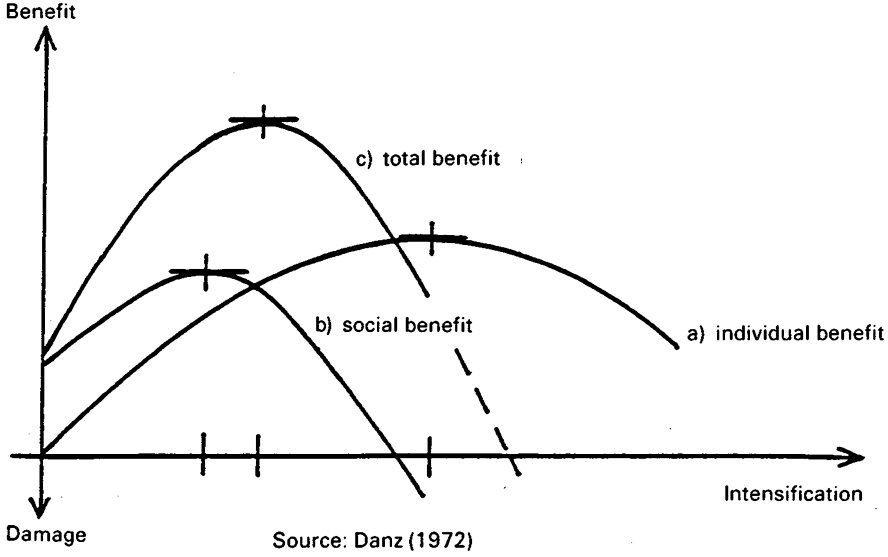
Figure 6
Increase in nitrate content of drinking water



Source: Weizsäcker (1990)

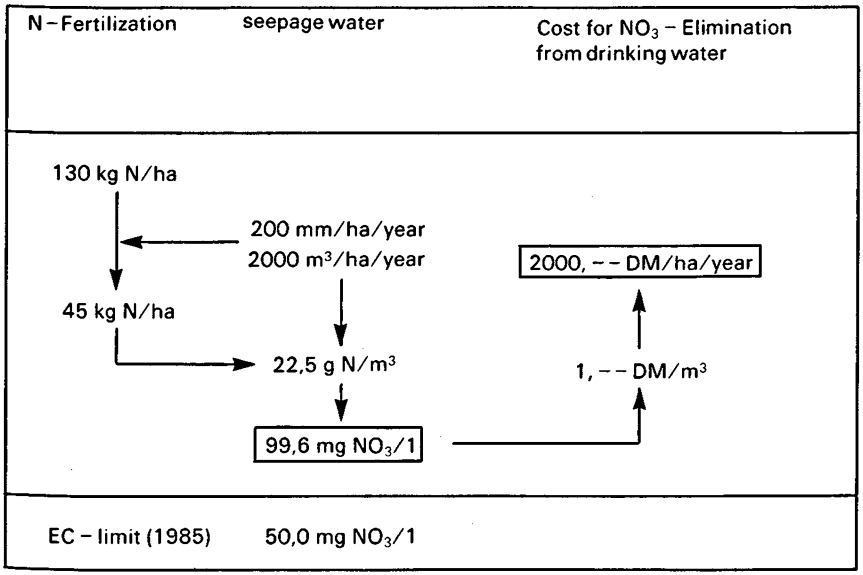
Wicke (1987), Director of the German Federal Environment Agency (UBA), estimated the total cost for soil degradation to be 5200 M DM/year and for water pollution to be 17 600 M DM/year. Part of these costs occur because of intensive agriculture and part arise from intensive livestock practices. These costs however are externalised and paid for by society as a whole and not by the individual farmer who incurred them. Danz (Figure 7) pointed this out in 1972, but agricultural policies have continued to subsidise a very costly development. The calculation of the costs of reducing the nitrate concentration in drinking water due to fertiliser application (as mineral fertiliser, or as slurry which leads to very similar results), shows how significant these problems will be in the future (Vogtmann, 1985) (Figure 8).

Figure 7
Social effects of livestock intensification



Source: Danz (1972)

Figure 8
Costs of reducing the nitrate concentration in drinking water



Source: Vogtmann (1985)

Weizsäcker, (1991) sees agriculture in a vicious circle because the economic influence of large cities and conurbations calls for steadily increasing rationalisation and intensification, due to the demand for cheap food; but this does not take into consideration the far-reaching multi-disciplinary function of the countryside as a whole. It is only if people in the cities and society as a whole, are prepared to pay the appropriate costs of ecological production, that they can expect farmers to practice agricultural, including livestock husbandry systems, that protect and enhance plants and wildlife and improve water quality. This means that by paying the real costs food prices would have to be higher, thus making ecological farming and livestock husbandry systems more attractive to the farming community.

A SELF-RELIANT SUSTAINABLE AGRICULTURAL SYSTEM AS AN ECOLOGICAL ALTERNATIVE

The sustainable agricultural system

The worldwide attempts made so far to produce food by chemo-technical means evidently do not represent the best solution to the problem for the future, as raw materials are no longer available in sufficiently large quantities and the ecological stresses could be too great. The destruction of the natural environment, in which modern plant and animal production systems have played so big a part, is felt in many countries as a personal threat. What other production methods are involved at a particular location is not yet clear in any detail, because scientific research has so far been very one-sided.

In a sustainable agricultural system, of which sustainable livestock farming plays an important part, the policy must be to limit the more or less controllable inputs, eg synthetic mineral fertilisers and various feed additives. In this way natural, finite resources would be maintained and the environment protected. Biological feed-back mechanisms must be used increasingly to create the new equilibria and cycles necessary for this. Whether and to what extent man must do without some 'advantages' (Figure 1) is an open question and depends greatly on the level of realism at which expectations are set. There is also the question of how these 'advantages' are defined. Is it only the amount of food produced or is it also the effects on the countryside, etc? This is our dilemma – the inability of our normal economic theories to calculate the true price of finitely available means of production (eg phosphate) or to determine the social costs of a method of production quantitavely. Basicially an ecological, permanent, self-renewing agricultural system of this kind should function according to the following guidelines:-

- the production of plants and animals and the use of raw materials should be in harmony with natural control mechanisms. This does not mean, however, that we should always and at whatever price, do without those resources which were made available by human effort.

- optimum (not maximum) production should be achieved by planned diversity
- soil fertility should be maintained, and where necessary improved, to achieve optimum production, primarily by using renewable resources
- new and appropriate technologies, the result of a better understanding of natural biological systems, should be developed
- foods of optimum nutritional value should be produced
- suitable technologies, eg decentralised marketing structures, should be used for processing, storage and distribution
- people living on the land should be included; ie not only biology but also sociology is involved
- animals involved in the production system should be kept and fed in a manner appropriate to their species
- this production system should also bring aesthetic satisfaction to those working in it and to those outside. It should, for instance, contribute to the aesthetic structuring of the countryside and not to its destruction.

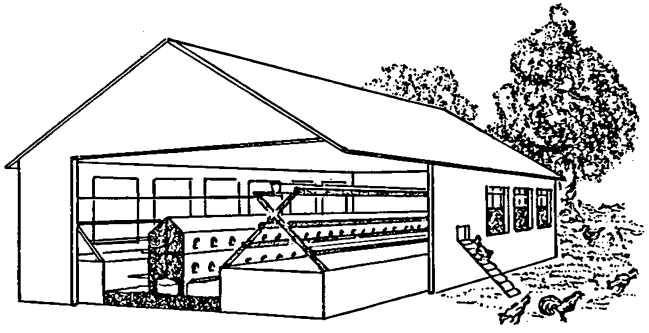
Alternatives in livestock husbandry

In the context of a greater awareness of the needs of farm animals and their welfare, and the growing interest in ecological farming practices, new developments in applied animal ethology have prepared the way for a serious look at farm animal husbandry practices. Research on the improvement of animal health and fertility, which started to decline with increased intensification of livestock production methods, has also opened avenues for new developments.

A critical analysis of modern livestock production systems was first conducted with poultry, when both social and ecological problems overshadowed large-scale poultry units. Research into animal behaviour resulted in appropriate husbandry and housing systems which give the animals a chance to fulfil their behavioural needs, without detriment to an acceptable production level. These new aviary housing systems for laying hens (Fölsch, 1983) (Figure 9) were subsequently put into practice and have been fully recognised by Government and the poultry industry in Switzerland as a viable, just, and economically alternative system. Similar developments have taken place in pig production. Following early work by Stolba (1981) further developments for practicable, behaviour specific housing systems for farrowing and lactating sows (Schmid, 1991) (Figure 10) and a combined husbandry system for breeding sows and fattening pigs (Wechsler, 1991) (Figure 11) have been tested under laboratory and field conditions. A number of farmers have already adopted these systems and are helping to develop them further.

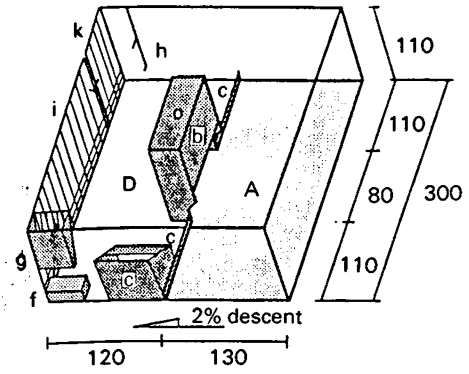
In addition research was undertaken at the University of Kassel to develop rations for the animals in accordance with behavioural needs and ecological requirements (Vogtmann & Deerberg, 1989). This is relatively simple for

Figure 9
Aviary housing systems for laying hens



Source: Fölsch (1982

Figure 10
Practicable, behaviour specific farrowing pen

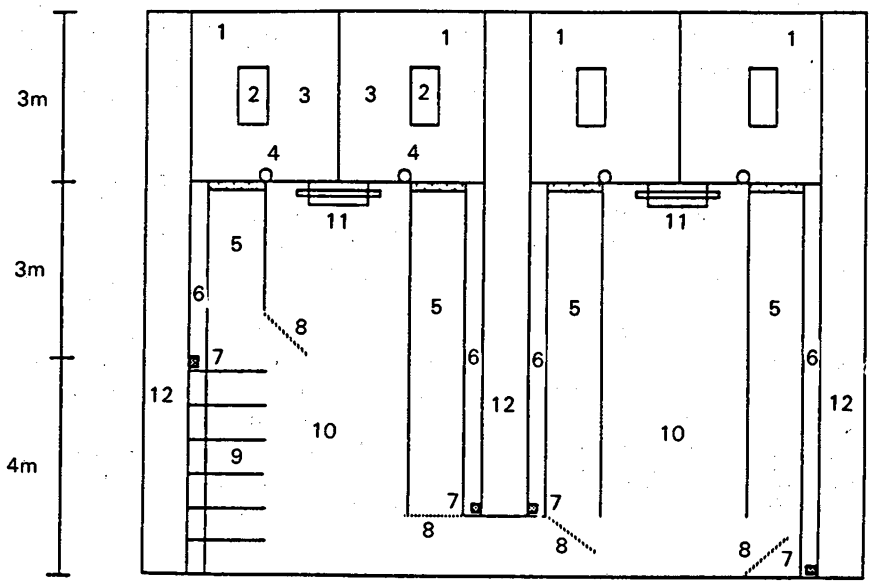


A NEST-AREA
b Dividing wall with installed heating source
c Threshold 10 cm high

D ACTIVITY-AREA
e Feeder for the piglets
f Feeding trough for the sow
g Straw-/hayrack
h Drinker
i Rail
k Gate

Source: Lampkin (1990)

Figure 11
Ground plan of a pen for one family unit of the Stolba family pen system for pig production



1) Nest area
2) Piglet nest
3) Farrowing nest site
4) Rubbing post
5) Corridor
6) Feeding trough
7) Drinker
8) Gate
9) Feeding stall
10) Activity area
11) Straw rack
12) Farmer's passageway

Source: Lampkin (1990)

ruminants, because they allow a crop rotation with a 2-3 year grass or lucerne clover mixture, which is the fertility building phase for the soil (Lampkin, 1991). It is much more difficult for monogastrics (poultry and pigs), where roughage can be fed only to a limited degree. The very specific requirement of the ecological approach is also that mainly home grown components are used for the animal rations. With decreasing producer prices for cereals this is no longer an obstacle, especially if a very reasonable added value can be obtained for grain through egg production.

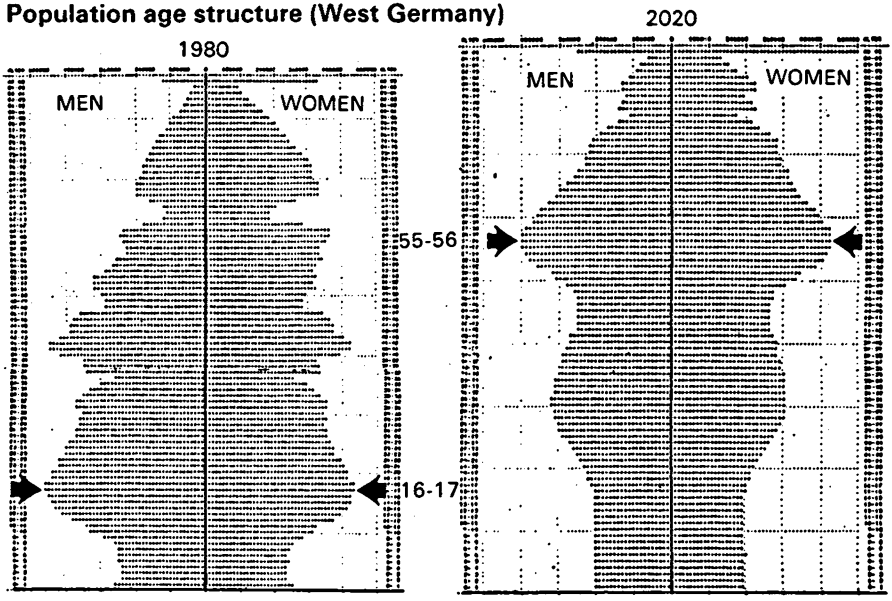
Overall it is important to ensure that livestock are fully integrated into an ecological farming system. Even if this does not take place on one individual farm, it might be an integration of several farms amalgamated into one larger but diverse unit, thus allowing appropriate management, and proper

timing and amounts of manure application. Because of the required bedding, slurry systems are practically non-existent under these livestock husbandry systems, except for yard scrapings. In Germany, farmers who produce meat or other animal products under ecologically sound livestock husbandry systems have created their own trade-mark ('NEULAND') and are able to market their products at a higher price very successfully. Consumers are obviously prepared to pay more for an 'ecological quality' product.

FUTURE DEVELOPMENTS FOR SUSTAINABLE LIVESTOCK FARMING

Bossel *et al* (1986) conducted a model-study for the German Government Commission for the Consequences of Technological Developments on Agriculture. Due to changes in age structure of the population (Figure 12), alterations in food habits, and also environmental constraints, there will be a clear influence on farming as a whole and livestock farming in particular. Three scenarios were studied, a technological option, an ecological option, and a continuation of the present position. The ecological option will inevitably lead to a reduction in animal production as a whole, with the emphasis falling mostly on pigs, a lesser decline in beef, and an increase in poultry (Figures 13, 14). This would be combined with more decentralised units closely connected to their feed and manure applications base.

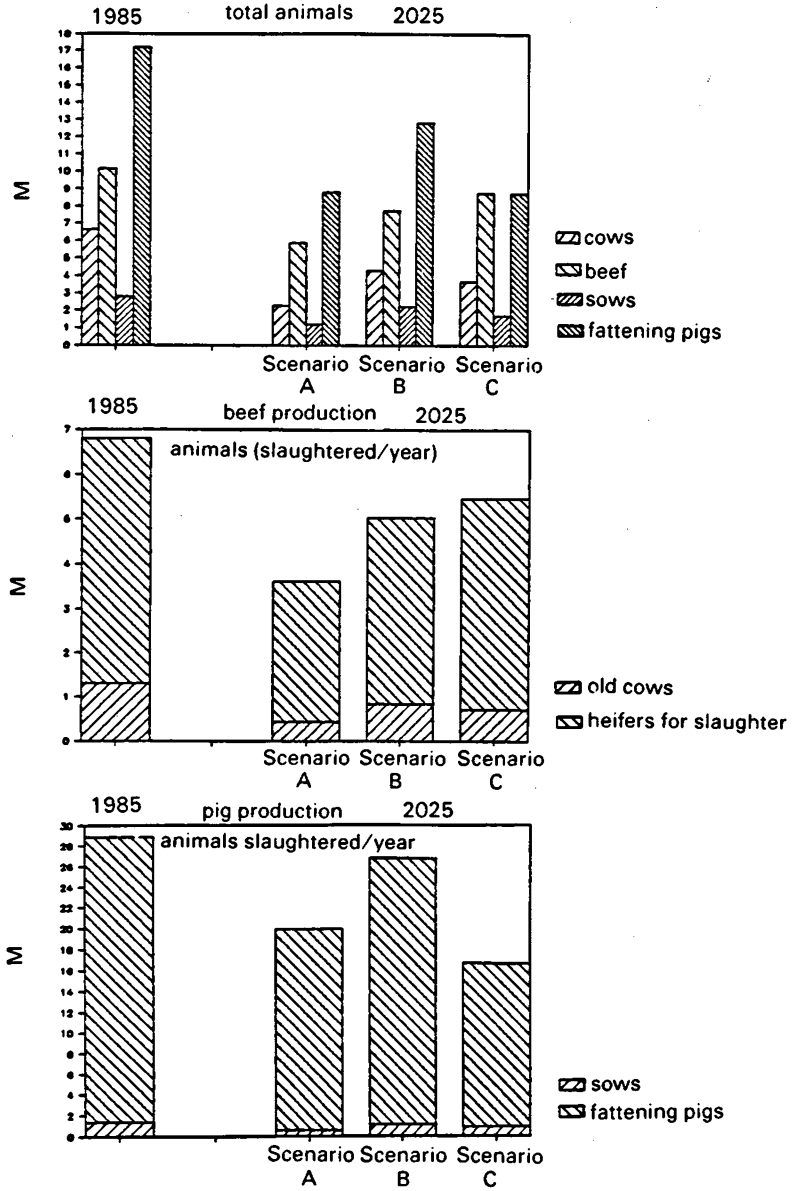
Figure 12
Population age structure (West Germany)



Source: Bossel *et al* (1986)

Figure 13

Government Commission (West Germany) model study of consequences of technological developments in agriculture – total animals, beef and pig production

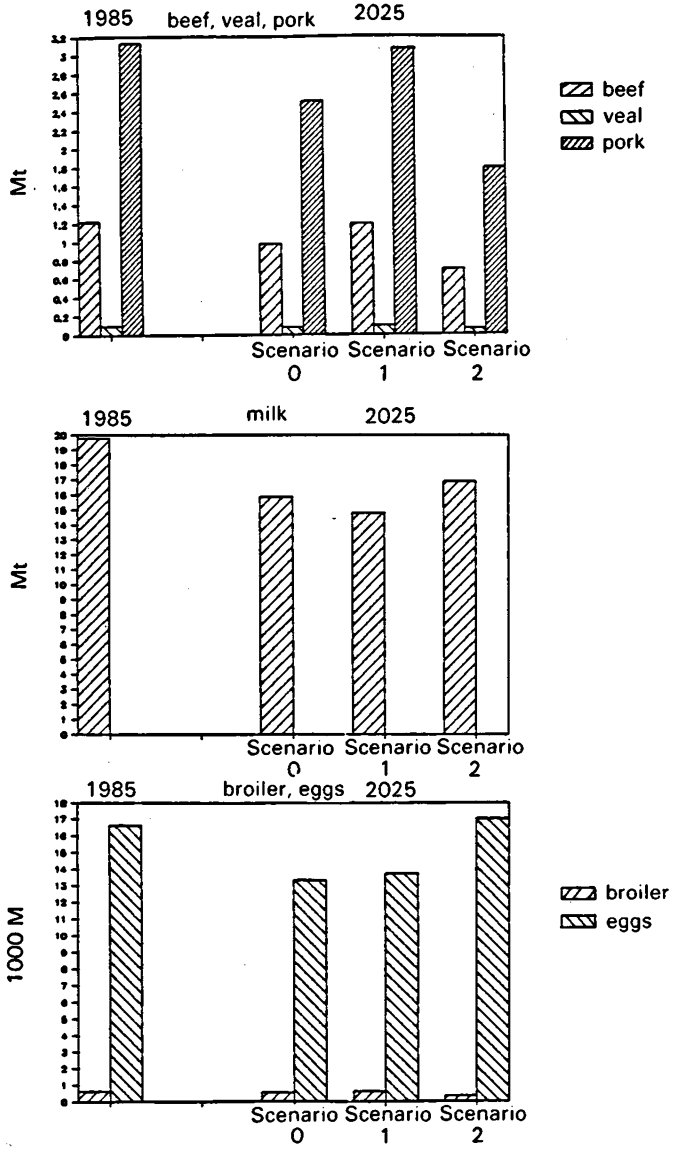


Scenario A – Intensification (technology) B – Continuation C – Ecologisation (ecology)

Source: Bossel *et al* (1986)

Figure 14

Government Commission (West Germany) model study of consequences of technological developments in agriculture – consumption per year



Scenario 0 – no change in food pattern

1 – increased consumption of meat and sugar, less potatoes and grain

2 – less meat and sugar, more potatoes and grain (whole food)

Source: Bossel *et al* (1986).

If one takes the EC recommendation 1143 (1991) on relations between animal husbandry and the quality of the environment seriously, there is no option but to visualise livestock farming as an integral part of ecological farming systems. Producers are however asked to act, probably to a large extent voluntarily, in accordance with Brubaker's (1991) 'Concept of corporate social responsibility', in which a longer-term and broader view will require transformation of today's thinking. Because of economic consequences producer or corporate actions will be measured against factors such as environmental quality or ethics.

Voluntary action seems necessary, because otherwise there will be a gigantic administrative nightmare ahead for livestock producers with numerous bills and regulations (Weizsäcker v, 1991). This action must however, be accompanied by political decisions leading towards a more ecologically oriented system of farming. In addition agricultural research activities need to be pointed in that direction.

One additional problem for livestock farming is looming on the horizon and that is 'food design'. The production of food imitates is gaining ground and could compete successfully with farming in general, and livestock farming in particular. The first breakthrough is the coffee whitener that can be produced from vegetable waste products or micro-organisms, with milk soon to follow (Meier-Ploeger, 1990). It is estimated that up to 10 m tonnes of milk will be replaced with this imitation product in the European Community, which means that about 120 000 dairy farmers will be put out of business, 2.2 m cows will be slaughtered creating another 'meat mountain', and 1 m ha of pasture will be unutilised. Meat imitates, once successfully tried, will be improved with new technolgies and will certainly enter the market and compete with livestock farms. These are the challenges but with speedy changes into ecological practices, livestock farmers could counteract some of the unfavourable developments.

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