The Swedish animal production system could it be applied across the European Union?

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1. Foreword

In 1995, Sweden joined the European Union (E.U.) along with Austria and Finland. Since then, Sweden has been questioning many of the systems in place within the E.U., particularly in the agricultural and environmental areas. A derogation was received from certain E.U. rules until 1st January 1999.

One specific area has been on the validity and acceptability of the European Unions' animal production model and the use of approved in-feed anti-microbial additives for meat producing animals. These anti-microbial products have been used for over 25 years and are under constant scientific evaluation by the Directorate DG VI (Agriculture) of the European Commission.

Prof. Dr. J. Viaene from the Ghent University, Department of Agricultural Economics, has examined the premise that the Swedish animal production model could be extended to the total European Union to the benefit of farmers, allied trades and consumers.

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2. Executive Summary

In 1986 Sweden introduced legislation allowing the use of anti-microbials on veterinary prescription only. In the paper a comparison is made between the Swedish and E.U. animal production system.

Swedish animal production structure is characterised by small scale units. The production of pig, beef and veal, and poultry meat is focused on indigenous consumption and is not export oriented. Swedish pig production represents less than 2 % of the E.U. production and poultry production is even smaller (1 %).

The Swedish ban of anti-microbials for in feed use without prescription and the Animal Protection Act have lowered production efficiency and increased costs. Consumption of in-feed antibacterials has remained at round 30-35 tonnes a year and scientists are not convinced that antibiotic resistance issues have been resolved by the ban. However, the Swedish animal production policy was quite protective between 1986 and 1991. Even after the abolition of guaranteed prices, the Producer Subsidy Equivalent for pig meat was 27 % higher in Sweden than in the E.U.-12 for 1994.

The four consequences of the growth promoter ban in Sweden are examined. First, the economic burden has been heavy for consumers and for farmers, through increased feed use, loss of production and increased use of therapeutic levels of antibiotics. Second, increased feed use results in more manure production with negative environmental effects. Also the alternative compound zinc oxide can build up in the soil. Third, the Swedish animal production has come under increasing pressure from exporting countries. Fourth, potential disadvantages to trade effects at EU level arise.

The EU animal production system for the WTO challenge has to exploit fully the available opportunities. The EU is tightly linked to the world economy and effective co-operation with other countries is the significant factor for further development. EU meat production and trade will meet an increasing competition with the USA on the world market. For pig and poultry meat, the USA is focusing on increasing exportation world-wide.

Within the open world market, European farmers will need to have access to all technologies which will enable them to hold costs at a minimum and to remain competitive. Alternative production systems for meat do exist, however they imply higher production costs and therefore, the end products must attract consumers by premium prices and keep a small market share.

Finally, by Total Quality Management in many EU countries, the meat chain is striving to bring high quality products to the market at the most competitive prices.

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3. Introduction

High efficiency performance in animal production within the European Union is necessary to achieve the basic aims of the agreements of the World Trade Organisation (WTO). These concern an open market access, reduction of tariff quotas and export subsidies and to maintain global competitiveness of the EU livestock industry.

In this study, the comparison between the Swedish and the European Union animal production models is presented. Economic factors of the current production, export and consumption levels are studied. Then, legislation and practices related to the systems with and without feed additive anti-microbial growth promoters are compared. The main advantages and disadvantages of these systems are revealed.

Finally, some consequences of a ban on feed additive anti-microbial growth promoters as well as the positive effects of their usage, compared with the rest of the world's practices, are described. In conclusion, the approach towards Total Quality Management is suggested so that the best interests for the producer may be realised, quality and safety for the consumer may be ensured and an improvement of competitiveness on the world markets may be achieved.

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4. The Swedish animal production system

4.1. Economic factors

4.1.1. Production, export and consumption in Sweden

The following table summarises the basic data about Swedish livestock production, export and consumption (table 1). During the period 1990-1995 there was an increase in the production of pig meat of nearly 7 %. However consumption increased by 21 %. Poultry meat production too increased by some 60 % and consumption by 33 %. Beef meanwhile saw an increase of nearly 8 % in consumption but a status quo in production.

Table 1. Production, export and consumption in Sweden in the sectors of pig, beef & veal and poultry meat during the period of 1990-1995

'000 tonnes	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	% change (95/90)
pig meat							
Indigenous production	291	268	278	289	308	311	+7
Net-Exports (a)	29	2	15	6	7	-7	-124
Consumption	262	266	283	283	301	318	+21
beef & veal meat							
Indigenous production	145	137	130	140	142	145	0

Net-Exports (a)	-3	-12	-18	-12	-16	-16	+433
Consumption	148	149	148	152	158	160	+8
poultry meat							
Indigenous production	50	51	54	62	65	80	+60
Exports (a)	0.1	0.1	0	0	3	12	-
Consumption	52	52	56	64	64	69	+33

(a) Live animals, meat and meat products
Source : European Handbook, EEC and International Statistics, 1996 (1)

The Swedish animal production structure is characterised by small scale units. Piglet production, for example, is on many very small units which will, presumably, be phased out soon as slaughter pig production becomes more centralised. Only 11 % of the herds have over 1.000 slaughter pigs and in 1994, this represents three quarters of the national production. (Simonsson, A. and Rydhmer, L., 1996) (2)

4.1.2. The size and importance of the Swedish livestock sector within the EU

In any debate on production practices, it is essential to compare the size of total production as a percentage of the EU-15 to measure its impact. Table 2 reveals that the Swedish pig production represents less than 2 % OF THE EU production and that poultry production is even smaller (1 %).

Table 2. Production of pig, beef and veal and poultry meat in Sweden and EU-15, 1995

'000 tonnes	**Sweden**	**EU-15**	**% Sweden/EU-15**
pig meat	311	16 035	1,9
beef & vela meat	145	8 160	1,8
poultry meat	69	7 135	1,0

Source : European Handbook, EEC and International Statistics, 1996 (1)

4.2. Policy and practices in animal production

In 1981, articles in the Swedish press announced that a substantial volume of antibiotics was being added to feed as growth promoters. Consumer protection organisations started to look closer at this subject. In the same year, the Federation of Swedish farmers (LRF) and Farmers co-operatives prepared policies to better control the use of antibiotics hoping to improve the image of home produced pig meat and to increase meat consumption.
(Stähle, G., 1996)(3)

In 1986, the Swedish government passed a new law allowing the use of anti-microbials on veterinary prescription only. Although at the time it was reported that many farmers believed this might help restrict imports and allow higher domestic prices, the decision was not welcomed by many on-farm producers and veterinarians. There are major differences in farms in terms of management, environment and animal hygiene in Sweden. Also there are different needs for animal health products to ensure animal welfare. Veterinary prescribing too varies with some vets being too strict and others considered as over generous.

The total consumption of anti-microbials and chemotherapeutics in Sweden has been studied by Björnerot et al.(1994)(4) and reported in the Veterinary Record. According to the study, antibiotic use has been rather constant between the years 1988 to 1993 at about 35 tonnes.

Following the ban of certain anti-microbials for in-feed use without prescription in 1986, veterinarians were forced to prescribe increased levels of antibiotics for therapeutic use due to increases in diarrhoea and post weaning mortality as well as decreased daily gain (Göransson, L., et al., 1992)(5). Use levels then settled to current amounts but often of higher potency therapeutics.

In September 1993, the Animal Protection Act was introduced with strict rules on housing and management of animals and their welfare. For example, the best chicken growers are allowed a maximum population density of 36 kg/m^2 or 25 birds/m^2(Littorin, 1996)(6).

A highly significant difference in broiler mortality was found due to outbreaks of necrotic enteritis where non-antibiotic supplemented groups were compared with supplemented (9.6 % and 2.4 %). All supplements of anti-microbial feed additives or coccidiostats significantly improved growth rate and feed efficiency in these experiments.
(Elwinger, K. & Teglöf, B., 1991)(7). Overall, the ban on growth promoters and the Animal Protection Act resulted in an increasing cost of production and at the same time, a lower level of performance, although Sweden now claims this has been overcome (Stähle, G., 1996)(3).

Between 1986 and 1991 however, the Swedish animal production policy was quite protective. Import taxes and support for the internal market price levels were in force. This artificial support compensated for reduced performance levels enabling farmers to receive adequate margins. The main objectives of the New Agricultural Policy, introduced in Sweden in July 1991, were over time to abolish all guaranteed price support schemes and export refunds. The aim of the reforms was to allow Swedish agriculture to respond better to the needs of the EU market. However, the Swedish PSE for livestock products was 5 % higher than in the EU for 1994. The sector most likely to suffer is pig meat where Swedish support measured by the PSE is 27 % higher than that in the EU 12 (MLC, 1995)(8). Again, during 1995, market prices for pigs have decreased by 25 % down to the Danish level leaving farmers with negative margins.

4.3. Consequences of the growth promoter ban in Sweden

4.3.1. Economic burdens

In pig production, the removal of in-feed anti-microbial use without prescription was seen to lead to health issues. Alternatives were sought which have included the introduction of high levels of zinc oxide into feeds and the reduction in early weaning practices. Zinc oxide is not

favoured by many scientists and environmentalists because of its ability as a heavy metal to stay in the soil.

In chicken production, lower energy feeds have been tried to reduce intestinal disorders and all ways of improving on-farm hygiene have been communicated to farmers. Additionally, certain coccidiostats with antibacterial activity may have helped intestinal disorders.

However, the economic burden has been heavy for farmers. Investigations carried out in 1986 on 200 piglet producing herds, in the South-East of Sweden, included 5 000 farrowings. Pigs needed 3 to 5 days more to reach 25 kg liveweight than before prohibition of in-feed anti-microbials. They also consumed an additional 2 kg of feed. Mortality at weaning rose by 10 to 15 %. Other researchers (Thafvelin, B. & Olsson, O., 1988)(9) state that it takes at least 7 days longer to bring piglets to 30 kg liveweight.

These factors together have a substantial impact on individual farms. The increased feed use, the increased use of therapeutic levels of antibiotics and losses of production throughput combined to bring serious disadvantages to the Swedish producers at that time.

The figures for swine farms indicate a lower turnover and net profit in 1995 compared with 1994. This has resulted from decreases in pig meat prices after Sweden joined the EU. Membership of the EU does not allow subsidies or other compensation for pig meat production.

Pig farmer costs have been almost unchanged. Along with decreased turnover, this means that the net profit for swine farms has decreased by around 10 % during 1995 (Lantbruk, 1996)(10).

4.3.2. Environmental effects

A ban on the usage of in-feed anti-microbials as performance enhancers has a negative impact on feed conversion (the kg of feed required to increase liveweight by 1 kg). Additionally, more feed used results in increased manure production. In Germany, for example, Kröger (1989)(11)

referred to a situation where, with an annual production of 36.5 million pigs, a further 1.27 million pigs and 0.965 million tonnes of feed would be necessary to sustain current levels of pig meat production if in-feed anti-microbials growth enhancers were removed from farmer use. In practical terms, this would involve an increase of 2.9 million m^3manure, 16-22.000 tonnes nitrates and 5-7 000 tonnes phosphates in the former West Germany.

Proportional calculations would indicate a clearly negative effect for all countries in terms of the environment.

4.3.3. Indirect effects on consumer prices and balance of trade

Since Sweden joined the EU, Swedish animal production has come under increasing pressure from exporting countries with its markets becoming more open to imports. Denmark and Finland as neighbours are seeking to exploit their lower production costs, and prices in Sweden may be forced down to compete. In many segments, the Swedish livestock production is not competitive with the EU nor with areas further afield as global trading

becomes a reality. During the January-August period 1996 with high prices overall EU, Swedish pig producers suffered losses of about 10 ECU per fattening pig.

4.3.4. Potential reactions to trade effects

Swedish commercial pig and poultry producers could well feel economically disadvantaged as their competition elsewhere continues to enjoy the benefits of the availability of scientifically approved and controlled feed additive anti-microbial products. At a recent meeting in Brussels where Swedish experts, politicians and lobbyists were making a case for "the Swedish model", they were challenged by the Belgian representative for the EU. Permanent Committee who stated that the overall Swedish use of antibiotics had not diminished according to his evidence. A further speaker from DG VI Agriculture in the European Commission at the same meeting gave firm evidence of the careful and scientific controls adopted for 70/524 substances over the past 25 years within the EU and argued that the European farmers benefited from the firm controls in both registration and use of approved substances based solely on quality, safety and efficacy.

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5. The EU animal production system

5.1. EU for the WTO-challenge

As the European Community is the world's largest trading entity, its trading activities account for more than one fifth of total world trade. The Community exports to the rest of the world about 9 % of its gross domestic product (GDP) and imports around 21 % of the world total and 10 % of GDP (The Uruguay Round, 1994)(12). Summarising, the Round has resulted in a further liberalisation of trade, substantial reductions in tariff levels and increased certainty that world trade continues to follow the trend of recent years. GATT rules are now including trade and services and agriculture has an equal status with other main subjects. In addition developing countries are more firmly integrated into the system. The overall result of the Round should be a more stable world trading environment. Sectors will be more market-oriented and competitive as well.

In this new and challenging situation for the European Community, it will be necessary to exploit fully the created opportunities. Following the external economic policy it is important to accept the fact that the European Community economic interests are tightly linked to the world economy and the effective co-operation with other countries is the significant factor for further development.

5.2. EU meat in an increasing competition with USA on the world market

Development of the international food trade is expected to take place. Its direction is changing as the industrial countries switched from being importers to massive exporters of food during the last 25 years. The USA is the largest food exporter. The export subsidies were the subject of many negotiations between the European Community and the USA. Both interested sides have committed to the reduction of tariffs in the meat sector. As the result of such reductions and the opening of the market, competitiveness will undoubtedly increase in the near future. Factors such as production costs, influenced by unit size, feed and labour costs and the use of scientifically approved feed additives will play their role in this competitiveness, which will

depend on the "ability of agricultural and foodstuff enterprises to secure and or extend profitable market shares in domestic and or foreign markets in competition with other suppliers." (Schmitz, P.M., 1996)(13).

The tarification system will probably contribute to integrating national markets into the world market. National prices will be linked to world market prices and elasticities on the world market will increase contributing to the decline in the instability of world market prices.

5.2.1. Pig meat

The biggest producer of pig meat remains China followed by the European Union. According to the forecast of the Meat and Livestock Commission, production of pig meat in 1996 is about one per cent lower than last year. The pig meat production in 1997 is forecast to be very similar to 1996. From 1990 till 2000, a production growth of 4.6 % is expected in the EU. A slight fluctuation in total exports of pig meat in the EU is foreseen up to 2000. It is believed that CAP reform measures should lead to lower feed costs and hence the improved prospects for EU exports of pig and poultry meat which can be done without the use of export subsidies.

The forecast suggests that imports should increase as a consequence of favourable concessions granted to the countries of Eastern Europe under the association agreements and the introduction of an import quota under the GATT proposal (CAP Working Notes, 1995)(14).

From 1990 till 2000, consumption of pig meat is expected to rise about 5.2 %. That gives an opportunity for those involved in pig meat production, processing, packaging, storage, retaliation and also exportation.

As the United States is the world's third largest producer and has an impact on the world trade in meat, the data concerning pig meat are presented in the same table. In 1995, the USA became a net exporter of pig meat for the first time in over 40 years, exporting over 100 million more pounds than it imported. Long-term USDA projections indicate increasing exports through 2005 (USDA, 1996)(15). Production of pig meat is expected to grow by 10 % between 1990 and 2000.

Table 3. Projection for EU-12 and USA of the production, exports and consumption of pig meat during the period of 1990-2000

E.U.-12		Average 1990-1993	1995	1996	2000	% change 2000-1990
Production	kt cwe	14 631	15 084	15 167	15 305	4.6
Exports[d]	kt cwe	577	522	536	589	2.1
Consumption	kt cwe	14 087	14 589	14 674	14 824	5.2

U.S.A.						
Production	kt cwe	7 447	8 359	7 960	8 194	10.0
Exports[d]	kt cwe	155	194	235	338	118.1
Consumption	kt cwe	7 634	8 202	8 014	8 315	8.92

[d] Excludes intra-EC trade. Source : OECD, Agricultural Outlook, 1995-2000, 1995(16)

5.2.2. Poultry meat

Total production of poultry meat on the Community market should increase by 17.6 % between 1990 and 2000. By differentiation of export refunds according to destination, the rules governing trade with non-member countries have been adapted to the world market situation so as to maintain trade flows. The reform of the Common Agricultural Policy and the situation on the internal and world markets have led to reduced export refunds since mid-1993.

The import quotas at reduced levies provided for, under the generalised system of preferences and the association agreements with countries of CEFTA, introduced the importation of chicken and turkey at zero duty from 1 July 1994.

Exportation of poultry meat in the EU will stay constant, while consumption will increase about 20 % up to the year 2000.

Table 4. Projection for EU-12 and USA of the production, exports and consumption of poultry meat during the period of 1990-2000

E.U.-12		Average 1990-1993	1995	1996	2000	% change 2000-1990
Production	kt cwe	6 800	7 341	7 536	7 997	17.6
Exports[d]	kt cwe	531	525	527	537	1.1
Consumption	kt cwe	6 427	6 991	7 186	7 647	19.0
U.S.A.						
Production	kt cwe	11 532	13 807	14 133	15 741	36.5
Exports[d]	kt cwe	743	1 417	1 303	1 475	98.5
Consumption	kt cwe	10 722	12 397	12 824	14 266	32.4

[d] Excludes intra-EC trade. Source : OECD, Agricultural Outlook, 1995-2000, 1995 (16)

During the last six years world production of poultry meat has increased steadily by an average of 3.6 % a year. In the United States the rate of increase has been even higher and accounts for 5 % (CAP Working Notes, 1995)[14]. The world market continues to expand slightly due particularly to growing demand for poultry meat in the Far East. The United States keeps the first place in exports thanks in particular to its exports flow-value cuts and promotional programs. Exports from the USA will probably increase up to 98.5 % till 2000 which gives the USA, together with a significant increase projected in consumption (about 32 % to 2000), the competitive advantage over the EU where there is no projection for such a favourable growth. The EU could be further disadvantaged if additional Swedish controls were introduced to reduce global competitiveness (see 4.3.).

5.3. Consequences of feed additive anti-microbials in EU meat production

Non agricultural specialists challenge the benefit of feed additive anti-microbials. According to the Swedish, "their use leads to the selection of resistant strains in the animal and this antibiotic resistance can cross over into antibiotics used by humans". The Swedish spokespersons base their argument on the example of resistance caused as a result of using the avoparcin additive in animals and vancomycin medication in humans, but they omit to mention that there is no evidence to suggest that the use of avoparcin in animals is the cause of antibiotic resistance to vancomycin in humans (SCAN opinion, 1996). Nor can vancomycin resistance in the USA be placed at the door of avoparcin, since avoparcin has never been registered or used in that market.

Fiems et al. (1991)(17) relate effects to a number of mechanisms :

- Nutrient-saving effect by a reduced destruction of nutrients in the intestinal gut flora.
- Increased absorptive capacity associated with reduction in thickening of the intestinal wall.
- Change in the microbial flora within the intestine, resulting in a reduced production of toxins or harmful substances, thus contributing to prevent initial and difficult to recognise infections.

Basically, there are two impacts of using feed additives. The first is the farm economic impact appearing in the increased growth and improved efficiency of feed conversion in healthy animals, which depends not only on farm structure and the adopted system of production but also it relies on the legislative environment in which a farm has to operate.

The second is the reduction of the environmental pollution in intensive livestock production. That is related to the decrease of slurry and has an influence on lowered N and P excretion to the ground water (Verbeke, W & Viaene, J., 1996)(18).

From the consumer point of view the studies show that quality of the meat is affected beneficially while using feed additives. A report of Fiems et al. (1996) (19) discusses the effect of anti-microbials on animal performance and looks at the effect of many of these compounds on the carcass and meat quality, animal health and environmental pollution. Quality of meat was analysed according to the content of protein (increased), fat (decreased) and saturated fatty acids (decreased). Meat was additionally checked for any possible residues of pesticides and growth promoters and showed a negative result. Several anti-microbials act positively in finishing diets, fed high energy diets, i.e. in order to prevent or reduce the occurrence of acidosis and liver abscesses.

5.4. Is the EU animal production model compatible with the requirements of producers and consumers ?

With the liberalisation of trade within the WTO, producers in the EU will become very aware of production and exports from competitive economies around the world. Agricultural products particularly will be challenged by efficient producers in the USA and increasingly from South-East Asia.

Within this open world market, European farmers will need to have access to all technologies which will enable them to hold costs at a minimum and to remain competitive.

In-feed anti-microbial feed additives, as well as helping reduce environmental pollution, have also been shown to reduce animal feed costs and assist efficient production from healthy animals.

The European model must continue to be based on the careful evaluation of compounds and on continuing control of use on farms and in feedmills. Their evaluation must be based on the scientific concepts of quality, efficiency and safety. It means safety to humans, to animals and to environmental needs for water, plants, fish and birdlife. This is in line with the sanitary and phytosanitary requirements of the WTO.

Additionally, consumer concerns must be respected to ensure safety, quality, best price and customer choice with required information and transparency.

Finally, welfare codes are now in place across the countries of the EU to ensure the five freedoms for farm animals (Spedding, C., 1996) (20)

- freedom from hunger and thirst,
- freedom from discomfort
- freedom from pain, injury and disease
- freedom to express normal behaviour and
- freedom from fear and distress

Consumers will demand that farmers adhere to these welfare principles for all classes of livestock.

5.5. Alternative meat production systems

Alternative production systems for meat do exist however, but they imply higher production costs and therefore, the end products must attract consumers by premium prices.

Alternative production systems are : free range pig meat production, branded meat programmes, labelled broiler production and outdoor hens system. In Great Britain a trend towards nature based systems of beef and pig meat production are also found. It is a system of outdoor production with a feed, free of any non approved substances.

Taking into account production specifications and performance, free range pig production or outdoor system production normally result in higher production costs. These costs vary according to specific systems but that implies higher meat prices at consumer level.

In broiler production, alternative production leads to labelled and branded meat products. Such kind of products have to meet specified production requirements. Within labelled broiler production in France, a distinction is made between two forms, with fattening periods of 84 days and of 91 days respectively. This together with the investment per bird, which can be considerably higher for labelled than for standard production systems, results in higher production costs, normally 64 % to 70 %. However, not only feed and the lack of performance enhancers are responsible for these higher costs.

In conclusion, it may be said that in many cases the higher price for the alternative meat products is necessary to cover the higher price, as such alternative products are perceived to be of higher quality, more healthy and environmentally friendly (De Craene, A. & Viaene, J., 1992)(21).

Nevertheless, good financial results in the alternative meat and egg production will remain possible only if supply and demand are in equilibrium. Taking into account a relatively small proportion of consumers willing to pay the higher price such types of production remain as an alternative only with a relatively small market share at present.

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6. Conclusions

6.1. Outlook

The use of in-feed anti-microbial additives for meat producing animals raises many issues especially when compared with the Swedish system to prohibit the non-prescription use of such products.

Farmers, veterinarians, feed millers and the public need to be reassured that the use of such additives is safe for the animals, humans and the environment. Scientific institutes around the world have carefully assessed the dangers of antibiotic resistance appearing in humans and animals and have concluded that with carefully controlled use, certain limited compounds can be approved for agricultural use. This in turn leads to better health in farm animals, a reduction in feed wastage from poorer feed conversion and less environmental pollutants such as methane, nitrates and phosphates.

One of the most prestigious academic institutes, the National Academy of Science in the USA, reports that it has never found data directly implicating subtherapeutic use of feed microbials as a risk factor in human illness (Network News).

Sweden, as a small producer of pigs and broilers (less than 2 % and 1 % of the EU production), has hoped through its actions to encourage its consumers to heed imports of foreign livestock products and thereby protect its local farmers. Evidence available does not suggest that this policy has yet succeeded. Farmers may suffer from lower prices and the threat of increased imports.

In the world-wide context, the challenge for farmers is to help triple the output of food to feed a global population which will double over the next 50 years (Avery, D.T., 1995)(22). This can only be achieved by raising the resource efficiency and reducing any negative environmental impacts of meat production. Most of the increased demand will come from

areas of the Third World, which is rapidly becoming affluent enough to eat Western levels of high quality protein.

Avery's thesis is that greater use of existing resources through continued intensification is the most environmentally friendly method of achieving these tough targets. At the end of the twentieth century, over 6 million square miles (equivalent to the total area of the South American continent) is under cultivation. If the world were to turn its back on current commercial farming practices in favour of more extensive methods, the area under cultivation would need to increase to 15-16 million square miles (equivalent to both North and South America).

6.2. The future

Searching for alternative ways to achieve higher rates of gain will almost certainly depend on improved scientific methods and biotechnological discovery.

In-feed anti-microbial additives are one part of this efficiency process and the feed compounding industry's expertise coupled with farmers skills are major contributions to a situation where all elements of the food chain can take responsibility for meat production with the development of safety and quality control systems in food production. In the food industry, these systems are already known as Total Quality Management and in many EU countries, the meat chain is striving to bring high quality products to the market at the most competitive prices.

Sweden's experiment has found a ready acceptance from a percentage of their population who are willing and able to pay premium prices for what they see as more natural products. In effect, it has been the consumers and the farmers who have paid for the Swedish experiment. It remains to be seen whether the EU as a whole could accept some of the limitations of such an experiment when forced, by increasing world trade competition from USA and Asia and rapidly reducing farmer subsidies and incomes, to become even more efficient. On balance, the EU system with its careful regulatory controls, more efficient production norms and its animal welfare codes seems better placed to operate within the global challenges of the twenty-first century compared with the Swedish experiment which has depended largely in the past on governmental intervention and subsidisation.

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