

International trade in agricultural products: The impact of environmental standards on costs and competitiveness

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Abstract

It is often hypothesised that the costs of higher environmental standards lead to unfair competitive disadvantages of countries. To test this, the costs of producing and processing vegetable oils, grain and broiler and of their environmental standards were calculated for Brazil, Germany and Indonesia. The results show that the impacts of environmental standards on the production costs are relatively small. For processing, the results are ambiguous. Total cost differences based on wage level, prices for land, machines, buildings and equipment are more significant. Differences in standards are often justified, depending on climate, population density, economic and social conditions and differences in the scarcity of environmental goods.

1 Introduction

International trade with agricultural products rapidly increases between countries with different levels of environmental standards, different levels of development and preferences as well as differences in natural resource endowment. At the same time, the awareness about environmental problems on global, regional and national scales has grown, especially voiced in developed countries. This situation has led to conflicting positions between developed and developing countries. Developed countries demand the enforcement of higher environmental standards to ensure that environmental costs are internalised. However, at the same time they fear losing international competitiveness because they assume that higher environmental standards will lead to higher production costs. Developing countries are afraid that higher standards requested from developed countries are abused as non-tariff barriers leading to restricted market access and the loss of competitive advantages.

In the past, several studies have tried to assess competitiveness in the scope of increasing environmental standards. They are all based on very different methods, time periods and countries (Nordström and Vaughan, 1999; Helm, 1995). Studies based on costs, generally choose a group of potentially environmentally-unfriendly industries, and analyse trends with respect to the allocation of production sites and international trade. They investigate whether increasing environmental standards lead to a reallocation of the production sites (so-called “pollution havens”) or to competitive disadvantages. Results from these studies differ. Some found that the export share of polluting products of industrialized countries tend to decrease—in comparison to developing countries where the share increases (Low and Yeats, 1992). Others showed that imports of environmentally-intensive products from the US and Japan increase relatively more than exports (Kalt, 1988; Sorsa, 1994; Lee and Roland-Holst, 1994). For Europe, Jenkins (1999) found little evidence of a general loss of competitiveness for environmentally-intensive industries. Also a comprehensive empirical study referring to different industrial sectors in Germany did not find a systematic relation between environmental costs and international competitiveness (Felke, 1998). Tobey (1990, 1993) tested whether world trade suffers from the imposition of environmental policy, but found little empirical evidence for it. According to him, the primary reason seems to be that the costs of pollution control have not been very large in pollution-intensive industries and countries with stringent pollution control policies.

The OECD (1997) estimated that direct environmental compliance costs make up only 1-5 % of the total production costs in the industrial sector. In previous studies, Dean (1992) and Jaffe et al. (1995) pointed out that for most producers, environmental costs amount to only a small part of the total costs. In the US, for example, it was found that production costs for steel amount to US-\$ 513 per ton with US-\$ 15 (or 3 %) being ascribed to environmental costs. In Mexico, production costs only amount to about US-\$ 415 per ton. Even if the US did not have to incur the environmental costs, their costs would still be higher by US-\$ 83 or little less than 20 % compared to Mexico (OECD, 1997). For primary agriculture, Brouwer et al. (2000) state that the compliance costs of environmental standards in primary agriculture are not particularly high (less than 3-4 %).

To test the hypothesis that costs of higher environmental standards lead to unfair competitive disadvantages of countries, a comparative study¹ on the production and processing of vegetable oils, grain and broiler in Brazil, Germany and Indonesia was conducted. The paper proceeds as follows: Chapter 2 shows the importance of the selected agricultural products in an international trade context and describes the methodology. Chapter 3 presents the results of the case studies which includes a total cost comparison and the estimation of costs of environmental standards. In addition, the question about the transferability of environmental standards will be tackled. Chapter 4 summarizes the major results of the case studies.

2 Selection of case studies and methodology

In an international comparative study, the production and processing of oilseeds (soybeans, rapeseed and palm oil), grain (corn, barley and wheat) and broiler in Brazil, Germany and Indonesia are analysed. All three product groups and countries play a significant role on the international market. Future trade liberalisation may lead to an increasing competition in production and processing of these products, and thus to an increasing importance of potential substitutes.

2.1 Selection of countries and products

Brazil

Brazil is one of the biggest producers and exporters of soybeans and broiler worldwide. The production of soybeans increased by more than 300 % from a volume of almost 10 million t in 1978 to more than 30 million t in 1998. The increase in soybean production in Brazil was mainly caused by a steady expansion of the production area but also by increasing yields which almost doubled from 1.2 t/ha to 2.3 t/ha within the last two decades. The traditional production sites are located in the South of Brazil, but a rapid expansion has been observed towards the Central and North-Eastern states. There, vast areas of dry savannah, the Cerrado, (approximately 200 million ha) are available for further expansion of the production of soybeans and corn which at the same time form the basis for an expanding poultry industry.

A large share of the soybean production volume is exported. In 1997, the exports of soybeans, -meal and -oil totalled some 18 million t. While soybeans and -meal are mainly exported to Europe, the significantly lower exports of soy oil are especially destined for China, Iran, Bangladesh, and the Netherlands. The production of corn also increased sig-

¹ The case studies were conducted in cooperation with the Center for Advanced Studies and Applied Economics (CEPEA) of the University São Paulo, Piracicaba, Brazil and the Center for Agricultural Policy Studies (CAPS), Jakarta, Indonesia. For details of the studies, see Grote, U., Deblitz, C., Reichert, T. and S. Stegmann (2001): "Umweltstandards und internationale Wettbewerbsfähigkeit – Analyse und Bedeutung im Rahmen der WTO. Vauk-publisher, Kiel.

nificantly in the last two decades, but basically meets the domestic demand. A big consumer of domestically grown corn and soybeans is the broiler industry.

The production of broiler shows a remarkable upward trend since 1970 from about 0.2 million t to about 4.5 million t in 1998, and similarly, exports of whole broiler and parts also increased significantly. Next to the US and France, Brazil is one of the biggest exporters of broiler. Importing countries are the Middle Eastern countries such as Kuwait, Oman and especially Saudi Arabia for whole broiler, and Hong Kong, Japan but also Germany and Italy for broiler parts. At processing level, there are a few major players dominating the market with a share of 55 %: Sadia, Perdigao, Ceval and Chapec.

Germany

Within Europe, Germany is the second biggest producer of rapeseed. The expansion of area for subsidized rapeseed production increased rapidly since the eighties until 1990 where it reached some 2 million t. In 1991, a further peak to almost 3 million t can be observed which is, however, mostly due to the inclusion of East Germany in the statistics. After 1991, the production and area stagnated and partly even decreased. The export volume reached close to 1.9 million t being dominated by the processing products. Within Europe, Germany is one of the biggest oilseed processors. In 1998, close to 4 million t of both rapeseed and soybeans have been processed in Germany. While two third of the rapeseed is supplied domestically and one third is imported from the EU, soybeans for processing are all imported, mainly from the US (1.8 million t in 1998) and Brazil (1.3 million t). More than 90 % of the oilseeds in Germany are processed in 14 oil mills clearly dominated by Archer Daniels Midland (ADM), Cargill and Eridania-Beghin-Say.

About 20 - 25 % of total agricultural land in Germany is used for wheat production. The increase in production of wheat over time especially derived from growing yields rather than from expanding area. Exports of wheat amounted to almost 1.8 million t in 1996/97, while imports also reached some 1.2 million t during the same year.

The broiler production increased steadily in Germany, however, the degree of self sufficiency for broiler amounted to only 66 % in 1998. Therefore, imports play a major role for meeting the demand. With respect to imports, there was a stronger increase in the demand for broiler parts than for whole broiler. While the major supplier of the German market is the Netherlands, there were also imports registered from Hungary and Thailand. Smaller amounts of exports are delivered from Germany to other EU countries, to Switzerland or to a minor extent to Russia.

Indonesia

Indonesia is one of the main producers and exporters of palm oil, accounting for 25 % of its GDP (1998). From the very beginning, palm oil was mainly produced for export, directly competing with other vegetable oils. The production of palm oil increased from 1.5 million t in 1987 to around 4.5 million t in 1996, and the plantation area more than tripled. The biggest increase of the plantation area during the last decade was realized by privately owned estates, followed by smallholders and government estates. The per ha yields of palm oil slightly decreased since 1995, mainly due to the negative effects of the climate (El Niño-phenomena). The exports of palm oil increased steadily since the mid eighties until 1997, reaching around 3 million t in terms of volume and almost US-\$ 1.5 billion in

terms of value. Major traditional destinations for palm oil exports from Indonesia are the Netherlands, Germany and Italy, and due to export diversification efforts of the government, significant amounts are also increasingly exported to other Asian countries, especially China, India and Pakistan. The worldwide demand for vegetable oils is still very high and further expansion of plantation area is possible in Indonesia.

2.2 Methodology and data base

The data basis for the case studies had to meet the following requirements:

- It should provide a realistic illustration of the situation in the countries considered.
- It should be as much as possible up to date (prices, legislation).
- It should allow the illustration of the physical procedures of the farm activities (influence of the production system on production cost).
- It should allow a differentiation of financial figures into their physical and their price part (for assessment of the cost components influenced by standards).
- It should provide the possibility to generalise the results as much as possible.

Against this background, the use of statistical averages or individual farm data were not appropriate. Instead, the concept of typical farms was used in Brazil and Germany and own surveys to generate the data basis were conducted. The surveys and the farm level analysis took place within the framework of the International Farm Comparison Network (IFCN)², which allows analysing agricultural production systems world-wide. In practice it means that 'panels', consisting of four to six farmers, one advisor and one scientist, are established. These panels define 'typical farms' which represent a region in terms of size, crops grown or livestock system and technology used.

For plant production, three typical farms in Brazil (1,000 ha in Goias, 500 ha in Minas Gerais and 290 ha in São Paulo) and four farms in Germany (700 ha in Mecklenburg-Vorpommern, 560 ha und 1,300 ha in Saxony-Anhalt und 100 ha in Lower Saxony) were defined. For broiler production, two enterprises with capacities of 24,000 and 15,000 broiler respectively in Brazil (São Paulo), and one enterprise in Germany with a capacity of 28,000 broiler (Lower Saxony) were constructed as typical enterprises. Data on costs and environmental information about production of oil palm trees and palm oil, respectively, were collected from two selected oil palm plantations in Indonesia (10,000 ha in Sumatra and 4,250 ha in West Java). The production of oil palm trees and the processing of their fruits into palm oil is integrated on the plantations because the perishable fresh fruit bunches need to be processed within a few hours after harvest and thus cannot be transported over long distances.

² For further information on IFCN: <http://www.fal.de/bal/ifcn.html>.

For each typical farm, a comprehensive physical and economic data set was then obtained. Total production costs for the selected products were then calculated, by differentiating between cost groups and positions as indicated in Table 1. Given the standardized procedure and identical definition of cost positions, IFCN allows an international comparison of data. At the same time, lists of environmental standards from input to processing level were established for each selected product group, and then related to the individual cost positions for quantification.

Table 2.1: Costs groups and positions for the calculation of total production costs

Cost groups	Cost Positions
Direct Cost	Seed Fertiliser Plant protection Herbicides Fungicides Insecticides Growth regulators Other Crop Insurance, MPCl Crop advisory service
Operating cost	Maintenance machinery Fuel and lubrication Depreciation machinery Dryer/Aeration Maintenance Energy Depreciation Insurance Custom work Equipment liability insurance Wages Unpaid labour
Overhead cost	Land improvement Maintenance Buildings Depreciation Buildings Farm insurance Farm taxes and duties Energy, Water, Advisor costs Accountant legal fees Phone & Utilities Other Overheads
Interest cost	Paid interest Unpaid interest for equity
Land cost	Paid rent for land Unpaid rent for owned land
Source: IFCN	

A reference system had to be established to estimate the cost of environmental standards as a share of total costs. The following two options exist:

- (i) Germany is used as a reference system and the cost effects of the German standards are added to Brazilian cost of production, or
- (ii) Brazil is used as a reference system and the cost effects of German standards are deducted from the calculated cost of production of the German farms.

If Germany would be chosen as a reference system, option (i), main problems would arise from estimating investment costs (e.g. for machines and buildings) and operating costs (e.g. for pesticides) which do not exist in Brazil. In addition, applying German standards to Brazil would be only useful if environmental conditions, problems and shortages would be similar in Brazil and Germany. Instead Brazil was used as a reference system, meaning that the status quo situation in Germany was taken and the cost without the German standards was simulated. This is manageable since it is possible to get sufficient information on the hypothetical (or the past) situation without standards.

Another problem arises from the choice of the exchange rate since it has a major impact on the total production costs. There has been a sharp devaluation of the Brazilian currency (Real R\$) in January 1999, which leads c.p. to a decrease of Brazilian production cost expressed in US-\$ - hence an improvement of the country's competitive position - and vice versa. For the cost comparisons between Germany and Brazil the exchange rate at the planting period of the main crop in Brazil (October-November 1998) has been applied. This is based on the farmers' expectation of the exchange rates to remain stable. If they had been able to foresee the sharp decline of their national currency in the beginning of 1999, they would probably have reduced the use of imported inputs like fertiliser and pesticides as it could be observed in the current planting season 1999/2000.

As a result of the financial crisis of the years 1998/99 a strong devaluation of the currency has also taken place in Indonesia. This means for oil palm production that imports of machines or pesticides to Indonesia have become relatively expensive while the exports of palm oil from Indonesia realise big profits. Considering these export incentives, the Indonesian government has imposed a temporary export ban to secure the supply of the domestic market during the Asian crisis. Due to long-term planning for oil palm with a period of use of 25 years the risk of changes in the rate of exchange is particularly high. For the calculations for the cost comparison with other vegetable oils the rate of exchange is used that was valid at the date of plantation establishment.

At processing level, the oilseed and broiler sectors in Germany and Brazil are highly concentrated and competitive. To obtain data from the companies was therefore extremely difficult so that the figures have to be interpreted as guidelines only. While balance sheets were partly available, other costs and environmental information had to be gained from expert interviews.

3 Empirical results for the selected agricultural products

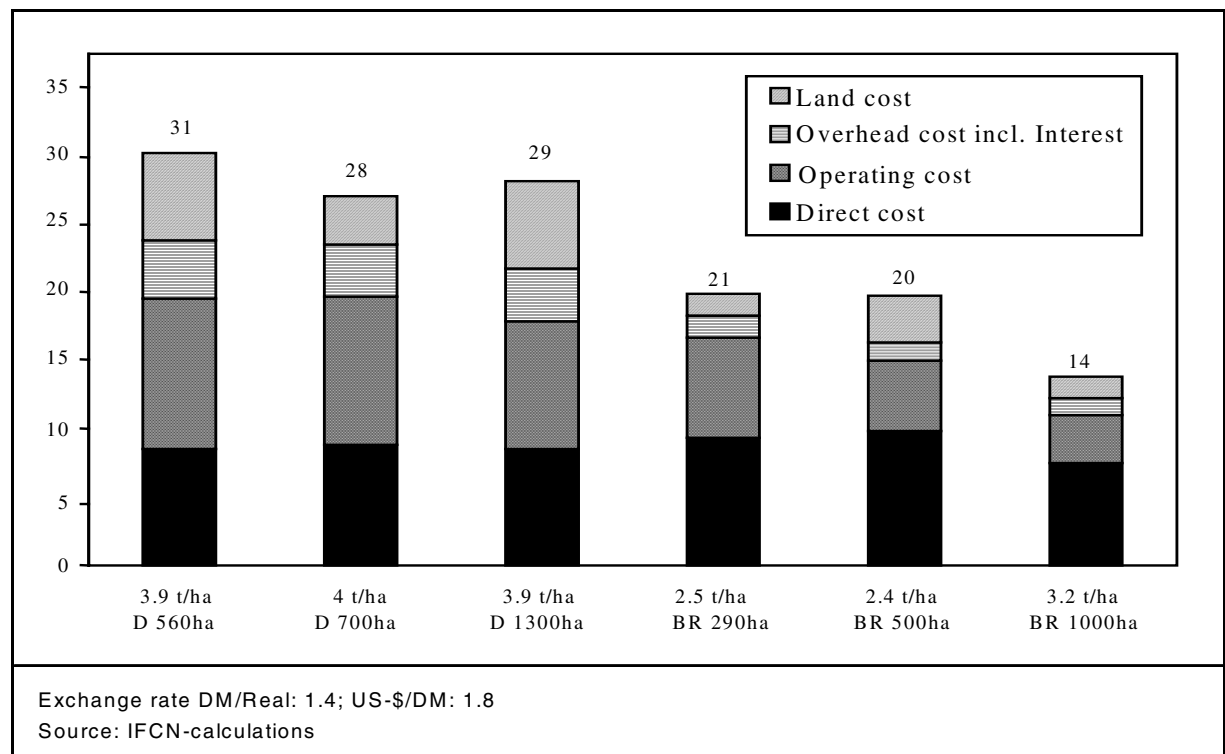
In the following, the results of the case studies are presented for each product group. After estimating the total costs, the environmental standards are identified and their cost share is calculated. This is done first for the production and then for the processing level.

3.1 Oilseeds/-fruits and grain

Production cost

At production level, there are considerable cost differences between the typical farms in Brazil and Germany. *Total cost* of rapeseed production on the three typical German farms vary between US-\$ 28 and US-\$ 31 per 100 kg while total cost of soybean production on the three typical Brazilian farms range between only US-\$ 14 and US-\$ 21 per 100 kg. Thus, Brazilian cost of production are between about 50 – 70 % of the cost of the German farms (figure 3.1).

Figure 3.1: Total cost of rapeseed production in Germany (D) and soybean production in Brazil (BR), 1998/99 (US-\$/100 kg)



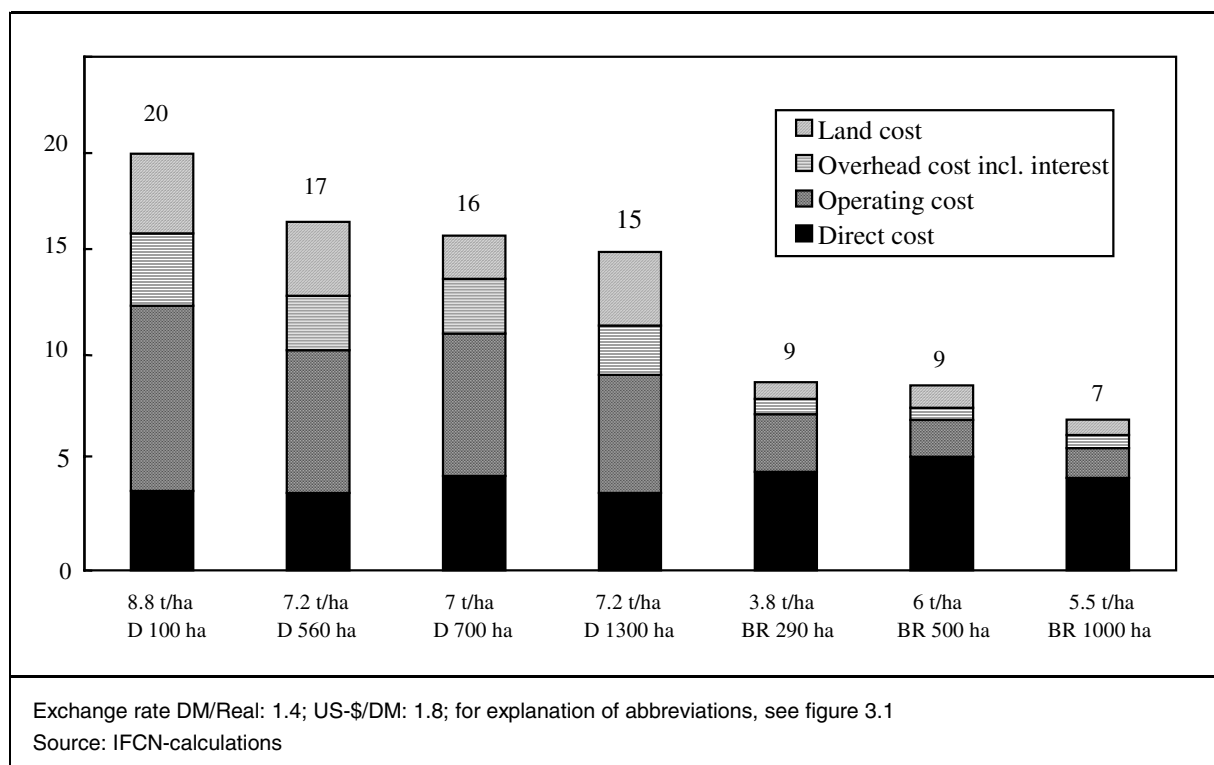
Note: To reflect the different oil and protein contents of rapeseed and soybean, the cost of soybean production were adjusted to rapeseed equivalents.

The abbreviations in the last row refer to the country (D = Germany and BR = Brazil) and the size of the farm in ha.

Due to the higher yields of oilseed production on the German (3.9 - 4 t/ha) compared to the typical Brazilian farms (2.4 - 3.2 t/ha), the cost differences per ha are even bigger than the cost differences per 100 kg. Compared with the soybean production cost in Brazil, the oil palm production has significant cost advantages, mainly due to the comparably high average yields of 4.5 t/ha crude palm oil. While the total cost in case of the 10,000 ha plantation are 40 % below the cost of the lowest cost producing farm in Brazil, the cost of the smaller plantation are only slightly above the cost of the Brazilian farm. Similarly, total cost for the typical farms producing grains are only between 30 % and 67 % of the cost of the German farms (figure 3.2).

The question arises: why are the production costs on the Brazilian typical farms so much lower than on the German typical farms? The detailed cost structure shows that *direct cost* which mainly consist of fertilizer and herbicide cost, amount to comparable levels. In Brazil, these are even slightly higher compared to Germany due to higher fertilizer prices and lower yields. The share of direct cost in total cost is around one third in Germany and 50 % in Brazil. The cost comparison within the Brazilian farm shows differences with respect to herbicide cost, resulting from the different cropping systems. Herbicide cost of the small farm with the conventional cropping system (BR 290ha) are only one third compared to the cost of the two other farms (BR 500ha, BR 1000ha) where production is based on the no tillage system; the latter require higher herbicide inputs due to the absence of mechanical weed treatment.

Figure 3.2: Total cost of winter-barley production in Germany and corn production in Brazil 1998/99 (US-\$/100 kg)



There are considerable differences with respect to the *operating cost*. In Germany, operating cost for grain production are for example between 2 to 6 times higher than in Brazil. Furthermore, in Brazil as well as in Germany, there are relatively high economies of scale realized with increasing farm sizes. The major causes for international cost differences are depreciation for machines and different labour cost.

Overhead cost including cost for maintenance and depreciation of buildings, land improvement investments, energy and water cost, advisor cost, accounting cost, farm insurance, farm taxes and duties, phone and office expenses as well as interest for the German farms are up to seven times higher than for the Brazilian farms. This is mainly because in Brazil, depreciation for buildings is very low and insurance, taxes and duties are not existent or negligibly low.

Land cost have been calculated by adding up the expenses for rented land and the opportunity cost of own land by applying the current regional rental price. Based on these calculations, land cost in Germany are almost five times higher than in Brazil.

Environmental standards and their cost implications

Environmental standards and their cost implications were identified for the oilseed/-fruit and grain production with the following results:

European regulations on the use of mineral and organic nitrogen fertilizers are translated into German law by the so-called Fertilizer Regulation. It specifies for example, that annual nitrogen balance statements have to be produced for farms with more than 10 ha. The cost of soil sampling amounts to about US-\$ 0.03 per 100 kg for grain and US-\$ 0.06 per 100 kg for rapeseed which is in both cases less than 1 % of the total cost. Also for oil palm trees in Indonesia, the fertilizer requirements are normally tested by means of leaf analysis, but costs have not been calculated. While this regulation creates minor costs, nutrient records may also lead to cost reductions through a more efficient adjustment of fertilizer levels to the soil conditions and the plants' needs.

As regards *plant protection*, it was found that in Brazil and Indonesia, some pesticides are applied which are either banned or for which approval has expired in Germany. To be able to quantify the cost of this ban, the additional costs which arise for Germany for using more expensive substitutes were calculated. For substituting Simazin for example, which is banned from use in grain production, higher cost arise for the German grain producers. The difference of US-\$ 33 per ha means a difference of approximately US-\$ 0,4 per 100 kg at yields of 8 t per ha. These costs have been considered in the total cost calculation.

Table 3.1: Simulation of Simazin use in German barley and wheat production

	Unit	Units/ha	US\$/Unit	US\$/ha
Without Simazin				
Round up Ultra	l	0.6	8.6	5.2
Hora Flo (IPU)	l	1.5	7.4	11.1
Foxtril Super	l	1.5	17.2	25.9
Starane 180	l	0.4	34.2	13.7
Total				55.8
With Simazin				
Round up Ultra	l	0.6	8.6	5.2
Simazin 500 liquid	l	0.2	8.9	1.8
Starane 180	l	0.4	34.2	13.7
Hora Flo (IPU)	l	1	7.4	7.4
Total	US\$			22.9
Difference	US\$			32.9
	%			-59%
Source: IFCN, WLZ Raiffeisen AG (1998), Bassermann (1999)				

With respect to cost related to the approval of pesticides it was found that (a) the approval cost charged by the responsible authorities are negligibly low with regard to the development cost of new plant protection substances (b) they certainly have an implicit influence on development cost and, thus, on the final product prices and (c) they cannot be compared due to different price and marketing strategies of pesticide-producers and the insufficient data availability. Furthermore, the case study shows, that the disposal of packages for pesticides is problematic for many farmers in Brazil. In Germany, the chemical industry has established a system called PAMIRA which allows to return the empty packages after use. The collection is free of charge, however, it can be assumed that the costs for disposal are added to the product prices. The additional costs for the disposal in Germany could not be quantified.

There is no indication that differences in design and technical fittings of *machines* in Brazil, Germany and Indonesia are due to environmental standards. However, there are differences in safety standards which can be allocated to social standards which differ within the three countries. The standards for work security are higher in Germany than in Brazil or Indonesia. However, the costs which are mostly included in the prices for buildings or equipment could not be isolated within the framework of this study.

Higher environmental standards were found, isolated and analysed in some *technical security* areas with respect to their cost implications. Thus, it was found that the typical farms have to cover additional cost due to technical security standards (TÜV) for pesticide sprayers in Germany compared to Brazil or Indonesia. However, these costs are negligible (< US-\$ 0.002/100 kg wheat). In Germany, higher cost also arise from the requirements for a special facility area designated for cleaning machines and equipment. Farmers who

decide to build these facilities have to construct a concrete area with oil separator and sewage treatment plant. Also for the establishment of a gas station, the farmers have to cover the cost for technical supervision, for a building permission and for the basin. Table 3.2 shows the assumptions on reductions in investment cost made for the calculations.

Table 3.2: Investment cost for facility area, oil separator and petrol station in Germany

	Unit	100 ha	560 ha	700 ha	1300 ha
Status quo situation					
Facility area (incl. oil separator)	US\$	0	16,666	16,666	27,777
Petrol station	US\$	2,500	8,888	8,888	13,888
Without regulations					
Facility area (incl. oil separator)	US\$	0	0	0	0
Petrol station	US\$	1,466	7,288	7,288	11,533
Difference	US\$	-1,034	-18,266	-18,266	-30,133
Source: IFCN-calculations					

Table 3.3 shows the result of the calculations on a per 100 kg basis. For the typical German farms, additional costs amounted to between US-\$ 0.04 and US-\$ 0.06 per 100 kg rapeseed and between US-\$ 0.006 and US-\$ 0.03 per 100 kg grain.

Table 3.3: Total cost comparison with and without regulations on cleaning place, oil separator and petrol station in Germany (US\$ per 100kg)

	Unit	100 ha	560 ha	700 ha	1300 ha
Rapeseed					
With standards	US\$/100kg	-	31.3	28.7	29.2
Without standards	US\$/100kg	-	31.3	28.0	29.2
Difference	US\$/100kg	-	0.06	0.05	0.04
Winter-Barley					
With standards	US\$/100kg	20.3	15.8	13.6	14.6
Without standards	US\$/100kg	20.3	15.7	13.6	14.6
Difference	US\$/100kg	0.01	0.03	0.03	0.02
Winter-Wheat					
With standards	US\$/100kg	20.2	16.9	16.30	15.49
Without standards	US\$/100kg	20.2	16.9	16.3	15.49
Difference	US\$/100kg	0.01	0.03	0.03	0.02
Source: IFCN-calculations					

For *fuels and lubricants* it can be concluded (a) that in Germany, there is a strong influence of regulatory framework conditions on fuel prices but that (b) there is no indication of different environmental standards leading to a significant price difference of fuel prices between Germany, Brazil and Indonesia. The same has been found with respect to water and waste water, electricity and energy (valid for the year of comparison 1999, before introduction of eco-tax in Germany). Electricity prices in Brazil for example are about half of German prices. However, there is not necessarily a correlation between environmental standards and electricity prices. The typical German farms get their water supply mainly from the public water pipes at prices of US-\$ 1.1 – 2.2 per m³. The total cost for fresh water amount to about US-\$ 1.7 – 3.3 per ha. The fees for waste water amount to about US-\$ 1.7 – 2.2 per m³. In Brazil, the water costs are difficult to quantify since the farmers draw water from their own wells. Also waste water disposal is presently free of charge, but the introduction of fees for waste water disposal has already been announced by the Brazilian government.

Further costs due to environmental standards which are often neglected since they are even harder to be identified and quantified (Chapman et al., 1995). These include labour cost due to additional environmental activities (e.g. time spent on writing environmental reports or on testing pesticide sprayer (TÜV); transport to and loading/unloading of the empty pesticide packages at the nearest place of disposal). However, these additional expenses might be compensated by the benefits of those standards like spraying pesticides more effectively. There are also sometimes costs due to long approval periods and time delays (e.g. in case of new broiler stables in Germany). If these additional cost occur, they can underestimate our final results.

In Brazil, the most important environmental regulation imposed on the typical farms is the law No. 4.771/65 from the year 1965. It has two main parts strongly affecting the land use and land cost: one is called *Legal Reserve*, and the other one *Permanent Preservation Ar-*

reas (PPA). Within the legal reserve, each farmer is obliged to permanently set aside at least 20 % of his land for the purpose of maintaining or replanting local species, mainly trees. Within the PPA, farmers have to permanently set aside stripes along rivers, lakes and waterways for nature conservation. However, due to insufficient enforcement, these standards are in most cases not or only partly cost effective. If the laws were strictly enforced, the Brazilian soybean farmers would have in extreme cases up to 15 - 23 % higher production cost.

Table 3.4: Cost effect of strict enforcement of the law on legal reserve in Brazil

	Unit	290 ha	500 ha	1000 ha
Soybean				
Status quo	US\$/100kg	20.6	20.5	14.3
With 20 % add. LR	US\$/100kg	23.8	25.3	17.1
Difference	US\$/100kg	3.2	4.8	2.7
Difference	%	15%	23%	19%
Corn				
Status quo	US\$/100kg	9.2	9.0	7.3
With 20 % add. LR	US\$/100kg	10.7	10.5	8.6
Difference	US\$/100kg	1.5	1.5	1.2
Difference	%	16%	17%	16%
Exchange rate DM/Real: 1.4; US-\$/DM: 1.8; LR = Legal Reserve				
Source: IFCN-calculations				

Similarly, the production costs of the palm oil producers in Indonesia would increase in case of a strict enforcement of the *Zero-Burning Law* which bans the use of fire for forest conversion. The additional cost for mechanical land clearing methods are roughly estimated to total some 20 - 25 % of the establishment costs of the plantation.

Processing cost of oilseeds and -fruits

The total cost of processing were estimated to amount to about US-\$ 26 - 39 per t crude oil for the German rapeseed processors, about US-\$ 20 - 36 per t for the soybean processing enterprises in Brazil and to US-\$ 31 - 33 per t crude oil for the Indonesian palm oil producers. Compared with the Brazilian processors, the cost for energy, taxes, insurance and especially depreciation are significantly higher in Germany. The latter is based on the fact, that Brazil has comparative advantages due to its climate. Processing for example takes place in open buildings. Thus, expensive investments in equipment for explosion protection which is essential in closed buildings like in Germany are not needed.

Significant scale effects were observed in the different processing mills. While a German medium-sized oil mill with a processing capacity of 300,000 t crude oil per year has total cost of US-\$ 39 per t crude oil, the cost of a large (1 million t crude oil per annum) and a very large oil mill (capacity of 2.5 million t crude oil per annum) amount to US-\$ 29 and

US-\$ 26 per t, respectively. Thus, the scale effects decrease with increasing sizes of the mills.

For the German rapeseed processing mills, relatively higher standards and costs caused by environmental regulations have been found compared with the soybean processing industry in Brazil and the palm oil mills in Indonesia. While in Germany, these additional costs amount to US-\$ 1.3 - 2 per t crude oil, which is equal to about 5 % of the processing costs, the corresponding values in Brazil amount to US-\$ 0.2 - 0.3 per t soy oil (0.5 - 1 % of the processing costs) and in Indonesia to US-\$ 0.1 - 0.4 per t (0.4 - 1.1 %).

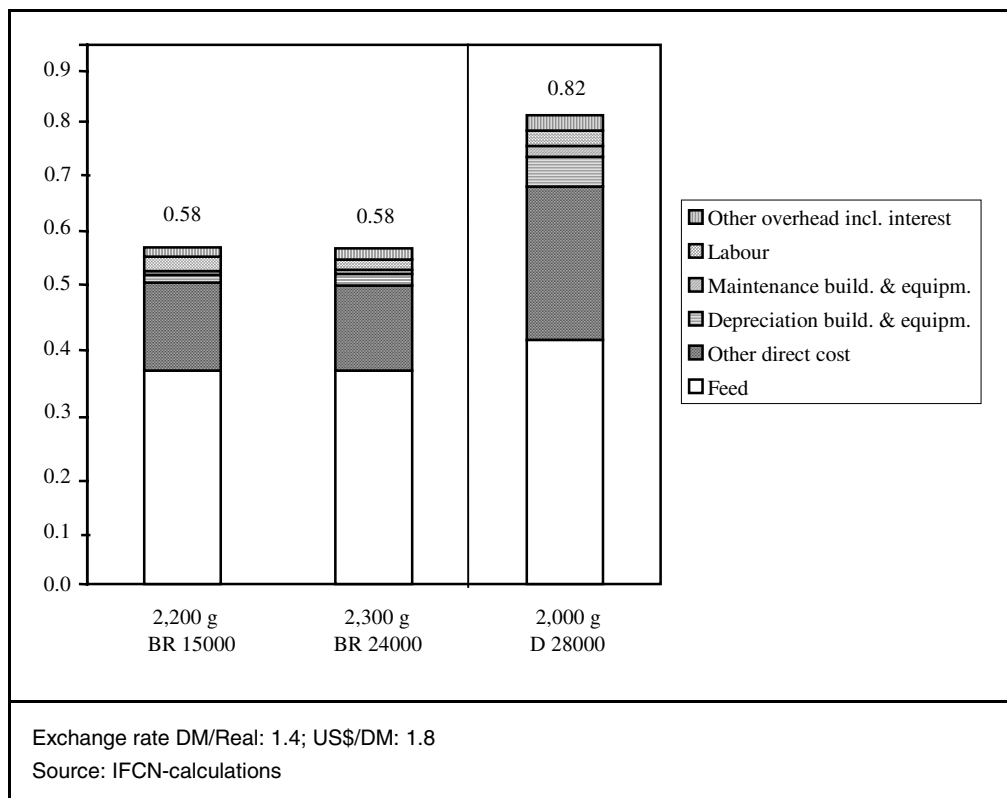
Considerable country- and product-specific differences exist with respect to the establishment of new processing mills, for explosion protection, air pollution control as well as the clearing of waste water. These differences refer not only to investments needed to meet environmental standards but also to operating cost.

3.2 Empirical results for broiler

Production cost

Total production cost for the two typical Brazilian broiler farms are comparable and amount to about US-\$ 0.6 per kg live weight (LW) with only minor differences in the cost composition. Total cost for the German farm amount to US-\$ 0.8 per kg LW. The corresponding values per broiler produced are US-\$ 1.3 for the small Brazilian farm (15,000 broiler), US-\$ 1.4 for the larger Brazilian farm (24,000 broiler) and US-\$ 1.6 for the German farm (28,000 broiler).

Figure 3.3: Total cost of broiler production for typical farms in Brazil and Germany 1998 (US-\$ per kg LW)



Direct cost include feed cost and other direct cost, with the latter representing cost for broiler chicks, vet and medicine, bedding, cleaning and disinfections as well as electricity, water and gas. In Brazil, the total direct cost amount to about 90 % of the total production cost, while in Germany this share is about 85 %.

Feed cost are both in Germany (US-\$ 0.43 per kg LW) and Brazil (US-\$ 0.37 per kg LW) by far the most important cost component. Their share accounts for 52 % of total cost on the German farm and 63 % on the Brazilian farms. These differences in feed costs are based on differences in feed prices (Brazil: US-\$ 0.19 per kg, Germany: US-\$ 0.23 per kg) and in feed conversion rates (Germany: approx. 1:1.8, Brazil: approx. 1:2.0) between the farms.

Other direct cost range between US-\$ 0.27 per kg LW in Germany (one third of the total cost) and US-\$ 0.15 per kg LW in Brazil (one quarter of the total cost). The most important cost item in both countries is the purchase of broiler chicks, varying between US-\$ 0.11 per kg LW in Brazil and US-\$ 0.18 per kg LW in Germany. The second most important cost component in Germany is electricity, water and gas (US-\$ 0.03 per kg LW), followed by expenses for vet and medicine (US-\$ 0.02 per kg LW). The latter are slightly lower in Brazil than in Germany, but still accounting for the second most important cost item.

Depreciation and maintenance cover buildings and equipment. In Germany, these cost amount to US-\$ 0.06 per kg LW for depreciation and US-\$ 0.02 per kg LW for maintenance. Thus, they are 4 - 5 times higher than in Brazil. This is not surprising considering

the investments in buildings and equipment. Capital investment in buildings range between US-\$ 37,200 and US-\$ 65,600 for the two farms in Brazil, whereas in the case of Germany the buildings cost around US-\$ 229,000. The respective values for equipment vary between US-\$ 77,200 and US-\$ 36,100 for the Brazilian farms and amount to US-\$ 84,400 for the German farm. This big difference between the Brazilian farms is mainly due to the fact that the small farm uses relatively old technology and manual feeding. The share for depreciation and maintenance in total cost varies between 3 – 4 % on the Brazilian farms and 6 % on the German farm.

Labour cost cover both wages and salaries as well as opportunity cost for the farmer's household labour input. They range between US-\$ 0.03 per kg LW on the small Brazilian farm and US-\$ 0.02 per kg LW on the larger Brazilian farm. In Germany, labour cost amount to US-\$ 0.03 per kg LW. Labour cost contribute between 3 and 4 % of total cost on all farms considered.

Other *overhead cost including interest* range between US-\$ 0.02 per kg LW for the Brazilian farms and US-\$ 0.03 per kg LW for the German farm. This is equal to about 3 % of the total cost on all farms considered.

Environmental standards for broiler production

The analysis showed that the cost disadvantages deriving from environmental standards mainly exist with respect to buildings and equipment on the German broiler farm. In this context, animal welfare protection standards are interpreted as environmental standards in their broadest sense. Costs caused by German regulations which do not exist in Brazil were calculated and then deducted from the total production cost of the German broiler farm. The German regulations include standards for

- Environmental protection according to the Federal Emission Control Act: floors of concrete with certain reinforcement and thickness; platform for dung, developing costs for water and electricity due to distance to village. An example of the calculation of the investment cost for broiler production with and without environmental standards is given in Annex 1.
- Animal welfare protection: certain no. of windows in the outer walls (3 % of the floor-space); certain no. of feed and drinking troughs and nipples; roof ridge ventilation; cooling-system; alarm system for climatic regulation and power supply; emergency generator.
- In addition: conservation of landscape (buildings to be painted on the outside) and working security (automatic trough winding system).

The additional cost for the German broiler farm which derive from these environmental and animal welfare protection standards total some 2.7 % of the total cost. However, it can be assumed that some of these measures might have been realized even without the existence of any regulations. In particular, cooling and alarm systems can prevent death of animals in case of emergency. Thus, they are not only relevant from the perspective of animal welfare protection but also from an economic point of view.

It should be noted that these additional cost can be quite significant for a broiler producer with low profit margins. Furthermore, control and planning cost (e.g. time spent for

meeting security officers, or for delivering environmental reports) can occur. For example, approval cost and opportunity cost due to time delays (up to a few years for the establishment of a broiler stable in Germany) can be significant market entry barriers. Thus, in some cases, the question appears not whether environmental cost lead to higher cost of production but whether any new stables or an expansion of the production capacity will be approved at all ('license to produce').

Processing cost

A considerable difference of up to US-\$ 15 per 100 kg LW has been found between the slaughtering cost in the surveyed broiler processing industries in Brazil and Germany. While experts estimate costs for slaughtering broiler in a Brazilian processing plant to reach some US-\$ 14 per 100 kg LW, the cost in a German processing plant amount to US-\$ 29 per 100 kg LW. Thus, the German costs are more than twice as high as in a comparable Brazilian plant. This result cannot be considered as representative, however, the more detailed comparison indicates some interesting country-specific cost differences.

To a large extent, these differences are based on additional cost due to environmental standards which exist in Germany but not in Brazil. Especially with respect to the waste water disposal and the process quality control, the German processing plant has significantly higher expenses than the Brazilian one. However, it cannot be concluded that the quality of the final products is superior based on the higher costs for quality control e.g. since the wage level of the controllers is much lower in Brazil than in Germany.

Considerable cost advantages for Brazilian plants derive from the sale of waste products from processing. In Germany, however, these waste products do not have any market value. On the contrary, it is expected that the German plants might have to pay for disposal of the waste products in the future.

The largest share of the additional cost in Germany result from the use of the air-cooling system compared with the less expensive water-cooling system used in Brazil. The use of air-cooling systems improves the quality of the final product. The incentive for the German plants to shift from water- to air-cooling systems was based on the expectation that higher prices due to better quality would materialize through the carcass classification scheme. However, a respective change of the classification system has not been introduced yet, opposed to the expectation of the German industry.

With respect to environmental standards, expert interviews with representatives from the German broiler processing industry indicated that their level is extremely high. For the German plant, total cost of US-\$ 4.8 per 100 kg LW were estimated to result from environmental standards. This is equal to almost 17 % of the total processing cost. For Brazil, these additional costs were estimated to amount close to US-\$ 0.55 per 100 kg LW or 4 % of the total cost.

Additional cost which have not been considered within this study because they are only relevant in exceptional cases, can be caused by administration and time delays. These can be prohibitively high in Germany, thus creating barriers of market entry. Additional cost also include losses in productivity due to the stopping or slowing down of the processing process in cases of environmental or security problems. However, with respect to the latter it is not clear whether any differences exist in an international comparison.

3.3 Transferability of environmental standards to other countries

In addition to the analysis of the cost effectiveness of environmental standards, the following questions were asked: Does it make sense to transfer environmental standards from one country to another? Is there a need to harmonize product-specific standards internationally? These questions can be tackled by comparing production systems and the environment in the three countries. With respect to plant production, the following features have been identified: First, it has been found that Brazil and Indonesia use pesticides (Atrazin, Simazin in Brazil and Sevin [with the active substance Carabyl] in Indonesia) which are not anymore approved in Germany. All three pesticides, however, are approved in other EU countries and the USA. Atrazin and Simazin even play a major role in the USA. In Brazil and other EU-countries also an insecticide with the active substance Tri-flumuron is allowed, which was found to be not approved anymore in Germany. However, the reason for the chemical industry not to extend the permit of using this insecticide in Germany after 1998, was not based on stricter environmental laws but rather on the fact that it was used only in greenhouses so that the market for selling the product in Germany was too small. Carbaryl, an active substance in a pesticide in use in oil palm production in Indonesia was forbidden in Germany based on the directive on bee protection which classifies the substance as hazardous to bees, especially the European honey bee. In Indonesia, a respective prohibition is not needed because first, the European honey bee does not exist in this part of the world, and second, the palm oil trees are neither fructified nor used as pasture-ground by domestic bees. Therefore, it is necessary to consider environmental factors when analysing the transferability of standards to other countries. Neglecting these factors may lead to quick misinterpretations and prejudices.

The intensity of production and also the level of yields in typical Brazilian farms in oil-seed and grain production are comparatively lower than the German ones. Obviously, the need for fertilizer per ha is relatively lower in Brazil than in Germany. Taking into account the yields, rapeseed in Germany has relatively higher physical P-, K- and Ca-efficiency than soybean in Brazil (indicated in kg nutrients per 100 kg yield). The nitrogen efficiency seems to be higher for corn in Brazil than for wheat and barley in Germany, while the relations between the other nutrients are the other way around. However, no statements can be drawn from these figures about the necessity of internationally harmonized environmental standards for fertilizer, for example for the protection of ground water, because fertilizing depends on regional soil and climate conditions.

The analysis of environmental standards at processing level shows that the need and the setting of standards is mainly determined by different processing methods and also different natural local conditions. For example the regulations for oilseed plants with respect to explosion and emission protection are especially strict and costly. In Brazil, these standards are of no relevance because the soybean processing takes place in open buildings where there is no danger of explosion due to the accumulating hexane gas. Palm oil in Indonesia again is gained through pressing, rather than extraction—also in open buildings.

For broiler production and processing, the environmental and animal welfare protection standards in Germany are relatively higher than in Brazil. But again, many of these regulations refer to buildings which are not relevant for Brazil where the broiler are normally kept in open Louisiana-type of stables.

With respect to the stocking rate, there are significant international differences. On the typical farms in Brazil, about 12 - 16 broiler have been found per m², while on the German farm, the number amounts to about 23 broiler per m². Good health of the broiler is, however, not only determined by the stocking rate but also depends e.g. on the temperature or on economic reasons. Higher stocking rates were tested on some Brazilian farms in the past, and it was found that the broiler compete too much on food and water, thereby climbing and picking on each other with resulting skin damages. Carcasses with skin damages have been rejected by consumers. Thus, different factor price relations and consumer preferences resulted in Brazil even in lower stocking rates than regulated in German decrees.

In general it has been found that the regulations regarding air emissions like odour and the landscape are relatively strict in Germany. The introduction and implementation of these regulations is mainly due to the higher population density in Germany and the preferences of the society for a high environmental quality compared with the other two countries. In Brazil, these kind of regulations play only a minor role since the broiler producers are mostly located in relatively big distance to settled areas. Considering the relatively low population density in some remote production areas, it is debatable to what extent the introduction of corresponding environmental standards would be appropriate in Brazil and Indonesia.

4 Summary

The case studies for selected agricultural products in Brazil, Indonesia and Germany have shown that the impact of environmental standards on the production cost is relatively small in case of the typical farms considered. In Germany, environmental standards cause additional costs of 0.3 - 4.4 % of the total production costs for rapeseed, grain or broiler production on typical farms. These standards mainly refer to the use of fertilizer, pesticide and to technical security. In Brazil and Indonesia, current environmental laws (like Legal Reserve Law in Brazil and the Zero-Burning Law in Indonesia) are at least partly neglected and hardly enforced resulting in large cost savings. However, total cost differences, especially due to different wage levels, prices for machines, buildings and equipment, show that the compliance costs deriving from environmental standards are relatively small and insignificant for impacting on the international competitiveness. Even if the laws were enforced in Brazil e.g., the total cost for the typical soybean producers would be still in two extreme cases around 10 - 45 % below the costs of the German rapeseed farms, and for grain production, the total production costs of the Brazilian farms would be about 20 % to almost 50 % below the costs of the German farms.

At processing level, the results are ambiguous. Environmental standards in the German oil mills cause additional cost of about 5 % of the total processing cost. For the soybean processing enterprises in Brazil the corresponding values range between 0.5 - 1 %, and for the Indonesian palm oil producers between 0.4 - 1.1 %. Major product-specific differences in the three countries exist with respect to the establishment of new processing mills, for explosion protection (only necessary in Germany due to processing in closed building), air pollution control and clearing of waste water. The total cost differences have been found to be less significant. Costs of environmental standards for the processing of broiler were, based on expert interviews, estimated to amount to 17 % of the total processing costs

compared with 4 % in Brazil. Especially standards with respect to waste water disposal and process quality control were found to be cost-intensive in Germany. There have been also significant total cost differences of around 50 % between the German typical farm and the two Brazilian farms.

The case studies have also shown that the standards are not easily transferable from one country to another, given the differences in terms of climate, population density as well as differences in the scarcity of environmental goods. This is especially of relevance for standards referring to buildings (no. of windows in broiler stable; explosion control in oilseed processing etc.) or to the use of certain pesticides (different effects in tropical or non-tropical environments). Environmental standards are often well adjusted to the respective environments in the different countries and regions. However, enforcement needs to be improved to avoid possibly significant adverse environmental externalities (such as overextended land use in Brazil and forest burning in Indonesia) in the context of liberalized trade with agricultural products. This refers especially to the expansion of agricultural production of exported soybeans in Brazil or palm oil in Indonesia.

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Annex 1: Investment cost and resulting unit cost for broiler production with and without environmental standards in Germany

	Unit	Status quo 1	Without standards 2	Difference US\$ 3 (2-1)
Investment cost (Barn size 80 m * 18 m = 1,440 m²)				
Construction	US\$	229,000	176,000	-53,000
Building	US\$	216,000	176,000	-40,000
Manure area	US\$/m ²	150	122	-50
Development cost	US\$	6,111	0	-6,111
Feeding and drinking	US\$	28,800	26,360	-2,450
Feed storage and transport	US\$	10,180	10,180	0
Feeding system	US\$	9,560	8,580	-980
Drinking system	US\$	9,095	7,600	-1,495
Climate system	US\$	36,000	23,000	-13,000
Ventilation	US\$	25,560	17,670	-7,890
Heating	US\$	5,320	5,320	0
Cooling	US\$	5,190	0	-5,190
Electrical installations	US\$	19,460	14,490	-4,970
<i>Total</i>	US\$	<i>313,425</i>	<i>239,840</i>	<i>-73,585</i>
Unit cost				
Total annual production	kg LW	378,398	378,398	0
Depreciation	US\$/kg LW	0.052	0.04	-0.01
Construction	US\$/kg LW	0.03	0.02	-0.01
Feeding and drinking	US\$/kg LW	0.01	0.01	-0.01
Climate system	US\$/kg LW	0.01	0.01	-0.003
Electrical installations	US\$/kg LW	0.01	0.004	-0.001
Maintenance	US\$/kg LW	0.018	0.014	-0.004
Construction	US\$/kg LW	0.01	0.01	-0.002
Feeding and drinking	US\$/kg LW	0.01	0.01	0.000
Climate system	US\$/kg LW	0.01	0.01	-0.001
Electrical installations	US\$/kg LW	0.01	0.01	-0.000
Interest	US\$/kg LW	0.03	0.02	-0.006
<i>Total</i>	US\$/kg LW	<i>0.096</i>	<i>0.073</i>	<i>-0.023</i>
Source: IFCN-calculations, based on data and information obtained from industry; US\$/DM: 1.8				