Institute of Farm Ecology

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International competitiveness of soybean, rapeseed and palm oil production in major producing regions

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Abbrevations

AIDA	=	Agricultural Income Disaster Assistance (Canada)
AMS	=	Aggregate Measure of Support
AMS	=	Agricultural Marketing Service of USDA
AMTA	=	see PFC
ARS	=	Agricultural Research Service of USDA
ARG$	=	Argentinian Peso
bu	=	Bushel
°C	=	Grad Celsius
CAN$	=	Canadian Dollar
CAP	=	Common agricultural policy
CCC	=	Commodity Credit Corporation (USA)
CIF	=	Cost, Insurance, Freight
cm	=	Centimiter
CPO	=	Crude palm oil
CT	=	Conservation tillage
DGE	=	Directorate General of Estates, Ministry of Agriculture (Indonesia)
DM	=	German Mark
e.g.	=	For example
GCM	=	Gross Crush Margin
GPD	=	Gross Domestic Product
dt	=	100 kg
EMZ	=	Yield point according to German classification system
EPV	=	Estimated Processed Value
ERS	=	Economic Reseach Service of USDA
EU	=	Europian Union
EURO	=	Currency of the EU
FAL	=	Federal Agricultural Research Centre in Braunschweig, Germany
FAO	=	Food and Agriculture Organiation of the United Nations
FAS	=	Foreign Agricultural Service of the USDA
FELCRA	=	Federal Land Consolidation and Rehabilitation Authority (Malaysia)
FELDA	=	Federal Land Development Authority (Malaysia)
f.f.a.	=	Free fatty acids
FFB	=	Fresh Fruit Bunch
FOB	=	Free on Board
GDR	=	German Democratic Republic
GMO	=	Genetically Modified Organism
ha	=	Hectare
HPRS	=	Household Production Responsibility System (China)
IFCN	=	International Farm Comparison Network
IIASA	=	International Institute for Applied Systems Analysis

JAWF	=	Joint Agricultural Weather Facility of USDA
LDP	=	Loan Deficiency Payment (USA)
LL	=	Liberty Link variety
MAL	=	Marketing Assistance Loan (USA)
MCI	=	Multiple Cropping Index
MLA	=	Marketing Loss Assitance Payment (USA)
m	=	meter
mill.	=	Million
mm	=	Millimeter
MPOB	=	Malaysian Palm Oil Board
MRB	=	Malaysian Rubber Board
MT	=	Minimum Tillage
NASS	=	National Agricultural Statistics Service of USDA
NISA	=	Net Income Stabilization Account (Canada)
PFC	=	Productin Flexibility Contract payment (USA)
PK	=	Palm Kernel
PO	=	Palm Oil
PPO	=	Processed Palm Oil
PORLA	=	Palm Oil Registration and Licensing Authority (Malaysia)
PORIM	=	Palm Oil Research Institute of Malaysia
PPP	=	Purchasing Power Parity
PPKS	=	Indonesian Oil Palm Research Institute (IOPRI)
PS&D	=	Production, Supply and Distribution (PS&D) online database of FAS
RCRE	=	Reserch Center for Rural Economy (China)
RISDA	=	Rubber Industry Smallholders Development Authority
RE	=	Rapeseed equivalent
RM	=	Malaysian currency
RMA	=	Risk Management Agency of USDA
RMB	=	Chinese currency
Rp	=	Indonesian currency
RR	=	Roundup Ready variety
R-$	=	Real
t	=	Ton
TIPI-CAL	=	Simulation model used in the IFCN
TRQ	=	Tariff Rate Quota
US-$	=	US-Dollar
USA	=	United States of America
USDA	=	United States Department of Agriculture
WGTA	=	Western Grain Transportation Act (Canada)
WTO	=	World Trade Organization
VAT	=	Value Added Tax
ZT	=	Zero Till (conservation tillage)

1 Introduction

1.1 Problem setting and objectives of the study

On-going liberalization and globalization of world markets, as observed with WTO expansion (recent entry of China and current negotiations with Russia), Agenda 2000, the recent approval for admission of the central European countries to the EU, is leading to a consolidation of markets and consequently to a more competitive international market environment. Under such conditions the European producers will have to face stronger competition not only regionally, but internationally as well. Thus, there is growing concern in Europe about the competitiveness of agricultural production. This is a major concern in the oilseed sector, where the seeds and processed products, namely vegetable oils and protein meals, are easily moved from one location with comparative production advantage (e.g. South America) to another (e.g. EU or China). The situation is aggravated by the fact that with technological innovation the processed products become more substitutable for one another.

In the last two decades, the world production of oilseeds and consequently processed products has more than doubled (Figure 2.1). The trade in oilseeds and processed products doubled on par with production (Figure 2.2). In volume terms, almost one third of produced meals and vegetable oils are exported. Seed exports are one fifth of the total production. During this period, the role of the major producers and consumers has changed markedly. On the supply side, Argentina and Brazil have emerged as major competitors for the United States in supply of soybeans and processed products. Malaysia and Indonesia have become the major suppliers of vegetable oil, namely palm oil, reaching a 50% share in total vegetable oil exports. On the demand side, China has emerged as a second major buyer, after the EU, of oilseeds and processed products due to a growing demand for meat and vegetable oils.

These and other developments in the world market can be explained by a shift in the level of competitiveness between countries as well as commodities traded in the international market. In an integrated world economy, it is vital for producers and agribusiness involved in production and trade to know the competitive position and future potential of major participants in the world oilseed sector.

For bulk commodities such as oilseeds and their processed products exist strong price competition between suppliers. Even though in some markets there exist imperfect competition[1] between commodities they are substitutable and their prices are inter-related. Thus, estimation of production costs and additional costs of transportating the commodity to the buyer may be useful in estimating competitiveness. Only those suppliers who deliver their commodity with profit under existing market conditions may sustain their operation and gain market share.

The level of production costs are influenced by different factors such as climate, macro-economic and sector-specific policies, infrastructure, and supporting institutions. Therefore, in order to better understand the competitive position of the analyzed countries and their competitive potential for the future those factors should be included in the analysis.

The major objectives of the study are following:

– Analysis of oilseed production costs of specialized arable farms in the major production regions in Argentina, Brazil, Canada, China, Germany, Indonesia, Malaysia and the USA;
– Analysis of major framework conditions (natural, economic, technological, political) influencing competitiveness of oil crop production at the selected locations;
– Analysis of production systems of selected oil crops at the selected locations;
– Development of an approach to make possible comparison of different commodities: soybeans, rapeseed and palm oil;
– Estimation and analysis of delivery costs of commodities from farm to the export destination;
– Estimation of processing costs of soybeans, rapeseed and palm fruits.

1.2 Structure of the study

Chapter 2 provides a descriptive overview of the world oilseed sector. Production and trade of major commodities and their importance in the world oilseed sector is discussed. Major producing countries and major trade participants of the selected commodities are identified. This chapter serves as a basis for the selection of commodities and countries for the analysis.

[1] In the EU palm oil is used mainly for industrial purposes (edible and non-edible) whereas soybean and rapeseed oil used directly for human consumption. On contrary to the EU, in Asia all three types of oils are widely used for human consumption and compete equally for the market share.

Chapter 3 reviews methodological aspects of the analysis. Problems involved in the international comparison of production costs are discussed and appropriate solutions are sought for.

Chapters 4 through 10 provide detailed information on countries selected for analysis. Country chapters include general information on agriculture, production history of oilseeds and major competing crops, climate and soils conditions, expansion potential, agricultural policies. Special emphasis in each country chapter is given to detailed analysis of production systems and productions costs of oilseeds at the selected locations.

Chapter 11 summarizes the major findings of the country chapters and provide an international comparison of production costs with analysis of the reasons for difference between selected locations. As delivery costs from farm to the export destination play a considerable role in the competitiveness position of each country estimates of these costs are added to farm level production costs and their influence is discussed. Processing costs are estimated for the selected commodities as well. Sensitivity analysis study the influence of alternative exchange rates and rapeseed equivalent coefficients on the results. Finally, problems of estimating opportunity costs of labor in China are discussed, and recommendations for further research are given.

2 World oilseed sector

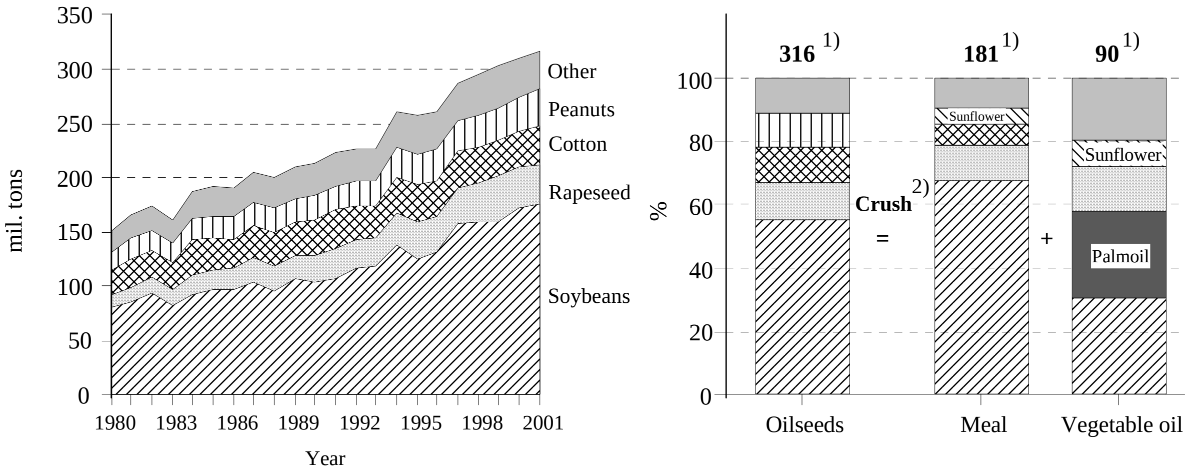
Oilseeds and their products are one of the most important categories of agricultural commodities traded on world markets based on value of trade.

A simple description and overview of the world oilseed sector is made difficult by the fact that there are about 10 different major oilseeds, 11 different meals and high protein feeds, and 17 different oils and fats that are produced and traded in the inter-related world market. These commodities are price inter-related, to varying degrees, due to substitution in utilization and/or production. The overview will focus primarily on three major commodities of the world oilseed sector: soybeans, rapeseed and palm oil.

Virtually all oilseeds are crushed and processed to produce oil and meal. The large majority of vegetable oil is used for human consumption, although relatively small and growing quantities are utilized for industrial purposes. For tropical oils (palm oil and coconut oil), industrial use makes up a considerable portion of total consumption. Meal is used predominantly for animal feed, although in certain countries is also used as a fertilizer. It is important to recognize that oilseed prices, and eventually their level of production and consumption, are determined by the supply and demand situation for both the oil and meal markets.

Oilseed production and consumption has increased dramatically over the past two decades (see Figure 2.1). The strong growth rate was due to strong demand from improvements in diets throughout most of the world and growing world population.

Figure 2.1: World production of oilseeds, vegetable oils and meals



1) Total in million tons for 2001.
2) 83 % of the total produced oilseeds were crushed in 2001.
Source: USDA-PS&D (2001).

Park_2002-10-10

There are 10 major oilseeds produced in the world, however only seven of these play a role in the world edible oilseed market. The four oilseeds account for over 85 percent of total oilseed production. Ranked in order of importance of production these are: soybeans (56 %), rapeseed (12 %), cottonseed (11 %), and sunflower (7 %) (Table 2.1). Other less important oil crops, particular in world trade are: peanuts, copra, palm kernel, linseed, castor seed and sesam seed.

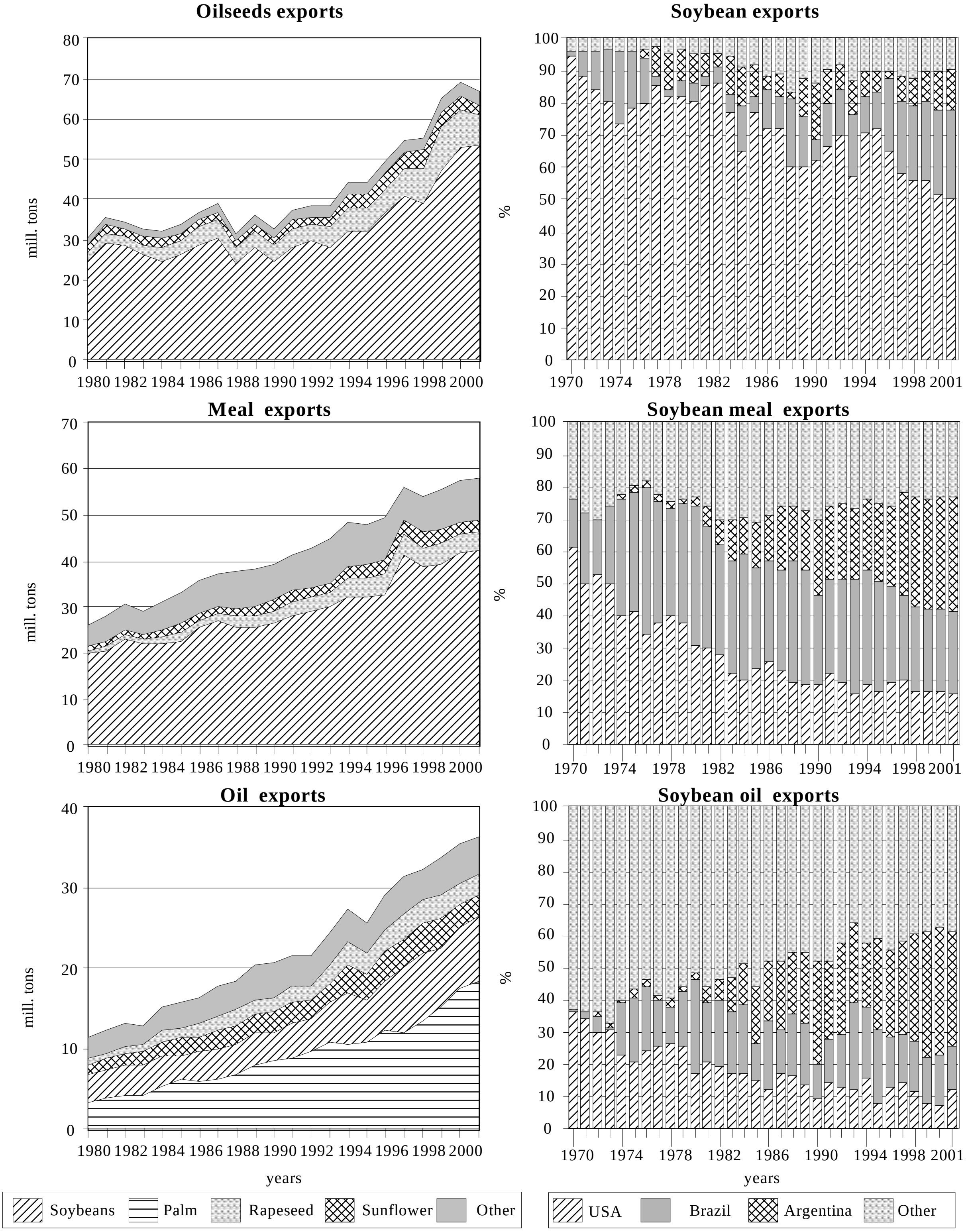
Table 2.1: Major oilseed producers, exporters and importers, 2000

	World oilseeds production			Exports			Imports	
Commodity	Share [%]	Region	Share [%]	Share [%]	Region	Share [%]	Region	Share [%]
Soybeans	**55.6**			**76.4**				
		USA	43.8		USA	51.5	EU [1]	31.9
		Brazil	21.8		Brazil	26.5	China	24.8
		Argentina	15.1		Argentina	11.8	Japan	9.1
		China	8.9				Mexico	8.3
Rapeseed	**12.1**			**14.0**				
		China	30.4		Canada	49.3	EU [1]	31.7
		EU (Germany)	24.4 (9.6)		EU [1]	26.3	China	25.0
		Canada	19.0		Australia	14.0	Japan	22.4
		India	9.9					
Cottonseed	**10.8**			**1.9**				
		China	21.1		Australia	43.0	Mexico	22.6
		USA	18.1		USA	16.5	USA	21.0
		India	16.2		EU [1]	14.2	EU [1]	19.1
		Pakistan	9.5				Japan	12.9
Sunflower	**7.4**			**5.0**				
		Russia	17.1		Russia	23.2	EU [1]	75.7
		Ukraine	15.3		Ukraine	26.9	Spain	16.6
		EU	14.6		EU [1]	17.6		
		Argentina	13.9					
Other	**14,1** [2]							

1) Including intra-european trade.
2) Peanuts, palm kernel, flaxseed, copra, sesam, castor.
Source: USDA-ERS, PS&D database, Own calculations. Park_2002-10-09

Soybeans and soybean meal dominate in the oilseed and meal trade, palm oil is leading in the vegetable oils trade (Figure 2.2).

Figure 2.2: Exports of oilseed and processed products, mill. t, 1980 to 2001



Source: USDA-ERS, PS&D database, own calculations (2003).

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Soybeans are the world's dominant oilseed crop and prices for soybeans have a major influence on prices of other oilseeds. Soybean meal is considered the premium oilmeal, with a high protein content (44 to 50 percent) and good palatability. Soybean oil requires little processing and is also considered a good quality oil for variety of foods. Small amounts of soybeans are used to produce tofu, soy sauce or snacks.

Soybeans accounted for 56 % of the world oilseed production and 76% of the oilseed trade in 2000 (Figure 2.1 and 2.2, Table 2.1). The United States is the largest soybean producer in the world contributing 44 % of the total soybean production (Table 2.1). Other major soybean producing countries include Brazil (22 %), Argentina (15 %) and China (9 %). The production and trade shares have changed considerably over the last decades. In the mid- to late 1970s, the United States dominated world oilseed production and trade. Market share in seed trade was over 70 percent, in meal and oil trade over 30 %. However, in the beginning of the 1980s Brazil and Argentina have emerged as major competitors to the USA. The USA yielded a considerable share of soybean meal and oil trade to both competitors from South America. Later on, in the mid of the 1980s, they have started to gain market share in the soybean trade as well (Figure 2.2). The major reason for dominating Argentina and Brazil in the trade of processed products was a result of differentiated taxation that was encouraging processing of soybeans domestically and export processed products.

The EU dominates the soybean seed and meal import markets, accounting for about one third of the world oilseed imports and was single largest soybean meal importer (Table 2.1). Other major soybean importers are China (25 %), Japan (9 %), and Mexico (8 %). However, China, a major soybean producer, has only recently emerged as a major importer of soybeans to respond to the rapid increase of demand for meal and oil that could not be covered by domestic production.

Rapeseed accounts for only about 12 percent of world oilseed but is the second most important oilseed crop traded on world markets. Rapeseed accounts for 14 % of total oilseed trade and a slightly lower share of the world oil and meal trade levels (Figure 2.2). Rapeseed production is concentrated in China (30 %); the EU (24 %), Canada (19 %) and India (10 %). However, Canada is the principal exporter of rapeseed (canola) and processed products accounting for 49 % of the world rapeseed exports with the largest share going to Japan and China. Relative small portion of rapeseed meal and oil is traded (Table A1.1 in Appendix). The USA is the major importer of rapeseed meal and oil.

World rapeseed production has grown at a faster rate than any of the major oilseeds, other than palm oil, over the last few decades (Figure 2.1). Most regions in the world produce winter rapeseed, whereas the spring varieties are dominant in Canada. The major cause of the increase in production and demand is the development of rapeseed with low erucic acid in the oil and glucosinolates in the meal (so-called canola in Canada or 00-varieties in the EU). Glucosinolates are a compound in the meal which limits its utilization and palatability in animal feeds. The elimination of erucic acid content in the oil has increased its value for human consumption, it is now considered a premium quality vegetable oil.

Palm oil, and to lesser extent, palm kernel production, have become extremely important players in the oilseed market. A fresh fruit bunch contains about 20 percent oil, a pulp of limited value and palm kernels. Palm kernels are removed from the palm fruit and processed into meal and palm kernel oil. Trade in kernels is limited, although palm kernel meal and palm kernel oil is gaining in importance with rapidly growing palm oil production. Palm trees produce the most oil per unit area, with about 3 to 5 t of oil per hectares. By comparison, even the high German rapeseed yields result in less than 1.5 t of oil per hectares (Figure 11.1 in Chapter 11).

Palm oil is produced in tropical countries, with Malaysia and Indonesia accounting for the majority of production (52 % and 30 %) and exports (61 % and 28 %) (Table A1.1 in Appendix). Palm oil accounted for about 27 % of world vegetable oil production and 50% of trade in 2000 (Figure 2.1 and 2.2). India, the EU, China and Pakistan are the major importers of palm oil. However, the EU has imported most of palm oil for industrial (food and non-food) purposes as consumers appear to be concerned with the high level of saturated fats in palm oil. This is the case with North America as well. Asian countries have imported palm oil primarily for food purposes.

Oilseed meals are the primarily source of protein in animal feeds. Many countries produce livestock under high intensity production system which require the utilization of compound feed. This is particular true in the production of pig, dairy and poultry. The value and utilization of any particular oilseed meal in compound feeds is influenced by both economic and technical factors. Economic variables, include factors such as the relative price of alternative feeds and the elasticity of the livestock supply with respect to feed prices. The demand for different types of meal is also dependent on physical differences between the oilseed meals in terms of: palatability, digestibility, the nutritional balance of absorbed amino acids (usable protein), and the presence of any toxic factors. Soybean meal contains 44 to 50 percent protein while other oilseed meals range between 35 to 40 percent. Oilseed meals are therefore referred to as high protein products, in contrast to cereals which only contain 6 to 15 percent protein and are thus regarded as primarily energy sources. Substitution between different oilmeals and most other protein sources is based on price differentials and is normally limited when price changes are small or are considered to be a short term phenomena.

Soybean meal is the most extensively used oilmeal in the world and serves as a protein supplement for all classes of animals. Given soybean's higher protein content compared to other oilseeds, soybean meal makes up over 60 percent of the total supplies of world oilseed protein meal (Figure 2.1). The meal content of soybeans is the highest of any of the oilseeds at approximately 80 percent, however, on a value basis soybean meal accounted for 71 percent of the value of the bean (Table 3.4).

Rapeseed meal has traditionally been used as a fertilizer or soil conditioner, a practice which still persists today in China. Its use in animal feeds was historically severely limited due to the presence of glucosinolates in the meal, a toxic substance which reduces palatability and lowers growth rate of animals. However, with the development of low glucosinolates varieties (known as 00-varieties in Germany, or canola in Canada and Australia), the constraint on the use of the meal in feeds was lifted. Rapeseed and canola meal contains 35 to 38 percent protein, although it has higher crude fiber content than soybeans, which lowers its value in the use of food for non-ruminants.

Oilmeal substitutes

The compound feed industry uses least formulas to select among and within the three major categories of feed, namely: cereals, oilmeals and other non-grain feeds. Cereals are used primarily to provide the necessary energy within animal feed, however they also provide different levels of protein and other important nutrients which will vary depending on which cereal is used and the grade quality. There are numerous different crop ingredients used in feeds, such as hay, silage and legumes, these tend to be used more in beef/dairy production than other livestock production.

The non-grain category is comprised of many different commodities that are mainly by-products of the food processing industry and have few uses other than for animal feed. Examples of non-grain feeds used are: cereal millfeeds, citrus and beet pulp, and various animal by-products. Manioc/tapioca and sweetpotatoes are also important non-grain feed crops. The degree to which non-grain feeds compete with or replace oilmeals is highly dependent on their protein/nutrient level.

The two most important other types of feed which often replace oilmeals due to their high or mid level of protein are: corn gluten meal and feed, and fish or animal meal.

3 Methods

3.1 Competitiveness and production costs

FREEBAIRN (1986) defines "competitiveness as an ability to supply goods and services in the location and form and at the time they are sought by buyers, at prices that are as good or better than those of other potential suppliers, while earning at least the opportunity cost of returns on resources employed".

It is perceived that competitiveness is the result of combined effect of market distortions and comparative advantage. "Comparative advantage is theoretical, explaining trade and optimal welfare in an undistorted world. Competitiveness, on the other hand, relates to the observable. If firms and industries cannot survive by selling at the going price, they are not competitive. If they able to survive and increase market share, they have become more competitive" (SHARPLES, 1990).

Thus, it is vital for producers and agribusiness involved in the production and trade to know the competitive position and future potential of major participants in the world oilseed sector.

Current economic theory does not provide a single universal measurement for competitiveness. There exists a variety of indicators for measuring competitiveness, which differ with respect to the level of investigation. Analysis can be done on multiple levels such as: the entire economy, a specific sector, or a single product. Additionally, one may assess competitiveness at different spatial dimension such as farm level, industry level or entire economy (FROHBERG, 1997; Table 3.1).

Table 3.1: Competitiveness analysis according to level of aggregation and spatial dimension

	Spatial dimension		
Product aggregation	Farms	Regions within country	Countries
Entire economy	no	no	yes
Single idustry	no	yes	yes
Single commodity	yes	yes	yes

Source: Frohberg (1997). Park_2003-08-28

Depending on the level of aggregation and focus of the research study, various indicators may be used to measure competitiveness. The balance of payments can be used for the analysis on the national level (NIELSEN et al., 1995); while analysis of the development of market share, cost and price development, and self-sufficiency level will provide information on the competitiveness level of the industry (SCHUELE, 1999). International competitiveness of selected commodities may be analyzed using the domestic resource costs (DRC) method, which compares the opportunity costs of domestic production (e.g., the costs of using domestic primary resources defined as land, labor, and capital, and non-traded inputs) to the value-added in border prices (TSAKOK, 1990).

Above mentioned indicators have proved to be useful tools in measurement of country or industry competitiveness, however they have a limited use for the purpose of this study. One indicator, analysis of development of market share, is applied to analyze the dynamics within oilseed sector. The results of the analysis show that soybeans, rapeseed and palm oil have become the major commodities in the oilseed sector. With Argentina and Brazil gaining market share from the United States in the soybean sector. Malaysia and Indonesia competing in the palm oil sector. However, the results can hardly provide details on what are the reasons for such developments and cannot say much about potential developments in the sector. As these commodities are produced at the farms and farmers decide whether to expand or reduce production of the selected crops, and consequently increase or decrease supply of the whole country, thus the focus of the study should lie on the farm level analysis (Table 3.1). Farmers decisions is influenced by number of factors such as economics of production, production possibilities (what crops can be grown and what are the alternatives under current natural conditions), expansion potential and government intervention (subsidies or taxation). Provided this information is collected for selected farms in major producing regions this may result in additional knowledge on the reasons for competitive position of the analyzed countries and their potential in the future.

So far, only a few studies have been carried out on farm level production costs to analyze international competitiveness of cash crops. International competitiveness of soybeans, rapeseed/ canola, palm oil, and wheat was analyzed by GLAZE et al., 1992; MOLL, 1987; ORTMANN et al., 1986; RANDALL et al. 2001; STANTON, 1986; DEBLITZ, 1999. However, one should note that most of them have a limited scope of analysis, which can be summarized as follows:

– based on secondary data, where problems exist with compatibility;
– provide ex-post analysis of competitiveness;
– analysis is done for one crop only;
– a limited number of countries are included in the analysis;
– the results are not comparable between studies;
– limited information was collected on reasons for cost differences and their structure.

Thus, this study should account for limitations of previous studies and provide a) international comparison of production costs based on homogenous data, b) analysis should include details on major factors influencing the decision of farmers which crop to produce (natural, technical, economic, political framework conditions), c) enable multi-commodity comparison for the most important production regions world wide.

3.2 Farm level production costs

In preparing an international comparative study, several issues are identified that have to be dealt in order to make the comparative analysis valid. First, an appropriate method of data collection and calculation should be discussed. Second, three different commodities are included in the analysis, thus an adjustment factor should be found that reflect the difference of the analyzed crops and makes results compatible for comparison. Third, the analyzed commodities have different life cycle - soybeans and rapeseed are annual crops, whereas oil palms are a perennial crop, which requires adjustments in cost calculation and allocation. Fourth, the collected data is expressed in local currency for each selected location that should be converted into a common currency to enable international comparison. Therefore, the issue of exchange rates and common currency of comparison is discussed. Fifth, farm level production costs are only a part of competitiveness. There is also need to take account of the marketing and transportation costs from farm gate to the export destination. As virtually all oil crops are crushed, processing costs have to be estimated in order to reflect their importance in the total production costs of raw material.

3.2.1 Data source and method of cost calculation

The critical point for a research work is to choose a way of collecting the data required to estimate the production costs for the selected oilseeds and nations.

There are several major possible alternatives to obtain data for cost comparisons: a) probability surveys, b) farm records systems, or c) economic engineering approach. Former two alternatives are considered to be the most accurate and comprehensive; however, they are very costly and require very intensive data collection. They are affordable for national or regional governments only. These methods are used to collect the data in the USA, Canada, the EU and some other countries. However, the use of the data for the international comparisons are limited by a number of factors:

– the datasets are not compatible between countries;
– different definition of sampling groups;
– different level of data aggregation;

– some datasets do not provide details of enterprise budgets;
– data is outdated;
– data is confidential.

The additional problem is that necessary data do not exist or is hardly available for a number of countries (South America and Southeast Asia) selected for this analysis. Thus, own primary data collection turn out to be the only possible solution to obtain data for the purpose of analysis in these countries. International Farm Comparison Network (IFCN) method developed in the Institute of Farm Economics and Rural Studies at the Federal Agricultural Research Center (FAL) in Braunschweig allows to collect this data. IFCN combines engineering approach and farm record method.

In the context of this approach, the information required to construct a farm model is collected from a producer panel with the help of local experts for a particular type of operation in a given region. The producer panel meeting provides information on the size of a typical operation, tenure arrangements, crop yields (expected and historical) and other details on the production system. The data is then used to calculate the cost of production in the farm simulation model (TIPI-CAL) and a financial statement is produced for the model farm. The results of the simulation are discussed with the local experts and compared to other available data and adjusted if needed.

Detailed description of the IFCN method and TIPI-CAL is to be found in HEMME (2000).

In this study, full cost of production are estimated for soybeans, rapeseed and palm fruits at the select locations for year 2000. The results in the country chapters are displayed in Euro per hectares and per yield unit. In the international comparison the results per yield unit are adjusted with rapeseed equivalent coefficient to reflect the differences between the analyzed commodities (for details see Chapter 3.2.2). Cost positions and their aggregation into groups are displayed in Table 3.2. Total costs consist of expenses from the profit and loss account and opportunity costs for farm owned production factors (family labor, land and capital). The estimation of opportunity costs must be considered carefully because the potential income of farm owned factors in alternative uses is difficult to estimate. In the short run, their use on a family farm can provide flexibility in case of low returns when the family forgoes income. However, in the long rung, opportunity costs must be considered because the potential successor of the farmer will make a decision on the alternative use of production factors, in particular his own labor input, before taking over the farm.

The cost calculations are based on the following assumptions:

- **Labor**: for hired labor cash labor costs currently incurred are used; for unpaid operator labor, the annual salary of a full time farm manager in the respective region is applied and differentiated according to farm size;
- **Land cost**: for leased land cash rental rates currently paid by the farmers are used. The same applies to owned land;
- **Capital**: Own capital is defined as assets without land plus circulating capital. For debts and owned capital, real interest rates in the countries compared are used;
- **Depreciation**: Machinery and buildings are depreciated by a straight line schedule on actual repurchase price minus residual values provided by the participants of the panel;
- All costs and returns are calculated without value added tax (VAT).

Where other assumptions were used for cost calculation is cited in the text.

Table 3.2: Cost groups and cost positions used for production cost analysis

Cost Groups	Direct costs	Operating costs	Overhead costs	Interest costs
Cost Positions	Seed Fertiliser Plant protection Herbicides Fungicides Insecticides Growth regulators Other Crop insurance Marketing	Drying costs Fuel and lubricants Maintenance Depreciation Machinery costs Fuel and lubricants Maintenance machinery Depreciation machinery Hired machinery (Contract work) Labour Unpaid Labour Wages incl. overheads	Building costs Maintenance buildings Depreciation buildings Taxes and duties Farm taxes Member fees Invalidity Insurance Other Drainage maintenance, Conservation Electricity (without Drying) Water Advisor costs Professional Fees (Accountant etc.) Phone and Utilities Farm insurance	Paid Interest Unpaid Interest **Land costs** Paid rent for land Unpaid rent for land

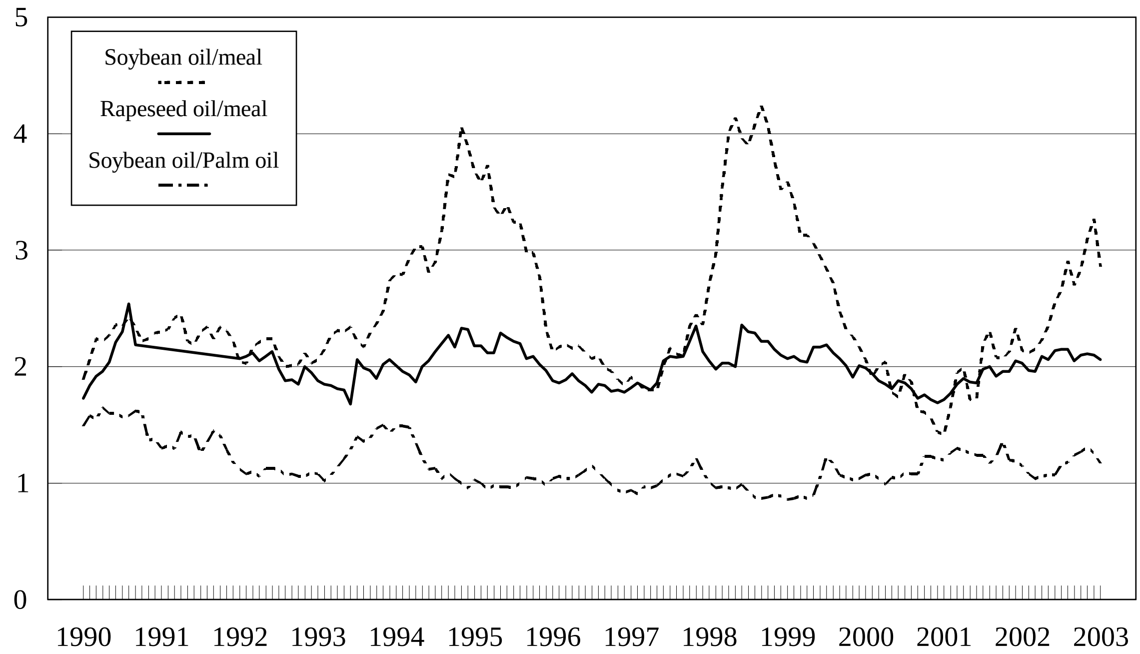
Source: Own illustration. Park_2002-10-14

3.2.2 Commodity specific adjustment

Three different commodities are to be compared in the analysis: soybeans, rapeseed and palm oil. Soybeans and rapeseed are produced at the farm level and are sold at the farm gate for further export or crush. Palm oil, on the contrary to both oilseeds, is obtained from palm fruits so-called fresh fruit bunches (FFB) directly at the place of production. The palm fruits cannot be moved for a long distance as they have to be processed within 48 hours after harvest and are very bulky for transportation. Thus, the results of the analysis are to be expressed per hectares and per yield unit of raw material: soybeans, rapeseed and FFB. Further steps of estimating processing costs for soybeans and rapeseed is discussed in the Chapter 3.2.5.

Most of produced soybeans, rapeseed and FFB are crushed into oil and meal (palm kernel in the case of palm fruits) and these processed products define the value of the raw material. The value of seed (FFB) are dependent on several factors: a) content of oil and meal (palm kernel) in the seed and b) price for processed products - oil and meal (palm kernel). In the short run content of oil and meal in the seed is fixed (Table 3.3) and prices for the processed products and respectively for raw materials (Figures A1.1 in Appendix) vary under market forces. The prices for processed product tend to have similar trend and are strongly inter-related, compared to raw materials. The reason for different trend in seed prices is their quite different composition in terms of oil and protein value (oil and meal content times oil and meal price) and shifting relationship between meal and oil prices (Figure 3.1). Thus, it seems appropriate to adjust production costs to reflect their different oil and meal content and their prices.

Figure 3.1: Price ratios between processed products



Source: Oilworld Monthly January 1990 to February 2003, own calculation and illustration. Park_2003-08-28

For this purpose an Estimated Processed Value (EPV) of seeds is calculated, where the value of one unit (ton) of selected oilseed (rapeseed, soybean and FFB) is calculated based on the value of products derived from the processing of each respective crop (Table 3.3).

$$EPV = \sum P_m * W_m + P_o * W_o$$

where: EPV - Estimated Processed Value in \$/ton; P_m - meal price in \$/ton; P_o - oil price in \$/ton; W_m - weight of meal in the oilcrop; W_o –weight of oil in the oilcrop.

For the calculation of average oil and meal prices a time period should be chosen. The results of production costs at the selected farms are calculated for the reference year 2000, thus the time period for calculation of average prices for oil and meal for estimation of EPV are for the same year. As variation in prices may strongly influence the level of EPV an alternative time period from 1990 to 1999 is evaluated in the sensitivity analysis in Chapter 11.

After the EPV is estimated for all crops a reference crop should be chosen for the calculation of adjustment coefficients. For the purpose of this analysis rapeseed is chosen as reference crop and adjustment coefficients are calculated by dividing EPV of all crops by the rapeseed EPV. The resulting figures (reverse) for soybeans are 0,996 and palm fruits 2,806 are used for adjustment of production costs in the international comparison.

Table 3.3: Oil and protein contents in major oilseeds, %

Crop	Oil content	Protein content
Soybeans	17.8	79.2
Rapeseed	38.0	59.0
Palm fruits	21.0	4.1 [1)]
Palm kernel	50.9	49.1
Sunflower	42.5	54.5
Cottonseed	16.2	44.9
Peanuts	42.5	56.6
Palm kernel	49.1	50.9
Copra	62.7	34.1

1) based on palm kernel protein content.

Source: Soya & Oilseed Bluebook, 2000, Soytech Inc. Park_2002-10-14

Table 3.4: Calculation of adjustment factors for selected crops

	Share of		Relation	Prices, US-$ per ton [1]					Adjustment
Product	Oil	Protein	Oil / Protein	Oil	Meal	Oil value	Meal value	EPV [2]	coefficient
	1	**2**	**3** [1/2]	**4**	**5**	**6** [1*4]	**7** [2*5]	**8** [6+7]	**9**
Rapeseed	38.0	59.0	0.64	347	131	132	77	209	1.00
Soybeans	17.8	79.2	0.22	338	189	60	150	210	**0.996**
Palm fruits	19.0	8.4 [3]	2.26	310	185.9 [4]	59	16	75	**2.806**

1) Prices for rapeseed and soybeans oils and meals, palm oil (US-$ per ton, cif Northsea harbours, average Jan to Dec 2000). 2) Estimated Processing Value.
3) Palm kernel. 4) Palm kernel average price Jan to Dec 2000, US-$ per ton, Ex-Mill Malaysia.
Source: Oilworld (2003), MPOB (2001); Own calculations. Park_2002-10-14

3.2.3 Perennial vs. annual crop

Oil palm is a perennial crop which produces a revenue for many years (usually up to 25 years). However, as a perennial crop, it takes three years from clearing the land and planting until the trees begin bearing fruit. On contrary to annual oilseed, palm oil producers must therefore base their decisions on whether to expand or reduce area planted on long-run price expectations for vegetable oil. Once the decision made intensive investments must be allocated during first years of establishing the crop without any revenues. Expenses associated with clearing the land, planting trees and taking care of them until on set of the productive phase are called establishment costs. These costs vary considerably, depending on whether the land is converted from rubber to oil palms, replanting of old plantation or reclamation of new areas. In Indonesia or Malaysia they can easily exceed 2000 Euro per hectares.

The establishment costs are estimated in the same manner as costs for annual crops. If these costs, plus interest on financial capital tied up in the production, are recovered during the productive period of the enterprise then it is considered that the enterprise is profitable. Therefore, the establishment costs of an enterprise, plus interest, must be added to the costs of productive years of the enterprise.

First, total establishment costs are estimated by calculating net expenditures in each preproductive year and adjusted to the end of the last preproductive year. It is calculated using the following equation:

$$EC = \sum_{j=1}^{J} R_j * (1+r)^{J-j} \qquad (1)$$

where,

EC - total establishment cost, j - index for j^{th} preproductive year, J - length of preproductive period in years, Rj - real net expenditures in year j, r - real interest rate.

Second, the total establishment costs have to be allocated over time to productive period of the palm trees. Using annuity method these costs are amortized over the productive life of the palm trees. The resulting annual amortization includes both depreciation expenses and interest and is calculated following equation:

$$A_{EC} = \frac{\left(EC - \frac{SV}{(1+r)^{(N-J)}}\right)}{\left(\frac{1-\frac{1}{(1+r)^{(N-J)}}}{r}\right)} \tag{2}$$

where,

J is the number of preproductive years, N is the total life of the enterprise, and SV - the salvage value of the enterprise in the same currency as EC.

3.2.4 Exchange rate

For the purpose of international comparison economic results for the selected countries have to be converted from local into a common currency. Two issues have to be decided: a) what common currency should be chosen for analysis, b) which exchange rate should serve for conversion and c) based on what time period. Commonly, in numerous international studies, US-$ has served as common currency of comparison as most of commodities are traded in US-$ terms and exchange rates are readily available for the most foreign currencies. However, with recent introduction of Euro in the European Union, its growing importance on the world markets and competitive position to US-$, the Euro is chosen as a common currency for the purpose of comparison.

The value of Euro against other currencies vary considerably with time and depend on method of estimation. Two methods are widely used for currency conversion: exchange rate and Purchasing Power Parity (PPP). Use of this two methods may lead to quite different results of analysis, their advantages and disadvantages are in detailed discussed by ISERMEYER (1987). For the purpose of international analysis real exchange rate, if available and not fixed by the governments, is more appropriate for currency conversion. Exchange rates of all currencies against Euro were readily available at OANDA (2003) and were used as a reference for calculations (Table 3.5). An average annual exchange rate of year 2000, reference year for the most of calculations, is used for the conversion of results. For Argentina and Brazil it is 1999, as update to 2000 was not possible (for details see Chapter 12).

Table 3.5: Average exchange rates of selected countries from 1999 to 2000, local currency per Euro

	ARG-$	R-$	CAN-$	DM	US-$	RMB	RM	Rp
				to EURO				
1999	1.07	1.93	1.59	1.96	1.07	8.83	4.05	8422
2000	0.92	1.69	1.37	1.96	0.92	7.66	3.51	7756
99 to 00 (%)	-13.3	-12.6	-13.4	-	-13.3	-13.3	-13.3	-7.9

Source: OANDA (2003); Own calculations. Park_2003-08-22

3.2.5 Marketing, transportation and processing costs

The international competitiveness of the oilseed crops is dependent not only on the farm level production costs, but also is strongly influenced by additional delivery costs from the farm gate to the export destination. Many factors influence their level and for some countries they play a considerable share of the total landed costs at the export destination. These costs are divided into a) inland marketing and transportation and b) transport costs from port of embarkation to port of destination. Inland marketing cots and transportation costs include transportation, storage, drying, loading and unloading, taxes and other costs associated with bringing commodity from farm to cargo vessel. International transport costs include freight costs, insurance costs and additional taxes. Both cost groups are not easy to estimate accurately as they are occurred by a number of different participants of the sector chain. Detailed description of estimation of these costs for selected countries is to find in Chapter 11.

Both oilseeds and processed products are traded intensively in the world markets. Prices for processed products (oil and meal) strongly influence the prices for raw seeds. A large share of soybeans and rapeseed is exported from the United States, Argentina and Brazil to the EU for further crush. However, in the case of palm fruits, they are processed locally and only palm oil is exported to the EU and other countries. Thus, estimation of processing costs of raw material become quite important for the analysis to make cost comparison more compatible. Palm fruits are processed on the plantation and processing costs are readily available for the analysis. However, difficulties arise with the estimation of soybean and rapeseed processing costs as both oilseeds are processed at industrial mills and these figures are confidential. For rough estimation of processing costs Gross Crush Margins estimated by OILWORLD (2003) can be used to reflect these costs. The basic idea behind Gross Crush Margin is the calculation of the difference between aggregate value of meal and oil obtained from a unit (ton) of seed.

4 Rapeseed production in Canada

4.1 Climate and soils

Canadian rapeseed production is mainly concentrated in three Prairie Provinces - Alberta, Manitoba und Saskatchewan (see Chapter 4.2), therefore the description of climate and soil conditions will focus on that area.

4.1.1 Climate

The Prairie Provinces - Alberta, Manitoba and Saskatchewan - are part of the Central Plains of North America. In latitude they extend from approximately 48° N to 60° N bordering with the United States in the south and Northern Territories in the north (see Map A2.1). British Columbia and Ontario are neighboring provinces in the west and the east.

No mountain barriers exist that could impede forthcoming cold wind masses from the north or warm wind masses from the south of the continent, which results in extreme temperature fluctuations in the region.

A sub arctic climate prevails in the north of the Prairies that limits the expansion of agricultural production northwards. In the south, arable farming suffers from water deficits during the vegetation period due to low rainfalls. High variation in rainfall is observed between regions. The climate in the region is semiarid, where about 60 % of rainfall falls between May and September. High evaporation due to strong winds often causes soil water deficits between May and July. This is especially the case in the south and southeast of Prairies where higher temperatures and strong winds prevail.

The rainfall average in the Saskatchewan province varies between 320 to 370 mm in the west (Maple Creek, Kindersley), 350 to 370 mm in the central south (Moose Jaw, Regina), 400 to 450 mm in the north (Meadow Lake, Prince Albert) and 410 to 470 mm in the east (Wynyard/Yorkton, Hudson Bay).

July is the warmest and January is the coldest month in the Saskatchewan province, where the difference between average temperatures of both months may vary between minus 29° C and 39° C. The difference between these two extremes grows from the west to the east (CAMPBELL et al., 1990).

Relatively short and hot summers in the region limit the vegetative period of the crops and hinder the realization of the yield potential. Soil conservation techniques and soil water deficit resistant plants may improve the production and expansion potential of the region.

Winters in the Prairies have severe frost periods. On average about 110 frost-free days are available in the Saskatchewan province. Annual average temperatures vary between 0° C in the north of arable region of the Saskatchewan and +3.5° C in the south east of Saskatchewan. Such conditions limit production of winter crops and therefore summer crops dominate in the most of regions.

4.1.2 Soils

Generally four soil groups can be found in the Prairies - brown and dark brown, black and grey wooded soils zones (see Map 4.1). Brown and dark brown soil zones are mainly located in southwestern Saskatchewan and extend westward to the Alberta province. Black and grey wooded soil zones are located above and extend northward and eastwards of the brown soil zones.

Brown- und Dark Brown Soil Zone

The average depth of the surface layer is between 10 to 15 cm in the brown soil and up to 20 cm in the Dark Brown soil zones. Most of these glaciated soils are of a medium (loam) texture with sand fraction prevailing in the surface layer. The soil pH-value range between 6.5 and 7.5, and therefore a lime application is not necessary. Some potassium maybe applied to improve available nutrients for crops. The content of organic matter is relatively low and ranges between 1.5 - 3.0 % for the brown soils and around 4 % for dark brown soils. Topography varies from nearly level to very hilly in the brown soil zone and plain in the dark brown zone.

Both regions have distinct problems with soil moisture deficits during the vegetation period (May to July). As a result yields vary considerably in these zones. Brown soil zone has lower annual rainfall of about 320 - 350 mm compared to 350 - 370 mm of the dark brown zone. The same trend is observed for the vegetation period.

Black Soil Zone

According to PUTMAN (1970), the Black Soil Zone covers about 16.8 mill. ha, where about 78 % is potentially usable for crop production.

Average rainfall in the Black Soil Zone is about 400 mm and more soil moisture is available for crops during the vegetation period compared to brown soil zones (see Map 4.1).

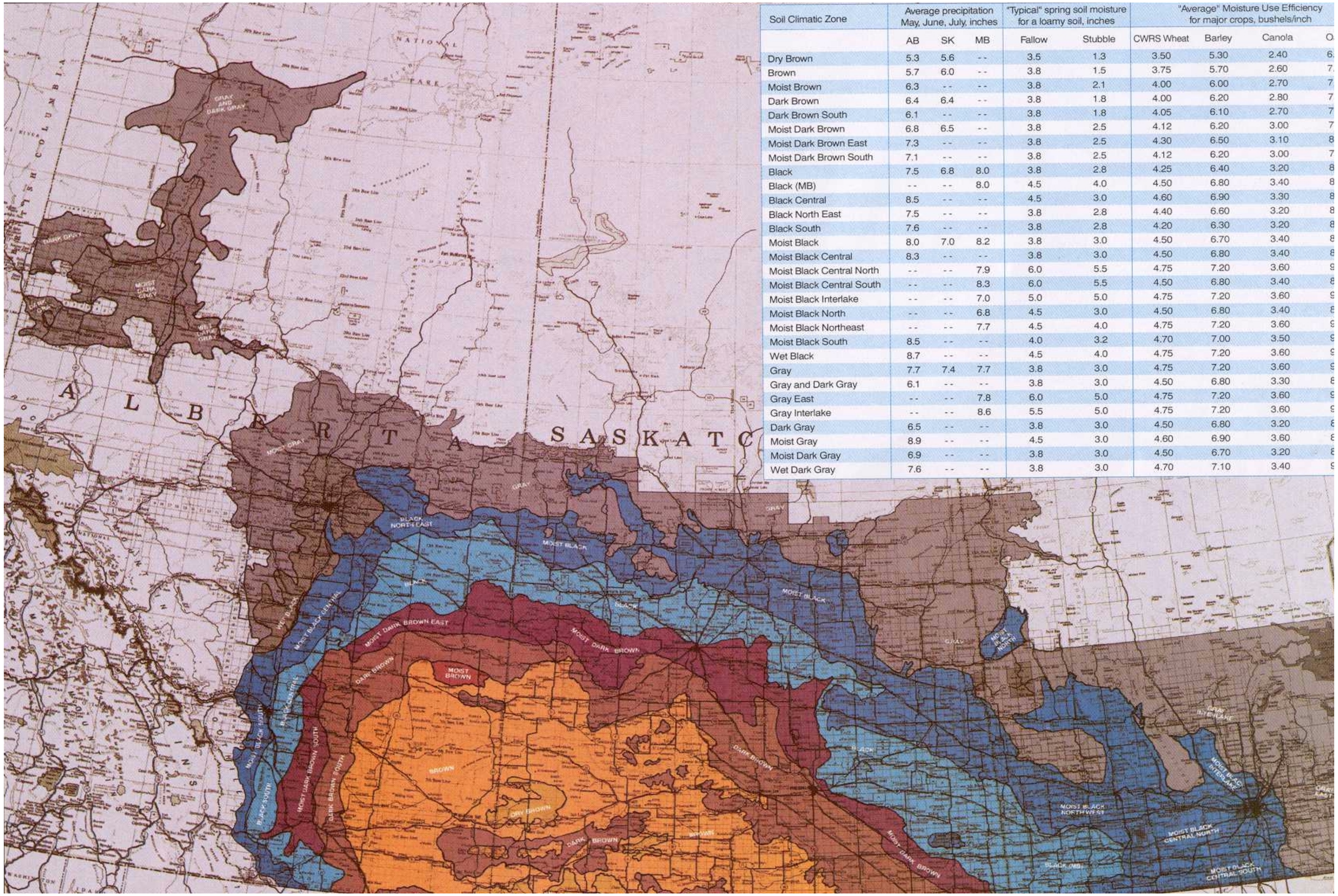
The depth of the surface horizon averages 20 - 25 cm and the soil contains about 8.7 % organic matter. The soil is mostly medium textured and the land is mainly level to gently rolling. The soil pH-value is neutral. The combination of higher rainfall with the high quality of the soils results in relatively higher yields of grains and oilseeds in the Black Soil Zone compared to others. It is a result of higher efficiency of the soil to keep water moisture (see Map 4.1).

Grey Wooded Soil Zone

The Grey Wooded soil zone covers around 60 mill. ha, where only 20 % have the potential to be used for crop production (PUTMAN et al., 1970). The climate of this zone is colder compared to the Black Soil Zone with fewer frost-free days. This leads farmers to choose early ripening crops.

The soil has a thin layer of dark colored humus, about 5 cm deep over a layer of gray colored soil. The organic matter of this grayish layer is generally low but can be quite variable ranging from as low as one to 10 %. With sufficient applications of nitrogen, phosphorous and sulphur fertilizers these soils have good productivity. Large areas of this zone are located in the Manitoba province (1.2 mill. ha) (EVANS, 1986).

Map 4.1: Soil zones of Canadian Prairie provinces



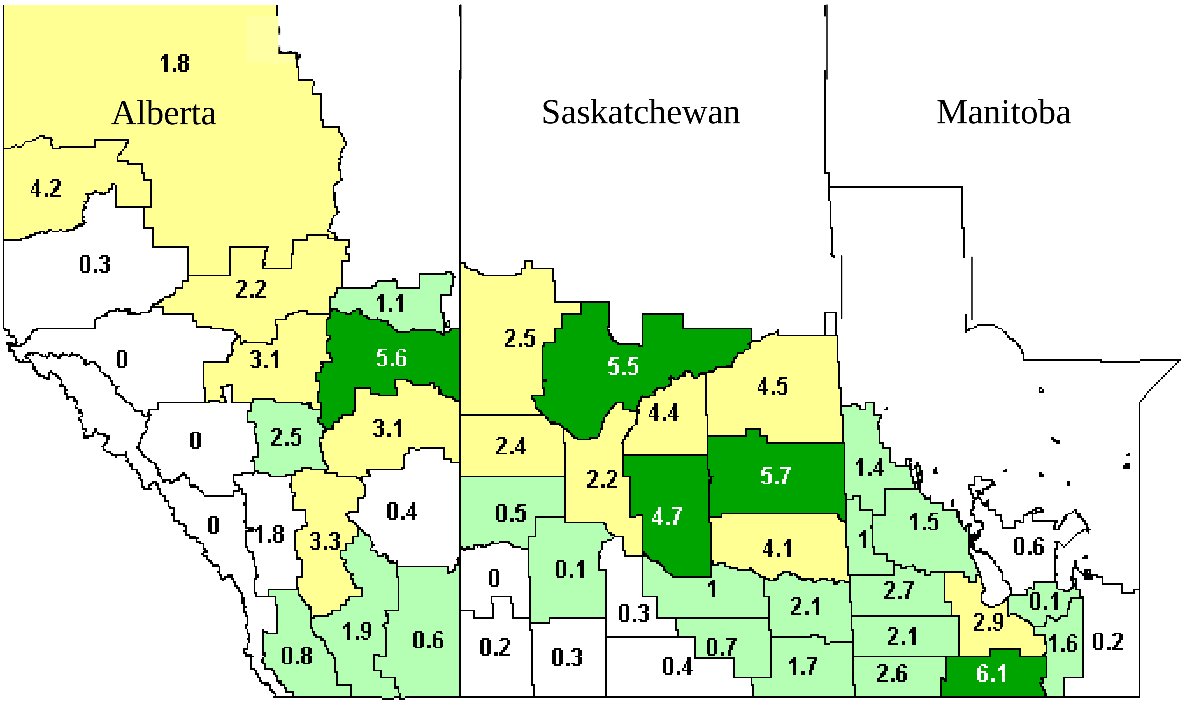
Soil Climatic Zone	Average precipitation May, June, July, inches			"Typical" spring soil moisture for a loamy soil, inches		"Average" Moisture Use Efficiency for major crops, bushels/inch		
	AB	SK	MB	Fallow	Stubble	CWRS Wheat	Barley	Canola
Dry Brown	5.3	5.6	--	3.5	1.3	3.50	5.30	2.40
Brown	5.7	6.0	--	3.8	1.5	3.75	5.70	2.60
Moist Brown	6.3	--	--	3.8	2.1	4.00	6.00	2.70
Dark Brown	6.4	6.4	--	3.8	1.8	4.00	6.20	2.80
Dark Brown South	6.1	--	--	3.8	1.8	4.05	6.10	2.70
Moist Dark Brown	6.8	6.5	--	3.8	2.5	4.12	6.20	3.00
Moist Dark Brown East	7.3	--	--	3.8	2.5	4.30	6.50	3.10
Moist Dark Brown South	7.1	--	--	3.8	2.5	4.12	6.20	3.00
Black	7.5	6.8	8.0	3.8	2.8	4.25	6.40	3.20
Black (MB)	--	--	8.0	4.5	4.0	4.50	6.80	3.40
Black Central	8.5	--	--	4.5	3.0	4.60	6.90	3.30
Black North East	7.5	--	--	3.8	2.8	4.40	6.60	3.20
Black South	7.6	--	--	3.8	2.8	4.20	6.30	3.20
Moist Black	8.0	7.0	8.2	3.8	3.0	4.50	6.70	3.40
Moist Black Central	8.3	--	--	3.8	3.0	4.50	6.80	3.40
Moist Black Central North	--	--	7.9	6.0	5.5	4.75	7.20	3.60
Moist Black Central South	--	--	8.3	6.0	5.5	4.50	6.80	3.40
Moist Black Interlake	--	--	7.0	5.0	5.0	4.75	7.20	3.60
Moist Black North	--	--	6.8	4.5	3.0	4.50	6.80	3.40
Moist Black Northeast	--	--	7.7	4.5	4.0	4.75	7.20	3.60
Moist Black South	8.5	--	--	4.0	3.2	4.70	7.00	3.50
Wet Black	8.7	--	--	4.5	4.0	4.75	7.20	3.60
Gray	7.7	7.4	7.7	3.8	3.0	4.75	7.20	3.60
Gray and Dark Gray	6.1	--	--	3.8	3.0	4.50	6.80	3.30
Gray East	--	--	7.8	6.0	5.0	4.75	7.20	3.60
Gray Interlake	--	--	8.6	5.5	5.0	4.75	7.20	3.60
Dark Gray	6.5	--	--	3.8	3.0	4.50	6.80	3.20
Moist Gray	8.9	--	--	4.5	3.0	4.60	6.90	3.60
Moist Dark Gray	6.9	--	--	3.8	3.0	4.50	6.70	3.20
Wet Dark Gray	7.6	--	--	3.8	3.0	4.70	7.10	3.40

Quelle: Agricultural Services Laboratories, Saskatoon (1996).

4.2 Production of rapeseed and major crops in Canada

Wheat (10.4 mill. ha), rapeseed (5.6 mill. ha), barley (4.4 mill. ha), oats (1.9 mill. ha) and legumes (1.3 mill. ha) were the major crops in Canada in 1999.

Map 4.2: Rapeseed production in Prairie Provinces, 1999



Displayed are shares of districts of the total rapeseed production of Prairie Provinces.
Source: Agriculture and Agri-Food Canada, 2000.

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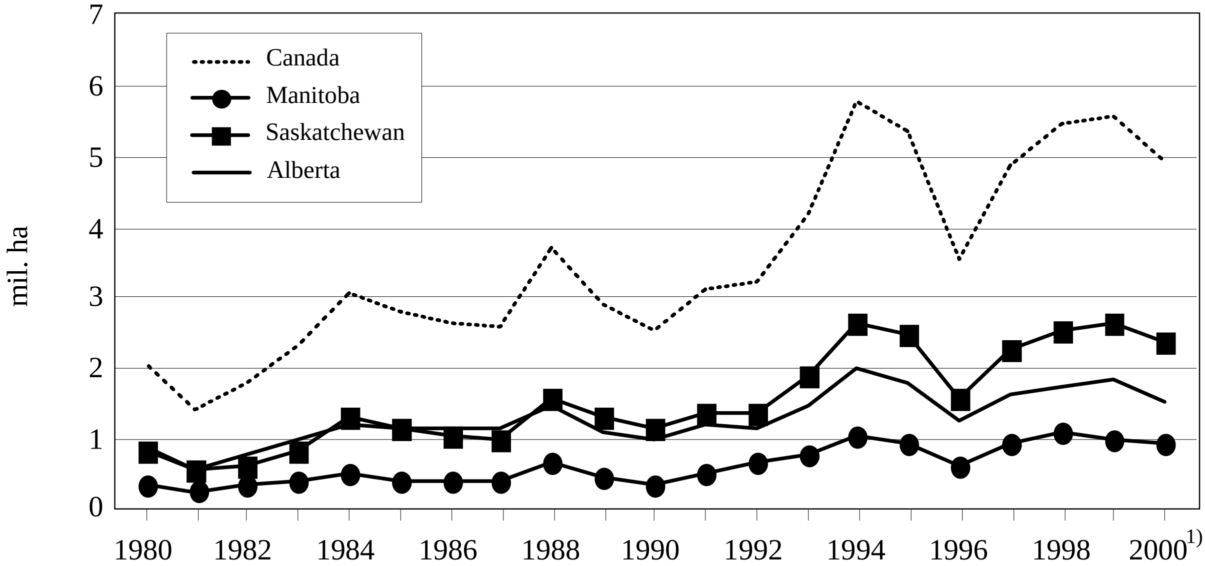
Rapeseed production prevails in Prairie Provinces. Map 4.2 displays the distribution of rapeseed production by province and district.

Rapeseed production

In the last two decades production of rapeseed has more than doubled (Figure 4.1). High prices in the middle of the 1990s set an incentive for expansion. At the end of 1990s, the introduction of herbicide resistant rapeseed varieties and relatively lower prices for competing wheat led to further expansion of rapeseed areas.

Figure 4.1: Rapeseed area in Canada, 1980 to 2000



1) Estimated.
Park_2003-07-04
Source: CANSIM (Canadian Socio Economic Information Management System), own calculations.

Comparing maps 4.1 and 4.2 it can be observed that black, grey and dark brown soil zones have the highest importance in the rapeseed production within the Prairie Provinces. They are the traditional rapeseed production regions that can be explained by relatively higher soil moisture in the regions. In recent years expansion of rapeseed production took place in the Brown Soil Zone of Saskatchewan and Alberta.

The Saskatchewan province lead in rapeseed production and area. In 1999 almost half of the total rapeseed area was planted in Saskatchewan, followed by Alberta (33 %) and Manitoba (18 %).

According to estimations of Statistics Canada rapeseed area had decreased by 12 % in 2000. The highest decrease (17 %) took place in Alberta followed by Saskatchewan (10 %) and Manitoba (5 %). The reasons for the decrease are manifold. Unclear export potential for GMO varieties, relatively low prices for rapeseed and the gaining popularity of legume crops are the reasons that may have influenced the planting decision of producers.

Grain production

About 78 % of planted wheat in Canada is spring wheat. Only 16 % is durum wheat and the remaining 6 % winter wheat.

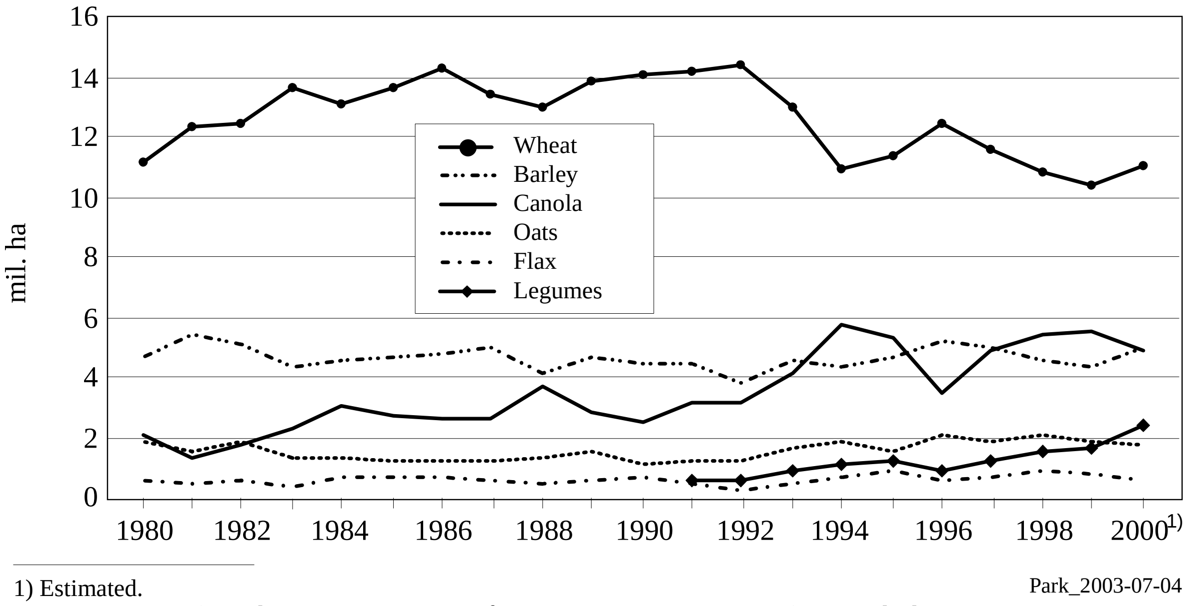
Saskatchewan produced over half (52 %) of the total Canadian wheat followed by Alberta (30 %) and Manitoba (12 %).

Since the beginning of the 1990s, the Canadian wheat area has decreased by 25 % (Figure 4.2). The greatest reduction took place in Manitoba (40 %) and Saskatchewan (30 %), whereas Alberta reduced its wheat area by only 10 %. Accounting for considerable expansion of rapeseed and legumes areas, it is to expected that part of this expansion took place on the reduced wheat areas.

This assumption may be valid for the previously constant, and from 1996 to 1999, reducing barley area in the Prairie Provinces. However, according to Statistics Canada barley as well as wheat areas have increased 680,000 ha in 2000. The largest part of expansion took place in Saskatchewan (344,000 ha), which has equal barley area as Alberta province.

From 1980 to 1998, the Canadian oats area had increased by 80 %, then it began decreasing. With about 809,000 ha and 1.5 million t in 1999 Saskatchewan dominated the Canadian oats production followed by Alberta (567,000 ha, 864,000 t) and Manitoba (328,000 ha, 854,000 t).

Figure 4.2: Area under rapeseed and major crops in Canada, 1980 to 2000



1) Estimated.
Source: CANSIM (Canadian Socio Economic Information Management System), own calculations.

Legumes

Interesting and important dynamics of production can be observed in legume expansion in Canada. The most important legumes are peas, chickpeas and lentils. In the beginning of the 1980s only about 0.5 % (218,000 ha) of the total planted area was allocated to legumes in 1999, the area has increased five fold with trend upwards. The major reasons for that rapid expansion can be seen in the technological success in improving the quality of the legumes that allowed an increase in exports.

Up to the middle of the 1990s, legume area in Canada has expanded to 720,000 ha and achieved its historical high of 1.36 million in 1999. For the period between 2000 to 2004, further expansion of over 60 %[1] is expected. The major expansion area is to be expected in Saskatchewan where 90 % of Canadian lentils and chickpeas are produced. High expansion is to be expected in the Alberta province as well. Chickpeas and lentils currently display the highest growth rates.

Improved drought and frost resistance of the legumes make them an interesting alternative for the marginal areas. The major competing crop is wheat.

According to experts, abolishment of the Western Grain Transportation Act (WGTA) in the middle of the 1990s has additionally supported expansion of legumes[2]. With abolition of subsidies for the transportation costs of agricultural products in Canada, the costs have tripled since then. As produced legumes have a higher value per ton of product compared to wheat or canola, when moved for export their export price, has lower share of transportation costs as wheat or canola.

4.3 Yields

Rapeseed yields for Canada and Prairies from 1980 to 2000 are displayed in Figure 4.3. For a comparison yields of other major crops produced in Canada are displayed in Figure A2.1 in the Appendix.

In Figure 4.3 it must be observed that Manitoba realized the highest average rapeseed yield (13.4 dt/ha) of Prairie provinces from 1980 to 2000, followed by Alberta (13.1 dt/ha) and Saskatchewan (12.5 dt/ha).

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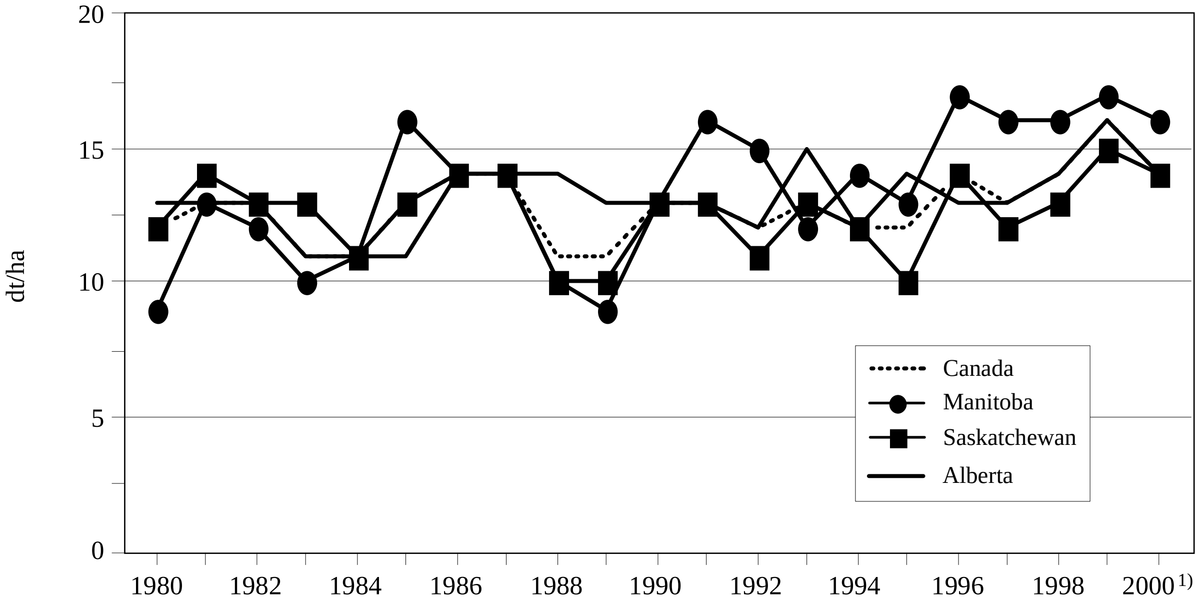
[1] See STAT Market Research, 2000 (www.statpub.com/stat/).

[2] CLANCEY (2000).

One should consider that these yields are highly aggregated and a high variation of yields exists within regions due to climate and soil variation mentioned in the previous part.

As an example, rapeseed yields for different soil zones in the Saskatchewan province are displayed in Figure A2.2 in the Appendix. A trend can be observed that the level and stability of rapeseed yields in the Black Soil Zone is considerably higher compared to other soil zones.

Figure 4.3: Rapeseed yields in Canada, 1980 to 2000



	Canada	Manitoba	Saskatchewan	Alberta
1999	15.71	17.02	14.89	16.14
Ø 1980 to 2000	12.89	13.45	12.54	13.08
Max. 2)	15.71	17.02	14.89	16.14
Min. 3)	11.00	8.66	9.90	10.53

1) Estimated.
2) Maximum yield in obserbed time period.
3) Minimum yield in obserbed time period
Source: CANSIM (Canadian Socio Economic Information Management System), own calculations.

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4.4 Location of the selected farms

Map 4.3 displays the location of the selected farms in the Saskatchewan province. In each soil zone two farms, one large sized and medium sized, were built to analyze the influence of substantial differences in yield productivity and production systems.

Black soil farms are located in the central part of the soil zone. According to the classification of Saskatchewan Agriculture and Food it is located in the Crop District 5 (Map A2.2 in Appendix) and is a traditional region for rapeseed production. In 1999 540,000 ha of rapeseed were planted in that crop district and 735,000 tons of rapeseed were produced there[3]. Regional marketing locations for rapeseed and grains is Wynyard. Two arable farms of 1,210 and 2,020 ha without summer fallow were build during the panel meeting for that soil zone.

Brown soil farms are located in the southwestern part of the soil zone. The soils at this location are less homogeneous compared to black soil and vary from brown to dark brown soils. The selected location is located in Crop Districts 3A-N, 3B-N and 3B-S (Map A2.2 in Appendix) and represents an expanded region of rapeseed production in the brown soil zone. In the beginning of the 1990s, only about 4,500 ha of rapeseed was planted in that region. In 1999, it had strongly increased to 48,000 ha with production of 58,000 t.[4] The selected region is a traditional production area for durum wheat with relative stable areas. Summer fallow in the region was reduced in recent years.

The marketing location for rapeseed and grains for this region is Swift Current. Two farms, a middle sized (1,210 ha and large sized (2,430 ha), were built there. Both are arable farms, and in contrast to black soil zones, allocate 20 % of their land to summer fallow, where rapeseed is planted within rotation.

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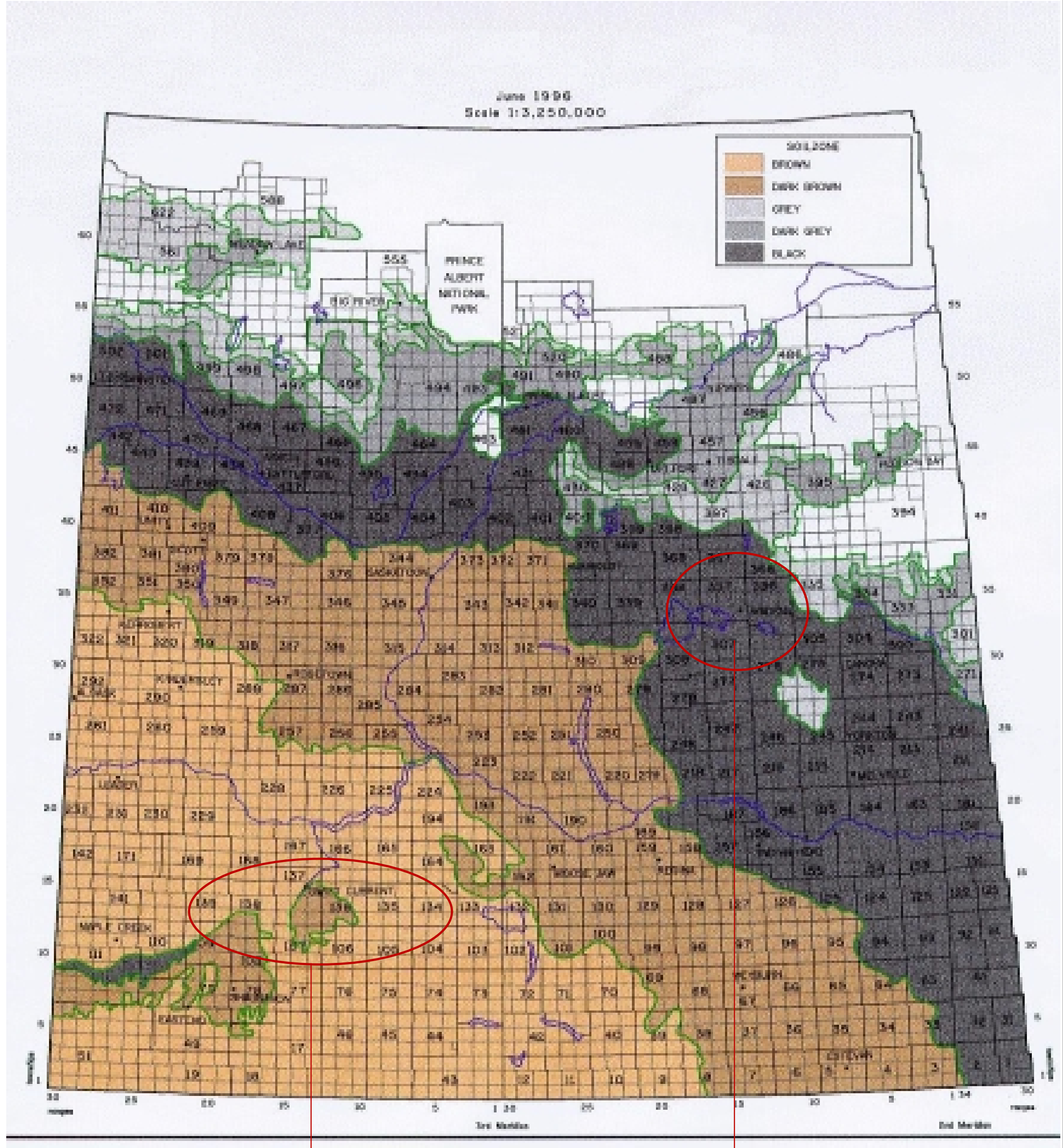
3 AGRICULTURAL STATISTICS IN SASKATCHEWAN AGRICULTURE AND FOOD (2000).

4 AGRICULTURAL STATISTICS IN SASKATCHEWAN AGRICULTURE AND FOOD (2000).

Map 4.3: Soil zones of Saskatchewan and location of the selected farms



Location of selected farms: 1,210 ha and 2,420 ha Brown Soil; 1,210 ha and 2,020 ha Black Soil

Climate and soils at the selected locations are displayed in Table 4.1.

Table 4.1: Climate and soils at the selected locations in Saskatchewan

Region Farm size (ha)	**Brown Soil** **1210**	**Brown Soil** **2430**	**Black Soil** **1210**	**Black Soil** **2020**
Soil type	Brown to Dark Brown	Brown to Dark Brown	Black Chernozem	Black Chernozem
Relative soil quality	poor to medium	poor to medium	very good	very good
Rainfall / mm per year	330 to 360	330 to 360	430	430
Rainfall distribution	prevailing May to September (60%)	prevailing May to September (60%)	prevailing May to September (65%)	prevailing May to September (65%)
Average temperature °C (min - max)	3.5 (-2.5 to 9.8)	3.5 (-2.5 to 9.8)	2.0 (-4.2 to 7.2)	2.0 (-4.2 to 7.2)
Average frost days	250	250	247	247

Source: Own data collection, Saskatchewan Agriculture and Food (1998). Park_2003-07-03

4.5 Production systems

In the framework of this analysis, the selected farms are located in the Saskatchewan province, so the description of production systems will focus on this region. Production systems in other Prairie provinces have many similarities with those in Saskatchewan.

The continental semi-arid climate of the Prairie Provinces places crop production at a high risk. Farmers crop-planting decisions are strongly influenced by available soil moisture and price-cost relationships. This is more important for the farmers in the brown and dark brown zones as compared to the black soil zone.

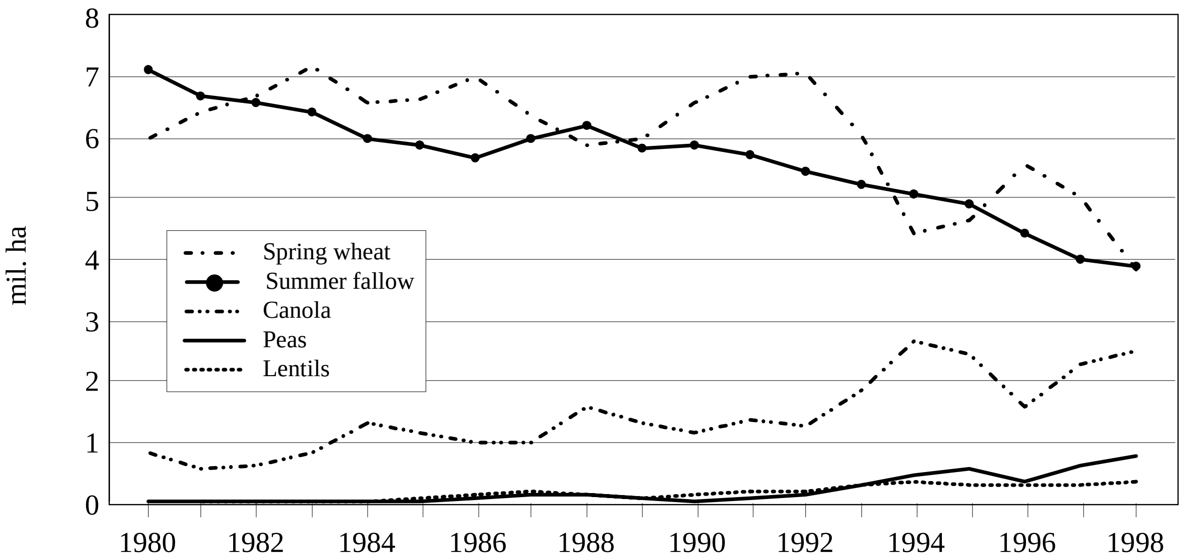
As a result, the traditional production system of the Prairie Provinces has for many years consisted of a monoculture (mainly spring wheat on brown and dark brown soils , and also barley and oats on black soils) and so-called summer fallow[5]. Summer fallow is used to improve the water-holding capacity of the soil for the following crop and to break the

[5] CAMPBELL et al. (1988).

development cycle of fungus or insects. The subsequent crops benefits from the summer fallow and respond with more stable yields.[6]

Since the end of the 1980s a downward trend of summer fallow areas and diversification of crop production has been observed in Saskatchewan as well as in the Prairie Provinces (Figure 4.4).

Figure 4.4: Area under rapeseed and major crops in Saskatchewan, 1980 to 1998



Source: Saskatchewan Agriculture and Food, Statistical Handbook (1998), own calculation. Park_2003-07-04

4.5.1 Production systems in Brown Soil Zone

As a result of relative low rainfall in brown soil regions, traditional crop rotations still consist of wheat - summer fallow or, depending on soil moisture at the time of wheat planting: summer fallow - wheat – wheat - summer fallow.

With time, negative impacts can be observed as well as the positive effects of summer fallow in the production system. A high share of summer fallow on the total acreage increases the risk of soil erosion, salinization and reduction of organic matter in the soils.

The negative impacts of summer fallow, downward trends in prices for wheat, improved drought and disease resistance of canola and legumes (mainly lentils and peas) have lead

[6] WALL (2000) has estimated that an average yield of Hard Red Spring Wheat after summer fallow was 2.20 t/ha, whereas wheat after wheat was 1.63 t/ha and after Canola 1.73 t/ha in the brown soil zone.

to diversification of crop production, and reduction of summer fallow in the Brown Soil Zone of Saskatchewan. Lentils, chickpeas, mustard, coriander and other special crops have gained importance in the crop rotation in the region in addition to major crops.

Federal and provincial governments support these developments with various research projects in the framework of "Canada and Saskatchewan Agricultural Green Plan Agreements".

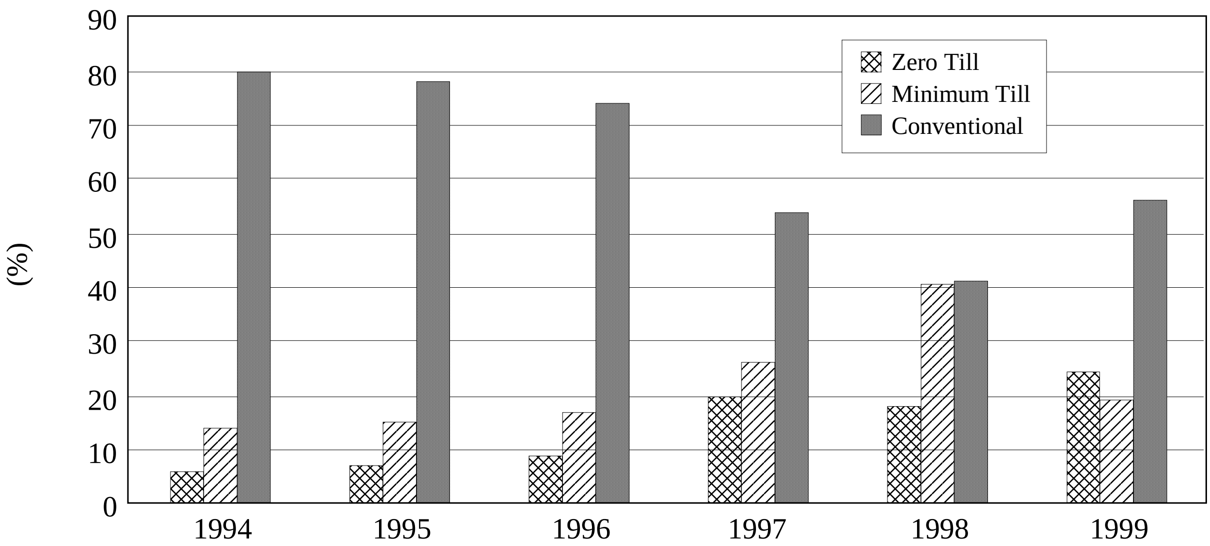
After the summer fallow, rapeseed is usually planted as it has higher water requirements compared to spring wheat or alternative crops.

However, the sustainable diversification of production systems was only possible with respective soil and water conservation techniques that have become available for farmers in recent years.

In 1996, according to the Census of Agriculture, only about 51 % of the surveyed farmers have practiced conventional tillage in Saskatchewan.

Results of one study that has analyzed soil tillage practices in the Brown Soil Zone for six years, shows that "Zero Tillage" (ZT) has gained considerably in importance (Figure 4.5).

Figure 4.5: Tillage systems in Brown Soil Zone



Source: Seeding Trends 1999, Agriculture and Agri Food Canada 1999. Park_2003-07-04

Generally, tillage systems are classified as "Conventional Tillage" (CT) and "Conservation Tillage". CT is a practice of tilling the land to prepare it for agricultural purposes; it includes cultivating for seeding and weed control and includes three to four tillage operations. Conservation tillage is subdivided into "Minimum Tillage" (MT) and "Zero Tillage" (ZT). The MT consists of fewer tillage operations as compared to CT and a cover of crop residue remains on the soil surface. The ZT is an extreme form of conservation tillage where the seeding of a crop takes place into untilled stubble by causing no more soil disturbance than opening a slit or very narrow strip of soil just to plant the seed. Generally weed control is done with the application of herbicides before seeding. Under ZT, seeds are planted in a wider rows and combined with nitrogen application. Any system in which more than 25 % of the soil surface is disturbed is usually not considered ZT.

According to various studies, the impact of conservation tillage systems varies considerably in brown and dark brown soil zones. The major negative impact is observed in yield losses especially for wheat-summer fallow crop rotations (ZENTNER et al., 1993). The yield loss is dependent on the amount of crops in the rotation, soil texture and susceptibility to wind erosion.

Introduction of herbicide tolerant rapeseed varieties complements expansion of reduced tillage in the Brown Soil Zone and vice-versa. Conservation tillage improves the available soil moisture for the rapeseed and the new herbicide resistant varieties allow application of total herbicides to combat weeds that permits minimum tillage of the soil.

Lack of know-how and high sunk costs related to the investments in new technologies (e.g., direct seeding machinery) hold back the expansion of conservation tillage on the middle and small sized farms in the Brown Soil Zone.

4.5.2 Production systems in Black Soil Zone

Higher rainfall and better water holding capacity of the soil in the Black Soil Zone allows more crops to be planted as compared to the Brown Soil Zone. Spring wheat, rapeseed and barley are the major crops produced in the region. Peas, oats and flax complement the crop rotation of many farms. The share of summer fallow in the crop rotation is considerably lower as compared to the Brown Soil Zone and many farms practice so-called "Continuous Cropping", where summer fallow is phased out from the rotation.

In the Black Soil Zone, the risk of wind erosion is considerably lower as compared to the Brown Soil Zone. However, the risk of late spring frost or early fall frost is much higher there. When combined with higher soil moisture and compact soil texture, it impedes early soil trafficability in the spring. Therefore the amount of time available for seeding and for harvesting is very limited and higher machinery power is needed to manage the field operations. The combination of these factors tends to increase the machinery investment and labor costs per hectares.

Conservation tillage in the Black Soil Zone has a longer tradition and is broadly implemented by the farms as compared to in other soil zones. The reasons for that are manifold. Conventional tillage with several tillage operations in the late fall and early spring has a negative impact on trafficability of soil for seeding. Under CT, more tillage operations are needed to combat intensive weed problems compared to the Brown Soil Zone which can be solved with the application of the total herbicide. As a rule, savings from lower machinery and labor costs are higher as compared to higher fixed machinery and chemical costs.

Most of the farmers who took part in the Panel meeting implemented "Zero Tillage" on their farms. This was valid for farms from both soil zones. It should be noted that the difference between "Minimum Tillage" and "Zero Tillage" is relatively vague and depends very much on the definition of terms. Accompanying researchers from the University of Saskatchewan have emphasized the increasing trend of direct seeding and favored it for both selected locations.

4.5.3 Rapeseed production systems in Brown and Black Soil Zones

The majority of rapeseed in Saskatchewan and other Prairie provinces is planted in the Spring due to unfavorable climate conditions for winter varieties. In recent years, an increasing trend can be observed of planting GMO varieties (Genetically Modified Organisms). In 1999, about a half of the rapeseed areas in Saskatchewan were planted with a GMO variety (Table 4.2).

About two thirds of the rapeseed areas are planted with herbicide resistant varieties. Two major groups exist: a) genetically modified varieties such as Roundup Ready (RR) or Liberty Link (LL) and b) conventionally bred varieties like "Clearfield" or "Smart". The former group is resistant to total herbicides such as Round up (a. i. Glyfosat) and Liberty (a. i. Glufosinate), the latter group is herbicide resistant to so-called IFI-family (Pursuit, Odyssey). In recent years, a new GMO variety of the so-called Navigator/Compass system appeared that is resistant to herbicides with a. i. Bromoxynil. The share of this system is relatively small, about 0.5 % in Saskatchewan and other Prairie provinces. According to expert estimates, this system will not gain a considerable market share in the near future.[7]

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[7] Personal communication with William Greuel, Provincial Specialist – Oilseeds and Transgenic Crops, Saskatchewan Agriculture and Food on 30.08.2000

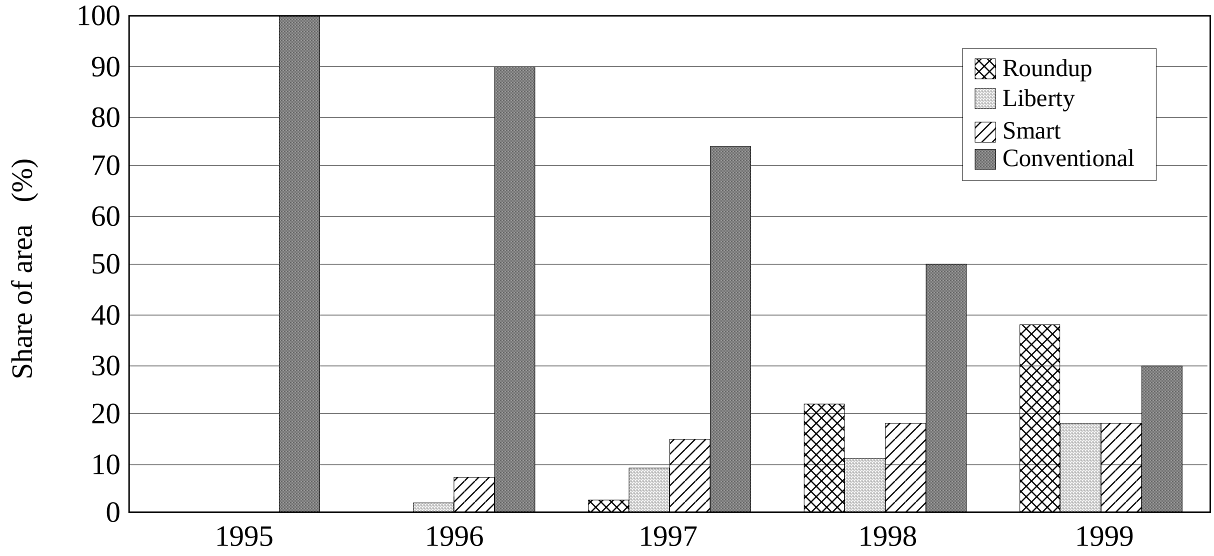
Table 4.2: Canola herbicide systems in Saskatchewan, 1999

System	Characteristic	Area of canola %
Conventional	non-GMO, no herbicide resistance	33.4
Clearfield (Smart)	non-GMO, resistant to herbicide of IMI-Group (Pursuit, Odyssey)	11.7
Roundup Ready	GMO, Glyfosat resistant	36.2
Liberty Link	GMO, Glufosinat resistant	18.2
Navigator / Compass	GMO, Bromoxynil resistant	0.5

Source: Unpublished statistics, Saskatchewan Agriculture and Food (2000). Park_2003-07-03

The rapid increase of GMO varieties in Prairie Provinces can be observed in Figure 4.6

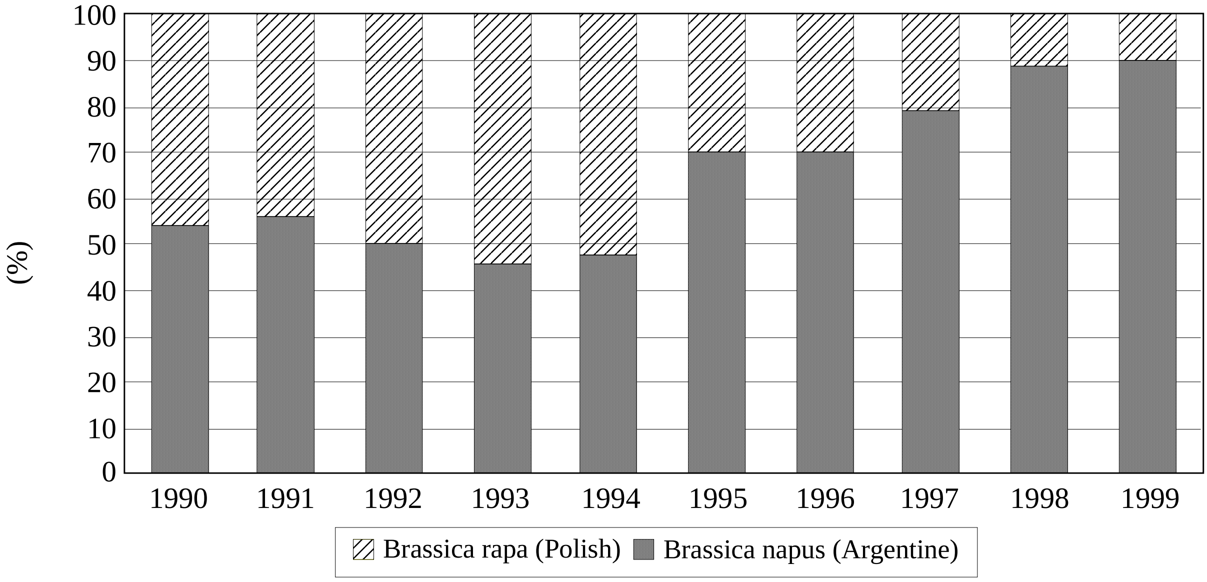
Figure 4.6: Use of various herbicide systems in the Prairie Provinces



Source: Canadian Canola Grower Association, 1999. Park_2003-07-04

The majority of rapeseed planted belongs to the species *Brassica napus* that is sometimes is called "Argentine Canola" due to it geographical origin. The second most important species is *Brassica rapa* or *Brassica campestris* ("Polish Canola"). The latter species has higher frost and drought resistance, however, due to its considerably lower yield potential of 15 to 20 %, it has lost its importance in the last years (Figure 4.7). This is valid for both the Brown and Black Soil Zones. Additionally, the majority of the herbicide tolerant varieties belong to Napus species.

Figure 4.7: Use of *Brassica rapa* and *Brassica napus* species in Prairie Provinces



Source: Canadian Grain Commission, 2000. Park_2003-07-04

The oil and protein content of Polish canola tends to be lower as compared to the Argentine species. However, the share of saturated fatty acids in the oil of Rapa species is considerably lower compared to Napus species that plays an important role for export to U.S. markets.

The major agronomic benefit of GMO varieties compared to conventional varieties is better weed management within the production system. The fighting of wild oats and wild mustard that are difficult to manage under the conventional system with high plant density are especially successful here. As a result, yield increases of up to 5 % are estimated for RR-varieties compared to conventional varieties. The yield benefits for the LL-varieties (conventionally bred hybrids) are estimated to be even higher at 10 to 15 % depending on plant density and intensity of weed problems.[8] An additional benefit of the application of

[8] According to results of two-year field study in the West Canada.

Roundup or Liberty herbicides compared to conventional systems is that there is no carry-over effect of active ingredients, which could damage subsequent crops.

Production systems with GMO-varieties allow higher flexibility in the application of herbicides. Time overlapping of herbicide application with other crops can be avoided with this system and thus optimize use of machinery and labor.

RR- and LL-systems can be well combined with direct seeding where the application of granular herbicide into soil can be avoided.

Use of the transgenic varieties may allow for an advance shift in planting time. Under conventional systems, herbicides should be applied into the soil before the seeds are planted, as soon as the soil temperature achieves a certain level. Under GMO-systems, weed management can be done later point in the plant growing period which allows for earlier planting.

Table A2.2 in the Appendix shows that panel farms in the Brown Soil Zone plant 50 % of their rapeseed area with conventional varieties. The remaining half consists of two thirds of RR-varieties and one third LL-varieties. In the Black Soil Zone, the share of GMO varieties is much higher and achieves 75 % with the same relation of RR- and LL-varieties (Table A2.3 in Appendix). The reason for the higher share of GMO varieties in the Black Soil Zone is a result of more intensive problems with weeds such as wild oats and wild mustard. The special importance of the RR system compared to Liberty or conventional herbicides is the ability to successfully control Gallium Boreal weed at this location.

The use of several herbicides systems on the farms allow producers to avoid a build up of herbicide resistance to the above mentioned weeds. The reasons for planting a large share of conventional varieties maybe a result of marketing concerns.

Especially at the locations where "Zero Tillage" is used in combination with Roundup, the shattered seeds are difficult to manage by the herbicide system. To solve this problem, the use of 2,4D or MCPA is necessary, which respectively increases the costs of the system.

Ultimately, when the advantages of the systems are compared, profitability of the systems should be considered as well. A detailed analysis can be found in Chapter 4.8.

In order to avoid frost risk in the late summer or early fall and achieve uniform ripening of the seeds, about 100 % of the planted rapeseed is swathed when the seed achieves 30 to 35 % moisture. This is practiced in part in the Brown Soil Zone as well, but the producer faces a risk that seeds will fall out of the pods due to strong dry winds. Harvesting is done when the seed achieves about 10 percent moisture. Due to unfavorable weather in the Black

Soil Zone this is not always possible, so seeds are harvested at a higher moisture level. Therefore, the seeds should be dried after the harvest, as frequently is the case with the grain.

An overview of the crop shares on the farms and yields of the selected crops are given in Table 4.3. Details on the production systems of conventional and GMO varieties used on the farms can be found in Tables A2.2 und A2.3 in the Appendix.

Table 4.3: Crop rotations, crop shares and yields at the selected farms in Saskatchewan

Region		**Brown Soil**	**Brown Soil**	**Black Soil**	**Black Soil**
Farm size	ha	1,210	2,430	1,210	2,020
Soil cultivation system		Minimum Till	Minimum Till	Minimum Till	Minimum Till
Share:					
Summerfallow	%	20	20	-	-
Spring wheat [1)]	%	40	40	30	30
other grains [2)]	%	-	-	20	20
Spring rapeseed	%	20	20	27	27
Legumes [3)]	%	20	20	20	20
Other [4)]	%	-	-	3	3
Yields:					
Spring rapeseed [5)]	t/ha	1.35	1.35	1.68	1.68
Spring wheat [6)]	t/ha	1.88	1.88	2.89	2.89
Spring barley	t/ha	-	-	3.77	3.77
Oats	t/ha	-	-	3.43	3.43
Lintils and chickpeas	t/ha	1.24	1.24	-	-
Peas	t/ha	-	-	3.03	3.03
Flax	t/ha	-	-	1.44	1.44

1) Durum and Hard Spring Wheat on Brown Soil; Hard Red Spring Wheat and Canadian Prime Spring Wheat on Black Soil.
2) Spring barley and oats on Black Soil.
3) On Brown soil lentils (50%) and chickpeas (50%) and on Black soil green and yellow peas.
4) Flax on Black Soil.
5) Average of conventional and transgenic varieties.
6) On Brown soil farms durum wheat yields 2.69 t/ha and on Black soil farms Canadian Prime Spring 3.36 t/ha.
Source: Own data collection and calculation. Park_2003-07-03

An overview of yields for selected crops of both analyzed regions is given in Table A2.4 in the Appendix. It can be observed that crop yields for the panel farms are much higher than the averages for the soil zones. This is the result of a) good management abilities of the farmers who took part in the panel and b) high yield variability even within small regions.

Extreme values and variation coefficients exhibit very high instability of yields for rapeseed and grains, especially for Brown Soil Zone, due to the influence of semiarid climate conditions.

According to the panel, no yield differences exist between the farms of different size under similar management and climate conditions. Therefore, for the following production costs analysis, the yield of the farms from the same region will be equal.

4.6 Agricultural policy in Canada

A range of domestic support programs for agriculture exist in Canada. The objectives of these programs include income support, price stability, market regulation, and the elimination of regional disparities. A number of government programs provide support activities in market access, market development, market readiness, and global competitiveness. Government intervention is the highest for eggs, dairy and poultry products. The oilseed sector is one of the commodity sectors that is least influenced by government intervention.

Major elements of Canadian farm policy such as the Canadian safety net system, transport and factor subsidies are reviewed in the following section.

4.6.1 Canadian Safety Net System (Income stabilization)

In 1991, the Farm Income Protection Act was introduced to provide a general framework for income stabilization programs. The major elements of this safety net framework are Crop Insurance, the Net Income Stabilization Account (NISA), and province-specific companion programs. Agricultural budget and expenses by program are to find in Table A2.5 in Appendix.

Similar to the United States, **crop insurance** provides production risk protection to producers by minimizing the economic effects of crop losses caused by natural hazards. The crop insurance is a three way cost-shared program among producers, provinces and the federal government.

In general, most of crops produced in Canada can be insured against crop losses as a consequence of drought, flood, hail, frost, excessive moisture and insects. Payments are triggered when a producer's yield falls below 70 – 80 % of that farm's average historical yield due to any of the risks listed. Insurance coverage is provided under a two-tier system. Tier one, or 50 % coverage, requires producers to pay 10 % of premiums with the federal and provincial governments sharing the other 90 % on a 50 : 50 basis, respectively. Tier two allows producers to purchase additional coverage of up to a 70 or 80 % coverage level; producers pay 40 % of the premiums for the higher coverage and the federal and provincial governments share the cost of the other 60 % on a 50 : 50 basis respectively.

Table A2.6 in Appendix displays insured areas in Saskatchewan allocated to various crops classified by coverage level. One may observe that a 70 % coverage level dominates in insured areas. Table 4.4 displays the level of participation in the crop insurance program, paid premiums and indemnities.

Table 4.4: The Crop Insurance Program in Saskatchewan: participation, paid premiums and indemnities, 1990 to 1998

Year	Planted area	Insured area		Amount of insured farmers	Premiums	Payments	Payment per insured farmer	Payment/ Premium
	ha	ha	Share in %		can$	can$	can$	%
1990	12,470,645	9,464,889	76	46,523	225,432,602	160,883,342	3,458	71
1991	12,456,279	11,122,083	89	51,466	165,294,474	61,312,350	1,191	37
1992	12,431,795	9,747,663	78	49,466	265,225,584	301,960,318	6,104	114
1993	13,039,433	7,910,664	61	45,752	200,239,386	181,809,677	3,974	91
1994	13,240,158	7,350,705	56	43,107	176,457,612	125,783,335	2,918	71
1995	13,352,661	7,743,813	58	40,904	181,559,846	153,804,482	3,760	85
1996	13,259,745	7,571,938	57	38,099	210,591,050	61,289,666	1,609	29
1997	13,226,399	8,153,503	62	36,030	184,176,191	84,488,198	2,345	46
1998	13,708,786	8,707,146	64	35,336	191,854,457	88,007,450	2,491	46
Average	13,020,656	8,641,378	67	42,965	200,092,356	135,482,091	3,153	68

Source: Saskatchewan Crop Insurance Corporation, Agri-Food Canada. Park_2003-07-03

The **Net Income Stabilization Account (NISA)**[9] is the primary income safety net program in Canada that foresees protecting farmers from income fluctuations and providing long-term farm income stability. Farmers, federal and provincial governments deposit money into individual and government accounts. Farmers may withdraw funds when farm income falls below specified trigger level.

Under the NISA, farmers contribute about 3 % of their eligible net sales (ENS) to their individual accounts (Fund 1) established with the government at their financial institutions. Eligible sales are those from grains, oilseeds and other eligible commodities. Dairy, poultry and eggs are excluded. The calculation of eligible sales includes government payments. In a separate government account (Fund 2), federal and provincial governments contribute two and one percent of the farmer's net sales respectively.

9 More information is available at http://www.agr.ca/nisa/

Farmers can withdraw funds from the NISA account through the Stabilization Trigger and the Minimum Income Trigger. Under the Stabilization Trigger, farmers can withdraw if the current year's gross margin falls below the average gross margin of the past five years. Under the Minimum Income Trigger, farmers can withdraw if the net income from all sources falls below a minimum income threshold plus the current year maximum matchable deposit. The minimum income threshold is 20,000 can$ for individual and 35,000 can$ for families. Withdrawals cannot exceed the producer's account balance.

Annually, producers can deposit up to **3 %** of their eligible net sales and receive full government matching contributions. They also have the option of depositing an additional 20 % of their eligible net sales with a maximum threshold of 250,000 can$. Although these deposits are not matched by the government, they still earn a 3 % interest bonus over and above regular interest rates offered by their financial institutions.

The NISA account is subject to an Account Balance Limit. An account is limited to 1.5 times the five-year average ENS. No further deposits are permitted until the account falls below the ceiling.

At the end of 1998, an **Agricultural Income Disaster Assistance (AIDA)[10],** a 2-year national program, was started to provide income support to farmers facing low income because of depressed commodity prices. AIDA is 60 percent funded by the federal government and 40 percent by the provincial governments. Total foreseen funding was around 1.5 billion can$. To qualify, farmers' gross margins have to drop below 70 percent of their average gross margins over the previous three years. A limit of 175,000 can$ per producer is placed on payments.

An example of AIDA payment calculation is given in Table 4.5.

Table 4.5: Example of calculation of compensation payment under AIDA program

Tax year			**1996**	**1997**	**1998**	**1999**
Calculated Revenues	can$		75,000	105,000	125,000	80,000
Calculated Expenses	can$		50,000	65,000	65,000	60,000
Programm-Profit	can$		25,000	40,000	60,000	20,000
Reference Profit	can$	= (25,000 + 40,000 + 60,000) / 3			41,667	
70 % Reference Profit	can$	=			29,167	
Maximum AIDA-payment	can$	= 29,167 - 20,000			9,167	

Source: Own illustration according to Agriculture and Agrifood Canada (2000). Park_2003-07-03

10 More information is available at http://www.agr.ca/aida

4.6.2 Transport subsidies

The year 1995 marked a turning point in Canadian agricultural policy because transportation subsidies under the Western Grain Transportation Act (WGTA) were eliminated. The WGTA was one of the most important policies affecting Canadian agriculture. In the past, the Canadian government strongly subsidized the rail transportation costs. From 1989 to 1992, for example, the cost to the federal government was about 725 million can$ per year, equivalent to about 20 can$ per metric ton of grain (ASH, 1998), to move grains from the Prairie Provinces to various ports for export. Canada ended these subsidies and other forms of transportation support in 1995 to comply with the URAA on export subsidies and to ease the federal deficit.

To compensate farmers for the value of the lost subsidy, the government established two transitional programs—the Western Grain Transition Payments Program and the Western Grain Transition Adjustment Fund. Both programs ended in 1997. Lower compensation was again added in 2000 when the provincial governments of Saskatchewan and Manitoba announced that grain and oilseed producers would receive a one-time payment.

Although transportation subsidies have been eliminated or phased out, the federal government continues to regulate freight rates.

4.6.3 Factor subsidies

4.6.3.1 Agricultural credit programs

Advance Payments Program (APP)

Credits obtained under the APP improve cash flow at or after harvest at low interest rates. The amount of the cash advance is based on half (50 %) of the expected farm gate price of the crop in storage, with the maximum advance being $250,000. The federal government pays the interest on the first $50,000 of an advance issued to a producer. The maximum period the advance can be held is one year.

In order to cover its operational costs, the organization may charge participating producers an administration fee.

For year 2000 following prices were set[11]:

– 65 can$/t - Hard Red Spring wheat
– 70 can$/t - Durum wheat
– 40 can$/t - forage barley
– 100 can$/t - canola
– 176 can$/t - lentils
– 66 can$/t - peas
– 220 can$/t - chickpeas.

Farm Improvement and Marketing Cooperatives Loans Act (FIMCLA)

The Farm Improvement and Marketing Cooperatives Loans Act (FIMCLA) is a federal government program designed to increase the availability of loans (maximum of 250,000 can$ per producer) for the purpose of improving and developing farms. The government guarantees the underwriting of 95 % of the credit loss. The loans are given at the current interest rate plus one percent.

4.6.3.2 Fuel tax rebates

Canadian producers benefit from a refund of provincial tax on gasoline and an exemption on the purchase of colored diesel for farming. The program was started in 1992 and applied to all fuel purchased from bulk fuel dealers. Federal taxes applied to diesel are 0.04 can$/l and for gasoline 0.10 can$/l in 1999/2000. Provincial taxes vary between provinces and were highest for Saskatchewan at 0.15 can$/l for both diesel and gasoline.

Producers can apply for an annual refund of the tax paid on the gasoline up to a maximum of 900 can$. The total estimated benefit to producers of the tax exemption on diesel and refund on gasoline was approximately 115 million can$ in 1999 (SASKATCHEWAN AGRICULTURE AND FOOD, 2000).

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[11] Look at Canadian Wheat Board http:www.cw.ca
Saskatchewan Pulse Growers (http://www.saskpulse.com/web/marketing-advance.html) and
Canola Council of Canada (http://www.canola-council.org/index.shtml).

4.6.3.3 Farmland property tax rebate

In Saskatchewan, producers are eligible for a 25 % rebate on their land property taxes. Property tax paid for "Home quarter" is excluded from the rebate. Home quarter is about 65 ha and is the most valuable part of the farm. The regulation is valid for the accounting year 2000/2001.

Similar programs can be found in other provinces.

4.6.4 Trade barriers

Import tariffs are relatively low and their importance is minimal as a large share of trade takes place between North American Free Trade Agreement (NAFTA) countries.

No export programs for oilseeds exist.

4.6.5 Quality standards

"Canola" is an official trade name for rapeseed of the Canola Council of Canada. Oil obtained from the seed should have less than 2 % erucic acid and meal should contain less than 30 μmol per gram of glucosinolates. The name "Canola" is a combination of "Canadian" and "Oil". As displayed in Figure 4.7, spring rapeseed (*Brassica napus*, "Argentine Canola") dominates in production, where only small share of *Brassica rapa* ("Polish Canola") is planted in Canada.

According to the Canadian Grain Commission grading system, seed is classified into three quality grades that serves as a basis for definition of market value. The seed is graded on the amount of damaged seed and foreign material available in the sample.

A detailed grade definition criteria of rapeseed for exports is given in Table A2.7 in the Appendix. Detailed quality characteristics of the 1999 harvest are given in Tables A2.8 to A2.9 in the Appendix. Figures A2.3 to A2.5 in the Appendix display realized oil, meal and glucosinolates contents of the past ten years.

4.7 Production costs

The figures used for production cost analysis and yields are an average of conventional and GMO rapeseed varieties produced on the farms for both soil zones. Summer fallow production costs are equally allocated to the crops produced on the brown soil farms. They include herbicide and operating costs, overhead and land costs.

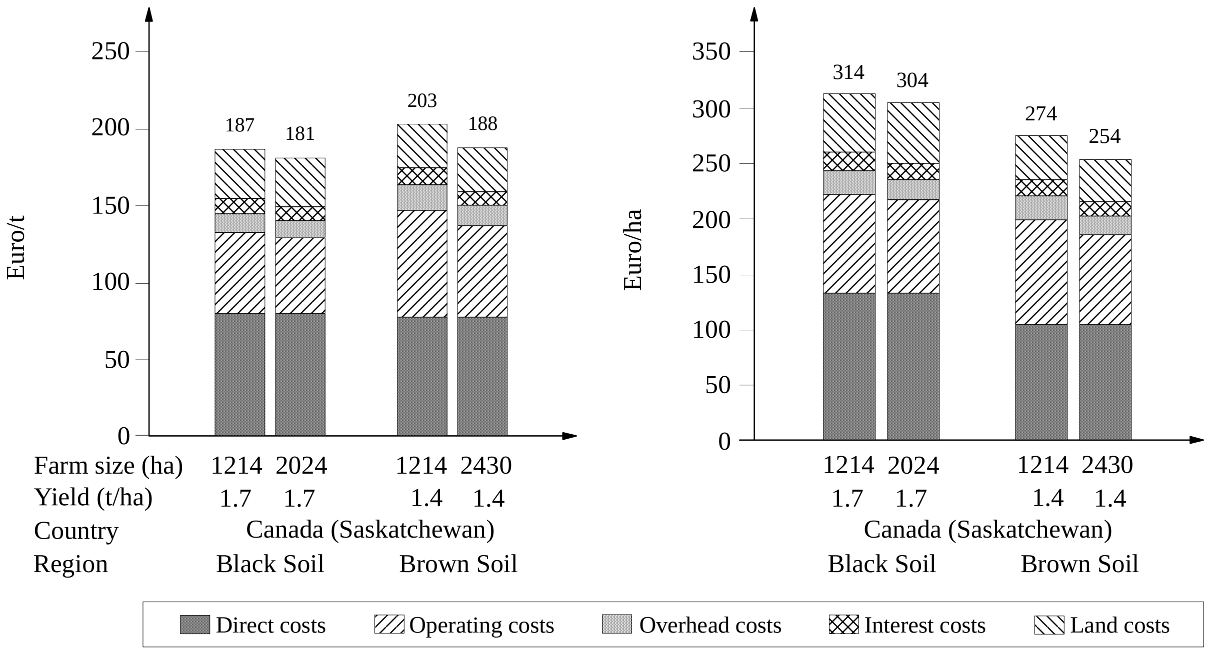
Total production costs

Total rapeseed production costs range between 254 Euro/ha (middle brown soil farm) to 314 Euro/ha (middle black soil farm). Brown soil farms have on average cost advantage of 45 Euro/ha as compared to black soil farms (Figure 4.8).

When expressed on the yield basis, the reverse situation can be observed where black soil farms (181 Euro/t to 187 Euro/t) exhibit a cost advantage of about 12 Euro/t over brown soil farms (188 Euro/t to 203 Euro/t) due to their 20 % higher yield productivity. Stronger economies of scale effects are observed for the brown soil location. The large brown soil farm is double the size of the middle farm whereas for the black soil location, the size relation is lower. This allows the large brown soil farm to reduce and efficiently allocate overhead costs, labor and capital costs.

Allocated summer fallow costs to rapeseed at the brown soil farms are about 15 Euro/t.

Figure 4.8: Rapeseed: Total production costs, 2000



Exchange rate: 1 Euro = 1.37 can$.
Source: Own calculations.

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Land costs

When land costs are excluded from the cost comparison, the cost advantage of black soil farms increases to 25 Euro/t. The large black soil farm achieves the highest 15 % cost advantage over the middle brown soil farm.

Relatively high land costs of the black soil farms contribute a considerable cost disadvantage. Their 40 % higher land rent of 54 Euro/ha compared to 39 Euro/ha is a result of relatively higher profitability of crop production in the black soil zone.

Land costs of the brown soil farms include allocated land costs of the summer fallow of about 5 Euro/t.

Direct costs

Higher per hectare and per ton direct costs of the black soil farms are the result of relatively higher use of inputs (Figure 4.9).

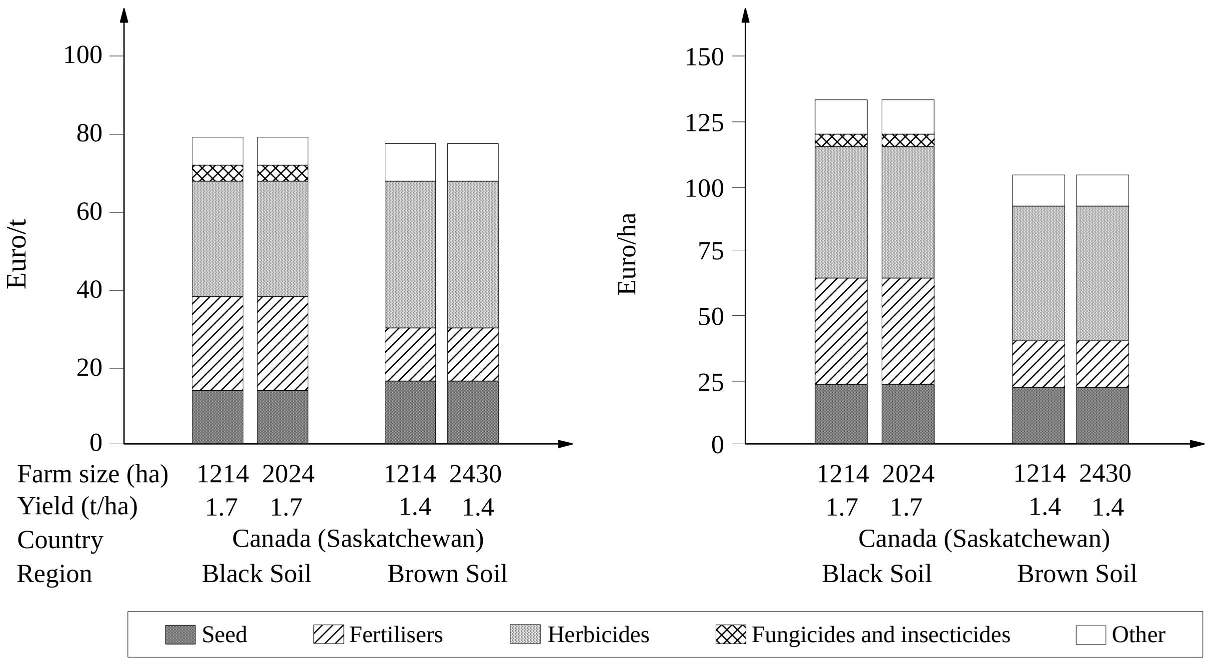
The highest difference between locations of 23 Euro/ha is in **fertilizer** costs. Higher fertilizer input, especially of nitrogen at the black soil farm, is the main reason for that. Even though the farmers at the black soil location apply 30 % cheaper nitrogen due to application of NH_3 compared to Urea at the brown soil location. The price difference (per kg of nutrient) cannot offset the four times higher application rate of nitrogen per hectare in the black soil farms. The rapeseed at the brown soil farms benefits from the nitrogen-pool build up by the summer fallow. On the black soil farms, rapeseed is usually planted after barley or wheat, and therefore requires higher fertilizer application.

Some panel farmers from the Brown Soil Zone sometimes plant rapeseed after grains. In this case, about 2.5 times more nitrogen application is required.

Seed costs of the brown soil farms (22 Euro/ha) per hectare are slightly lower than those of the black soil farms (24 Euro/ha). Both locations have similar seed planting density. However, the brown soil farms have a higher share of conventional seed that is cheaper compared to licensed GMO seed.

According to panel farmers, no input rebates exist for larger farms. Therefore, just as the level of applied inputs (seed, fertilizer, chemicals) is similar between the large and medium farms, their direct costs components are similar as well.

Figure 4.9: Rapeseed: Direct costs, 2000



Exchange rate: 1 Euro = 1.37 can$.
Source: Own calculations.

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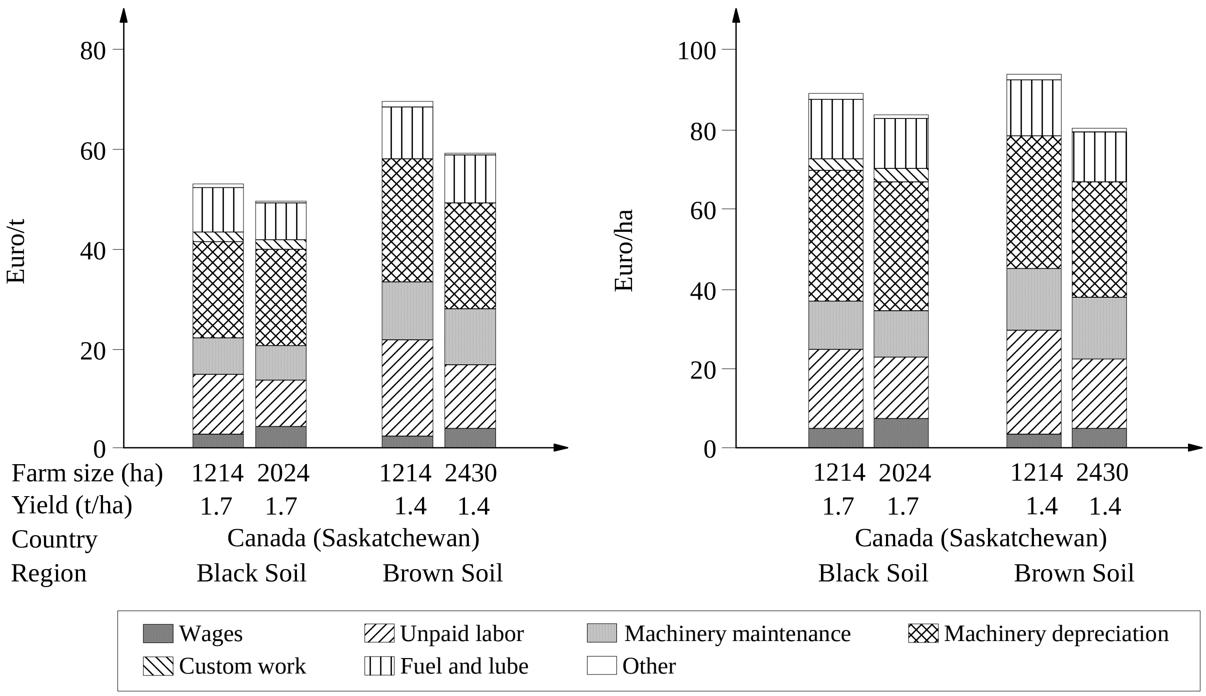
Chemical costs contribute the highest share (40 to 50 %) of the direct costs. For the brown soil farms, herbicide costs are the major component with some additional costs coming from the seed treatment (52 Euro/ha including around 6 Euro/ha of allocated summer fallow herbicide costs). On the black soil farms, costs are higher because due to higher plant density and higher rainfalls the use of fungicides and insecticide is necessary to combat pest problems. When the chemical costs are converted per yield units, the cost disadvantage of black soil farms is more then offset by very high yield.

Accounting for very high instability of yields and market prices, **harvest insurance** assists considerably in risk management at the both locations (Chapter 4.6.1). Panel farmers choose 70 % coverage level for their rapeseed crop. At the brown soil location a higher hail risk exists, and as a consequence the insurance costs are slightly higher there per ton of crop (5.3 Euro/t vs. 5.2 Euro/t).

Operating costs

The large brown soil farm has the lowest operating costs of about 80 Euro/ha (including the summer fallow costs). However, when yield is accounted, the cost advantage is lost to the black soil farms (Figure 4.10).

Figure 4.10: Rapeseed: Operating costs, 2000



Exchange rate: 1 Euro = 1.37 can$.
Source: Own calculations.
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The higher harvest and transport capacity of the black soil farms results in a slightly higher **machinery depreciation** (32.5 Euro/ha vs. 31.3 Euro/ha). Not least, it is a result of additional burden of summer fallow costs at the brown soil farms.

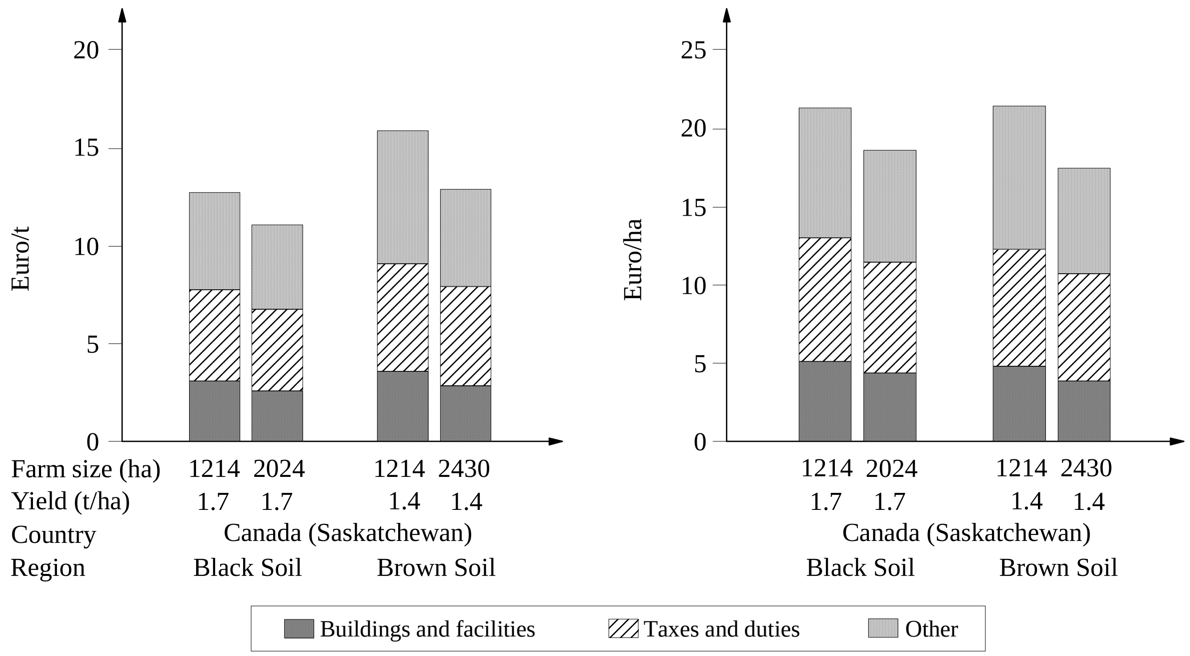
Application of fungicides and insecticides in the black soil farms is usually done with an airplane which result in **custom work** costs of 3.2 Euro/ha (1.9 Euro/t).

Labor costs of the black soil farm are considerably higher than those of the brown soil farms (1.8 Euro/ha) due to peak field activities during the planting and harvesting. However, when converted per yield unit, higher land productivity offsets the cost disadvantage. Opportunity costs of labor are considerably higher at the brown soil farms (4 Euro/ha or 5.5 Euro/t) mainly due to additionally allocated summer fallow costs.

Overhead costs

Overhead costs contribute about 6 % of the total costs at the both farms and range between 17 to 21 Euro/ha (11 to 16 Euro/t) (Figure 4.11). Black soil farms have slightly higher (0.4 Euro/ha) building costs and taxes and fees costs (0.4 Euro/ha). When costs are expressed per yield unit, the black soil farms have a cost advantage in all cost components.

Figure 4.11: Rapeseed: Overhead costs, 2000



Exchange rate: 1 Euro = 1.37 can$.
Source: Own calculations.

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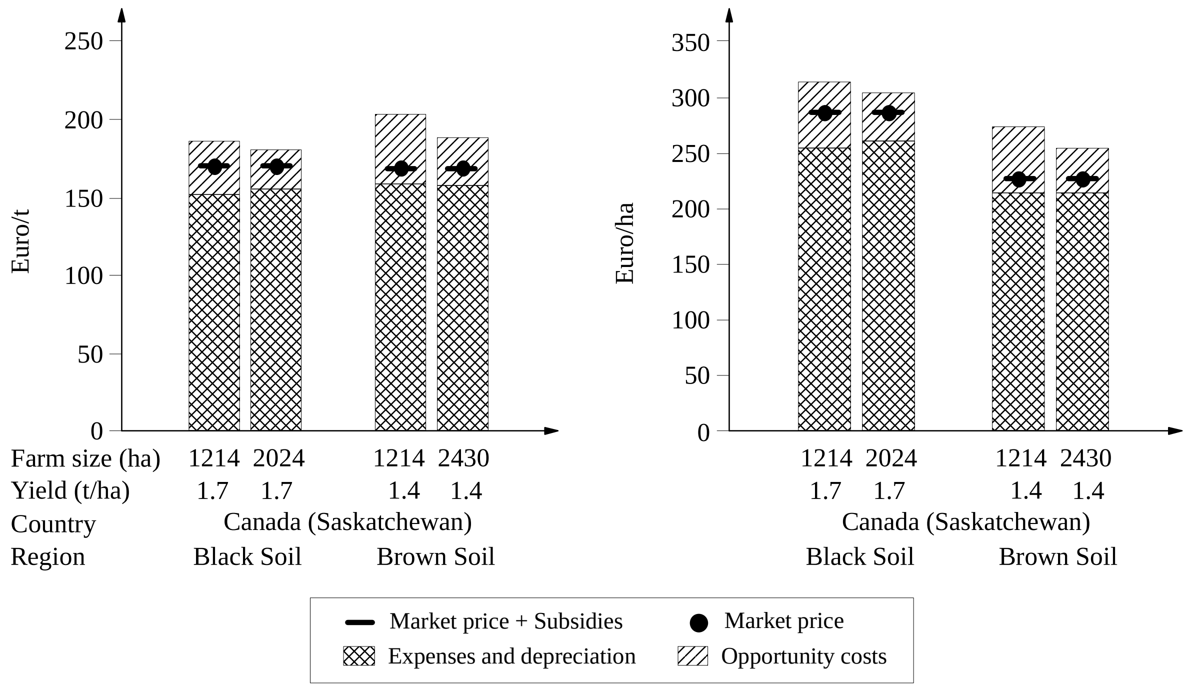
Interest costs range between 12 Euro/ha (large brown soil farm) to 16 Euro/ha (middle black soil farm). The black soil farms have lower share of paid interest (about 30 %) of the total interest costs, whereas for the brown soil farms, the share is more than 35 %. The reason for that is tendentially higher level of external loans in the brown soil zone.

4.8 Profitability

Figure 4.12 displays the profitability of rapeseed production at the selected locations. Total production costs divided into expenses and depreciation and opportunity costs are displayed against revenues from the sales in the marketing year 2000/2001. Under the current market conditions, none of the farms were able to achieve positive entrepreneurial profit. A similar situation can be observed for grain production.

Figure 4.12: Rapeseed: Profitability of production, 2000



Exchange rate: 1 Euro = 1.37 can$.
Source: Own calculations.

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As mentioned in Chapter 4.5.3, the use of transgenic varieties is rapidly expanding. Therefore it is quite important to quantify the benefits of GMO varieties over conventional one.

A Gross Margin comparison that is frequently used for short-term analysis will be used for this purpose.

Table 4.6 displays gross margins for conventional, RR- and LL-varieties used on the farms in black and brown soil locations.

One may note that gross margins at the brown soil farm do not differ much compared to the black soil farm. Agronomic and field activity benefits in the production system are quite difficult to quantify. So if these benefits are not accounted for the transgenic varieties at the brown soil farm, they (GMO) have only a slight advantage (4 to 9 %) over conventional varieties. At the black soil farm, GMO varieties show a quite considerable advantage of 15 % (RR) and 21 % (LL) over conventional systems.

Table 4.6: Gross Margins of conventional and GMO rapeseed varieties at the brown and black soil farms (2000)

		Brown Soil			Black Soil		
		Convent.[1]	**RR[2]**	**LL[3]**	**Convent.**	**RR**	**LL**
Yield	t/ha	1.30	1.36	1.46	1.59	1.67	1.79
Market price	Euro/t	168.79	169.42	169.05	170.38	170.33	170.25
Revenues	**Euro/ha**	**219.42**	**230.42**	**246.81**	**270.91**	**284.45**	**304.75**
Seed costs	**Euro/ha**	**19.43**	**21.85**	**31.50**	**19.43**	**21.85**	**31.50**
TUA[5]	Euro/ha		20.27			20.27	
Herbicides	Euro/ha	49.35	33.67	55.20	56.20	28.03	49.56
Insecticides and fungicides	Euro/ha				5.47	5.47	5.47
Plant protection	**Euro/ha**	**49.35**	**53.94**	**55.20**	**61.67**	**53.77**	**55.03**
Fertilisers	**Euro/ha**	**18.24**	**18.24**	**18.24**	**40.79**	**40.79**	**40.79**
Fuel	Euro/ha	13.68	13.73	13.75	15.29	14.48	14.48
Machinery maintenance	Euro/ha	14.96	15.61	15.61	12.20	12.22	12.22
Variable machinery costs	**Euro/ha**	**28.64**	**29.34**	**29.36**	**27.49**	**26.70**	**26.70**
Share of summerfallow [5]	Euro/ha	6.08	6.08	6.08			
Crop insurance	Euro/ha	8.22	8.22	8.22	9.99	9.99	9.99
Interest	Euro/ha	4.09	3.99	3.99	3.31	3.28	3.28
Variable costs	**Euro/ha**	**134.04**	**141.65**	**152.60**	**162.67**	**156.38**	**167.29**
Gross margin	**Euro/ha**	**85.38**	**88.76**	**94.22**	**108.24**	**128.07**	**137.46**

Exchage rate: 1 Euro = 1.37 can$ (2000) Park_2003-07-03
1) Conventional system. 2) Roundup Ready system. 3) Liberty Link system.
4) TUA = Technology Use Agreement.
5) Herbicides and machinery costs of summerfallow.
Source: Own calculations.

GMO varieties at the both locations have a considerable cost disadvantage in seed costs that is a result of higher price for certified seed.

GMO varieties at the black soil farms have a cost advantage in plant protection costs, which is not the case for the brown soil. For the RR system, the costs consist of herbicide costs and a license fee (Technology Use Agreement - TUA).

Higher yield of GMO varieties over conventional one bring considerable benefits for gross margins at both locations.

The results are supportive for the further expansion of transgenic varieties, especially in the black soil zone. However, one should be careful not to overestimate long-term effects of the GMO systems. Experiences made with the GMO systems are relative new and the yield advantages that are a major reason for higher economic benefits have to be proved to be sustainable. Additionally, active ingredient restrictions within crop rotation system must be taken into account as well as the management efficiency of special weeds.

5 Soybean production in the United States

5.1 Climate and soils

Soybeans in the United States are produced under different climate and soil conditions. As will be shown in the Chapter 5.2, western states of the Corn Belt and, in recent years, the Northern Plains, have become the major regions of soybean production (Map A3.1 in Appendix). Therefore, the farms analyzed were selected in those regions and the following description of natural conditions will focus there.

5.1.1 Climate

Soybean is a short-day plant that is very sensitive to the length of the day. When the plants are exposed to the long days, some flowering distortion may be observed. Seed growth also has a positive correlation to short days (GEISLER, 1988).

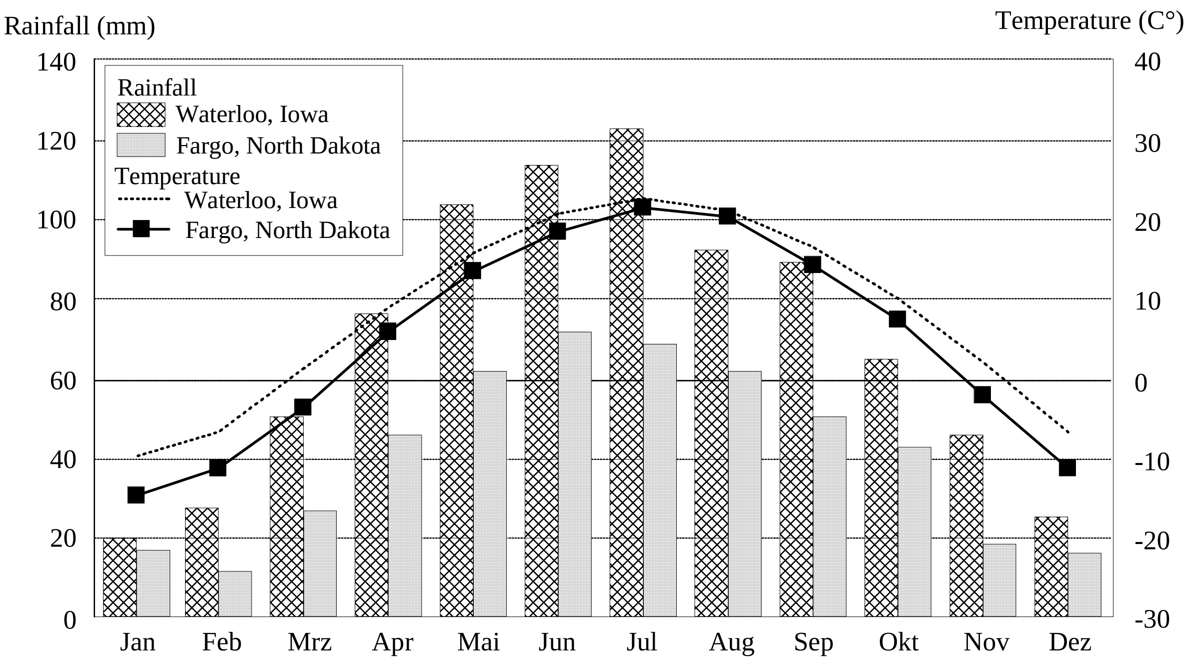
The vegetation period available for soybean growth strongly determines the level of the yield potential for the selected locations.

Soybean plants strive for a relatively high minimum temperature of about 8 to 10° C to start germination. During the vegetative period from July to the end of August, mild weather ensures higher yields. The plants can well withstand drought spells during the development and vegetative period. Dry weather at seed ripening additionally benefits the yield potential.

The Corn Belt has the most suitable climate for soybean production in the United States. The highest soybeans yields are realized in the region (Chapter 5.3). The last spring frosts occur at the end of April and early fall frost starts at the beginning of October. On average about 160 days are available for the vegetative period in the region. High rainfalls are available for the plants during the main vegetation time and in September, during ripening, the rainfall level drops. Annual rainfall ranges between 800 mm to over 900 mm depending on the location.

In May, soils warm up very rapidly and ensure fast seed germination. With high soil moisture, young plants emerge very quickly. The average annual temperature range is between 8 and 9° C.

Figure 5.1: Rainfall and temperature distribution at selected locations in the Corn Belt and Northern Plains



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature													**Annual Ø**
Waterloo, Iowa	-9.67	-6.61	1.22	9.06	15.67	20.61	22.83	21.28	16.61	10.06	2.06	-6.50	8.06
Fargo, North Dakota	-14.50	-11.11	-3.39	6.11	13.44	18.61	21.72	20.44	14.28	7.61	-2.17	-11.33	5.00
Rainfall													**Total**
Waterloo, Iowa	20.32	27.43	50.80	76.20	103.63	113.54	122.68	92.46	89.15	65.28	46.23	25.40	855.98
Fargo, North Dakota	17.02	11.43	26.92	46.23	62.23	71.63	68.58	61.72	50.55	42.67	18.54	16.51	494.03

1) Corn Belt: Iowa, Illinois, Indiana, Ohio, Missouri.
2) Northern Plains: North Dakota, Kansas, Nebraska und South Dakota.
Source: National Oceanic and Atmospheric Administration (NOAA); own calculations.

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Moving from the north of Iowa or the south of Minnesota westward or northward leads to shorter vegetation period (120 to 130 days) and longer days. As a result, flowering of the plants is distorted and a shorter time period is available for seed formation and ripening. This is a major limiting factor for the realization of yield potential in the expansion regions of the Northern Plains.

Map A3.2 in the Appendix shows the downward trend of annual rainfall when moving in a northwestrly direction. In northern Minnesota, rainfall is relatively high, about 635 mm to 760 mm, but is less,about 508 mm, in North and South Dakota as well as in a large part of the Northern Plains. Even though rainfalls prevail during the vegetative period in these regions, it is not enough to avoid soil moisture deficits in July and August (Figure 5.1). Therefore relatively low rainfall in the expansion regions is the second limiting factor for further expansion of soybeans in the Northern Plains. An exception is the southern part of Red River Valley, south east of South Dakota as well as east of Nebraska.

Furthermore, annual average temperatures at the locations in the Northern Plains is considerably lower than those of the Corn Belt. In the southeast of North Dakota, the average temperature is about 5° C. Late spring frost can appear in the last week of May and early fall frost in the second week of September.

5.1.2 Soils

An overview of the soils distribution in the USA is given in Map 5.1. Classification of soils is made according to "Soil Taxonomy" of the USDA (1999).

Soils of the Corn Belt and the Northern Plains belong mainly to Mollisols type. This type of soil prevails in the soybean producing states of Iowa, Illinois and Minnesota. They can also be found in parts of North and South Dakota, Nebraska and Kansas.

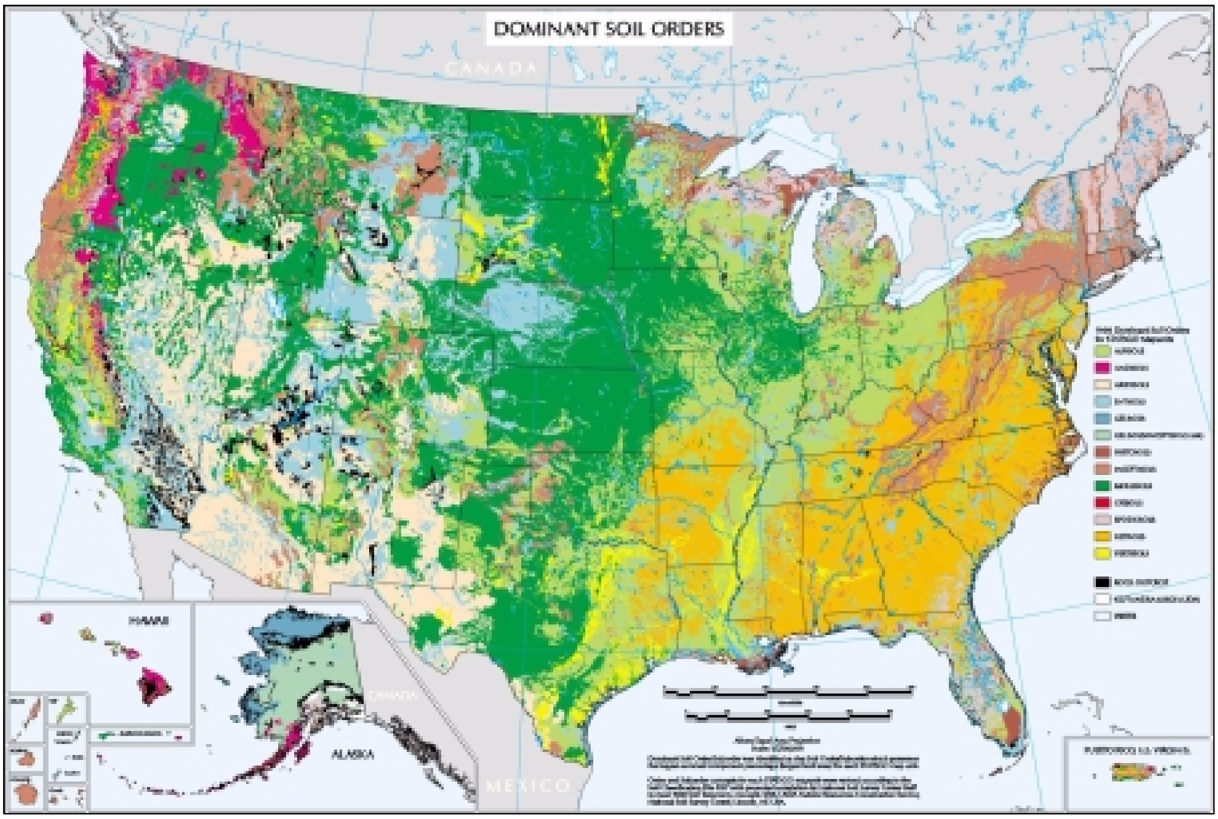
The Mollisols have a number of suborders. One of the most important for the soybean-producing regions are Udolls (Map A3.3 in Appendix). Udolls soils dominate in Iowa, southern Minnesota and northern Illinois. They are typical prairie black earth soils which extend northwards to the black soil zone of Saskatchewan and Manitoba in Canada (Chapter 4.1.2).

According to the FAO classification, most of the Udolls of the Northern Plains and the Corn Belt are *Chernozem* type and are several thousand years old. Some of the Udolls can be classified as *Solonchak- or Solonetz* types. All three types of soil are thick and rich in organic matter with high calcium carbonate content. Soil pH-value is neutral and lime application is not required.

Udolls were formed in sediments and on surfaces of varying ages from the Holocene to the mid Pleistecene periods during glacial and interglacial stages. Loess deposits are to be found in some areas of southern Minnesota and northeastern Iowa.

Neutral pH-values and good water holding capacity of soils set good conditions for successful soybean and corn production for the most of regions.

Map 5.1: Soil types of the USA



Two other important soil groups, *Aquoll*-soils (Map A3.3 in Appendix) and *Vertisols* (Map A3.4 in Appendix), are to be found in the Red River Valley, southern Minnesota (Minnesota River Basin) and central north Iowa. These are the most productive soils of North America. They have relatively high level of ground water and a high clay content. Soils where soybeans or corn are planted frequently have underground drainage due to the sensitivity of this crop to wet soils.

The relief of the most selected locations in the Corn Belt and the Northern Plains is flat and well situated for soil cultivation.

5.2 Production of soybeans and major crops in the United States

According to the USDA (2000) about 102 million ha were allocated to major crops (corn, soybeans, wheat, barley, sorghum, oats, cotton and rice) in 2000. Corn, soybeans and wheat were the major contributors with 31 %, 30 % and 25 % respective shares in the total area.

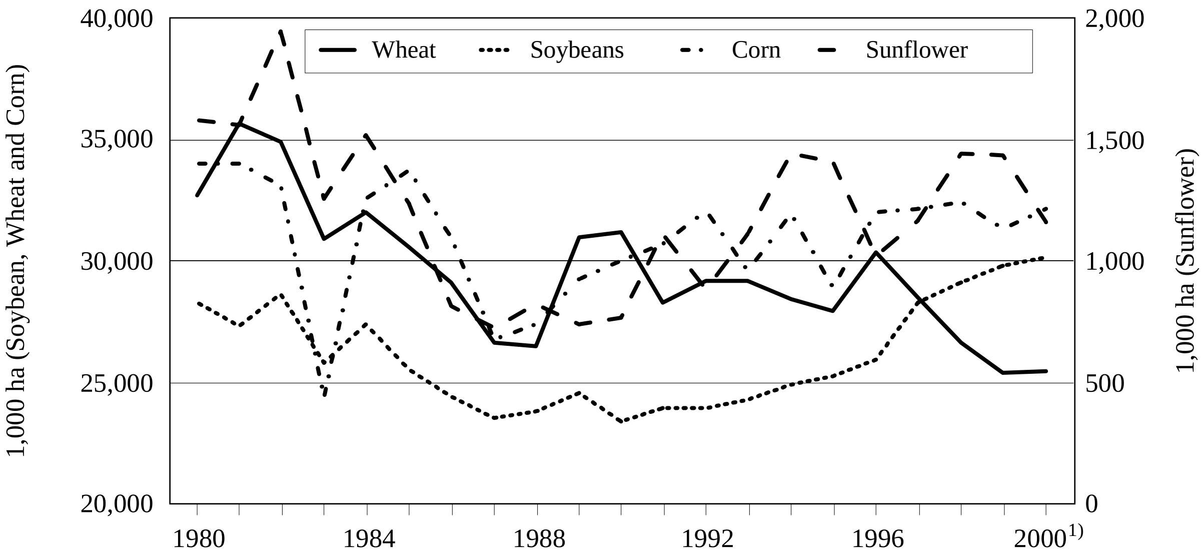
Figure 5.2 and Table A3.1 in Appendix give an overview of planted areas for these major crops from 1980 to 2000.

Soybean production

The area planted with soybeans in the United States has stagnated and went down slightly between the middle of the 1980s to the first half of the 1990s. Since 1995, it has increased by 19 % and reached a record level of 30 million ha in 2000.

The reasons for this are manifold. One of the most important reasons is to look at changed agricultural policy with the introduction of the U.S.farmers' decisions were strongly influenced by product specific programs before 1996. Producers were paid high product-specific subsidies and had to keep a basis area planted with program crops. Oilseeds and cotton were excluded from the program.

Figure 5.2: Area under soybeans and major crops in the USA, 1980 to 2000



1) Estimated.
Source: USDA-NASS On-Line Database.

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In the framework of the FAIR Act, payments were decoupled from production and obligatory set aside rules were abolished. The producers were given flexibility to decide what crops to plant and are completely oriented on the market signals.

At the beginning of the second half of the 1990s, high prices for soybeans drove area expansion. Even price deflation for oilseeds in the following years could not halt the expansion (Figures A3.1 and A3.8 in Appendix). The relation between loan rates for soybeans and its major competing crops, corn and wheat, was one of the major reasons.[1] The relation of loan rates favors soybean production under low market prices for oilseeds and grains[2] (LIN, 2000).

Expansion of soybeans in the USA took place in a number of regions on different scales. Since 1995, the rate of soybean area expansion in traditional producing states of the Corn Belt (Iowa and Illinois) was considerably lower than in the previoly unimportant states of the Northern Plains (Table 5.1). The area allocated to soybeans in 1995 (3.4 million ha) has increased by 67 % and reached 5.7 million ha in 2000. This area expansion in the Northern Plains contributed 40 % of the total U.S. expansion in the last five years.

Table 5.1: Area under soybeans in major producing regions of the USA, 1980 to 2000

Year	Soybeans area (1,000 ha)					
	Production regions 1)					
	IA	IL	MN	OH	NP	USA
1980	3,359	3,804	1,943	1,538	1,769	28,300
1981	3,278	3,743	1,805	1,416	1,910	27,334
1982	3,428	3,743	2,003	1,518	2,171	28,686
1983	3,238	3,683	1,882	1,335	2,121	25,811
1984	3,440	3,723	2,145	1,538	2,610	27,420
1985	3,318	3,683	2,064	1,578	2,299	25,554
1986	3,440	3,662	1,922	1,477	2,499	24,446
1987	3,217	3,561	1,902	1,599	2,618	23,545
1988	3,298	3,561	1,983	1,578	2,817	23,812
1989	3,359	3,602	2,044	1,619	2,849	24,614
1990	3,238	3,723	1,902	1,416	2,772	23,389
1991	3,521	3,723	2,226	1,538	2,968	23,950
1992	3,318	3,845	2,226	1,518	2,995	23,950
1993	3,480	3,764	2,185	1,679	2,853	24,316
1994	3,561	3,845	2,307	1,619	3,286	24,937
1995	3,764	3,946	2,388	1,639	3,403	25,291
1996	3,845	4,006	2,428	1,821	3,501	25,979
1997	4,249	4,047	2,671	1,760	4,229	28,331
1998	4,209	4,290	2,792	1,781	4,573	29,148
1999	4,371	4,290	2,833	1,862	5,099	29,858
2000 2)	4,290	4,168	2,914	1,781	5,666	30,150
% Δ 1995 to 2000	14.0	5.6	22.0	8.6	66.5	19.2

1) IA = Iowa, IL = Illinois, MN = Minnesota, OH = Ohio, NP = Northern Plains: Kansas, Nebraska, North Dakota, South Dakota.
2) Estimated.
Source: USDA-NASS On-Line Database, Own calculations. Park_2003-07-03

[1] See Chapter 5.8.

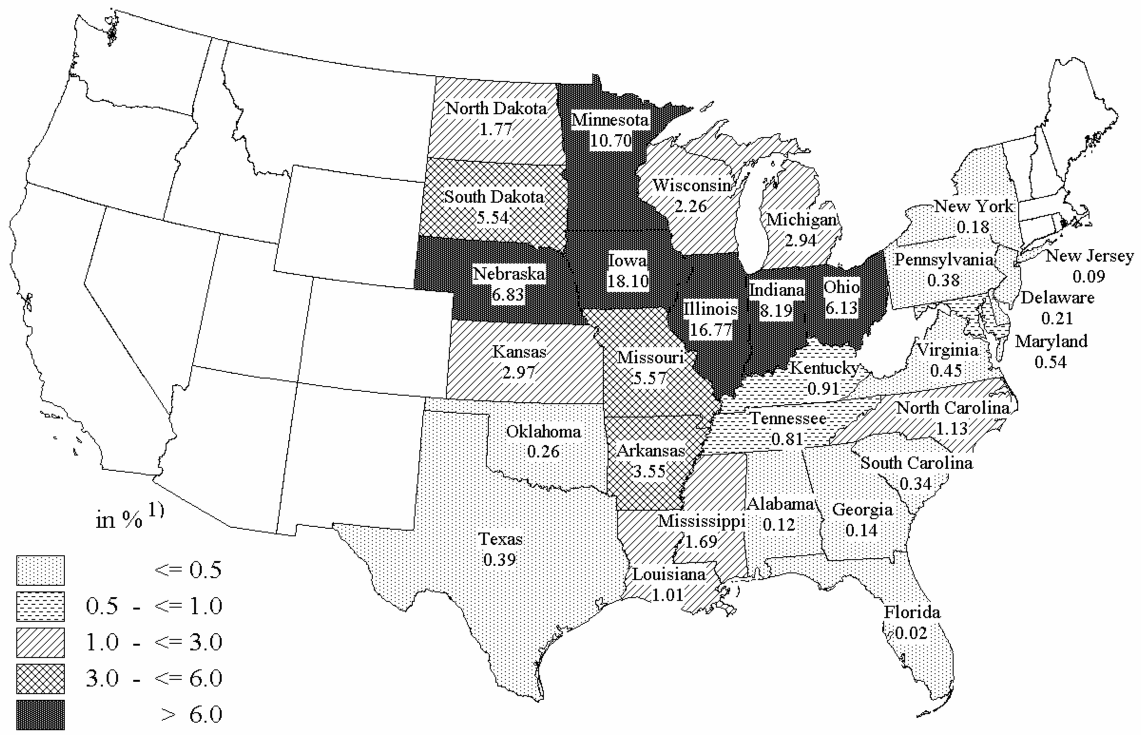
[2] See Chapter 5.8.

These regions have particularly benefited from the introduction of Roundup resistant soybean varieties and related simplifications in the production system. According to the USDA, around 60 % to 70 % of the soybeans planted in South Dakota, Nebraska and Kansas in 2000 were GMO varieties. Whereas the U.S. average is only 54 %, and that has increased six fold since 1996 (LIN, 2000) (Table A3.7 in Appendix).

The soybean expansion rate in Minnesota is relatively high compared to the expansion rates of the traditional regions (Table 5.1). The main reason for this is that rapid soybean expansion took place in the previoly unimportant northwestern part of the state. In the traditional south of Minnesota, a considerably lower expansion rate is observed.

Map 5.2 displays the important U.S. soybean production states in 1999. The major producing states Iowa, Illinois and Minnesota produced around 46 % of the total U.S. soybean output.

Map 5.2: Regional distribution of soybean production in the USA, 1999



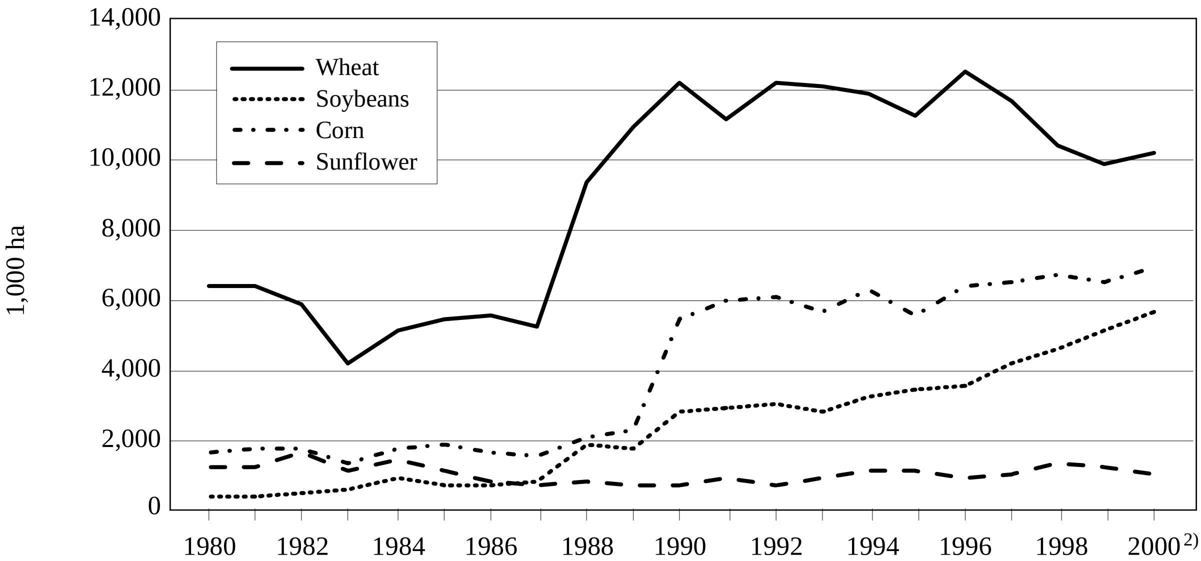
1) As a share of the total US soybean production.
Source: USDA-NASS On Line Database (http://www.usda.gov/nass).

Grains

The major regions of soybean production described above are similarly important for **corn**. It is especially true for Illinois, Iowa and south of Minnesota where corn is planted dominantly in a two-year rotation with soybeans. The corn area of the major states of the Corn Belt - Iowa, Illinois, Minnesota and Indiana - was about 45 % (14.5 million ha) of the total U.S. area (31 million ha).

According to the USDA about 25.5 million ha was planted with **wheat** in 2000 (Table A3.1. in Appendix). Winter wheat was dominant with 69 % share, followed by spring wheat (25 %) and durum wheat (6 %).

Figure 5.3: Area under major crops in the Northern Plains, 1980 to 2000



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1) Northern Plains: Kansas, Nebraska, North Dakota, South Dakota.
2) Estimation.
Source: USDA-NASS On-Line Database (http://www.usda.gov/nass).

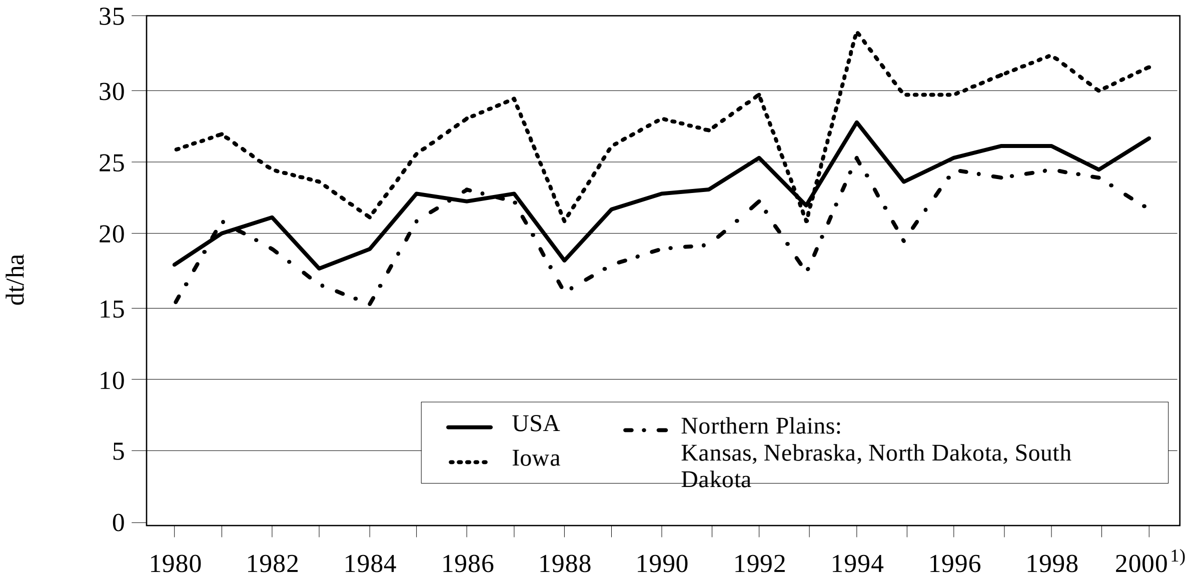
Before 1997 total U.S. wheat area was higher of the soybeans. Since 1997 situation has reversed and soybeans area is about 15 % higher in 2000 (Figure 5.2). The major wheat producing states are located in the Northern Plains (Kansas, North Dakota, South Dakota and Nebraska). They contributed about 40 % of the total U.S. wheat area in 2000. Since 1996, a decrease in wheat areas in the Northern Plains can be observed while soybean areas expand (Figure 5.3 and Table A3.3 in Appendix). Downward trends for wheat prices, improved profitability of oilseeds and more intensive disease problems were the major reasons for wheat area reduction.

5.3 Yields

Differences in climate and soils introduced for selected locations in Chapter 5.1 strongly influence yields realized regionally .

Figure 5.4 displays average soybean yields for Iowa, the Northern Plains and the USA. Higher yield levels in Iowa are observed than for the Northern Plains. Additionally, one may note relatively high yield levels in Iowa and the Northern Plains in the last six years. Relatively high rainfall in this period, above long-term average, has improved production conditions. Especially the Northern Plains with its semiarid climate have benefited from the improved rainfall. According to the experts, with a return of dry weather to the Northern Plains and favorable market prices, a considerable shift from soybean to wheat is to expect in the region.[3]

Figure 5.4: Soybean yields in selected regions of the USA, 1980 to 2000



	USA	Iowa	Northern Plains
1999	24.53	29.93	23.79
Ø 1980 to 2000	22.71	27.40	20.37
Max. 2)	27.83	33.97	25.39
Min. 3)	17.61	20.85	15.05

1) Estimation.
2) Maximum observed yield.
3) Minimum observed yield.
Source: NASS-USDA On-Line Database (2000); own calculations.

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3 Personal communication with Jim Palmer, Executive Director, Minnesota Soybean Grower Association and Gary Koerbitz, Vice-president of Cenex Harvest States Mankato on July 5, 2000.

Yields of major crops in the Northern Plains and the USA are displayed in Figure A3.2 and A3.3 in Appendix.

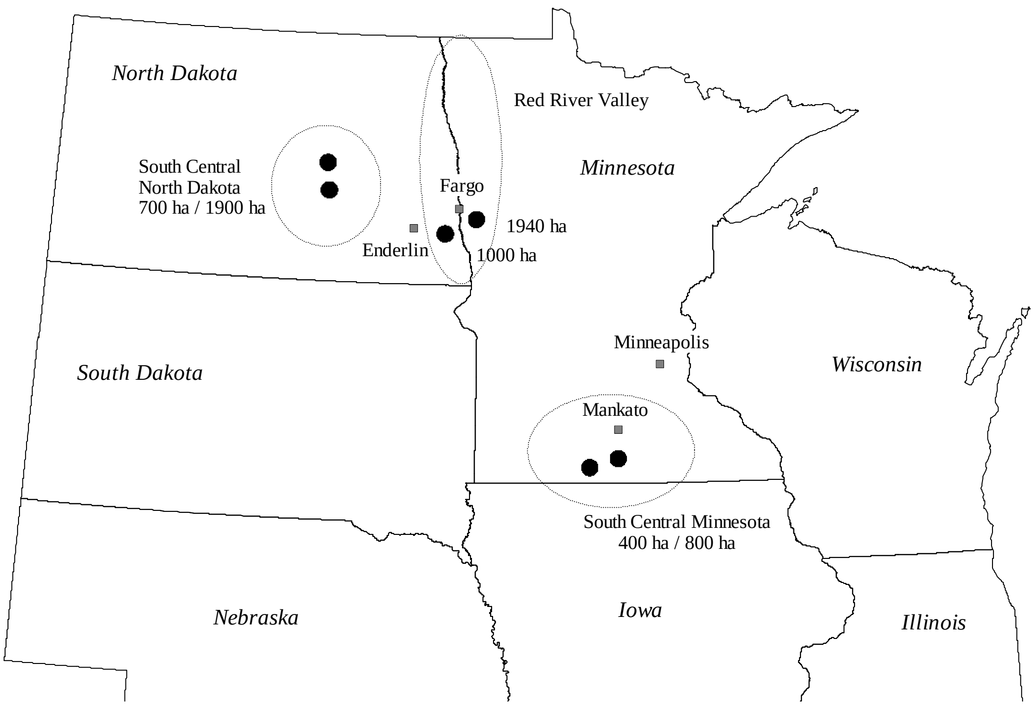
5.4 Location of the selected farms

Map 5.3 displays location of the selected farms in the USA. They are located in North Dakota and Minnesota.

North Dakota is located in the Northern Plains and, before introduction of FAIR Act, was a relatively unimportant soybean producing state. However, since 1995, soybean areas have expanded considerably from 270 thousand ha to 850 thousand ha in 2000 (Table A3.2 in Appendix).

Minnesota is the third largest producer of soybeans in the USA. The most important soybean producing regions are located in the south of the state and have very similar climates and soils, yields, rotation and production systems as neighboring Iowa and Illinois (Map 5.4).

Map 5.3: Location of the selected farms in the USA



Source: Own illustration.

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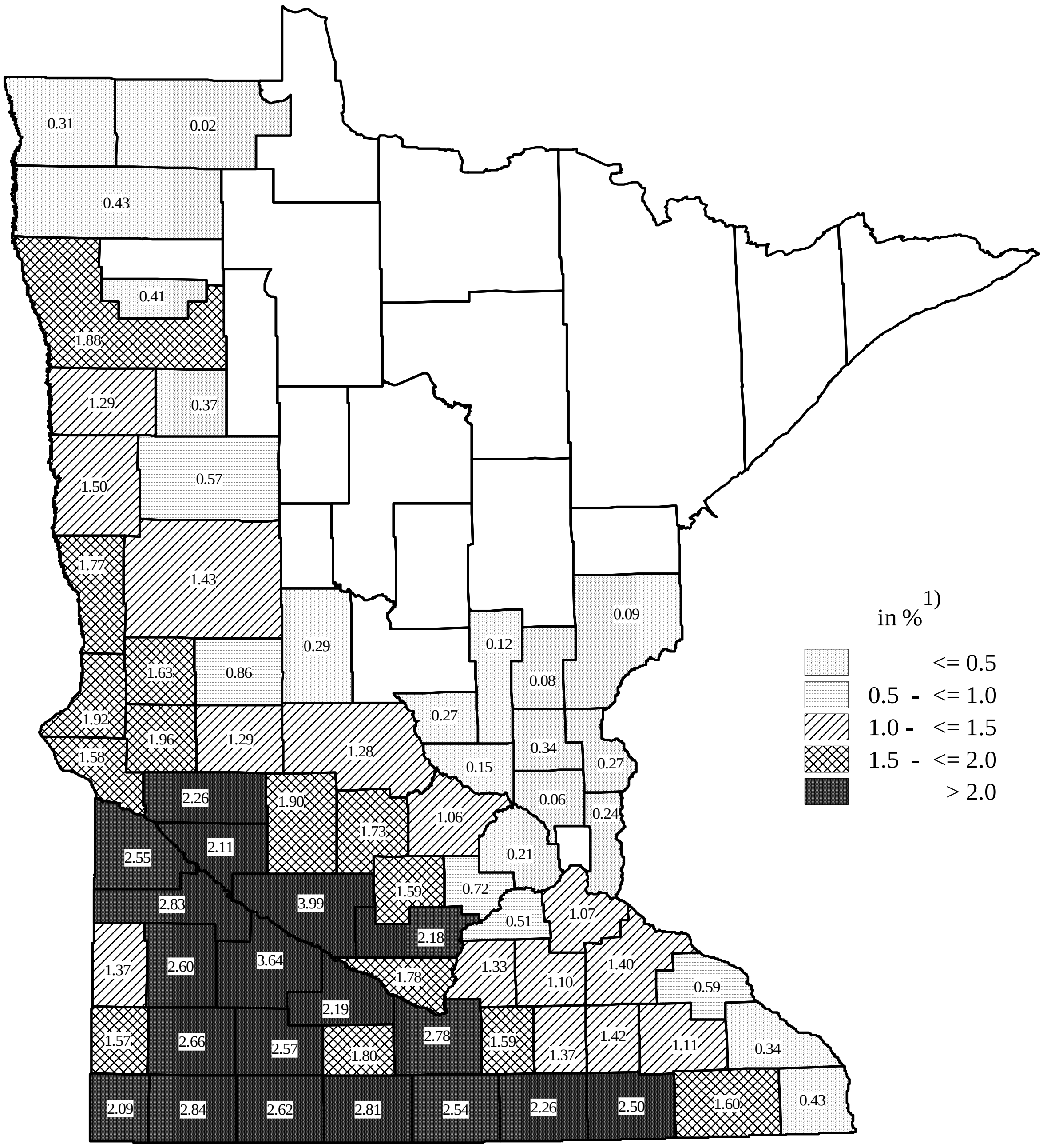
In **North Dakota,** two arable farms of 700 ha and 1900 ha were built up during the panel meeting in the central southern part of the state. Sunflower is a major broadleaf competing crop for soybeans in the region.

Soybeans are processed in Enderlin, located 80 km westwards from Fargo.

Map 5.4: Regional distribution of soybean production in Minnesota



1) As a share of the total state soybean production.
Source: USDA-NASS On Line Database (http://www.usda.gov/nass).

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The major soybean producing region of North Dakota is located in the west of the **Red River Valley** (Map A3.5 in Appendix). Major expansion of soybean production of northern Minnesota took place in the eastern part of Red River Valley. Two arable farms of 1,000 ha and 1,940 ha were built up during the panel meeting there.

Hard Red Spring Wheat dominates grain production in the region, that in recent years has yielded substantial areas to soybeans. The share of soybean crop rotation has increased to 30 % in many regions. This trend is stronger for the regions that have more intensive wheat disease problems.

In southern Minnesota (**South Central Minnesota**) crop rotations consist mainly of soybeans and corn. Two arable farms of 400 ha and 800 ha were build up during the panel meeting there.

Table 5.2: Climate and soils at the selected locations in the USA

Farm size (ha)	**South Central North Dakota 710 ha**	**South Central North Dakota 1.900 ha**	**Red River Valley 1.010 ha**	**Red River Valley 1.940 ha**	**South Central Minnesota 400 ha**	**South Central Minnesota 810 ha**
Soil type	Chernozem	Chernozem	Vertisol	Vertisol	Vertisol, Chernozem	Vertisol, Chernozem
Relative soil quality	good	good	very good	very good	very good (drained)	very good (drained)
Rainfall / mm per year	460 to 480	460 to 480	495 to 530	495 to 530	800 to 850	800 to 850
Rainfall distribution	prevailing May to Sept. (70 %)	prevailing May to Sept. (70 %)	prevailing May to Sept. (65 %)	prevailing May to Sept. (65 %)	prevailing May to Sept. (60 %)	prevailing May to Sept. (60 %)
Average temperature °C (Min. - Max.)	4.4 (2.2 to 7.2)	4.4 (2.2 to 7.2)	5,0 (3.9 to 8.3)	5,0 (3.9 to 8.3)	7.8 (6.1 to 11.1)	7.8 (6.1 to 11.1)
Average frost days	235	235	220	220	200	200

Source: Own data collection, National Agricultural Statistics Service Minnesota, North Dakota (1998). (www.nass.usda.gov/mn/ und www.nass.usda.gov/nd/); Extension Service University of Minnesota (1998). Park_2003-07-03

Soybeans produced in South Central Minnesota are processed in Mankato.
Climate and soils at the selected locations are displayed in Table 5.2.

5.5 Production systems

The above described differences of climate and soils at the selected locations result in relatively different production systems, crop rotations and yield productivity. A detailed overview can be found in Table 5.3 and Tables A3.4 to A3.6 in the Appendix.

Table 5.3: Crop rotations, crop shares and yields at the selected farms in the USA

		South Central North Dakota	**South Central North Dakota**	**Red River Valley**	**Red River Valley**	**South Central Minnesota**	**South Central Minnesota**
Farm size	ha	710	1,900	1,010	1,940	400	810
Soil cultivation system		conventional	conventional	conventional	conventional	conventional	conventional + plow
Share:							
Spring wheat [1)]	%	50	50	50	50	-	-
Corn	%	-	-	-	-	50	50
Spring barley [2)]	%	10	10	-	-	-	-
Soybeans	%	32	32	28	30	50	50
Sunflower	%	8	8	-	-	-	-
Sugarbeets	%	-	-	22	20	-	-
Yields:							
Spring wheat	t/ha	2.64	2.64	2.57	2.57	-	-
Corn	t/ha	-	-	-	-	8.98	9.85
Spring barley	t/ha	3.39	3.39	-	-	-	-
Soybeans	t/ha	2.15	2.15	2.02	2.02	3.08	3.28
Sunflower	t/ha	1.90	1.90	-	-	-	-
Sugarbeets	t/ha	-	-	42.6	42.6	-	-

1) Hard Red Spring Wheat. 2) Feed and malt barley.
Source: Own data collection and calculation. Park_2003-07-03

5.5.1 Production systems at the selected locations

Hard Red Spring Wheat dominated crop production in **North Dakota** before the sunflower was introduced in the mid 1960s. Since that time, high quality wheat areas have varied, depending on rainfalls and influences of agricultural policy on summer fallow. In the northern and western parts of the state, monoculture wheat still dominates agricultural production. Similar to bordering southwestern Saskatchewan, durum wheat prevails in production due to climate conditions. In recent years summer fallow and wheat yielded to rapeseed production.

In the central and southeastern parts of North Dakota, summer fallow yielded completely to sunflowers. Sunflower is rotated with grains every fourth or fifth year depending on its price relation to wheat. In years with normal weather, wheat after sunflower usually has higher yields compared to wheat after wheat. In years with dry weather, the reverse can be observed due to reduced available soil water moisture.

Sunflower after soybean planting is limited due to herbicides used in soybean weed management. There are no obstacles to plant soybeans after sunflowers.

With soybean expansion in southern parts of North Dakota, the wheat share on the farms has reduced considerably from 60 % to the current 40 - 50 %.

A similar trend is observed in the **Red River Valley** where about one third of the area is planted with soybeans. Soybeans are usually planted after sugar beets or wheat, and seldom before sugar beets due to problems with herbicides used.

As mentioned above, two-year crop rotation of soybean-corn dominates in the south of **Minnesota**. Corn is also planted in the south of North Dakota and Red River Valley but is not able to reach yield level of the Corn Belt. Wheat production in the south central Minnesota is limited by the moist and warm weather that results in disease problems that are difficult to manage.

Soybean and corn shares as displayed in the Table 5.3 have been historically established over the last 20 years. The relation between crops remained stable that is not at last reflected by preceding crop value. According to long year experiments in the southern Minnesota, in corn-soybean rotation, corn achieves 13 % higher yield compared to corn in monoculture (PORTER et al., 1997). For soybeans, a 10 % higher yield is observed compared to soybeans in monoculture. Similar results were achieved by COPELAND et al. (1993) and the major reason for higher yields of soybean and corn were traced to improved use of available soil moisture.

An additional benefit of corn-soybean rotation is the disruption of cycle development of the corn borer. Savings of insecticide costs and fertilizer costs for corn have to be considered in an estimation of the value of soybeans as preceding crop.

Soil cultivation systems at the selected locations can be classified according to North American standard as "Conventional Tillage"[4]. For soybean production usually one stubble cultivation is done in fall and in spring seedbed preparation is done in two to four weeks in advance of planting. Direct seeding is implemented seldom, however increasing trend is observed with decreasing rainfalls within Northern Plains when moving northwards or westwards.

[4] See Chapter 4.5.

In **North Dakota** soil cultivation in the fall is mainly used to manage shattered seed and weeds. Black grass is a major weed problem there that is a result of long year cultivation of grains. During fall soil cultivation for grains or sunflowers, nitrogen and some phosphorous. are applied. Spring soil cultivation (usually middle to end of April) helps to warm up the soil, manage weed problems and prepare seedbeds for planting. At the same time, herbicides are applied in sunflower cultivation.

In the **Red River Valley,** soil cultivation practices are quite similar to North Dakota. Additional soil loosening cultivation for soybeans and wheat is needed after sugar beets. Sugar beet harvesting and transportation from the field leads to a considerable compaction of soil.

Similar to the Red River Valley, soil loosening is done in **south Minnesota** after corn. A field cultivator or plow is used for deep cultivation (up to 30cm) of relative compact soil in the region. Intensive stubble cultivation after corn or soybeans helps to manage problems with corn borers. With an increasing share of Bt-corn, the importance of this field cultivation is decreasing. As a result, the value of soybean as a preceding crop is reducing as well.

5.5.2 Soybean production systems

Detailed aspects of soybeans production systems at selected locations are displayed in Tables A3.4 to A3.6 in the Appendix.

The share of Roundup (RR) and Conventional soybean varieties used for cultivation varies considerably between selected locations. In south central Minnesota, a higher share of herbicide resistant varieties are planted as compared to Red River Valley or south central North Dakota.

About 46 % of the soybeans planted in Minnesota are GMO varieties (Table A3.7). High regional differences exist in use of GMO varieties between the expansion region in the north west of Minnesota or eastern part of Red River Valley, and major soybean production regions in the south of the state. On average, about 30 % of the soybeans are GMO varieties in the Red River Valley, whereas in south central Minnesota it is about 60 %. In south central North Dakota, the share of soybean GMO varieties is only 25 % and the state average is even lower at 22 % (Table A3.7 in Appendix).

The productivity level of transgenic soybeans is slightly lower than conventional varieties under similar production conditions. This is true for the farms located in southern

Minnesota. However, according to farmers in North Dakota and Red River Valley, GMO and conventional varieties show no difference in yields. One may expect that inbred yield disadvantage of GMO varieties is offset by better weed management.

Relatively favorable conditions for soybean production in the south of Minnesota result in considerably higher yields. In Minnesota, farmers harvest 3.1 to 3.3 t/ha soybeans, whereas farms in the Red River Valley and central North Dakota only about 2.0 t/ha are harvested. The higher yield of a large farm in Minnesota is a result of more intensive soil cultivation. The large farm uses a plow and a large subsoiler to loosen the compacted soil more deeply, whereas the middle size farm limits its soil cultivation to surface preparation due to financial constraints.

Favorable climate conditions in southern Minnesota allow to soybeans to be planted with higher density. The seeds are planted in wide rows of 76 cm with a planter. In the Red River Valley, an airseeder is used for planting soybeans where seed is planted in narrower rows of about 40^cm. In North Dakota both practices are used for planting. Meanwhile, farms switched to airseeder technology for sunflower seeding which allows higher density of planting. Sunflowers with high density can better compete with weeds and they build up smaller heads that ripen earlier. Earlier harvest and saved drying costs are good incentives for this practice.

The planting of soybeans with airseeder technology in narrow rows leads to a foregoing of mechanical weed management after emergence of the plants. A combination of airseeder and RR-varieties in soybean production proves to be a very labor saving technology. After planting of RR soybeans, application of herbicides can be shifted to a later date and usually only one application of Roundup is needed to combat weeds. Whereas for conventional varieties, an average of two herbicide applications is necessary. In the Red River Valley weed problems for soybeans are not that acute due to intensive chemical and mechanical weed management in sugar beets.

In North Dakota and Red River Valley only phosphorous is applied at the selected farms (Tables A3.4 to A3.5 in Appendix). In southern Minnesota, phosphorous and potassium application is necessary due to higher rainfalls and nutrient removal related to higher yields. Both nutrients are applied in the corn area and the amount of applied fertilizer is based on official recommendations for soybeans and corn (Tables A3.6 in Appendix).

For soybean production, no nitrogen application is necessary since the plants can fix nitrogen themselves due to symbiosis with nodule bacterias. However, in North Dakota, some seed is treated with bacteria. This is done especially in the areas where soybeans are planted for the first time.

In the north of Iowa and south of Minnesota, intensive corn and soybean production has strong connection with hog feeding. Highly specialized and integrated farms purchase soybeans and corn from regional producers. These large farms produce a high amount of manure that is relatively strictly regulated. The farms give up the manure to neighboring soybean/corn producing farms for free.

In recent years, an increase in the Soybean Cyst Nematode (SCN) has become an important issue in U.S. soybean production. The University of Missouri-Columbia has estimated yield damages of SCN around 1.67 milliard US-$ in 1998 (THE SCN COALITION, 1999). The largest negative impact is observed in the Corn Belt regions and to a lesser extent in the Northern Plains. The colder climates of the northern states limit expansion of the SCN northwards where soybeans are planted to limited extent. Intensive problems with the SCN in Iowa, Illinois and south Minnesota show the negative impact of soybean monoculture rotation systems. In corn-soybean rotation systems, problems with the SCN are considerably lower. Areas infected with nematodes have to be taken out of soybean production or nematode-resistant plants have to be planted. However, seed costs of the nematode-resistant varieties are considerably higher.

5.6 Agricultural policy in the USA

The Federal Agricultural Improvement and Reform Act (FAIR Act) introduced in April 1996 provided a new farm sector law for 1996 to 2002. The 1996 FAIR Act accelerated trends of the previous two major farm acts toward greater market orientation that have gradually reduced the government’s influence in the agricultural sector through traditional programs. It removed the link between income support payments and farm prices by providing annual fixed but declining „production flexibility contract payments“for seven years. Participating producers may receive government payments largely independent of farm prices, in contrast to the past when deficiency payments were dependent on farm prices.

Constraints in individual farm decision making as a condition for the receipt of payments by past programs are reduced. With the elimination of obligatory set aside, farmers have much greater flexibility to make planting decisions and respond to market signals.

Major elements of the U.S. agricultural policy under the FAIR act are given in the following section.

Table A3.8 in Appendix gives an overview of government expenditures on specific programs.

5.6.1 Production Flexibility Contract Payments (PFC)

The FAIR Act has changed income support by replacing the target price/deficiency payment program, which had been in place since the early 1970s, with a new program of decoupled payments for seven years that are not related to most farm-level production decisions or market prices. To receive payments and be eligible for loans on contract commodities, a producer entered into a **production flexibility contract** for 1996 to 2002. That contract required the participating producer to comply with conservation, wetland, and planting flexibility provisions, as well as to keep the land for agricultural uses. Farmers need not to obtain catastrophic crop insurance if they waive eligibility for disaster assistance. Land eligible to enter into a contract includes land enrolled in acreage reduction programs for any of the crop years 1991 through 1995, land considered planted under program rules (certified acreage), or land that had been enrolled in the conservation reserve program (CRP) that had a crop acreage associated with it. Farmers receive production flexibility contract payments for seven years, 1996 through 2002, where payments are based on enrolled contract acreage and are not related to current plantings.

An eligible farm's payment quantity for a given contract commodity is the product of the farm's program payment yield for that commodity, times 85 % of the contract acreage (base acres). A per unit payment rate for each commodity is determined annually by dividing the annual contract payment level for a contract commodity by the total of all contract farm's program payment production.

The annual payment rate for a contract commodity is multiplied by each farm's payment quantity for that commodity, and the sum of such payments acres contract commodities is the farm's annual payment.

Annual contract payments are limited to 40,000 US-$, a 10,000 US-$ reduction from the previous 50,000 US-$ limit on deficiency payments. Under the three-entity rule, a producer may receive up to 80,000 US-$ in contract payments directly from the government on three separate entities as long as his/her stake in the second and third entities does not exceed 50 percent of each such entity.

Cumulative outlay for PFC payments for years 1996 through 2002 is capped at nearly 35,6 billion US-$. Payment levels are allocated among contract commodities according to percentages specified by the FAIR Act, generally derived from each commodity's share of projected deficiency payments for fiscal years 1996 through 2002 in the Congressional Budget Office (CBO) budget baseline.

Table 5.4 displays per unit rates for contract commodities. Figure A3.4 in the Appendix displays shares of contract crop payments in the total PFC payments.

Table 5.4: Production Flexibility Contract Payment Rates (US-$ per yield unit)

Crop	Yield unit	1996/97	1997/98	1998/99	1999/00[3)]	2000/01	2001/02	2002/03
Corn	bu[1)]	0.251	0.486	0.377	0.364	0.334	0.269	0.261
Sorghum	bu	0.323	0.544	0.452	0.436	0.400	0.322	0.312
Barley	bu	0.332	0.277	0.284	0.273	0.251	0.202	0.196
Oats	bu	0.033	0.031	0.031	0.030	0.028	0.022	0.022
Wheat	bu	0.874	0.631	0.663	0.640	0.588	0.473	0.460
Rice	cwt[2)]	2.766	2.710	2.922	2.827	2.599	2.096	2.035
Cotton	lb	0.089	0.076	0.082	0.079	0.073	0.059	0.057

1) 1 bu (= 1 Bushel) Corn, Sorghum = 25.40 kg, 1 bu Soybeans, Wheat= 27.22 kg, 1 bu Barley = 21.77 kg.
2) 1 cwt (= 1 Hundredweight) = 45.36 kg, 1 lb (=1 Pound) = 0.45 kg. 3) estimation.
Source: USDA-ERS (2000). Park_2003-07-03

5.6.2 Non-recourse Marketing Assistance Loans and Loan Deficiency Payments

Commodity loan programs are one of the major domestic support programs in the United States. These programs have been in existence in various forms since the 1930's, primarily covering major field crops and providing income support to farmers.

Farmers may receive a loan rate from the government at a designated rate per unit of production (loan rate) by pledging and storing a quantity of commodity as collateral. Loan rates for most crops are based on 85 % of the preceding 5-year average of farm prices, excluding the high- and low-price years. Maximum loan rates are specified for wheat, corn, upland cotton, soybeans, and minor oilseeds. Corn, wheat, and upland cotton loan rates are capped at their 1995 levels, while soybean loan rates can vary between 4.92 US-$/bu (its 1995 loan rate) and 5.26 US-$/bu. Corn and wheat loan rates also may be further reduced based on stock-to-use ratios. Loan rates for sorghum, barley, and oats are set, taking into account their feed values relative to corn.

Loan rates are established annually at the national level. The national rates are based on a combination of statutory formulas and limits, and, to some extent, secretarial discretion. With the exception of rice, national loan rates for each marketing assistance loan commodity are adjusted to the local level (county or warehouse) to reflect spatial differences in markets, transportation costs, and other relevant factors. Loan rates for major crops and contract areas for recent years are be found in Table A3.9 in Appendix.

The interest rate charged on a commodity loan is set at one percentage point above CCC's (Commodity Credit Corporation) cost of borrowing from the U.S. Treasury at the time the loan is made which results in considerably lower interest rate compared to the market one. A farmer may obtain a loan for all or part of a crop at any time following harvest through the following March or the following May, depending on crop. The producer may repay the loan (plus interest) at any time during the 9- to 10-month loan period. However, the quantity of commodity pledged as collateral for a loan may not be delivered to CCC in lieu of repayment prior to loan maturity.

Most relevant for **income support** are the **marketing loan benefits realized** during low commodity market prices. Producers can receive marketing loan benefits in two different ways: the loan program itself and loan deficiency payment. Under the loan program, farmers place their crop under the commodity loan program, as described earlier, by pledging and storing all or part of their production as collateral for the loan, receiving a per-unit loan rate for the crop. But rather than repay the full loan (plus interest), farmers may repay the loan at a lower repayment rate at any time during the loan period that market prices are below the loan rate. When a farmer repays the loan at a lower posted county price (PCP), the marketing loan gain, or the difference between the loan rate and the loan repayment rate, represents a program benefit to producers. In addition, the program waives any accrued interest on the loan when the loan repayment rate is below the loan rate plus interest. An example of Marketing Loan Gain calculation is given in Table 5.5.

Table 5.5: Calculation of Marketing Loan Gain

Crop	Soybeans
Contracted amount	10,000 Bushel (bu)
County Loan Rate	5.15 US-$ pro bu
Subtotal	10,000 bu x 5.15 US-$ = 51,500 US-$
CCC Loan interest	6.50 %
Interest for 9 month	2,511 US-$
Total interest plus loan	54,011 US-$
PCP[1)]	4.20 US-$ per bu
MLR[2)] = PCP x 10,000 bu	42,000 US-$
Marketing Gain	51,500 US-$ - 42,000 US-$= 9,500 US-$
Saved interest	2,511 US-$
Marketing Loan Gain	**9,500 US-$ + 2,511 US-$= <u>12,011 US-$</u>**

1) PCP = Posted-County-Preis = Applicable Alternative Loan Repayment Rate.
2) MLR = Market Loan Repayment.
Source: Own calculation and illustration. Park_2003-07-03

Alternatively, farmers of crops covered by the loan program may choose to receive marketing loan benefits through direct **loan deficiency payments (LDP)**. The LDP option allows the producer to receive marketing loan benefits without having to take out, and subsequently repay, a commodity loan. The LDP rate is the amount by which the loan rate exceeds the posted county price, and thus is equivalent to the marketing loan gain that farmers could obtain for crops under loan. If an LDP is paid on a portion of the crop, that portion cannot subsequently go under loan.

Posted county price (PCP) or the alternative repayment rate reflects CCC's estimate of a local market price for each of the relevant commodities.

Total marketing loan gains and loan deficiency payment paid per producer are limited to 75,000 US-$ and 150,000 US-$ under three-entity rule.

Table A3.10 in Appendix displays the extent of used loan rates and realized LDPs for the harvest year 1999.

According to WTO rules, MALs and LDPs are classified as "amber box" which are trade distorting. In 1999 estimated the AMS (Aggregate Measure of Support) for soybeans was considerably higher than the allowed 5 % "De-Minimis" rule under WTO (see Table A3.11 in Appendix).

5.6.3 Federal Crop Insurance Program

Crop insurance plays a significant role in U.S. agricultural policy. Some form of yield insurance existed as early as end of 1930's and, with time, the spectrum of products offered to farmers was expanded considerably. Government subsidies of crop insurance programs allow farmers to minimize production risk through crop insurance for very low cost.

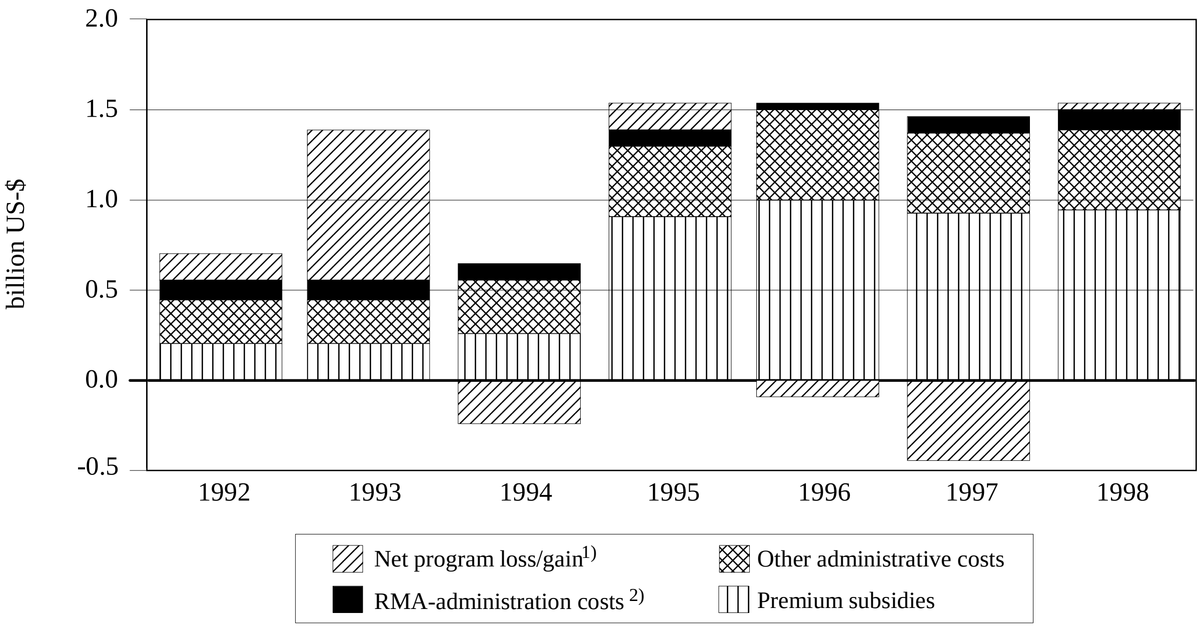
The Federal Crop Insurance Corporation (FCIC) offers a number of crop insurance programs through local crop insurance agents. The FCIC pays a portion of the insurance premiums and pays an additional subsidy to insurance companies for administrative and operating expenses. The government also shares underwriting gains and losses with the companies under the Standard Reinsurance Agreement. Under the Agreement farmers pays around 40 to 50 percent of the total premiums for most levels of coverage (for details see Table A3.12 in Appendix). Producers can choose from Multiple Peril Crop Insurance, Catastrophic Insurance, Crop Revenue Insurance, Group Risk Plan and buy up Supplemental Coverage. Basically the programs insure producer against yield losses (has a long history) and revenue loss. Some base premium and indemnity payments on farm yields or revenue, while others use county yields or revenues.

Producers have been required at various times to obtain crop insurance in order to be eligible for benefits from other farm assistance programs, but insurance participation is generally voluntary.

From 1995 to 1998 on average about 1.2 billion US-$ per year were spent by the government on premium subsidies, administration costs and loss underwriting. Figure 5.5 displays in detail government costs of the crop insurance program.

In 1999 insurance premiums were 2.31 billion US-$, where government has contributed 1.39 billion US-$ (60 %) in premium subsidies and producers paid the rest of 920 million U.S.-$. In the same year 2.4 billion US-$ were paid in indemnities. This implies that for every dollar of premium, producers received 2.64 US-$ indemnity benefit. In 1998, this ratio was 1.8 and in 2000 about 1.8 (USDA-RMA, 2001).

Figure 5.5: Government costs of Crop Insurance Program in the USA



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1) Negative if indemnities exceed premium payments.
2) RMA = Risk Management Agency.
Source: Risk Management Agency, USDA (2000).

5.6.4 Emergency and supplemental assistance

Ad hoc emergency assistance plays a prominent role in U.S. agricultural policy. Direct payments are provided to producers to partially offset financial losses due to severe weather and other natural disasters or stressful economic conditions. Supplemental assistance was included in five legislative packages from 1998 through 2001. The most influential were following acts:

- The Crop Year 2001 Agricultural Economic Assistance Act (August 2001) provided 5.5 billion US-$ of economic assistance to U.S. farmers. Where 4.6 billion US-$ were supplemental MLA payments for program crops and 424 million US-$ for soybean and other oilseed producers.
- Agricultural Risk Protection Act of 2000 (June 2000) reformed crop insurance and provided additional emergency assistance. About 8. 2 billion US-$ (over 5 years) are foreseen for crop insurance reforms (up to 90 % for increase of insurance subsidies), 5.5 billion US-$ for additional MAL payments (they are equal to PFC payments) and 500 million US-$ for oilseed producers.
- Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act of 2000 (October 1999) provided additional 5.5 billion US-$ for MLA payments and 475 million US-$ for oilseed producers.

5.6.5 Export support

In addition to other provisions, the U.S. government uses various programs to support exports of domestic produce through international trade. Major programs are listed below:

Export Enhancement Program (EEP) was initiated in 1985 to help U.S. exporters meet competition from subsidizing countries, especially the European Union. Under the program, the government pays cash to exporters as bonuses, allowing them to sell U.S. agricultural products in targeted countries at prices below the exporter's costs of acquiring them. Major objectives of the program are to expand U.S. agricultural exports and to challenge unfair trade practices. Annual budget of EEP ranged 250 to 579 million US-$ from 1996 through 2002 (USDA-FSA, 2001).

Export Credit Guarantee Program (GSM-102/GSM-103), begun in 1982, is the largest U.S. agricultural export promotion program. It guarantees repayment of private, short-term credit for up to 3 years. GMS-103 complements the GSM-102 and guarantees private credit for 3 to 10 years.

Food Aid Program (Public Law 480 or Food for Peace Program) helps to expand foreign markets for U.S. agricultural products, combat hunger and encourage economic development. Under three separate titles, commodities are available as a long-term credit (up to 30 years) at low interest rates (Title I), donated as emergency food relief (Title II) and granted as food assistance to least developed countries (Title III).

5.6.6 Factor subsidies

5.6.6.1 Fuel tax rebate

U.S. farmers, similar to Canadian and German farmers, benefit from a refund of federal and provincial tax on gasoline and diesel for farming purposes only.

Federal tax applied on diesel is 0.244 US-$/Gallon (= 0.0644 US-$/Liter) and on gasoline 0.184 US-$/Gallon (= 0.0486 US-$/Liter). Provincial tax is applied additionally and varies between federal states. In Minnesota 0.20 US-$ per Gallon (0.0528 US-$/Liter) is paid for both diesel and gasoline.

5.6.6.2 Agricultural credits

The Farm Service Agency (FSA) of USDA provides direct and guaranteed loans to farmers unable to obtain loans from the Farm Credit System or other commercial lenders. All FSA loans provide some subsidy value or credit enhancement to the borrower. Interest rates on loans made directly by FSA are lower than those loans from commercial lenders because FSA rates reflect lower government borrowing costs and do not fully account for administrative costs.

5.6.7 Quality standards

According to § 810.1601 of the **United States Grain Standards Act** (USGSA) soybeans are defined as follows:

"Grain that consists of 50 percent or more of whole or broken soybeans (*Glycine max (L.) Merr*) that will not pass through an 8/64 round/hole sieve and not more than 10 percent of other grains for which standards have been established under the United States Grain Standards Act."

Two classes of soybeans exist: yellow soybeans and mixed soybeans.

Yellow soybeans have yellow or green seed coats and which in cross section, are yellow or have a yellow tinge, and may not include more than 10 percent of soybeans of other colors.

Mixed soybeans are those that do not meet the requirements of the class yellow soybeans.

Grades are defined on the basis of the minimum test weight per bushel, damaged kernels and availability of foreign material in the sample. Four grades of soybeans exist. Grade requirements for the seed are given in a detail in Table A3.13 in the Appendix. It must be noted that oil and protein content in the seed are not determinant for the grade classification.

The Commodity Credit Corporation (CCC) adjusts loan rates and loan deficiency payments paid to farmers according to grade classes. Price discounts take place if the seed does not correspond to minimum grade and quality standards.

The processing industry and elevators pay higher price for so-called High Oleic or High Protein soybeans (on average about 0.40 US-$/Bushel High Oleic and 0.25 US-$/Bushel High Protein[5]). Oil obtained from High Oleic soybeans contains about 80% monounsaturated fatty acids compared to 23 % of the normal soybeans. Meal obtained from High Protein soybeans contains on average 3.5 % higher protein content compared to the normal soybeans.

5.7 Production costs

Farmers at the selected locations use conventional and GMO soybean varieties. For the following economic analysis results are displayed as an average of both varieties. The figures are not converted into rapeseed equivalent.

Total production costs

Total production costs of soybeans at the selected locations in the United States range between 201 Euro/t (South Central North Dakota) and 271 Euro/t (Red River Valley). When costs are expressed per hectare, the middle-sized farm in the North Dakota has around half (407 Euro/ha) high production costs of the large farm in the southern Minnesota (804 Euro/ha) (Figure 5.6).

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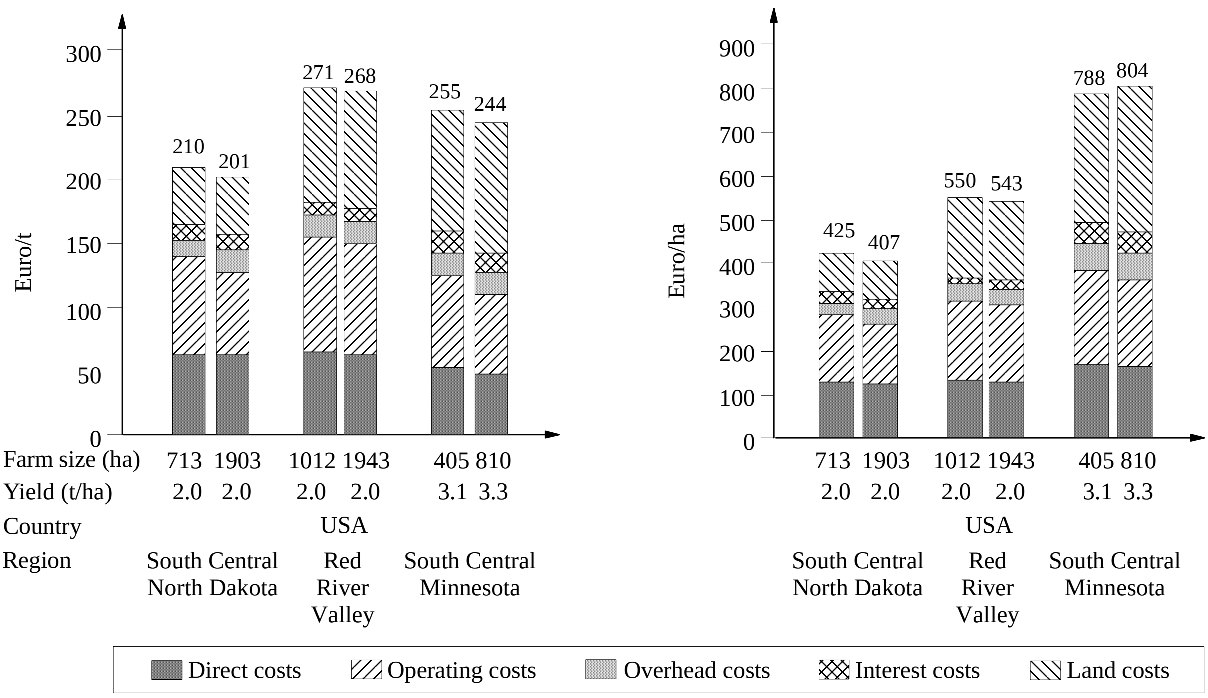
5 University of Illinois, Illinois Speciality Farm Products, April 2000.

Figure 5.6: Soybeans: Total production costs, 2000



Exchange rate: 1 Euro = 0.92 US-$.
Source: Own calculations.

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Such considerable difference of production costs between the farms can be explained by a) different yields between North Dakota or Red River Valley and southern Minnesota where 40 % higher yields are achieved and b) a high gap in land costs between southern Minnesota and the other locations. The rank of farms turn out to be different when total production costs are compared without land costs. Without land costs, the large farm in the southern Minnesota has the lowest production costs per yield unit.

Land costs

While the farms in North Dakota pay about 89 Euro/ha (48 Euro/t), producers in southern Minnesota have to pay about three times higher land rent of about 334 Euro/ha (101 Euro/t) and producers in Red River Valley about 182 Euro/ha (90 Euro/t). Higher land rents for both locations are attributed to strong non-farm demand for farmland, higher productivity of crop land in southern Minnesota that result in higher returns and government payments and high profitability of sugar beets in Red River Valley (KRUPA et al., 2001; PERSONAL COMMUNICATION, 2000).

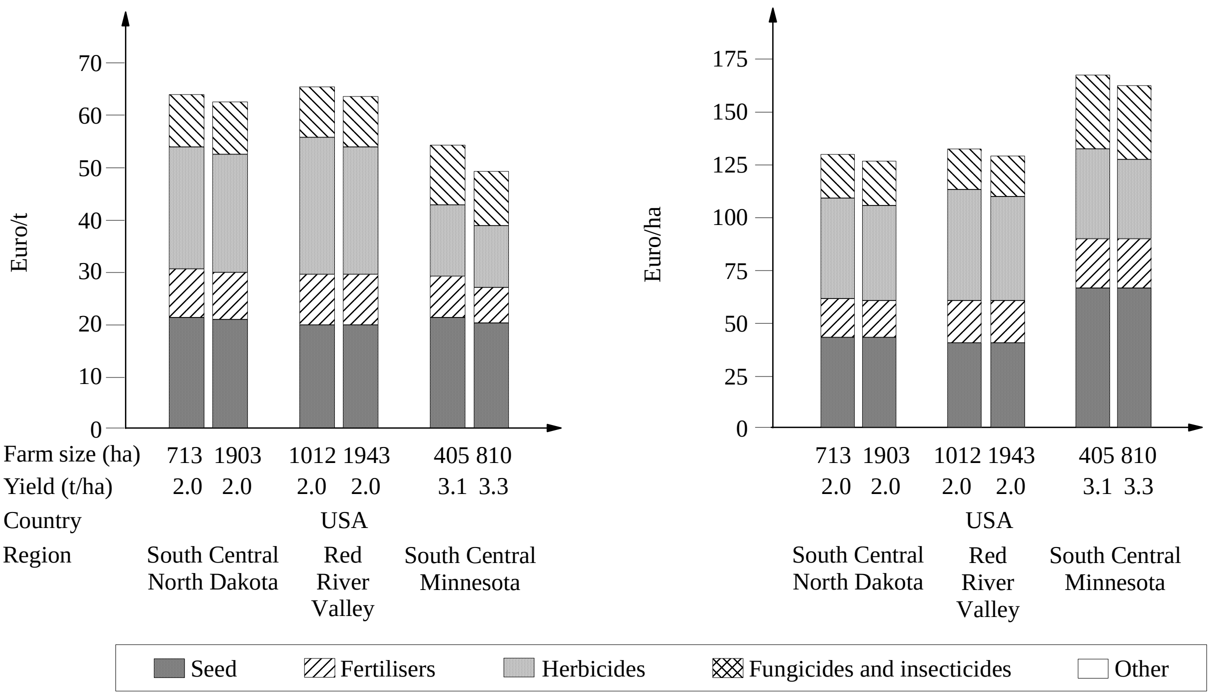
Direct costs

Relative low production intensity in south central North Dakota is reflected in low direct costs per ha (127 to 130 Euro/ha) (Figure 5.7). When land productivity is accounted, farms in the southern Minnesota have the lowest direct costs of about 52 Euro/t followed by Red River Valley (64 Euro/t) and North Dakota (64 Euro/t).

Higher **seed costs** on the farms in southern Minnesota are result of higher share of RR-soybeans (60 % vs. 25 % to 30 %) and slightly higher seed density compared to the other locations. Additional cost savings in North Dakota and Red River Valley comes from the use of own seed for planting whereas in the southern Minnesota only certified seed is used.

However, a lower share of RR-soybeans in the Red River Valley and North Dakota results in higher **herbicide costs**. Even though in southern Minnesota conventional soybeans cost about 62 Euro/ha (vs. 54 Euro/ha) when weighed against RR-soybeans (22 Euro/ha) the average result is considerably lower.

Figure 5.7: Soybeans: Direct costs, 2000



Exchange rate: 1 Euro = 0.92 US-$.
Source: Own calculations.

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Higher **fertilizer costs** on the farm in Minnesota are the result of additional potassium and lime fertilization that cannot be offset by lower phosphorous fertilization costs.

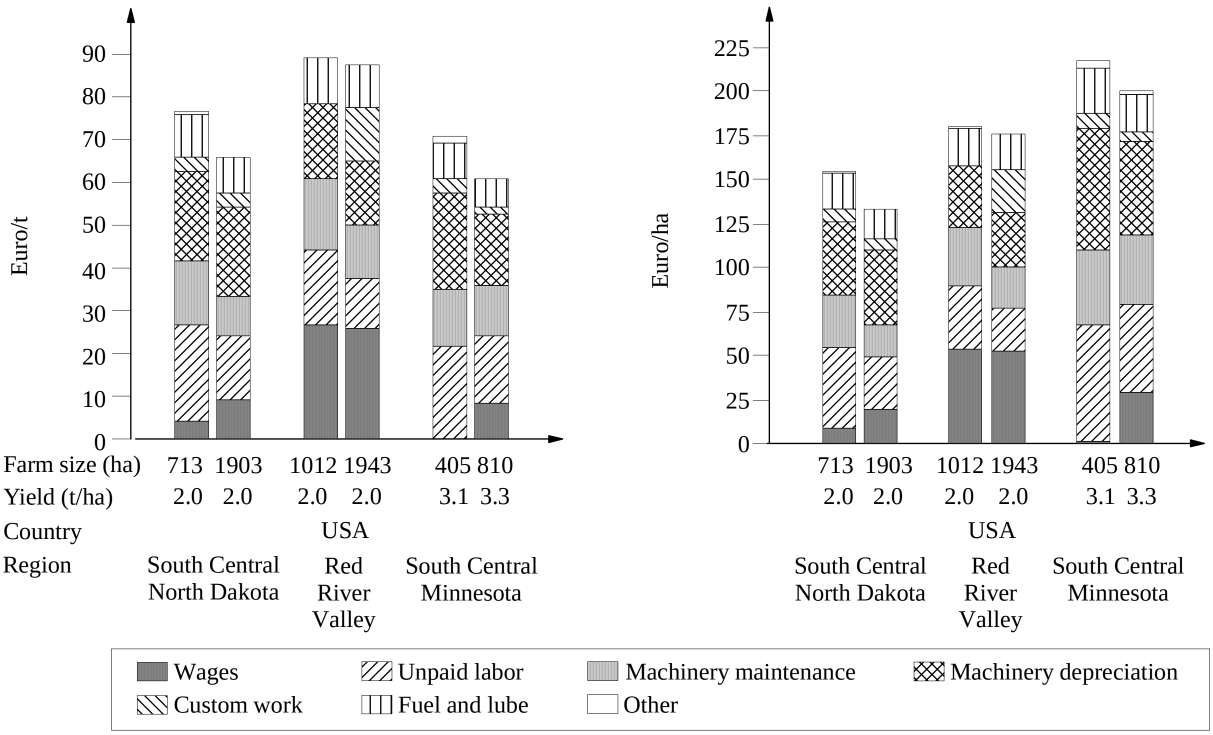
Cost differences between medium and large sized farms are the result of price discounts available for larger farms especially for plant protection products. No difference exists in the amount of applied inputs between the farms at the same locations.

Higher **other costs** for the farms in the Southern Minnesota mainly reflect higher **crop insurance** that is determined by the crop yield. Additionally, fees due to the Soybean Growers Association are included in the other costs, which is calculated as 0,5 % of revenues.

Operating costs

High land productivity and respective intensive production systems of the farms in southern Minnesota is reflected by considerably higher **fuel** and **repair costs** (Figure 5.8). The same situation is to be observed for **machinery depreciation**.

Figure 5.8: Soybeans: Operating costs, 2000



Exchange rate: 1 Euro = 0.92 US-$.
Source: Own calculations.

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The farmer himself manages mid-sized farm in Minnesota and only at the peak time of the harvest part time assistant is employed. This is the reason why **labor costs** consist mainly of labor opportunity costs and paid labor costs are negligible. While at the large sized farm has a full time employee is working on the farm.

In Red River Valley sugar beet harvesting is overlapping with soybean harvest, therefore the large sized farm allow 50 % of the soybeans to be harvested by contractor that result in relative high **custom costs**.

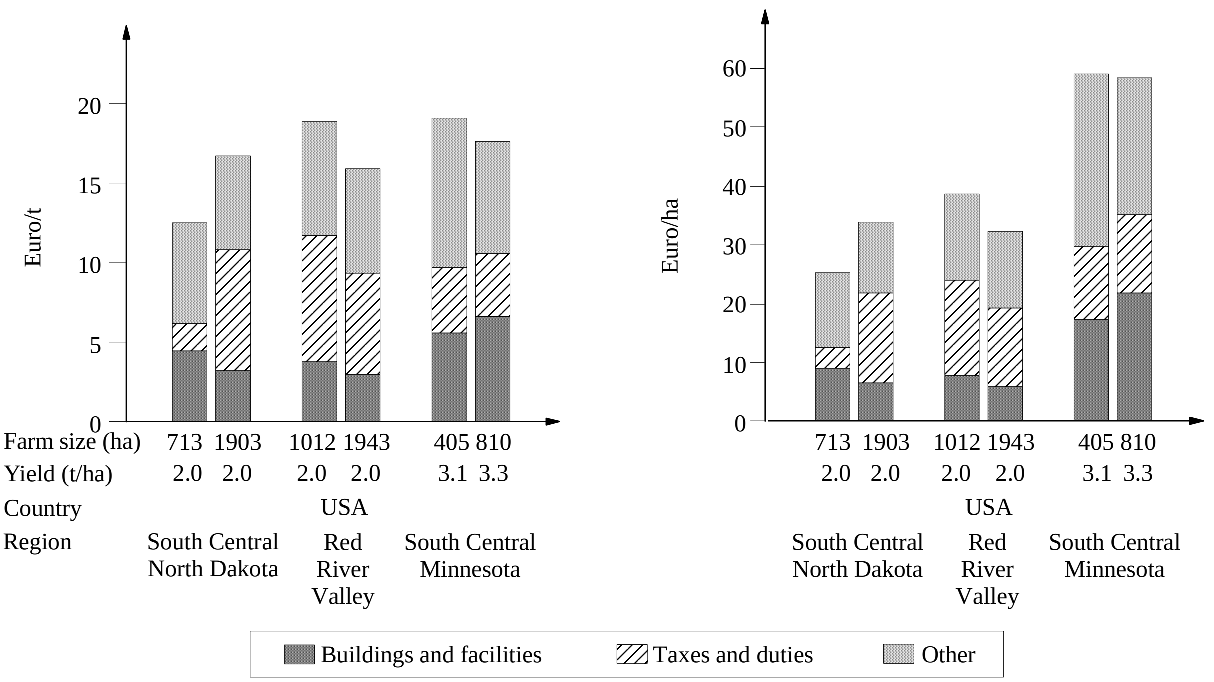
The cost disadvantage of Minnesota farms on a per hectare basis of up to 40 % is completely compensated by higher yields which result in the lowest operating costs per yield unit.

Overhead costs

Relative high rainfalls and moist soils frequently lead to water standing in southern Minnesota. For successful management draining of almost all farm area is necessary. Such practices are not needed in North Dakota and only some areas in Red River Valley are drained. As a result of this practice high **drainage costs** in the southern Minnesota are allocated to **building costs** and therefore are three-fold higher of the other locations (Figure 5.9).

Noticeably higher **taxes and fees costs in** the Red River Valley and Minnesota are the result of very high property taxes. Property taxes are calculated according to the market value of the land and other property. Depending on many factors, property taxes vary considerably between regions. On average, the lowest property tax of about 13 Euro/ha is paid in North Dakota, followed by considerably higher property taxes in Red River Valley (41 Euro/ha) and Minnesota (38 Euro/ha). The level of taxes displayed in the Figure 5.9 also strongly depends on the share of own and rented land at the selected locations.

Figure 5.9: Soybeans: Overhead costs, 2000



Exchange rate: 1 Euro = 0.92 US-$.
Source: Own calculations.

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Interest costs

In the southern Minnesota considerably higher interest cost of 50 Euro/ha (15 Euro/t) are to observe compared to North Dakota and Red River Valley that range between 17 to 26 Euro/ha (8 to 13 Euro/t). The major reasons for the cost disadvantage are to look at higher machinery capacities and input use compared to other locations.

5.8 Profitability

5.8.1 Profitability of soybean production

Figure 5.10 displays total production costs of soybeans against market receipts and payments in the marketing year 2000/2001. For a more detailed overview of the structure of the revenues they are displayed separately and consist of Posted County Price (PCP), Loan Deficiency Payments (LDP), Market Loss Assistance (MLA) and Production Flexibility Contract (AMTA) payments. The latter two payments (MLA and AMTA) are decoupled payments and are not product specific. They are equally allocated to all crops. Crop insurance payments are not accounted in the analysis.

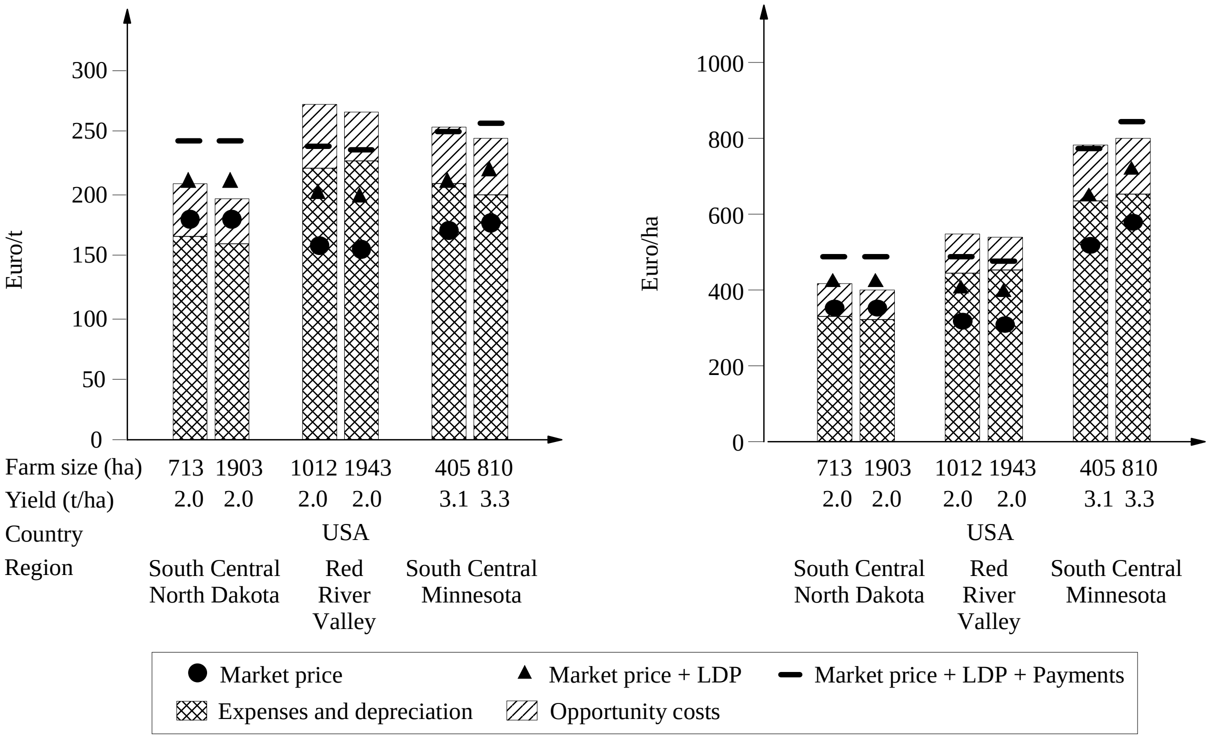
With regard to marketing of the crops, producers follow different strategies depending on their risk aversion and liquidity situation. Some of them decide to risk collecting LDPs during seasonal low market prices and wait until the prices increase to sell the crop. Due to low market prices in the marketing year 2000/2001, oilseed producers were not able to receive prices higher than the regional soybean loan rates. A similar situation was observed for the competing crops.

Figures A3.5 to A3.7 in the Appendix display loan rates, posted county prices (PCPs) and respective LDPs for selected crops in the analyzed regions. One may observe that PCPs remain predominantly under the loan rate level.

The large sized farm in Minnesota delivers most of its corn and soybean harvest directly to Minneapolis, and therefore receives higher price compared to medium sized producer. Additional transportation costs are accounted and allocated to the operating costs. The medium sized producer delivers his harvest to the local elevator, as he is limited in transportation and labor capacities.

Only farms in North Dakota are able to generate positive family farm income (market price minus expenses and depreciation) under the current market prices for soybeans.

Figure 5.10: Soybeans: Profitability of production, 2000



Market price = PCP (Posted County Price). Park_2003-08-07
LDP = Loan Deficiency Payments.
Payments = Total of AMTA (Production Flexibility Contract) and MLA (Market Loss Assistance).
Exchange rate: 1 Euro = 0.92 US-$.
Source: Own calculations.

Farms in the Red River Valley and the middle-sized farm in Minnesota are not able to generate positive entrepreneur profit in soybean production even when market receipts and payments are included. In such a situation, it seems that high land rents paid in Red River Valley and Minnesota are too high. Very profitable sugar beet production in the Red River Valley is a major reason for overvalued land rents. A large part of subsidies involved in sugar beet production roll over to the landowners.

5.8.2 Soybean internal farm position compared to other crops

To explain the reason for rapid expansion of soybeans in recent years, the profitability of soybeans is compared to competing crops (Figure 5.11). One may observe that under current market conditions (including payments), production of corn and wheat at the selected farms is not profitable.

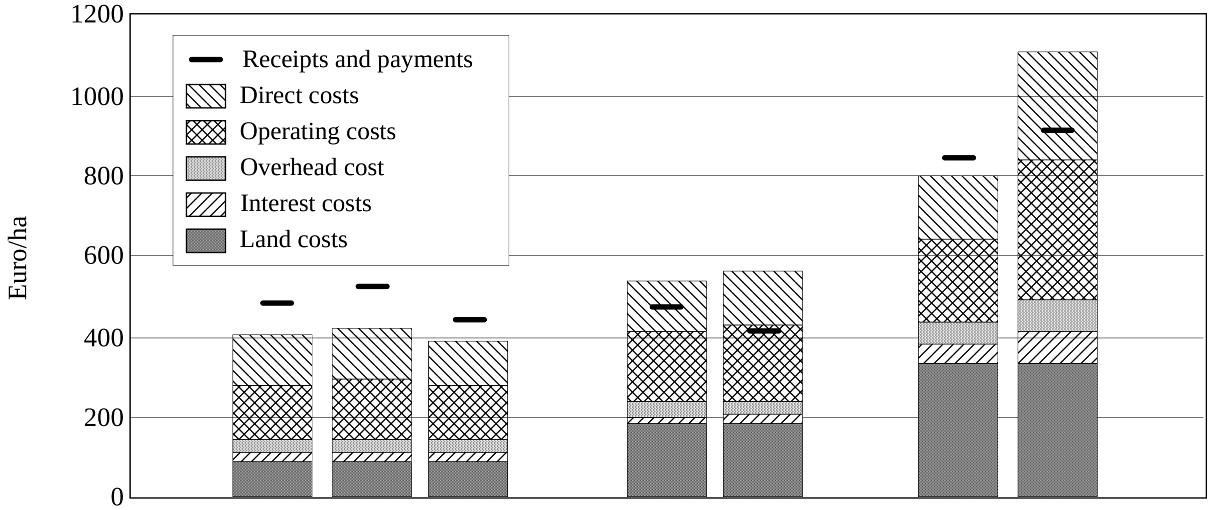
Even high yielding corn production in the Minnesota is not able to generate positive entrepreneurial profit.

Under such market conditions where relatively low market prices are below loan rates, unequal ratios between loan rates of competing crops compared to the ratio of market prices may set an incentive to produce one crop and not another. In general, the ratio is a simple measure of relative returns for soybeans and competing crops. Accounting for the fact that loan rates are fixed by the government and based on historical prices, which were very high for some crops, e.g., soybeans, the loan ratio maybe well above the market price ratio which is adjusted by market forces.

For a detailed analysis, ratios between loan rates of soybeans and competing crops, and market prices at the selected locations are displayed in Table 5.6. Gross margins, as a major indicator for short-term decision-making, are given at the same time.

The soybean-corn market price ratio in Minnesota is 2.31, US-$/bu this means that loan rate for soybeans should be 2.1 US-$/bu higher than the loan rate for corn (1.75 US-$/bu) in order to generate the same net return under given conditions. However the loan rate for soybean is 2.75 higher. Respectively, corn loan rate should rise to 1.98 US-$/bu to equate net returns of producing corn and soybeans.

Figure 5.11: Profitability of soybeans and competing crops at the selected locations, 2000



Crop	Soy-beans	Sun-flower	Wheat	Soy-beans	Wheat	Soy-beans	Corn
Yield (t/ha)	2.0	2.0	2.6	2.0	3.0	3.3	10.4
Country	USA						
Region	South Central North Dakota			Red River Valley		South Central Minnesota	
Farm size (ha)	1900			1940		810	

Receipts = Market price + LDP (Loan Deficiency Payments). Park_2003-08-13
Payments = Total of Production Flexibility (AMTA) and MLA (Market Loss Assistance) payments.
Exchange rate: 1 Euro = 0.92 US-$.
Source: Own calculations.

For North Dakota and the Red River Valley a similar situation is observed for soybeans and wheat, where soybeans have higher incentives to be produced.

Table 5.6: Price and loan rate ratios between soybeans and competing crops

Location		South Central Minnesota		South Central North Dakota		Red River Valley	
Crop		Soybeans	Corn	Soybeans	Hard Red Spring	Soybeans	Hard Red Spring
Yield	dt/ha	33	104	20	26	20	30
Loan Rate[1)]	US-$/dt	18.9	6.89	17.9	10.0	18.1	10.0
Direct costs	US-$/ha	153	253	107	80	117	122
Seed	US-$/ha	61	84	40	17	37	23
Fertilser	US-$/ha	22	91	13	37	18	46
Plant protection	US-$/ha	37	57	43	22	44	38
Other	US-$/ha	33	21	11	5	18	15
Variable machinery costs	US-$/ha	52	73	27	26	32	37
Fuel and lube	US-$/ha	17	18	10	10	12	15
Machinery maintenance	US-$/ha	35	55	17	16	20	23
Variable drying costs	US-$/ha		27		2		1
Labor costs		24	58	35	44	67	65
Interest	US-$/ha	10	18	8	7	10	10
Total costs	**US-$/ha**	**240**	**429**	**177**	**159**	**226**	**235**
Gross Margin [2)]	***US-$/ha***	***383***	***285***	***184***	***103***	***139***	***67***
		Soybeans	**Corn**	**Soybeans**	**Hard Red Spring**	**Soybeans**	**Hard Red Spring**
Market price relation	**Soybeans**	**1.00**	**2.31**	**1.00**	**1.39**	**1.00**	**1.46**
Loan Rate relation	**Soybeans**	**1.00**	**2.75**	**1.00**	**1.79**	**1.00**	**1.81**

1) Regional Loan Rates 1999/2000. 2) Gross Margin under selected Loan Rate.
Source: Iowa State University, Centre for Agricultural and Rural Development, Statewide LDP Information (2000); Own calculations. Park_2003-07-03

5.8.3 Profitability of production of conventional and RR-soybeans

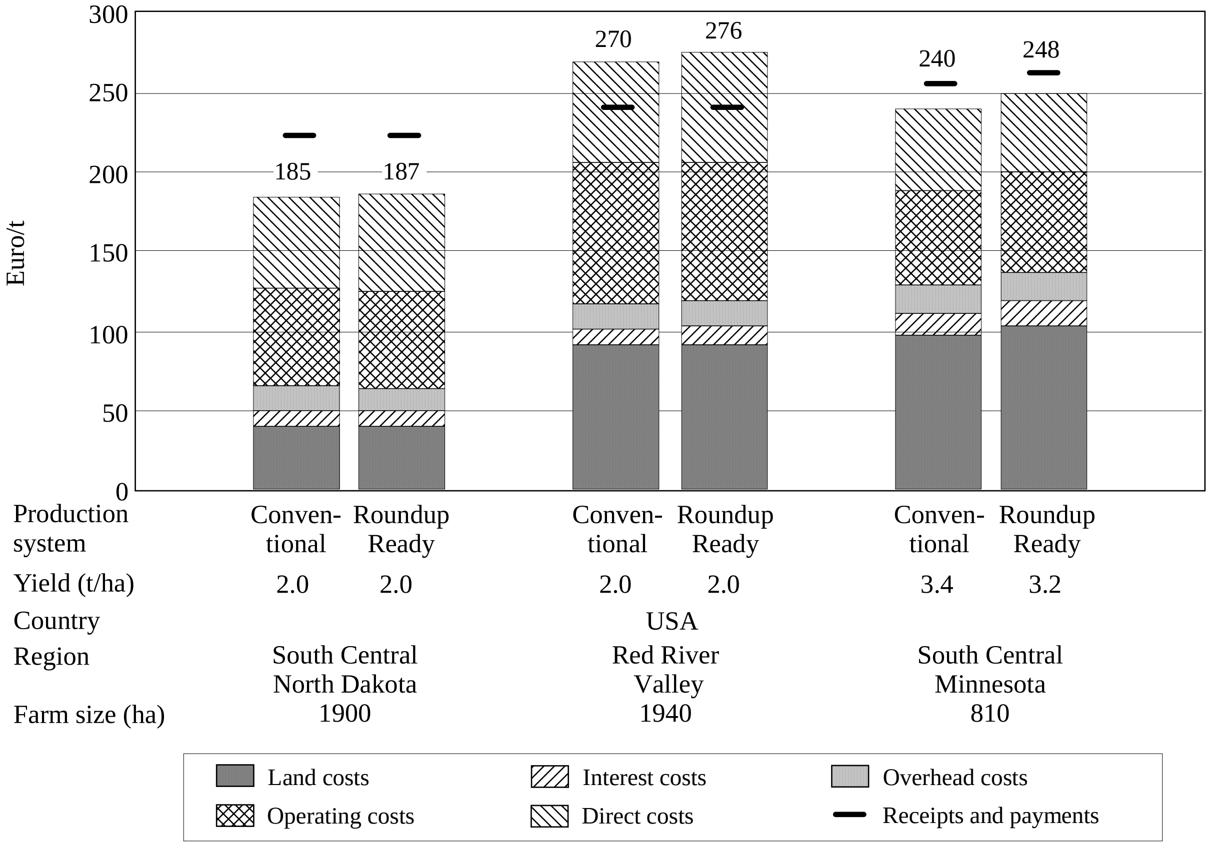
With rapid expansion of GMO soybeans in the United States, it is important to look at this production system from economic point of view.

Figure 5.12 displays total production costs against revenues for conventional and RR-soybeans. One may observe that transgenic varieties exhibit no cost advantage over conventional varieties at any location.

In the **Red River Valley** and **North Dakota,** higher direct costs contribute the major cost disadvantage for GMO varieties where higher seed costs are not offset by lower herbicide costs.

In the southern Minnesota higher yield of conventional varieties have offset higher production costs per hectare that result in a slight cost advantages in operating, overhead, interest and land costs.

Figure 5.12: Profitability comparison of conventional and RR-soybeans, 2000



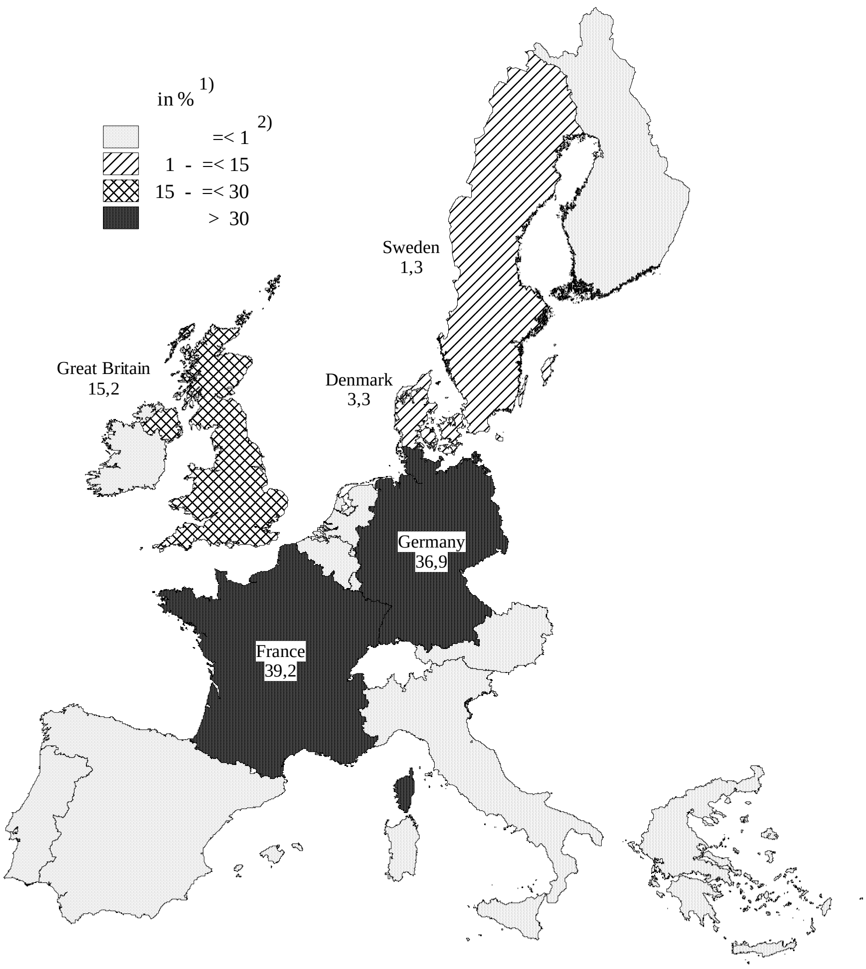
Receipts = Market price + LDP (Loan Deficiency Payments). Park_2003-08-13
Payments = Total of Production Flexibility (AMTA) and MLA (Market Loss Assistance) payments.
Exchange rate: 1 Euro = 0.92 US-$.
Source: Own calculations.

6 Rapeseed production in Germany

6.1 Rapeseed production in Germany and Europe

In EU-15 record harvest of 11.4 million tons rapeseed was harvested in 1999. About two thirds of the total production was harvested in France (39 %) and Germany (37 % = 4.2 million tons).[1] The third largest EU-producer was Great Britain with 15 %, followed by Denmark (3.3 %) and Sweden (1.3 %). Germany and France are the largest producers in the EU-15 (Map 6.1).

Map 6.1: Distribution of rapeseed production in the EU, 1999



1) As a share of the total EU rapeseed production.
2) The rest of countries have contributed 4.1% of the EU rapeseed production.
Source: Oil World Statistic Update, 7. April 2000.

Park_2003-07-14

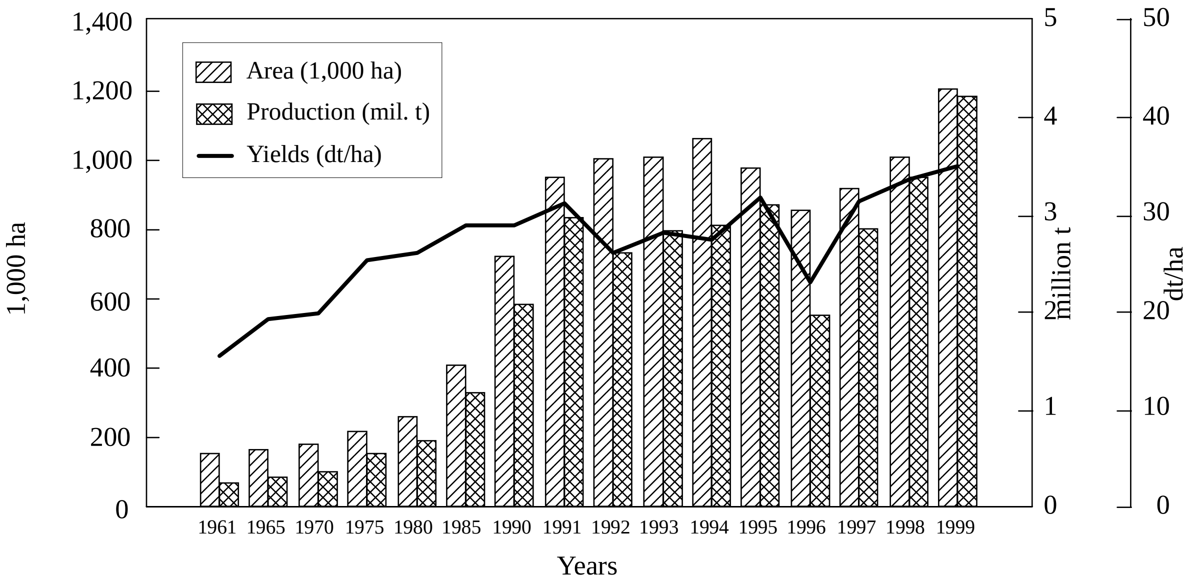
[1] Statistischer Monatsbericht 4/2000 BML (Reihe: Daten-Analyse).

In time, both countries shifted their leadership in EU rapeseed production (Figure A4.1 in Appendix). In the last forty years, production has increased twenty fold. The production growth was primarily due to area expansion and secondarily to yield increase (for Germany, see Figure 6.1).

In Germany winter rapeseed dominates rapeseed production. Summer rapeseed plays a minor role, and its share is less than 5 %.

The reasons for rapeseed expansion in the EU and Germany are manifold. The primary reason is breeding achievements of higher quality rapeseed (0- and 00-Rapeseed) and consequently improved marketing possibilities. Secondly, a shift in support policies has created relatively lucrative conditions for rapeseed production compared to alternative crops. And, finally, rapeseed adapts readily to climate and soils differences of the regions.

Figure 6.1: Rapeseed production in Germany, 1960 to 1999



Source: Own illustration, FAO (2000). Park_2003-07-04

6.2 Climate and soils

6.2.1 Climate

As a long-day plant, rapeseed is well cultivated in the temperate zone of the Europe. During the fall vegetative phase, plants form their vegetative organs, and after winter dormancy, are able to rapidly continue growth. Rapeseed tolerates frosts up to -20° C (GEISLER, 1988).

The climate of the most crop production regions in Germany are generally favorable for rapeseed production. The mild and moist climate on the borders of low mountain ranges and especially coastal regions are very favorable for rapeseed production.

6.2.2 Soils

Most of Germany has temperate brown and deep brown soils. Their formation is dependent on relief, hydrologic conditions, vegetation, and human intervention.

Germany's finest soils are developed on the loess of the northern flank of the Central German Uplands, the Magdeburg Plain, the Thuringian Basin and adjoining areas, the Rhine Valley, and the Alpine Foreland. They range from black to extremely fertile brown soil types, and most of them are arable land under cultivation. The till (ground moraine) of the North German Plain and Alpine Foreland has heavy but fertile soil. Brown soil covers much of the Central German Uplands and is used for agriculture and grazing. With increasing elevation, soils are suitable only for grazing or forestation. In the northern plains the soil types are sand, loam, and brown podzols, which are heavily leached of mineral matter and humus by deforestation and grazing. Along the North Sea littoral in the northwest there are some extensive areas of sand, marsh, and mud flats that are covered with rich soil suitable for grazing and growing crops (BRITANNICA, 2002).

The remainder of German soil types, because of the preponderance of mountainous and forested areas, range from sand to loam, from loam to clay, and from clay to rocky outcrops.

Soil quality in Germany is expressed in EMZ (Ertragsmesszahl)[2] grades and Map A4.1 in Appendix displays EMZ distribution.

6.3 Distribution of rapeseed production in Germany

Sugar beets dominate in the crop rotation as a broadleaf crop in the regions with the highest soil quality. Rapeseed is seldom planted there and only when sugar beets do not make up enough of the broadleaf share in the rotation system due to lacking sugar beet quota.

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[2] The EMZ accounts for yield potential at selected region under influence of soil quality and climate.

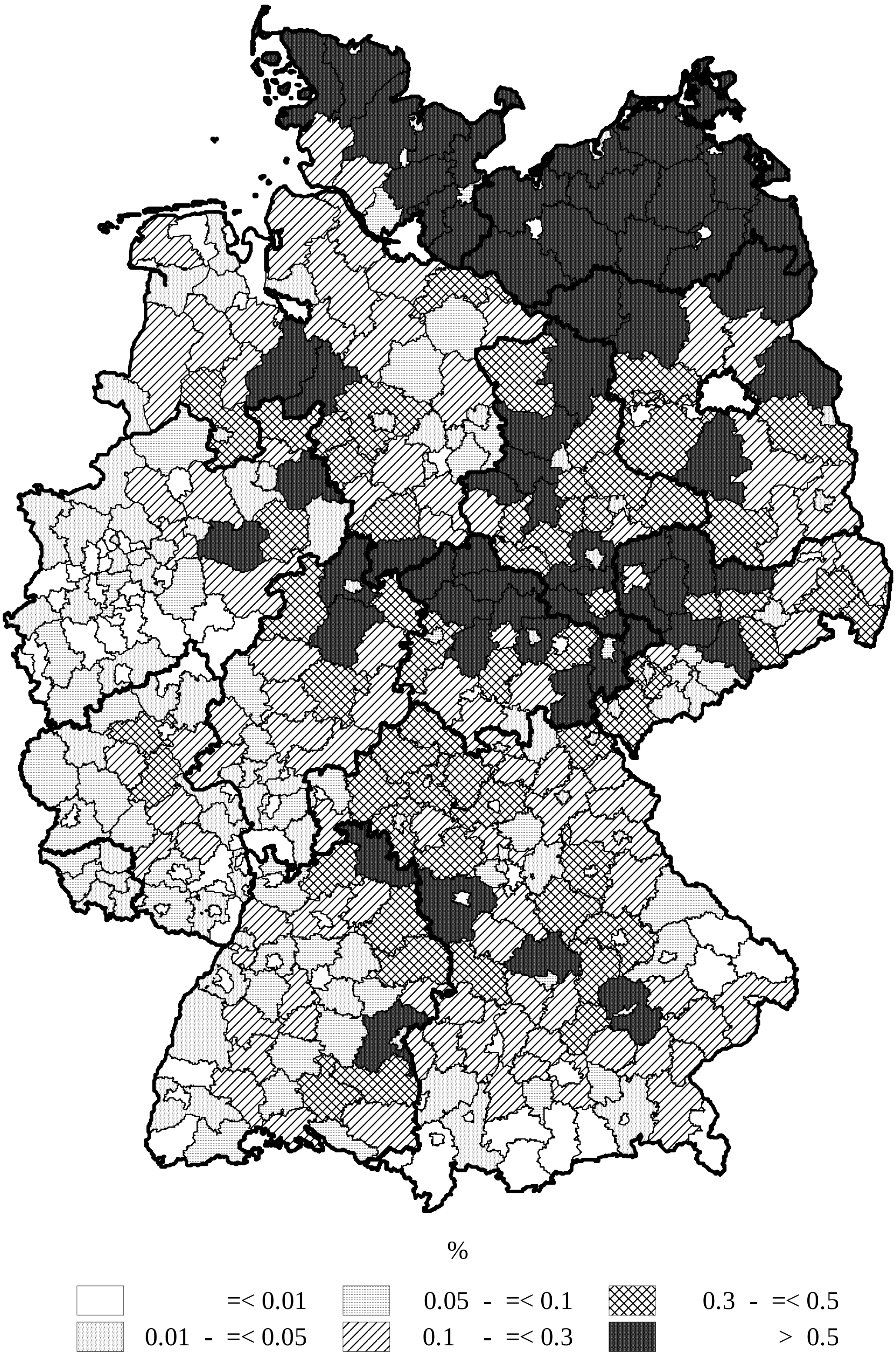
Maps 6.2 and 6.3 show that major rapeseed production regions are located in the middle of Germany. From its center in the Magdeburger Börde in Sachsen-Anhalt, it extends southwards to the north of Thüringen and eastwards to the west of Sachsen. The sugar beet share of the agricultural land there is historically low and usually does not exceed 10 %. Under current price and premium relationships, rapeseed becomes a welcome alternative to grains that dominate in the crop rotations.

The highest share of rapeseed production and area are in Schleswig-Holstein and Mecklenburg-Vorpommern. Both states together produced around 29 % of the total German output in 1999. In Mecklenburg-Vorpommern alone, about 190 thousand ha of rapeseed was planted.

Other important regions for rapeseed production are located in Franken, low lands of Lower Saxony, parts of Sachsen-Anhalt, Brandenburg and low mountain ranges of east Germany.

Due to the very high rapeseed production and area share of Mecklenburg-Vorpommern and Sachsen-Anhalt in the national total, locations in these two states are selected for the analysis in the framework of this study. Therefore the following description will focus on area and yield trends in these two selected states and Germany in total.

Map 6.2: Distribution of rapeseed production by rural district in Germany, 1999



Source: RAUMIS.

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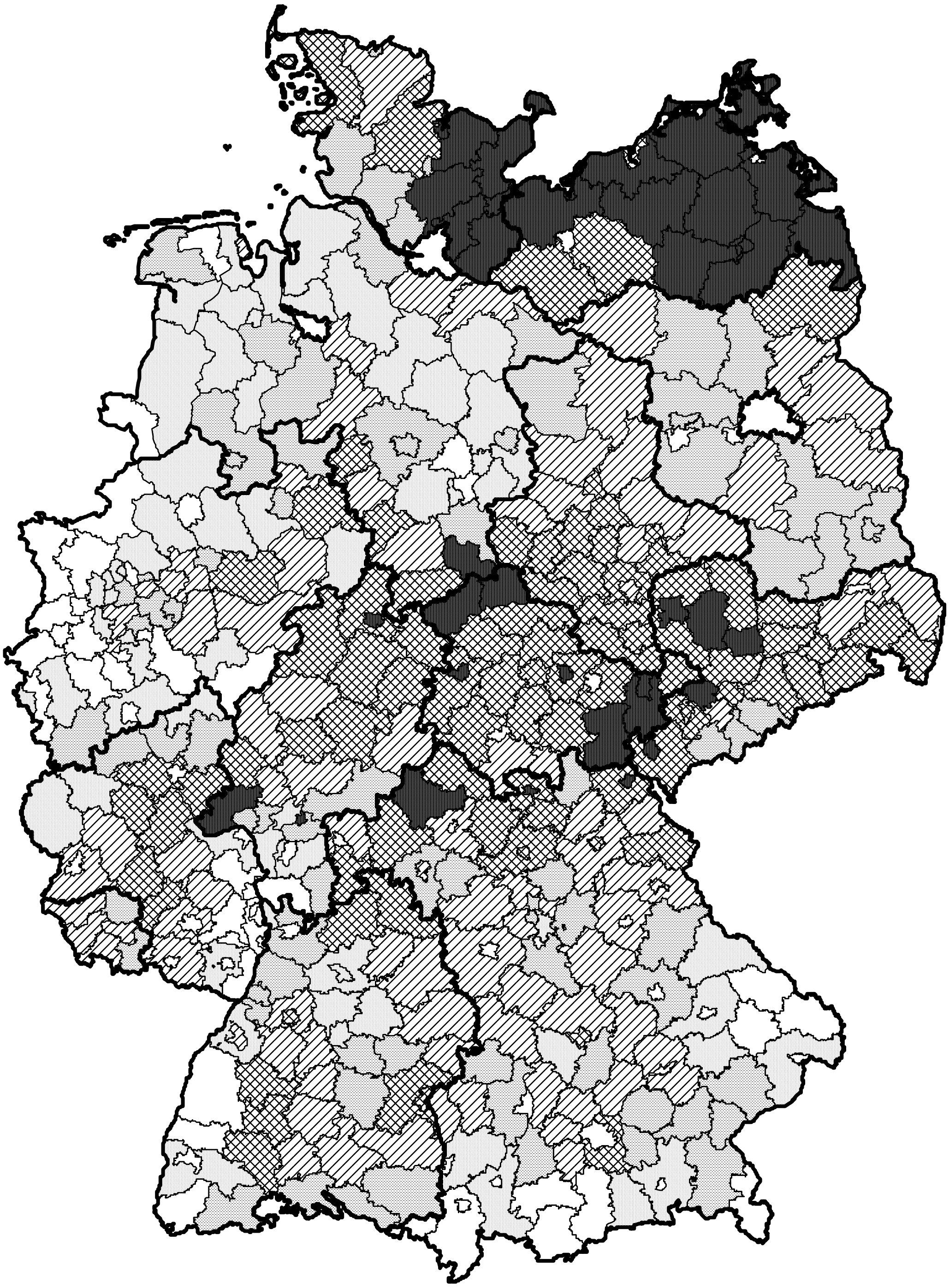
Map 6.3: Share of rapeseed area on agricultural land, 1999



Source: RAUMIS.

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6.4 Rapeseed and major crops in Germany

Germany

Rapeseed has not long been a traditional crop for Germany compared to grains or sugar beets (Figure 6.1).

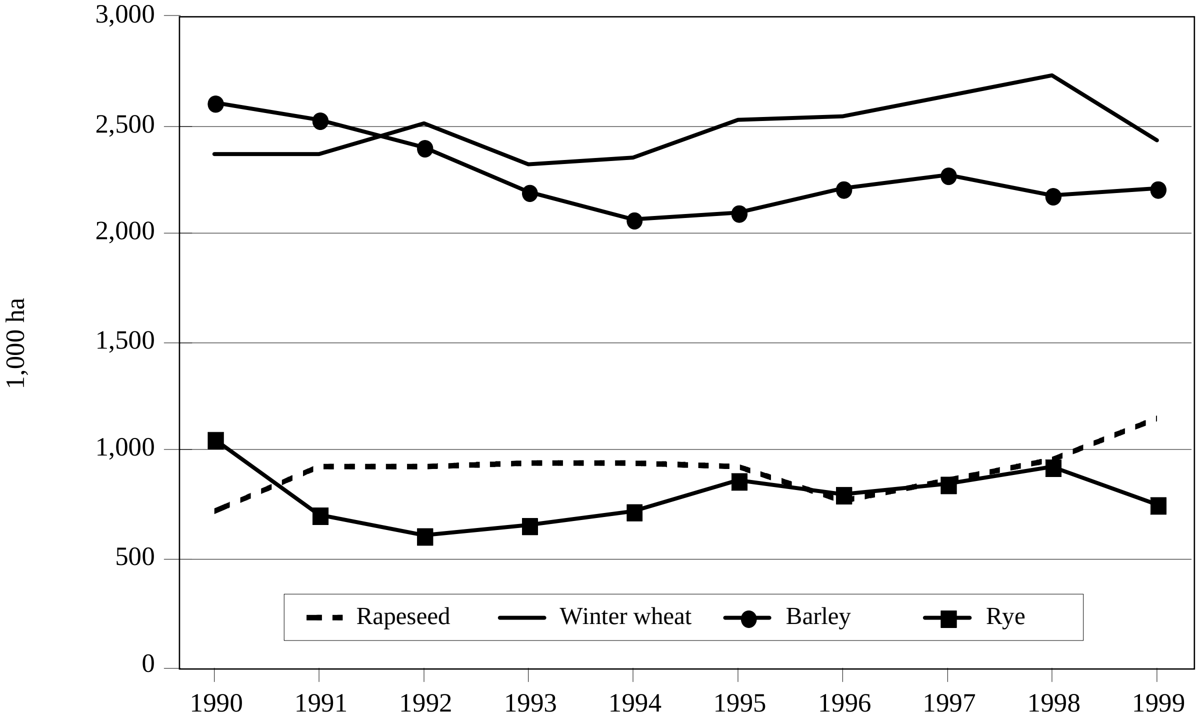
In 1960 about 1.5 % of agricultural land was allocated to rapeseed. In 1999, already 8.5 % of agricultural land was allocated for rapeseed production for food and non-food purposes. The highest growth rates were observed in late 1980s and early 1990s. Due to rapid area expansion, production of rapeseed has tripled from less than one million tons in 1985, to almost 3 million tons in 1991.

Rapeseed expansion in the early 1990s was strongly influenced by German Unification. In the newly formed German states under conditions of planned economy in GDR times, rapeseed substituted for the production of special crops, potatoes, forage crops and rye. In the following years, production of rapeseed remained constant and in 1996 had dropped considerably due to the strong impact of winter frost. Production increased rapidly again under influence of relative high oilseed prices on the world market (Figure 6.1). In 1999 1.2 million ha was allocated to rapeseed and 4.2 million tons were harvested with a record yield of 35dt/ha. About half (588 thousand ha) of the rapeseed area was in the newly formed German states.

Rapeseed production competes mainly with grains. Winter wheat and rye are the major competing crops for rapeseed. In Figure 6.2 one may observe that areas allocated to these crops partially shift in the opposite direction.

However, rye production in Schleswig-Holstein and Mecklenburg-Vorpommern is a pre-condition for rapeseed production, due to time constraints in field activities. In the past four decades, rapeseed yields in Germany have on average increased annually by 38 kg/ha. Furthermore, five year moving average has almost doubled from 17 dt/ha (1960 to 1964) to 32 dt/ha (1995 to 1999) (Figure 6.1).

Figure 6.2: Area under rapeseed and major crops in Germany, 1990 to 1999



Source: Statistisches Bundesamt, Fachserie 3, Reihe 3, Bodennutzung und Pflanzliche Erzeugung, various years; Own illustration.

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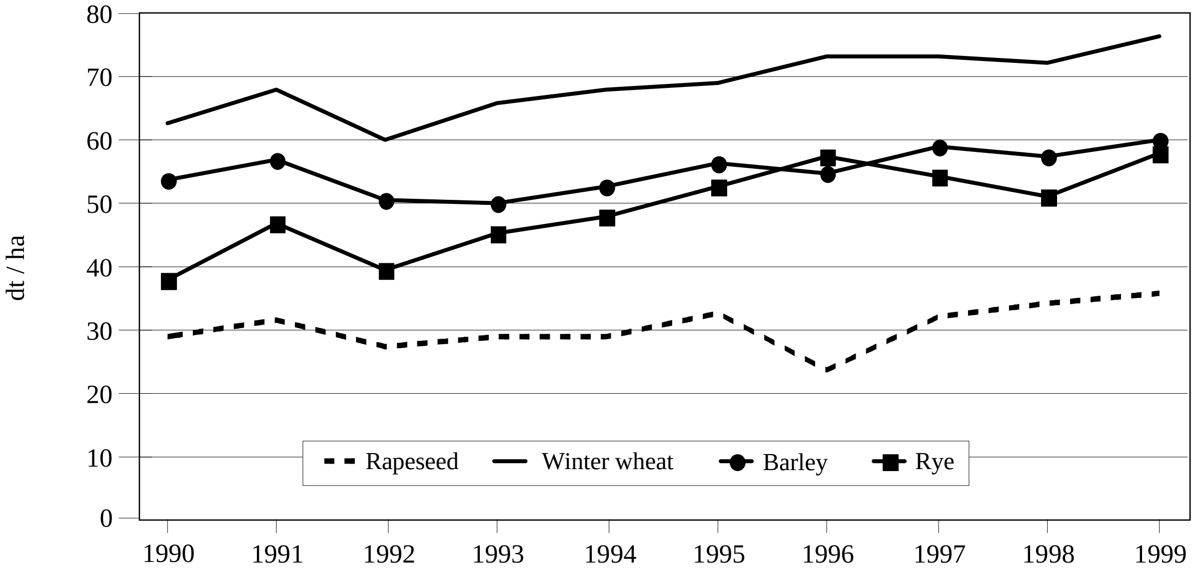
Furthermore, in the last decade rapeseed yields have increased with even higher rate of 53 kg/ha (Figure 6.3). However, one should remember that yield statistics of all crops in the first half of the 1990s were influenced by German Unification.

Figure 6.3: Yields of rapeseed and major crops in Germany, 1990 to 1999



	Rapeseed	Winter wheat	Barley	Rye
1999	35.6	76.4	60.2	57.9
Ø 1990/91 to 1999	30.5	69.1	55.2	49.0
Max. 1)	35.6	76.4	60.2	57.9
Min. 2)	23.6	60.3	50.0	37.8

1) Maximum yield.
2) Minimum yield.
Source: Statistisches Bundesamt, Fachserie 3, Reihe 3, Bodennutzung und Pflanzliche Erzeugung, various years; Own illustration.

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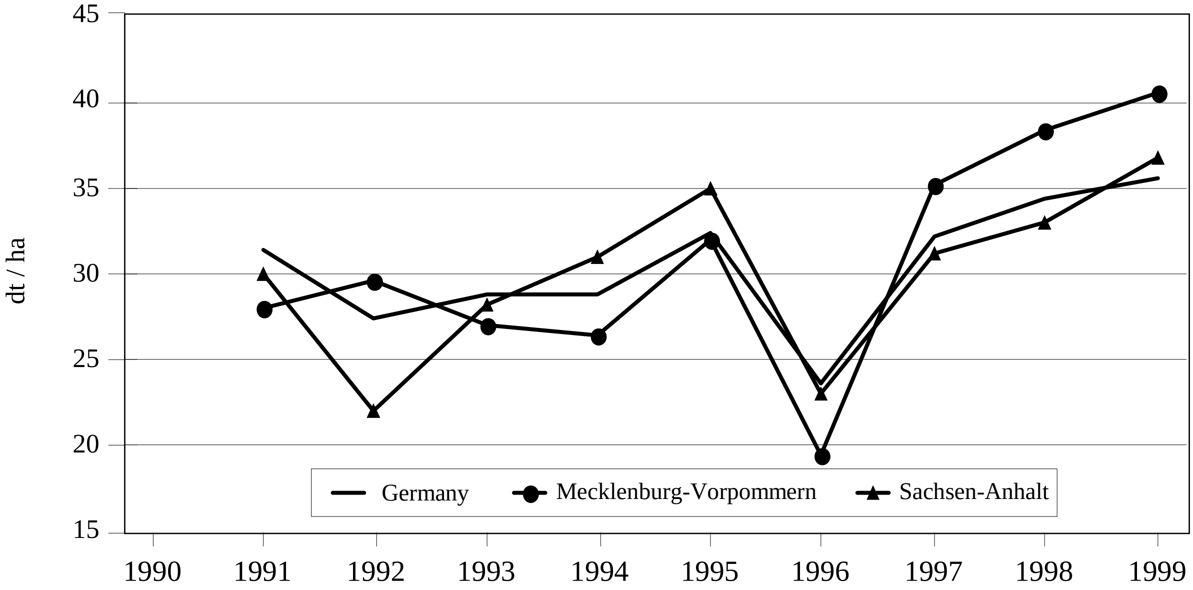
Rapeseed yields in **Mecklenburg-Vorpommern** and **Sachsen-Anhalt** in general follow national trends (Figure 6.4). Due to extreme spring drought in 1992, yields have dropped considerably in Sachsen-Anhalt. Extreme frosts in 1996 were the result of yield depression in Mecklenburg-Vorpommern.

From 1993 to 1996, Sachsen-Anhalt had higher rapeseed yields than Mecklenburg-Vorpommern. Since 1997 Mecklenburg leads with a 4 to 5 dt/ha yield difference.

Figure 6.4: Rapeseed yields in Germany, Mecklenburg-Vorpommern and Sachsen-Anhalt, 1990 to 1999



	Germany	Mecklenburg-Vorpommern	Sachsen-Anhalt
1999	35.6	40.5	36.8
Ø 1990/91 to 1999	30.5	30.7	30.0
Max. 1)	35.6	40.5	36.8
Min. 2)	23.6	19.5	22.0

1) Maximum yield.
2) Minimum yield.
Source: Statistisches Bundesamt, Fachserie 3, Reihe 3, Bodennutzung und Pflanzliche Erzeugung, various years; Own illustration.

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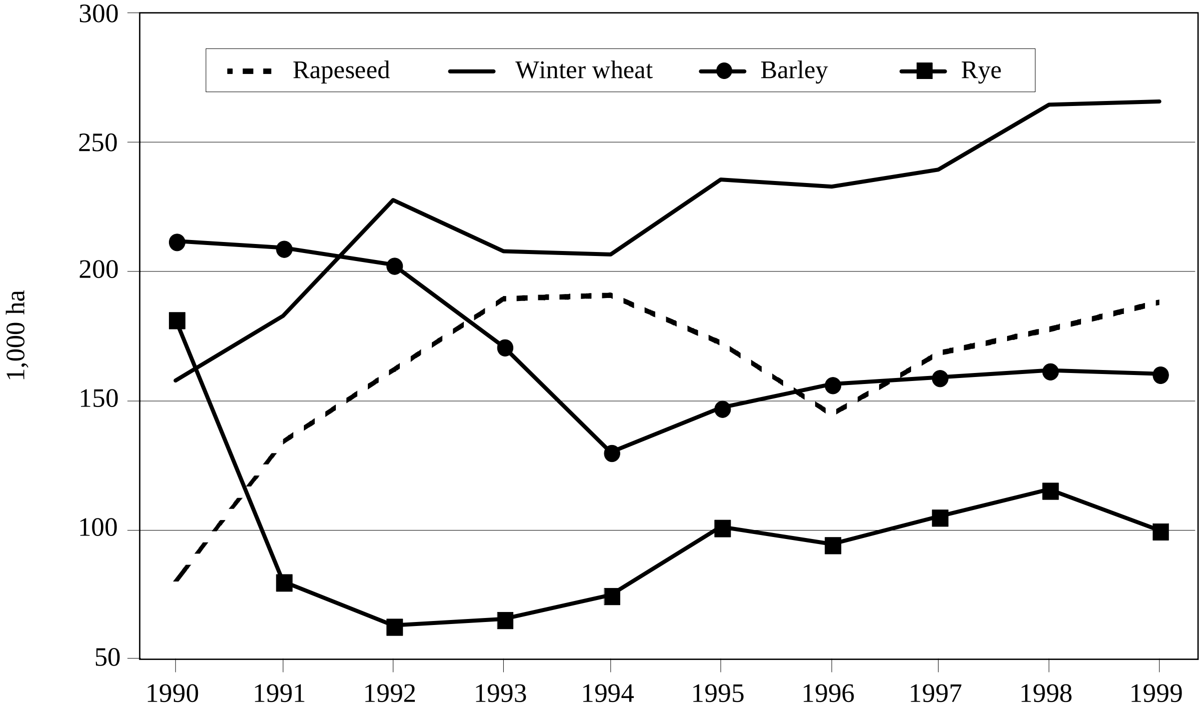
Mecklenburg-Vorpommern

In Figure 6.5 one can observe a considerable rapeseed area expansion in Mecklenburg-Vorpommern.

At the same time, rye areas have decreased from 190,000 ha (average 1985 to 1990) to 66,000 in 1992. This reduction can partially be explained by the introduction of obligatory set aside in 1992. Especially locations with lower yields in the southern Mecklenburg were impacted by this rule.

With expansion of broadleaf crops through rapeseed, wheat areas have increased considerably as well. About 266,000 ha were allocated to wheat in 1999. From available statistics it is difficult to estimate the share of wheat planted in wheat monoculture. Rapeseed was planted on 188,000 ha and their share of agricultural land was about 17.6 %. However, in the central and northern parts of the state, shares are even higher (Map 6.3).

Figure 6.5: Area under rapeseed and major crops in Mecklenburg-Vorpommern, 1990 to 1999



Source: Statistisches Bundesamt, Fachserie 3, Reihe 3, Bodennutzung und Pflanzliche Erzeugung, various years; Own illustration.

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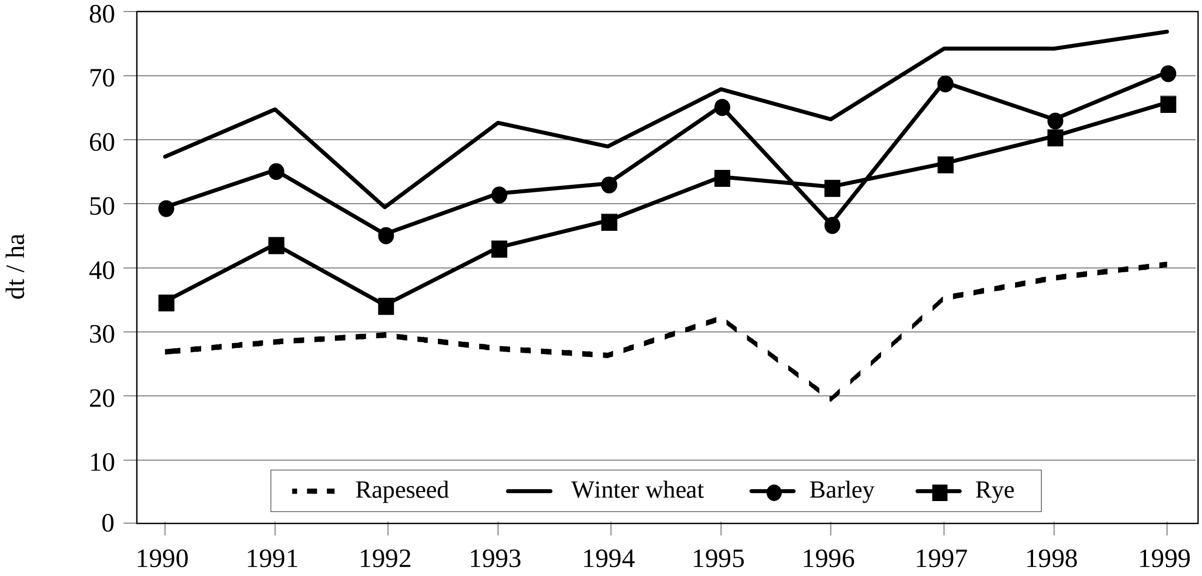
With expansion of rapeseed and wheat production not only rye and barley production was reduced but also feed potatoes and forage crops.

Figure 6.6. displays development of yields for rapeseed and major grains in Mecklenburg-Vorpommern. One may observe that all crops have a similar trend of rapid yield increase until middle of the 1990s. Under favorable conditions in 1999 the highest yields were achieved within observed period.

Figure 6.6: Yields of rapeseed and major crops in Mecklenburg-Vorpommern, 1990 to 1999



	Rapeseed	Winter wheat	Barley	Rye
1999	40.5	77.3	70.9	65.8
Ø 1990/91 to 1999	30.7	65.2	57.0	49.2
Max. 1)	40.5	77.3	70.9	65.8
Min. 2)	19.5	49.6	45.3	34.0
Variation coefficient	0.21	0.13	0.16	0.22

1) Maximum yield.
2) Minimum yield.
Source: Statistisches Bundesamt, Fachserie 3, Reihe 3, Bodennutzung und Pflanzliche Erzeugung, various years; Own illustration.

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Sachsen-Anhalt

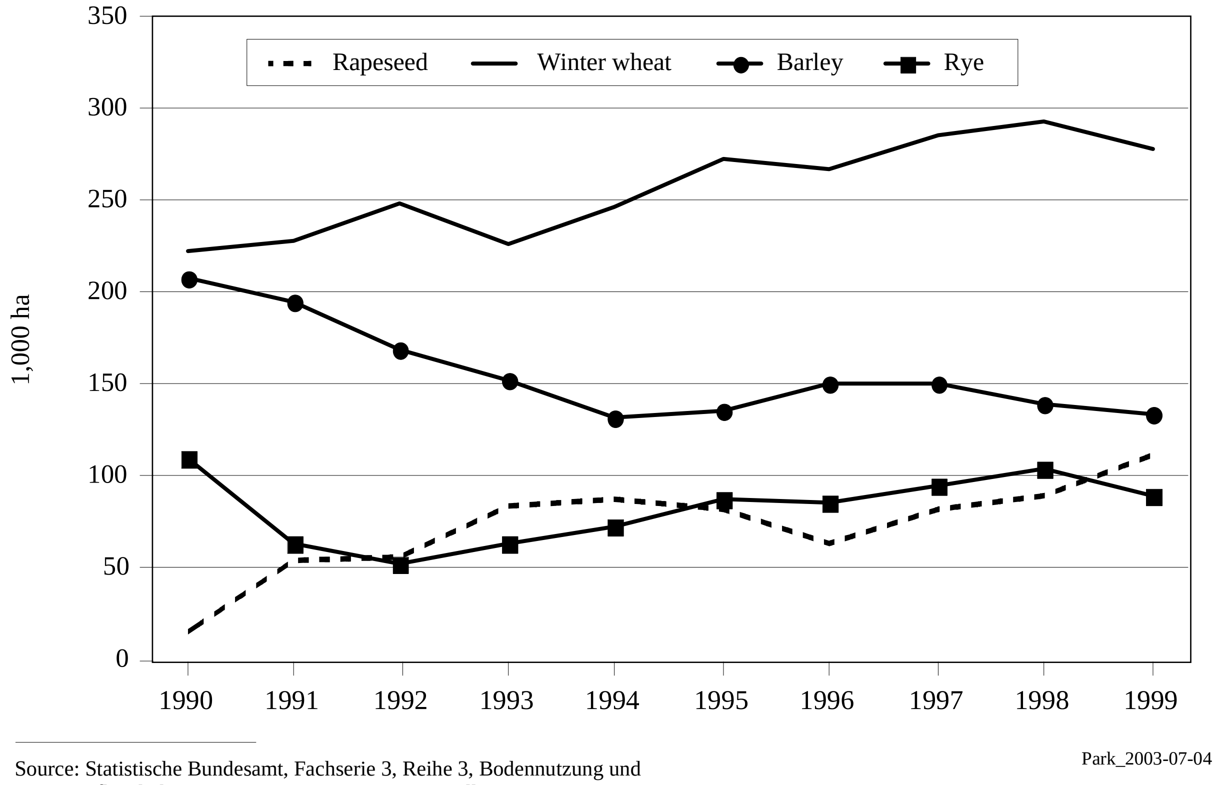
Since 1990, similar as to Mecklenburg-Vorpommern, rapeseed production has rapidly expanded in Sachsen-Anhalt (Figure 6.7). However, due to the relative high historical share of wheat areas in the state, an increase of wheat area was moderate from 225,000 ha in 1990 to 293,000 ha in 1999.

Relatively high shares of wheat before German Reunification (40 % of grain areas and 25 % of agricultural land in 1990) were possible due to relative high share of broadleaf crops (sugar beets, potatoes and feed legumes) in Sachsen-Anhalt.

With expansion of rapeseed and wheat production, a reduction of rye and barley areas is observed (Figure 6.7). Barley production has stagnated since 1994, whereas rye areas have returned to their 1990 level. Under the relatively dry climate conditions of central Germany, planting of hybrid rye turns out to be a good alternative to wheat.

Considerable expansion of rapeseed area from 1998 to 1999 is reflected by area reduction of wheat and rye.

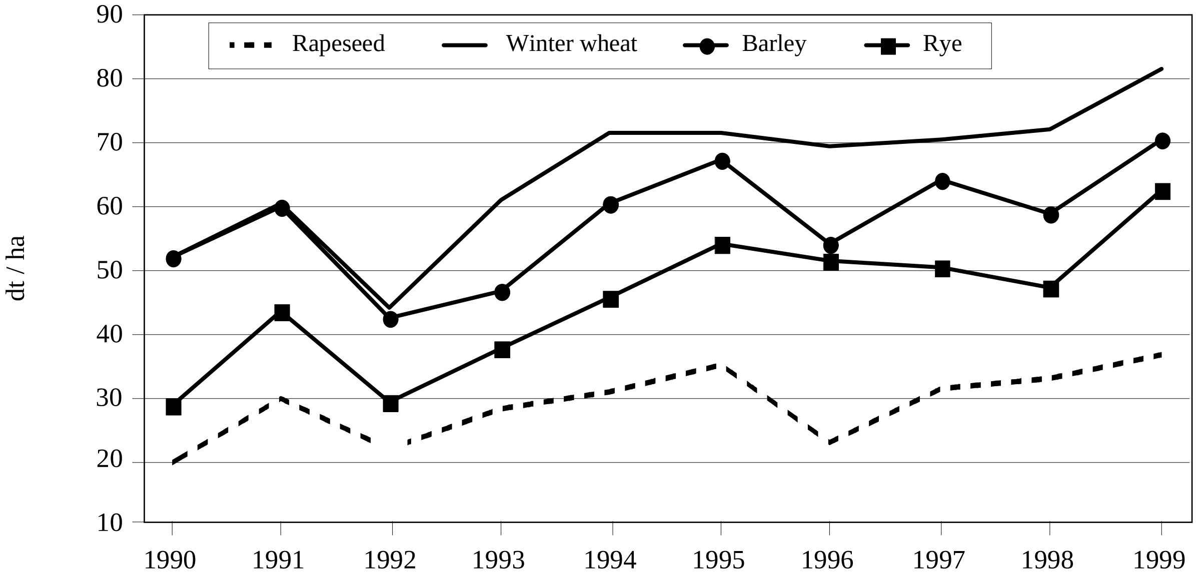
Figure 6.7: Area under rapeseed and major crops in Sachsen-Anhalt, 1990 to 1999



Source: Statistische Bundesamt, Fachserie 3, Reihe 3, Bodennutzung und Pflanzliche Erzeugung, various years; Own illustration.

In Sachsen-Anhalt, the yield difference between wheat and rapeseed is tendentially higher than in Mecklenburg (Figure 6.8). This is especially true in the years when high yields are harvested (e. g., 1999). Average yields of rapeseed and major crops are of similar level compared between two regions (Figure 6.6 and Figure 6.8).

Figure 6.8: Yields of rapeseed and major crops in Sachsen-Anhalt, 1990 to 1999



	Rapeseed	Winter wheat	Barley	Rye
1999	36.8	81.7	70.4	62.9
Ø 1990/91 to 1999	30.0	65.6	57.8	45.2
Max. 1)	36.8	81.7	70.4	62.9
Min. 2)	22.0	44.3	42.4	29.0
Variation coefficient	0.17	0.17	0.15	0.24

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6.5 Location of the selected farms

Map 6.4 displays the location of the selected farms in Germany. In Mecklenburg-Vorpommern the selected farms are located in Agrarregion 4 in the so-called „Zentrales Binnenland Mecklenburg-Vorpommern". Soils are of relative good quality with average EMZ grade of about 40. Climate conditions compared to coastal regions are relative continental with average rainfall of about 600 mm and average temperature of about 8° C (Table 6.1). It is the largest agricultural region of Mecklenburg-Vorpommern and covers Güstrow, Demmin and Müritz districts.

In **Sachsen-Anhalt** the selected farms are located in the Magdeburger Börde. In the Magdeburger Börde soils are predominantly chernozems of alluvial origin and of very high quality with EMZ grade reaching 80.

Table 6.1: Climate and soils at the selected locations in Germany

	Central Mecklenburg-Vorpommern		**Magdeburger Börde**	
Farm size (ha)	700 ha	1,500 ha	560 ha	1,300 ha
Soil type	Brown soils		Chernozem to Brown soils	
Relative soil quality	poor to medium	poor to medium	very good	very good
Rainfall / mm per year	600	600	500	500
Rainfall distribution	spring drought May to June	spring drought May to June	spring and summer droughts May to June	spring and summer droughts May to June
Average temperature °C	7.9	7.9	8.7	8.7
Average frost days	68	68	72	72

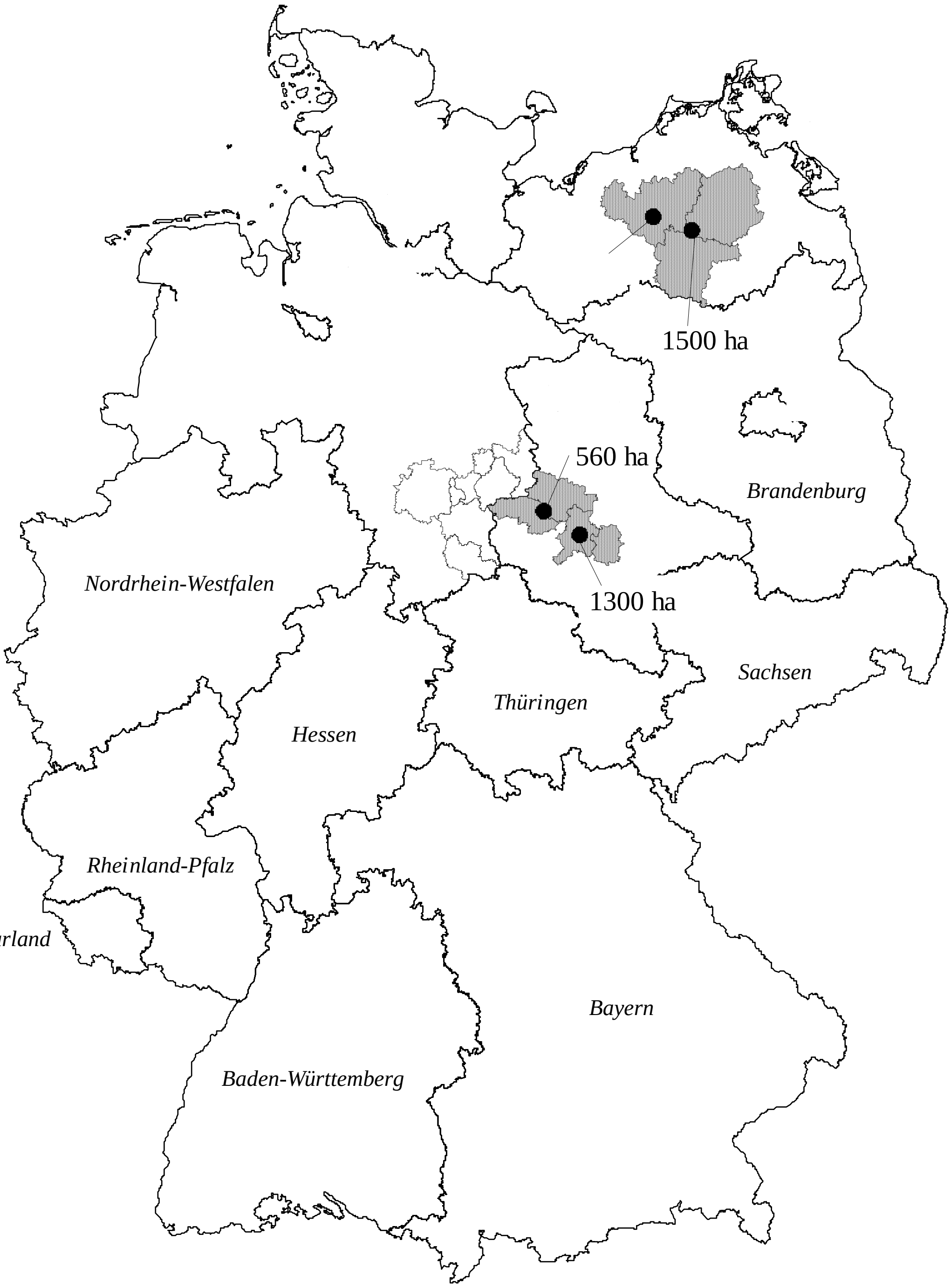
Source: Deutscher Wetterdienst (1999). Park_2003-07-03

Relatively low rainfalls vary between regions and tendentially lessen from the north west (600 mm) to the south east (450 mm). Rainfall distribution is relatively unfavorable compared to central Mecklenburg-Vorpommern.

The continental climate in the region frequently results in the prolonged dry periods during the main vegetation period that cannot be offset by higher soil quality. In the fall, a lack of rainfall impairs soil cultivation and the emergence of the plants. Winters are usually frosty and with little snowfall. However, an average temperature is slightly higher compared than those of Mecklenburg (Table 6.1)

In both regions two arable farms, one large size and one middle size, were built up during the panel meetings.

Map 6.4: Location of the selected farms in Germany



Source: Oun data collection and illustration.

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6.6 Production systems

The production systems of the selected farms at both locations are quite similar. A detailed overview of the rapeseed production systems at the selected farms is given in Table A4.1 in the Appendix.

The plow is intensively used for soil cultivation of stubble at the both locations (Table 6.2). More intensive soil cultivation is usually practiced in Mecklenburg as compared to Magdeburger Börde. In Magdeburger Börde, soil moisture preservation is of high concern. After plowing in Mecklenburg, a field cultivator is used for seedbed preparation. This is not done in Magdeburger Börde and frequently after planting, soil is rolled in order to preserve soil moisture.

In both regions soil cultivation after broadleaf crops (rapeseed, sugar beets and peas) is usually not practiced.

The **Mecklenburg** farms practice a three-year crop rotation of rapeseed-wheat-barley. In less fertile regions, wheat and barley are substituted by rye (rapeseed-rye-rye). Stubble wheat practice is limited (about 4 %) due to disease problems that have very negative impact on yields. Wheat after wheat plantings are only possible at the locations with relative good soil quality. About 5 % of the farmland is set aside.

A considerable disease advantage of three-year crop rotation for grains (wheat) results in strong negative impacts (disease and pest problems) on rapeseed. Therefore, stubble cultivation after the rapeseed is gaining in importance.

In Mecklenburg, relatively early planting of rapeseed (beginning mid-August) and wheat (September) has proved to be successful. As a consequence, peak periods exist where grain and rapeseed harvests overlap with rapeseed and wheat plantings. Therefore under such conditions relatively high machinery power is necessary.

In the **Magdeburger Börde,** the above-mentioned overlap of activities is not acute. Rapeseed planting is done in mid-August when wheat harvesting is usually finished. Additionally, the share of rapeseed in the Magdeburger Börde is relative lower compared to Mecklenburg (Table 6.2). Usually rapeseed is planted in a four-year crop rotation.

Share of stubble wheat in the Magdeburg is relatively higher and is about 10 to 15 %.

Table 6.2: Crop rotations, crop shares and yields at the selected farms in Germany

		Central Mecklenburg-Vorpommern		Madeburger Börde	
Farm size	ha	700	1,500	560	1,300
Soil cultivation system		conventional with plow, after broadleafs (sugarbeets and rapeseed) only field cultivator			
Share:					
Wheat	%	33	33	44	44
Rye	%	11	11	8	8
Barley	%	23	23	13	13
Peas	%	-	-	8	8
Rapeseed	%	26	26	16	16
Subarbeets	%	4	4	8	8
Set aside	%	3	3	3	3
Yields:					
Wheat [1)]	t/ha	8.4	8.4	7.8	7.8
Winter rye [2)]	t/ha	8.5	8.5	8.5	8.5
Winer barley [3)]	t/ha	7.5	7.5	7.2	7.2
Peas	t/ha	-	-	4.5	4.5
Rapeseed [4)]	t/ha	4.1	4.1	3.9	3.9
Sugarbeets	t/ha	53	53	49	49

1) Soft wheat A and B quality. 2) Hybrid rye . 3) Forage barley.
4) Yields of food and non-food rapeseed are equal.
Source: Own data collection and calculation. Park_2003-07-03

The amount of fertilizer applied to rapeseed is relatively high at both locations and is a result of relative high yields. In Mecklenburg higher amounts of nitrogen, sulfur and magnesium are applied due to less fertile soils (Table A4.1 in Appendix). In GDR times, basic fertilizer application was frequently mismanaged. As a result potassium problems exist in some regions of Magdeburger Börde and in Mecklenburg lime has to be applied intensively to manage acidity problems.

6.7 Agricultural policy in the EU and Germany

Since the 1960s, the most important change affecting the Common Agricultural Policy (CAP) has been a revolution in productivity that transformed the EU from a large importer to a major exporter of most agricultural commodities. High and stable prices have encouraged investment, restructuring, and rapid and continuous adoption of modern production technology. High prices also limited growth in EU demand. Given CAP mechanisms, the inevitable result was the emergence of surpluses. Surpluses, growing conflicts among world agricultural exporters and growing budget costs have provoked numerous CAP reforms. The most recent and important for oilseeds was Blair House Agreement (1992) and for agriculture in overall MacSharry reform (1992) and the

Agenda 2000 (1999). The reforms were a major shift from market price support towards support through direct payments. Farmers received permanent compensatory payments linked to land use for arable crops to compensate for price reductions. Growing public concern for the environmental impacts of agriculture was addressed for the first time with payments to induce farmers to adopt environmentally favorable production methods.

The following part will focus on the measures that directly influence oilseed production in the EU and Germany.

6.7.1 Blair House Agreement on oilseeds between the EU and the USA

In 1992, the EU and USA signed the so-called "Blair House Agreement" that resolved a long-standing dispute between two countries on oilseed production subsidies. The dispute was originated with the introduction of oilseed production subsidies for EU oilseed crushers just a few years after the EU granted oilseed and oilseed meal duty-free status in 1961.

The key elements of the agreement include:

– The EU agreed to limit the planting of subsidized oilseeds to a base area of 5.483 million ha;
– The EU agreed to set aside a minimum of 10 percent of oilseed base in all subsequent years;
– If the guaranteed area is exceeded, the EU will reduce oilseed payments by one percent for each one percent that the planting area exceeds the agreed upon limit;
– Oilseeds grown for non-food (industrial) purposes are exempt from the maximum area limits, but the output is not to exceed one million tons annual of soy meal equivalent.

The EU guaranteed oilseed area was divided between the member states according to their average share from 1989 to 1991 (Table 6.3).

The German oilseed guaranteed area under the Blair House Agreement was negatively impacted by the German reunification. The reference area for Germany was set as a total of FRG and GDR oilseed areas, whereby for East Germany oilseed areas were set according to the government plan. In 1992, as a result of rapid expansion, especially in the eastern Germany, area allocated to oilseeds (mainly rapeseed) exceeded about 200,000 ha of the guaranteed area. Addressing this problem the guaranteed area for newly formed states was solidly increased by 150,000 ha and the total German guaranteed area was set at 929,000 hectares (836,000 ha accounting for 10 % set aside) in 1993 (Table 6.3).

Table 6.3: Oilseeds guaranteed areas in the EU by the members, harvest 2000

Country	**Oilseed Guaranteed Area (Gross)**	**Sanction Free [1] Oilseed Areas (Net)**
	1,000 ha	
Belgium	6.0	5.4
Denmark	236.0	212.4
Germany	929.0	836.1
Greece	26.0	23.4
France	1,730.0	1,557.0
Ireland	5.0	4.5
Italy	542.0	487.8
Luxembourg	2.0	1.8
Nehterlands	7.0	6.3
United Kingdom	385.0	346.5
Spain	1,168.0	1,051.2
Portugal	93.0	83.7
Austria	147.0	132.3
Finland	70.0	63.0
Sweden	137.0	123.3
EU-15 [2]	**5,483.0**	**4,934.7**

1) 10% deduction . 2) Total according to allocation of EU-Commission.
Source: Ministry of Consumer Protection, Food and Agriculture, Agenda 2000 Crop Sector. Park_2003-07-03

As displayed in Figure 6.1 German rapeseed area has considerably exceeded the guaranteed area (1.1 million ha) in 1994. Member states of the EU were in the same situation so the limited EU oilseed area was surpassed that has triggered penalties. As farmers in the West Germany have contributed in a limited extent to the surpass of the guaranteed area so they have pushed for introduction of the federal state guaranteed areas. The national guaranteed area was divided between the states in 1995 and after correction in 1996 is valid up to date (Table 6.4).

According to above described rules, if the EU guaranteed oilseed area is surpassed, and that is the case in Germany, only those federal states that have exceeded their guaranteed areas face decreasing compensation payments.

Under such policy, producers were put into rather difficult situation. Oilseed production is strongly subsidized with high compensatory payments on the one hand, but on the other, limited in expansion due to guaranteed area and penalty sanctions.

Before 1999 the **oilseed compensation payment** was made in two installments. Between 15th May (the deadline of application) and 30 September producers received up to 50 % of the payment. For calculation of the payment oilseed reference price of 196.8 Euro/t was multiplied with EU oilseed reference yield of 2.36 tons/ha (average of 1986/87 to 1990/91 excluding the lowest and the highest yields). Estimated EU oilseed compensation payment was about 464 Euro/ha. Regional differences of reference yields resulted in a variation of compensation payments between member states and regions.

Table 6.4: Oilseeds guaranteed areas in Germany by the states, harvest 2000

State ha	Oilseed Guaranteed Area (Gross)	Sanction Free [1)] Oilseed Areas (Net)
Baden-Württemberg	64,330	57,897
Bayern	128,640	115,776
Berlin	180	162
Brandenburg	78,762	70,886
Bremen	153	138
Hamburg	919	827
Hessen	52,698	47,428
Mecklenburg-Vorpommern	173,400	156,060
Niedersachsen	87,540	78,786
Nordrhein-Westfalen	43,311	38,980
Rheinland-Pfalz	31,119	28,007
Saarland	2,551	2,296
Sachsen	46,303	41,673
Sachsen-Anhalt	61,579	55,421
Schleswig-Holstein	103,023	92,721
Thüringen	54,490	49,041
Germany	**929,000**	**836,100**

1) 10% deduction.
Source: Ministry of Consumer Protection, Food and Agriculture, Agenda 2000 Crop Sector. Park_2003-07-03

The second part of the compensation payment was a balance payment that accounted for the first installment paid earlier and the final regional reference payment. The final regional reference payment was dependent on the changes of the world oilseed prices during the fiscal year.

With the introduction of Agenda 2000, oilseed payments were considerably reduced and equal regional grains payments (for more details look following chapter on Agenda 2000).

6.7.2 Agenda 2000

Until the EU's 1992 reform of the CAP, high internal prices provided the majority of income support to farmers. The reform lowered EU support prices, supplementing farmers' income with direct payments, and imposed a mandatory land set aside for supply control.

Agenda 2000 builds on the 1992 reforms by further reducing prices for some commodities while compensating producers for half of the price decline through direct payments. The Agenda 2000 is valid for years 2000 through 2006.

According to the Agenda 2000, compensatory payments for oilseeds, cereals and set aside areas are set at the same level as cereal crops and should be valid from the harvest 2002. The changes should a) simplify management of the programs and b) remove basis for the restrictions of the Blair House Agreement for special support of the oilseed production.

The basis for the calculation of the compensation payment will be the average regional yield of grains (excluding corn in selected states) that is multiplied with a fixed payment of 58.67 Euro/t. For protein crops the payment is 72.5 Euro/t.

During the transition period of Agenda 2000 from 1999 to 2002 differentiated compensatory payments for crops were paid to producers. The **payments** for **grains**, **legumes** and **flax** are based on the regional reference yields (average from 1986 to 1990) multiplied by fixed payments. In 1999, the payments for grains were 54.34 Euro/t, for legumes 78.49 Euro/t and flax 105.10 Euro/t. Set aside area was eligible for compensatory payment as well. The payment was based on the regional average grain yield multiplied by 68.83 Euro/t. It is paid even if the set aside area is planted with oilseeds used for non-food purposes. Farmers are obliged to set aside minimum 10 % of the farm area allocated to "Grand Culture" crops. They have an option to voluntary allocate maximum of 33 % of the "Grand Culture" crop area.

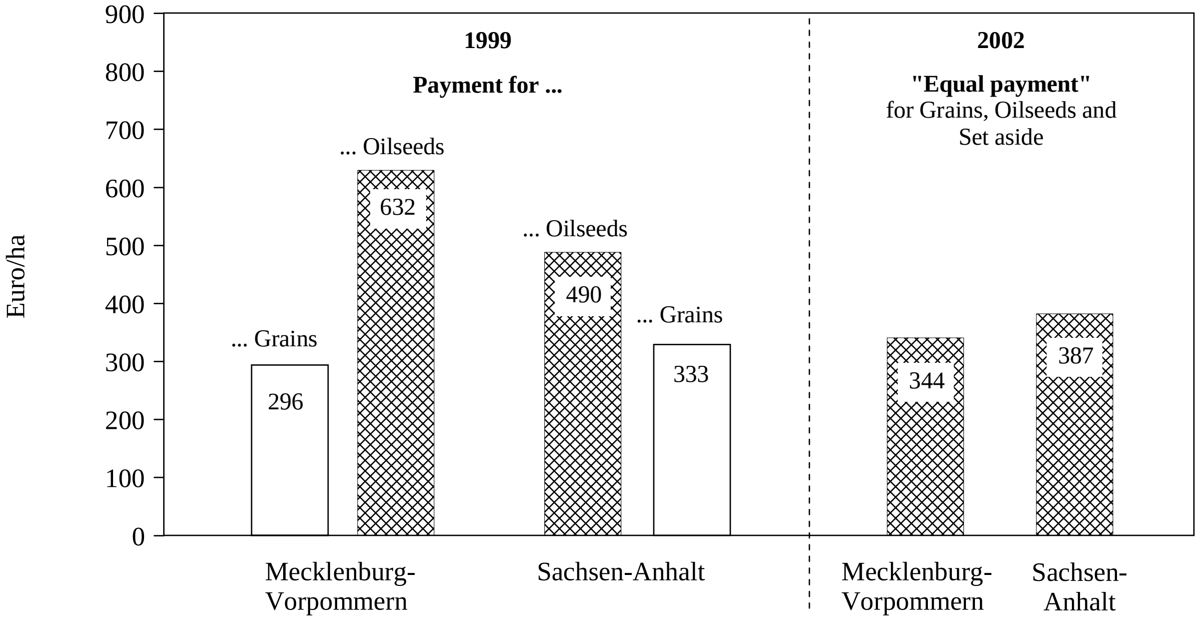
In Germany during the transition period **oilseeds payments** will be based on old reference oilseed yields with the payments gradually decreasing to the grain payments level (Table A4.2 in Appendix).

After the transition period compensatory payments for oilseeds will on average decrease 38 % from 575 Euro/ha (1999) to 353 Euro/ha (2002). In Mecklenburg-Vorpommern the payments will fall almost 50 % (344 Euro/ha) whereas in Sachsen-Anhalt the decrease will be relatively mild at about 20 % (Table A4.2 in Appendix).

Before the Agenda 2000, high differences between oilseeds and grain yields in Sachsen-Anhalt resulted that oilseed compensatory payments below the national average. From 2002, oilseed producers in Sachsen-Anhalt will receive the highest payments after Schleswig-Holstein and Sachsen (Table A4.2 in Appendix).

Figure 6.9 displays how the Agenda 2000 has changed the oilseed payment relationship in Sachsen-Anhalt and Mecklenburg-Vorpommern. In 1999 Mecklenburg had clear oilseed payment advantage over grain payment compared to Sachsen-Anhalt. With the introduction of the Agenda 2000 in 2002, the reverse situation can be observed, but to lesser extent. At the both locations rapeseed production is losing its attractiveness to grains through considerable reductions of the oilseed payments.

Figure 6.9: Change of crop payments through Agenda 2000 in Mecklenburg-Vorpommern and Sachsen-Anhalt



Source: Own illustration.

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6.7.3 Quality standards

The EU Commission follows a very strict quality policy in the production of rapeseed and other oilseeds (UHLMANN, 2000). Only rapeseed varieties with specified quality (00-varieties with low erucic acid (<2 % of total fatty acids) and low glucosinolate levels (< 25 µmol/g of total seed)) are eligible for compensation payments. Producers with contracts with less strict standard requirements for seed are also eligible for compensation payments. Producers should supply proof of quality for the produced seed through a) use of certified seed for planting or b) through random sampling by certified experts.

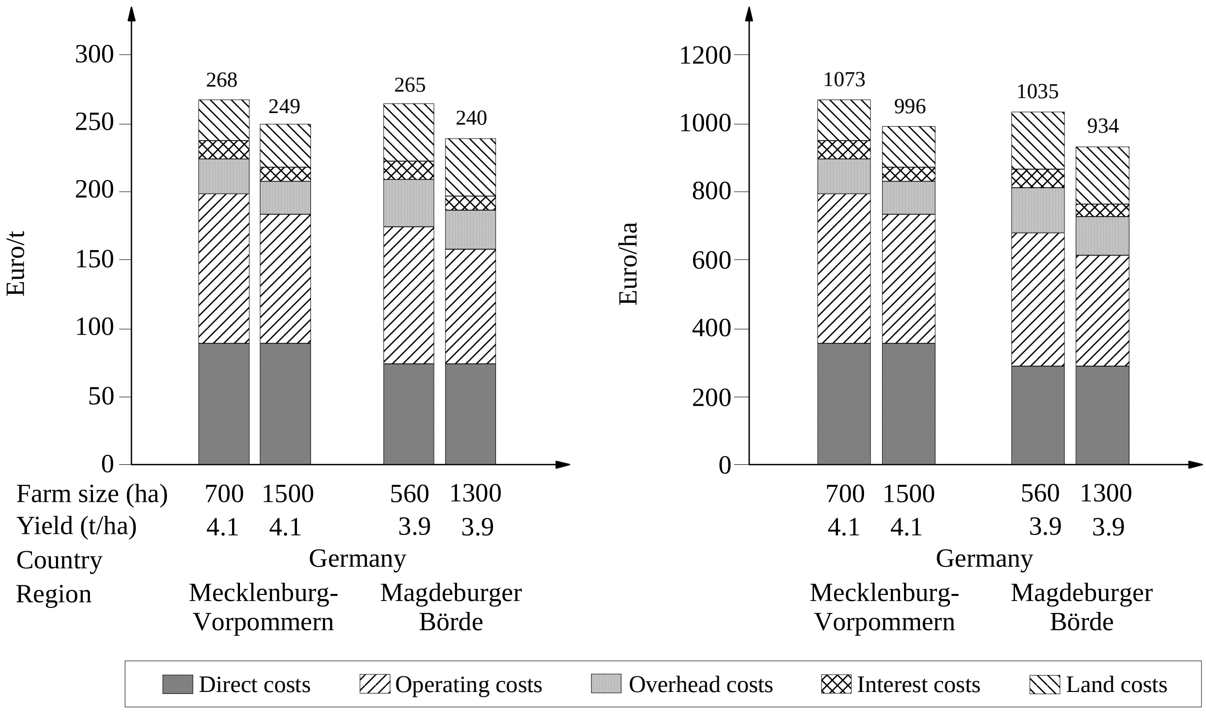
6.8 Production costs

Production systems of rapeseed for food and non-food purposes are similar at the selected locations. Therefore, production costs displayed in Figure 6.10 through 6.13 include both rapeseed groups. Only in the profitability analysis do these two groups receive differentiated market price (Figure 6.14).

Total production costs

Total production costs at the selected farms range between 934 to 1,073 Euro/ha (Figure 6.10). Average production costs of the farms in Mecklenburg-Vorpommern are 50 Euro/ha higher of the farms in Sachsen-Anhalt. Cost disadvantages due to higher direct (19 %) and operating costs (12 %) cannot be offset by lower land and overhead costs. When costs are expressed per yield unit the cost disadvantage is reduced due to slightly higher yields and is about 6 Euro/t. At both locations an economy of size effect can be observed for the operating and overhead cost groups.

Figure 6.10: Rapeseed: Production costs, 2000



Exchange rate: 1 Euro = 1.96 DM.
Source: Own calculations.
Park_2003-08-07

Land costs

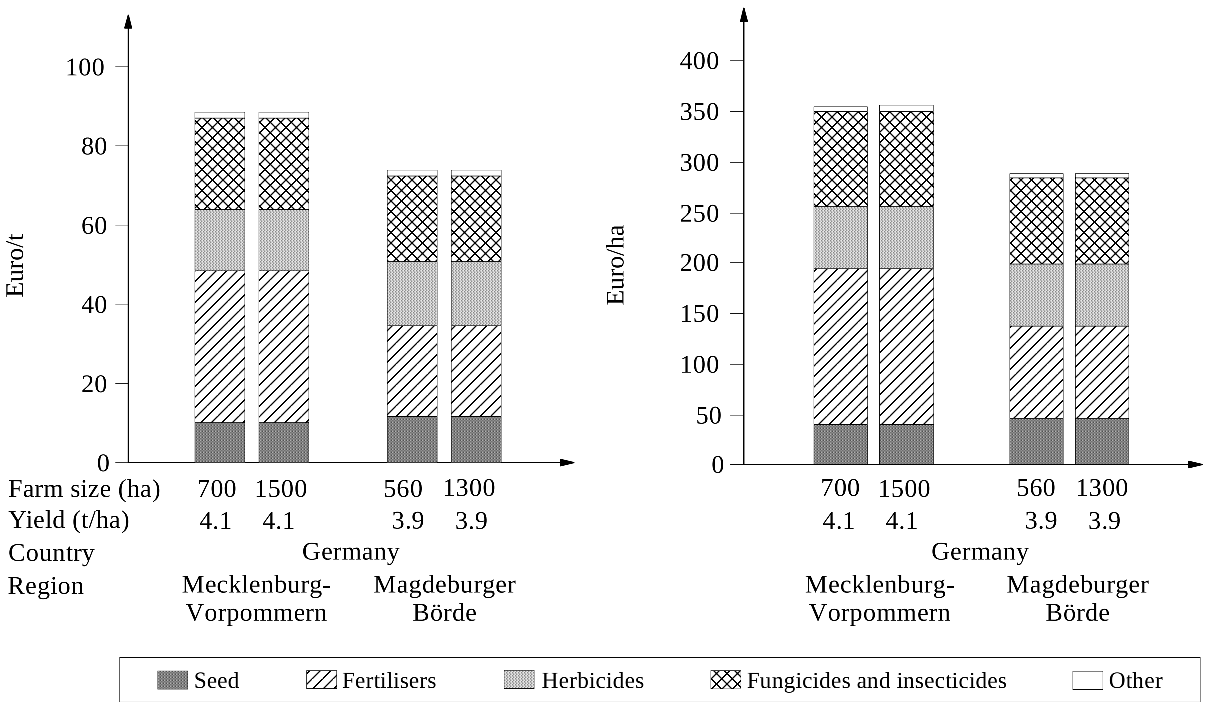
The higher share of sugar beets area on the farms in Magdeburger Börde (8 % vs. 4 %) strongly influences total profitability of the farms. The influence of sugar quotas on the land rent at the both locations is accounted as an opportunity cost of 15 Euro/t of sugar beets. After the land costs are cleared up of the sugar beet quota influence, the land cost of rapeseed in Magdeburger Börde is about 165 Euro/ha (42 Euro/t) that is 30 % higher than Mecklenburg-Vorpommern (121 Euro/ha or 30 Euro/t). The major reason for such a high difference in the land rents is to be found in the soil quality. With an average soil quality of 80 EMZ on the farms in Magdeburger Börde about 2.1 Euro per EMZ is paid there. The farms in Mecklenburg Vorpommern pay slightly higher price of 2.7 Euro per EMZ (45 EMZ).

When the land costs of the both locations are compared to West Germany it becomes evident that in general their level is considerably lower. According to DOLL and KLARE (2000) average land rent in East Germany is only 45 % of the level of the West Germany. Another reason for lower land rents in eastern Germany is to be found in the involvement of the so-called "Bodenverwertungs- und -verwaltungsgesellschaft (BVVG)" in the management of the soil resources of the former GDR. This organization is responsible for long-term rent and sale of the soils of the former GDR and it serves as a benchmark for other players on the market. Shortly after reunification, the best soils were rented below 2 Euro/ha per EMZ, however with time an increase of rents is anticipated (DOLL and KLARE, 2000).

Direct costs

Direct costs of rapeseed in Mecklenburg-Vorpommern (356 Euro/ha or 89 Euro/t) are 19 % higher than Magdeburger Börde farms (289 Euro/ha or 74 Euro/t) (Figure 6.11). Higher fertilizer (70 %) and chemical costs (10 %) contribute to the cost disadvantage of the Mecklenburg farms that cannot not be offset by lower seed costs. Slight differences in yields between two locations could not reduce the cost disadvantage when expressed per yield unit.

Figure 6.11: Rapeseed: Direct costs, 2000



Exchange rate: 1 Euro = 1.96 DM.
Source: Own calculations.

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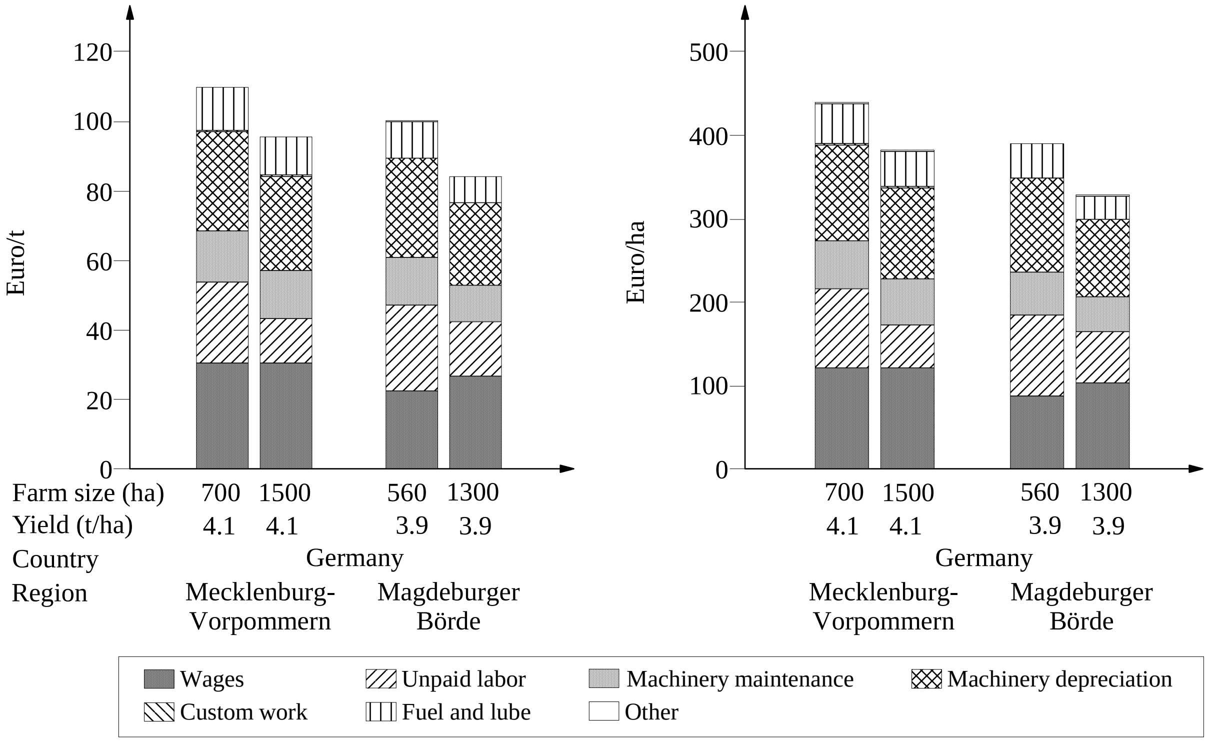
In Mecklenburg-Vorpommern higher fertilizer input is necessary to improve soil nutrient status cause of higher **fertilizer** costs (Table 11.1). Higher **fungicide** and **insecticide** costs are result of more intensive problems with diseases and pests due to shorter crop rotation in Mecklenburg (3 vs. 4 years) and climate conditions.

Operating costs

Operating costs range between 328 to 439 Euro/ha (84 to 110 Euro/t) and are the largest cost group contributing about 40 % of the total rapeseed production costs (Figure 6.10 and Figure 6.12). Despite the larger size of the farms in the Mecklenburg-Vorpommern, they exhibit an average cost disadvantage of 51 Euro/ha (10 Euro/t) that is 12 % higher of the Magdeburger Börde. Higher labor costs (paid), machinery and fuel costs were the major contributors for the cost disadvantage.

Figure 6.12: Rapeseed: Operating costs, 2000



Exchange rate: 1 Euro = 1.96 DM.
Source: Own calculations.
Park_2003-08-07

Higher **machinery maintenance**, **fuel** and **lubrication** costs are the result of more intensive drying of the seed. The farms in Mecklenburg-Vorpommern have to dry about half of their harvest, whereas in Magdeburger Börde it is usually around 10 %.

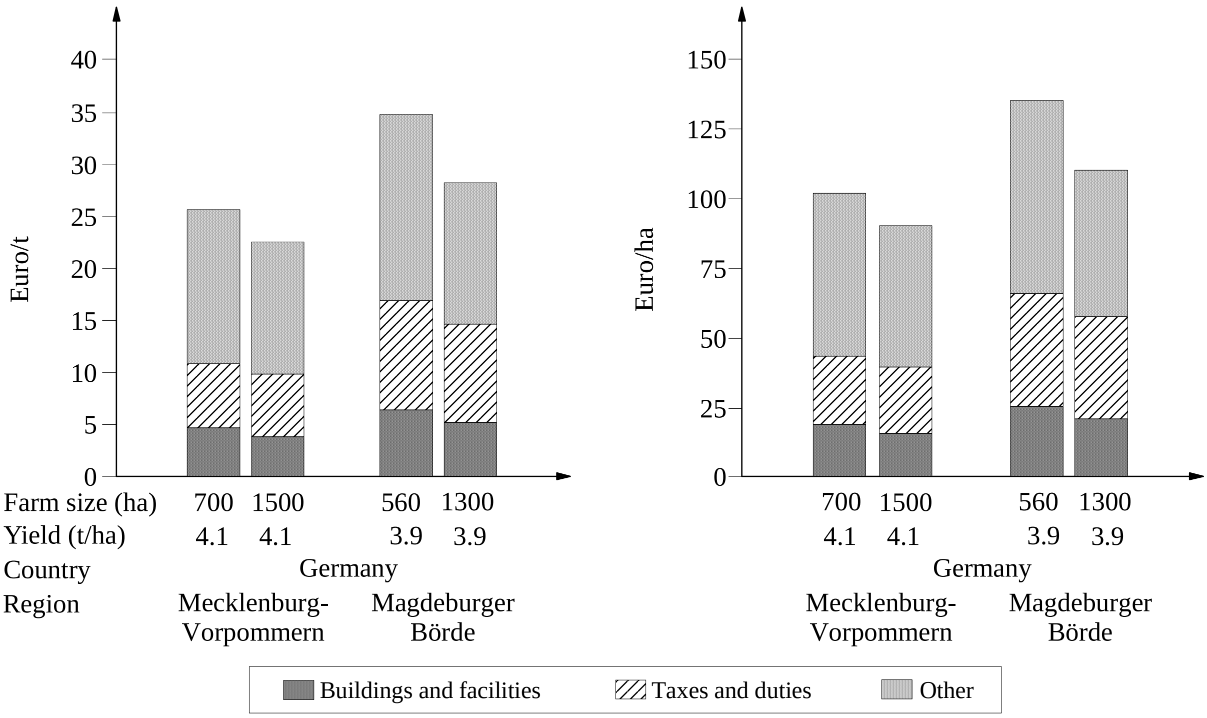
Higher **paid labor** costs at the farms in Mecklenburg are result of more intensive field activities compared to Magdeburger Börde. Regular collection of stones on the fields and larger share of seed for drying result in the labor cost disadvantage. However, due to relative larger size in the both size groups farms in the Mecklenburg-Vorpommern have slightly lower labor opportunity costs for farm manager (5 Euro/ha).

The very short time available between wheat harvest and rapeseed planting in Mecklenburg-Vorpommern requires a relatively higher harvest and planting machinery capacity that results in slightly higher **machinery depreciation** costs.

Overhead costs

Rapeseed overhead costs of the farms in the Magdeburger Börde (123 Euro/ha or 32 Euro/t) are 28 % higher than those of the Mecklenburg-Vorpommern farm (96 Euro/ha or 24 Euro/t). Overhead costs of medium sized farms are considerably higher than the large sized farms, exhibiting an economy of size effect (Figure 6.13).

Figure 6.13: Rapeseed: Overhead costs, 2000



Exchange rate: 1 Euro = 1.96 DM.
Source: Own calculations.

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All cost components contribute to the cost disadvantage of the Magdeburger farms. The highest cost disadvantage of 14 Euro/ha contributes taxes and fees (due to higher liability insurance and land taxes based on EMZ), followed by building (more expensive storage facilities) and other costs (6 Euro/ha).

Interest costs

Interest costs are on similar level at the both locations where medium sized farms have higher interest costs. They range between 38 to 52 Euro/ha (10 to 13 Euro/t).

6.9 Profitability

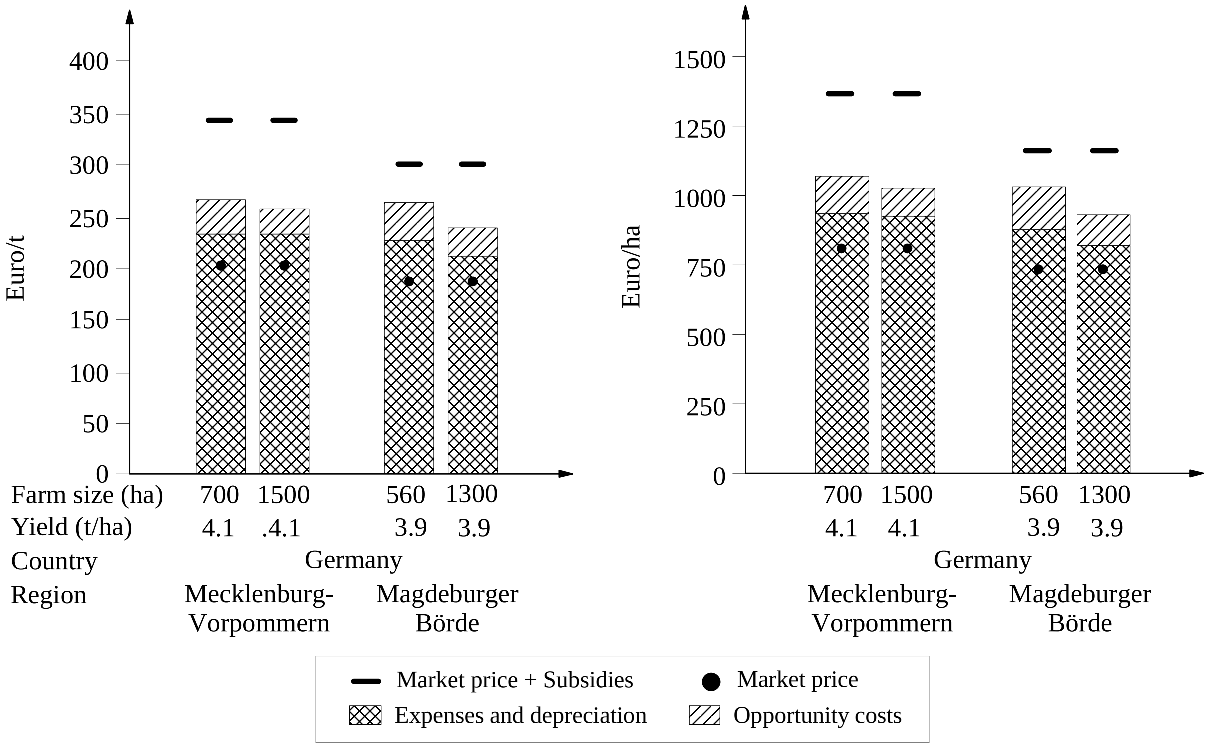
About 40 % of rapeseed is planted on set aside (for industrial purposes) at the farms in Mecklenburg-Vorpommern. Due to a lower share of oilseed guaranteed area at the both farms in Magdeburger Börde rapeseed planted on set aside is even higher there, reaching half of the total rapeseed area. Production systems and therefore production costs for food and industrial rapeseed is the same, however market prices and area based payments are different, resulting in different profitability of rapeseed production. Total revenue for food rapeseed (market price plus oilseed payments) is 14 % higher than for non-food rapeseed (market price plus set aside payment) in Magdeburger Börde and even 29 % higher in Mecklenburg-Vorpommern. Higher differences between food and non-food rapeseed revenues in Mecklenburg-Vorpommern are a result of considerably higher oilseed payments in the region (due to higher oilseed yields) and difference of the market prices of about 26 Euro/t in 2000.

At the both locations non-food rapeseed is a reasonable and profitable alternative for fallow that does not compete with food rapeseed. In the framework of this analysis, detailed comparison of these two systems will be foregone.

Figure 6.14 displays profitability of the food rapeseed production at the selected location. One may note that entrepreneur profits in Mecklenburg-Vorpommern (298 and 373 Euro/ha) are almost double those of the farms in the Magdeburger Börde (135 and 236 Euro/ha). Oilseed payments of about 111 Euro/t in Magdeburger Börde and 140 Euro/t in Mecklenburg contribute 37 to 40 % of the total revenues. Without oilseed payments, production of food rapeseed in 2000 were unprofitable.

The preceding crop value of rapeseed is an additional aspect of the profitability of rapeseed production. The major benefit of rapeseed as a preceding crop is the improved yield of the following crops. According to the farmers from the panel meeting in Mecklenburg-Vorpommern, wheat planted after rapeseed may yield 10 % (0.8 t/ha) more; in Magdeburger Börde it may increase up to 35 % (2.3 t/ha).

Figure 6.14: Rapeseed: Profitability, 2000



Exchange rate: 1 Euro = 1.96 DM.
Source: Own calculations.

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Additional savings are anticipated for wheat after rapeseed (vs. wheat after wheat) in variable costs such as fertilizer, fungicides, maintenance of machinery and fuel.

The total estimated preceding crop value of rapeseed is about 164 Euro/ha in Mecklenburg and 297 Euro/ha in Magdeburger Börde.

7 Soybean production in Argentina

7.1 Climate and soils

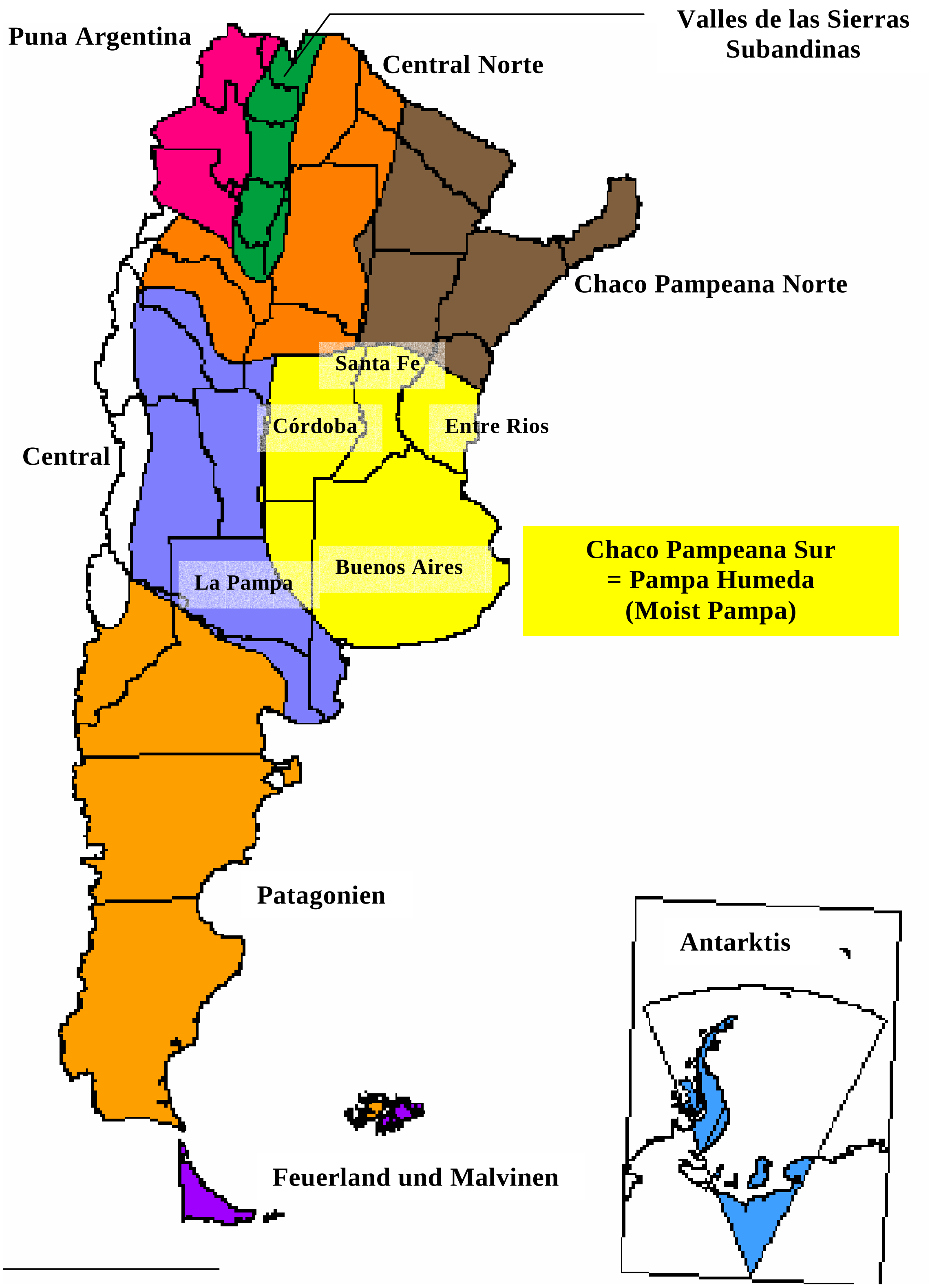
7.1.1 Climate

Map 7.1 shows the climate zones in Argentina. The main production regions for field crops, milk and meat in Argentina is in the region known as Pampa Humeda (Humid Pampas) in the east of the country. About 90 percent of all Argentina’s agricultural products are produced here. The Pampa Humeda includes just about all of the provinces of Buenos Aires and Cordoba, large portions of the Santa Fe and Entre Rios provinces as well as part of the province La Pampa (not to be confused with the natural area "pampas").

The climate in the Pampa Humeda is relatively wet, on the coast of the southern part of the province of Buenos Aires it is oceanic. In the western border areas of the Pampa Humeda, a transitional climate to the semi-arid conditions of the La Pampa region is found.

Map 7.2 shows the distribution of precipitation in Argentina. Each line signifies a difference of 100 mm precipitation in on an annual average. The most important lines of the same precipitation are marked. An important orientation point is the 600 mm precipitation line which at the same time marks the borders of the Pampa Humeda.

Map 7.1: Climate zones in Argentina



Source: SAGPyA

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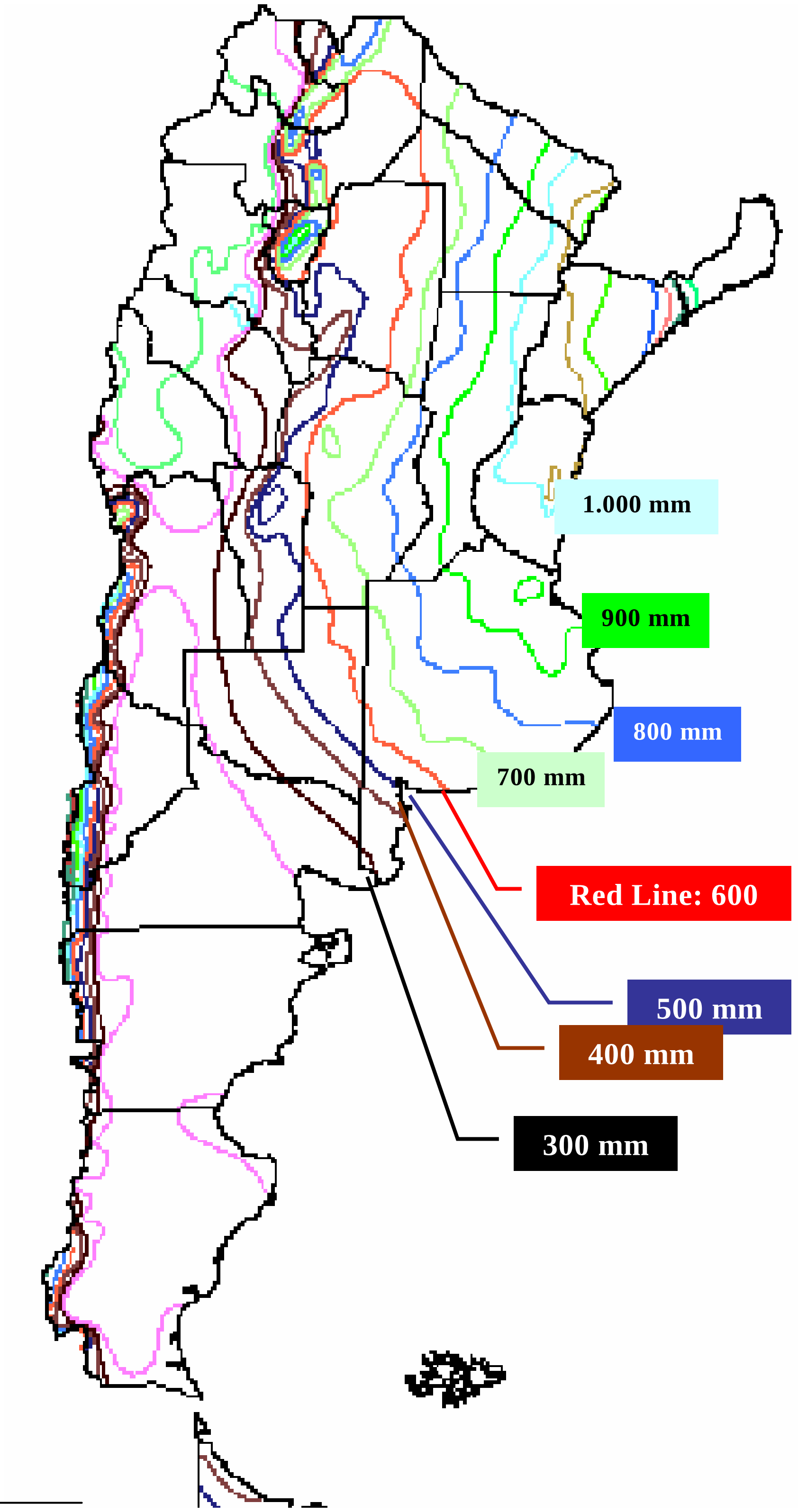
Map 7.2: Distribution of rainfall in Argentina



Source: SAGPyA (1996).

7.1.2 Soils

Map A5.1 in Appendix shows soil points for the Pampa Humeda. The Argentinian Soil Classification features only 0 to 100 points, as does the German system. As shown on the map, the best soil is to be found (light green) in the north of Buenos Aires, in the south and central part of Santa Fe and in the east of Cordobas. These regions are also known as the Argentinian "Corn Belt". Other good sites can be found in the south of the Buenos Aires province.

The planting of soybeans is limited to locations with soil categories 1, 2 or 3. These have soil point values of between 60 and 100, and explain, in conjunction with higher precipitation, why a) soybeans dominate in the Corn Belt and b) sunflower cropping takes place on the lower quality soils of the Pampa Humeda or outside of these regions (see Chapter 7.2).

7.2 Production of soybeans and major crops in Argentina

The following Maps 7.3 to show the main crop areas for soybeans and sunflowers production as well as the main competitive crops, wheat and corn. The Maps A5.2 to A5.5 in the Appendix display the production quantities for these cultures on the level of "Departamentos", (the equivalent of counties) for the Harvest Year 1995/1996. More recent data is not available for this aggregation level.

As Map 7.3 showsthe main areas of **soybean** production are in the Corn Belt in the north of the Buenos Aires province, in south Santa Fe and in the east of the Cordoba Province. The tables at the bottom of the map also show that about 90 percent of the soybean production takes place in these three areas: Buenos Aires (about 21 percent); Cordoba (about 27 percent) and Santa Fe (about 43 percent). In the past five years, Cordoba was able to increase its production capacity to the disadvantage of Santa Fe. In the Corn Belt it is possible to plant soybeans as a second crop after wheat (see Chapter 7.5).

Map 7.4 shows the main crop areas for **sunflowers**. It shows that the production is concentrated in the southwestern Buenos Aires province as well as in the weaker areas bordering the Corn Belt in the south of Cordoba and the north of the La Pampa province. The Buenos Aires province leads with 60 percent of total production. The second most important region is the La Pampa province which was able to increase its production by 15 percent in the past few years. In third place is the Cordoba province with about 13 percent of the production.

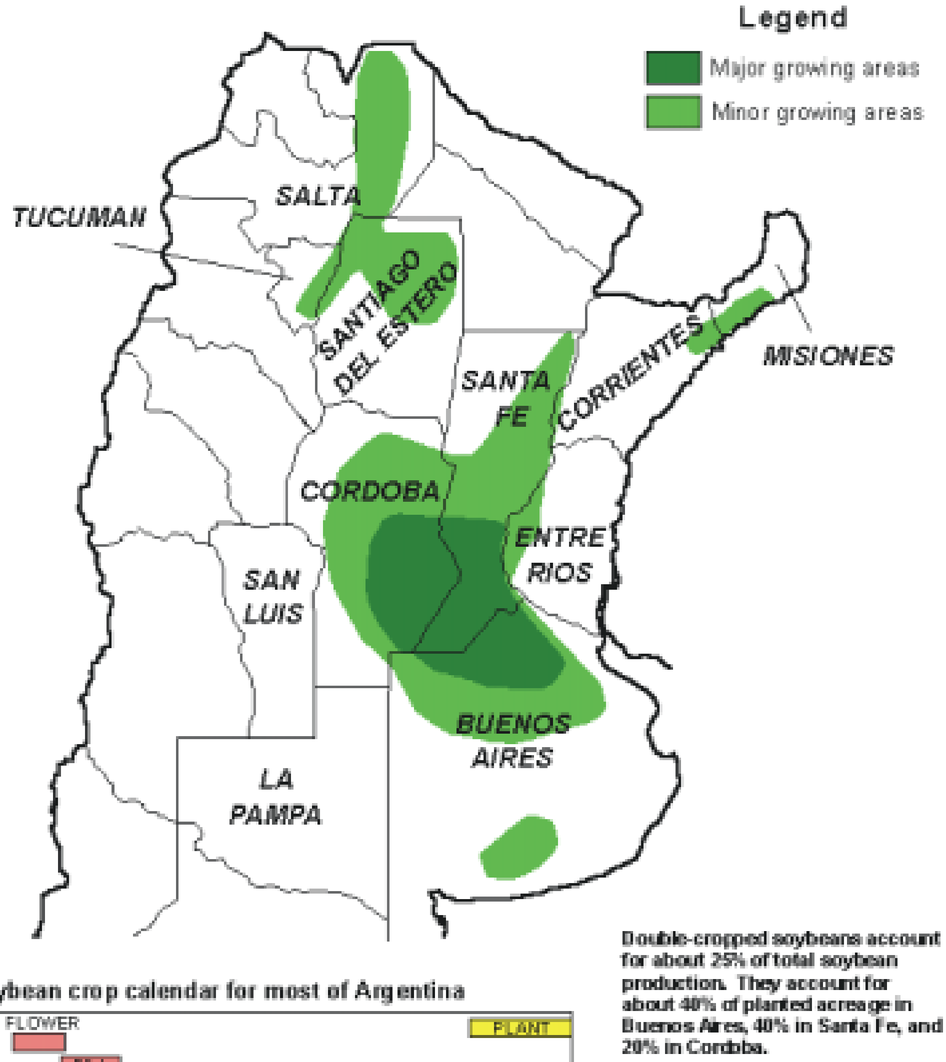
Wheat production primarily takes place in previously mentioned Corn Belt as well as in the cooler climates in the south of the Buenos Aires province (Necochea, Tres Arroyos) (Map 7.5). Due to high temperatures and dryness, the regions north of the Corn Belt are not suitable for wheat.

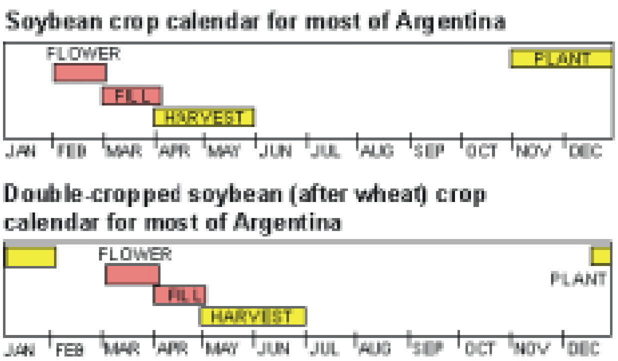
Map 7.6 shows the main crop areas for **corn**. In the Corn Belt, the corn locations often cross with the soybean areas, but the corn production extends even further into (south)western Cordoba and in the north of the La Pampa province. Here too, the Buenos Aires province is the most important (45 percent of the total production) followed by Cordoba (22 percent) and Santa Fe (18 percent).

The most important factors determining the locations of the main crops, are, in addition to soil quality, the climatic conditions and the proximity to ports. All Argentinian ports for grain are located either within the Pampa Humeda or border on it. A maximum distance of 500 km to the ports is a characteristic of the most important crop areas. Outside of the Pampa Humeda, the transportation costs increase both due to the increasing distance to port, but also due to the poorly defined structure of the road and railroad networks. The transportation system in Argentina was privatised during economic reforms in the 1990s as was trade. Improved efficiency of domestic transportation resulting from the reforms, as well as the expansion to the Parana to the north, gave new impulses to the soy and grain cropping outside of the core areas. (WAINIO and RANEY, 1998).

The development of the crop areas and production quantities of soybeans, sunflowers, corn and wheat in Argentina can be seen in Figures A5.1 and A5.2 in the Appendix. The development of the crop areas for soybeans and sunflowers in selected Argentinian provinces can be seen in Figures A5.3 and A5.4 in Appendix.

Map 7.3: Major soybean production regions in Argentina





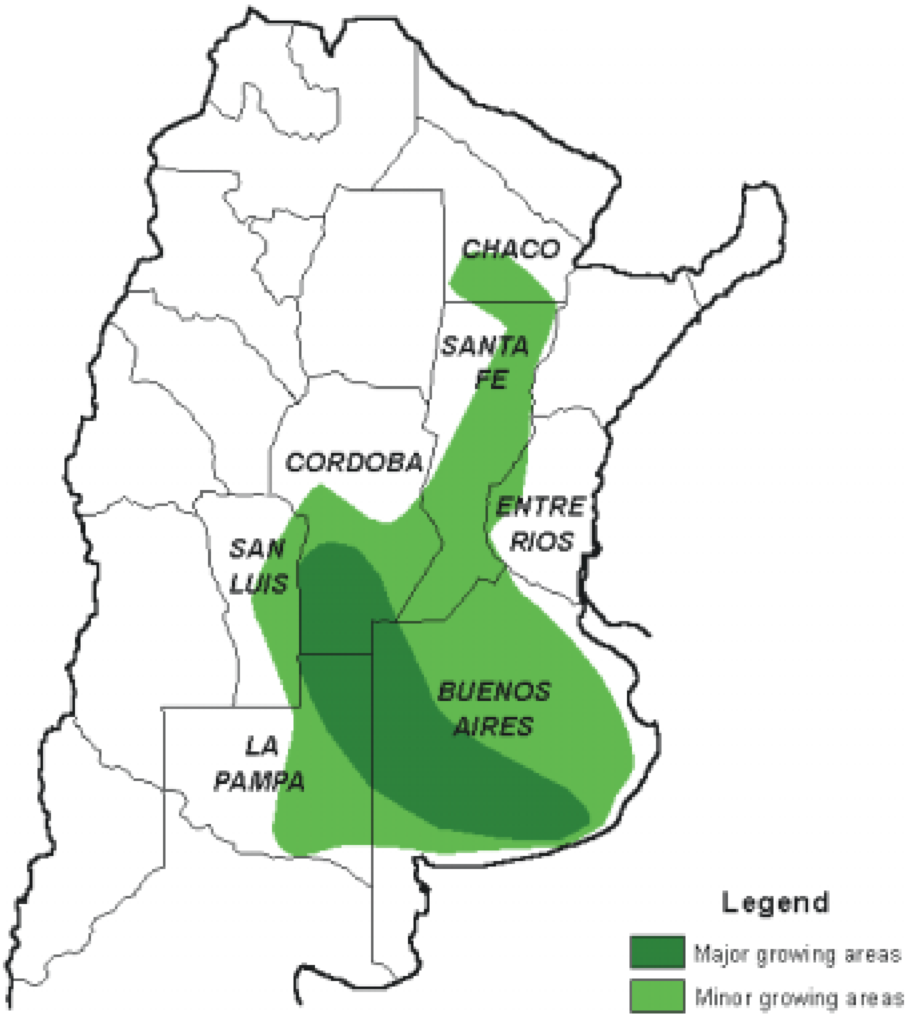
Percent of total production by province
(1993/94-1997/98 average)

Buenos Aires	21 %
Córdoba	27 %
Santa Fe	43 %
Others	10 %

Source: USDA (1999); Table is updated according to SAGPyA (2000).

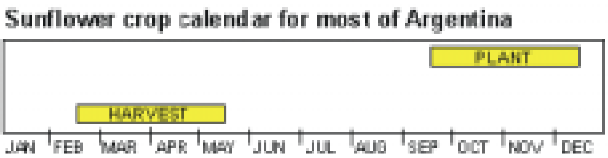
Park_2003-09-01

Map 7.4: Major sunflower production regions in Argentina



Percent of total produ on by province
(1993/94-1997/98 average)

Buenos Aires	60 %
La Pampa	15 %
Córdoba	13 %
Santa Fe	7 %
Others	5 %



Source: USDA (1999); Table is updated according to SAGPyA (2000).

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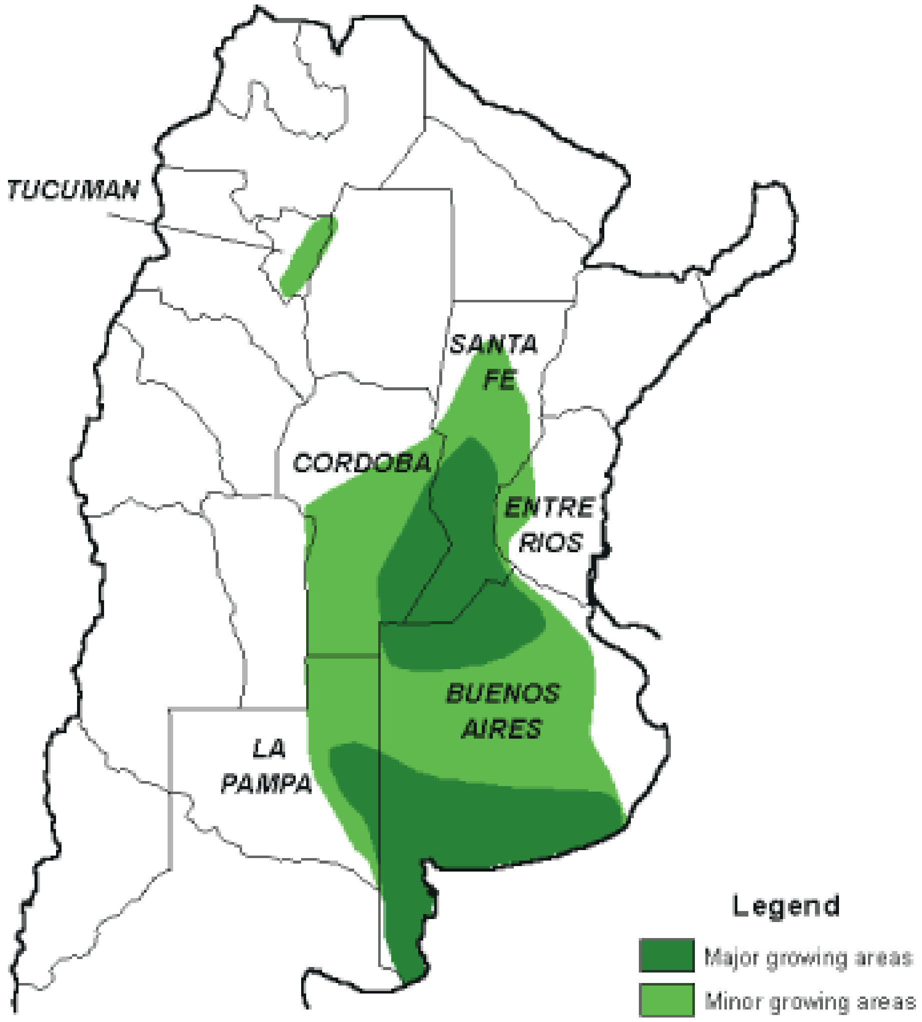
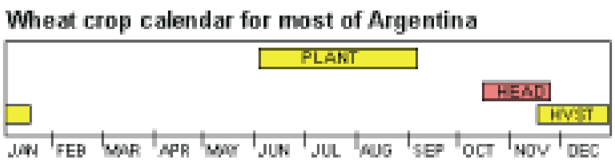
Map 7.5: Major wheat production regions in Argentina



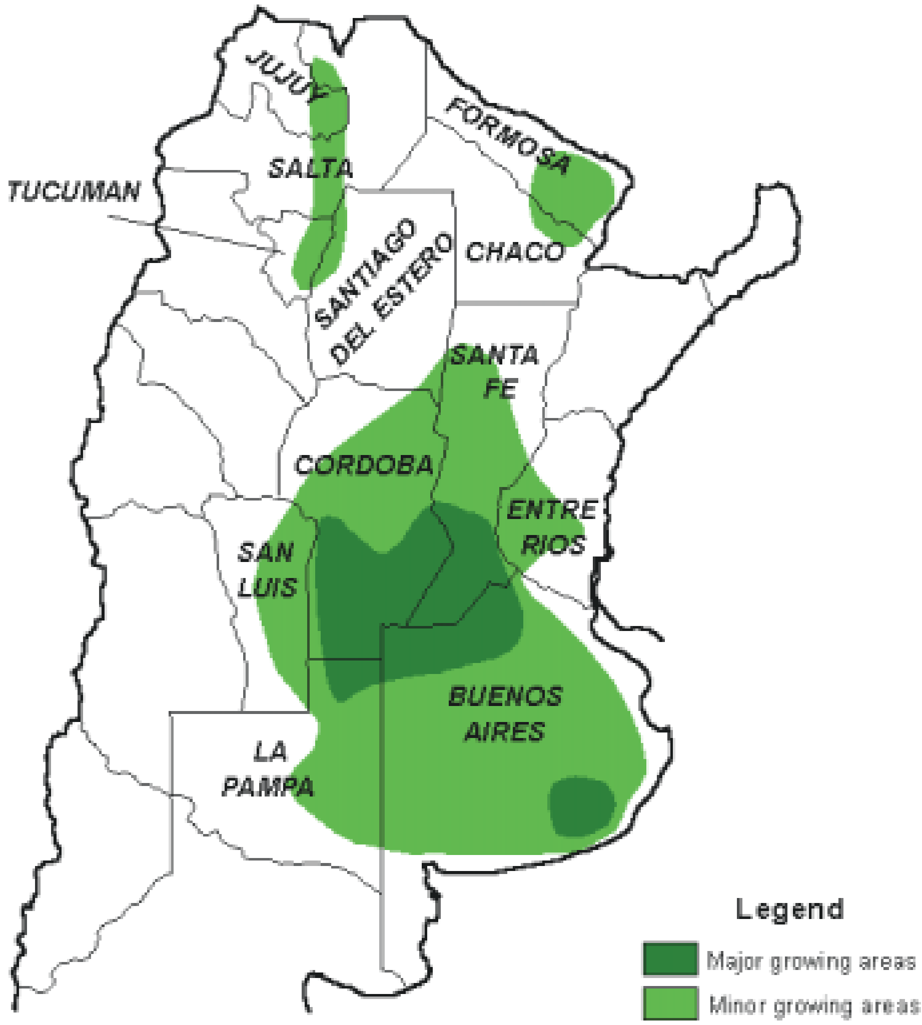


Percent of total production by province
(1993/94-1997/98 average)

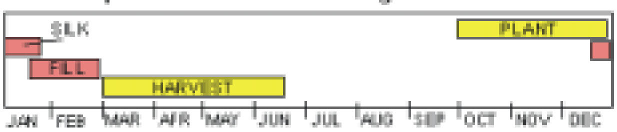
Buenos Aires	66 %
Santa Fe	15 %
Córdoba	8 %
La Pampa	7 %
Others	4 %

Source: USDA (1999); Table is updated according to SAGPyA (2000). Park_2003-09-01

Map 7.6: Major corn production regions in Argentina



Corn crop calendar for most of Argentina



Percent of total production by province
(1993/94-1997/98 average)

Buenos Aires	45 %
Córdoba	22 %
Santa Fe	18 %
La Pampa	2 %
Others	13 %

Source: USDA (1999); Table is updated according to SAGPyA (2000). Park_2003-09-01

7.3 Yields

Table 7.1 shows the average yield level for the four main crops soybeans, sunflowers, wheat and corn for the years 1993/1994 to 1998/1999 in the main crop regions. Figures A5.5 to A5.8 in the Appendix show the development of yields in the last ten years.

It must be noted that these values are regional averages. But the following can be observed:

- Santa Fe is the region with the highest soybean yield. Here, the climatic advantage of high temperatures has a positive effect on the yields;
- Santa Fe and Buenos Aires are the regions with the highest corn and wheat yields;
- Cordoba is in the middle for all crops;
- The yields in La Pampa are significantly lower for soybeans and corn than in other regions. This can be explained to a large extent by the margin area to Pampa Humeda and thus poor natural conditions for soybean and corn production (low rainfall);
- The fewest regional differences were found in the production of sunflowers.

Table 7.1: Yields of major crops in the most important production regions of Argentina (average 1993/1994 to 1998/1999, t/ha)

	Soybeans	**Sunflower**	**Wheat**	**Corn**
Buenos Aires	1.97	1.90	2.39	5.43
Córdoba	2.03	1.73	1.80	4.06
La Pampa	1.67	1.72	1.66	2.82
Santa Fe	2.34	1.77	2.10	5.67

Source: SAGPyA. Park_2003-07-03

In general, no significant trend for the yield development of soybeans can be seen. This is because of changing weather conditions that influence share of soybeans planted as a second crop (see Chapter 7.5). And their share has increased over the past several years (Figure A5.9 in the Appendix). The yields for the second soybean crop are generally much lower and suffer much stronger variation as do soybeans in main crop.

The yield potential for soybeans and sunflowers is probably much higher than the observed averages. The average yields for soybeans in the Corn Belt farms that are members in the so-called CREA movement[1] are between 3.0 and 3.8 t/ha (1999). The highest sunflower yields were achieved in the south and east of the Buenos Aires province and in 1999 were between 2.0 and 2.6 t/ha (CREA,2000). The CREA-farms are commonly seen as the leading farms in Argentina and represent according to crop between 3 percent (soybeans), 4.5 percent (sunflowers), 4.2 percent (wheat), and nine percent (corn) of overall production. It has been shown in the past that the yield level of the CREA farms is ultimately achieved by other farms after several years. Thus the numbers for the CREA farms can be used as orientation data for the future yield trends.

It can be seen that the yield differences between the average yields of the CREA farms and the national average of wheat (+44 percent in the CREA farms) and in particular corn (+60 percent) are higher than those for oilseeds (sunflowers +18 percent and soybeans +12 percent). While for the soybeans primarily properly timed plant protection management and improved soil tillage, or rather planting techniques, are important, in the case of wheat and corn the targeted use of fertiliser and the soil testing could be the determining factors of the yield advantages in the CREA farms.

In field tests by the INTA[2] in southern Santa Fe average yields of soybeans of up to 5.0 t/ha were achieved for Group IV (AGROMERCADO, 1999b). In the case of sunflowers the values are somewhat over 4.0 t/ha (AGROMERCADO, 1999a).

7.4 Location of the selected farms

Map 7.7 displays location of the selected farms for analysis. Since the Corn Belt is the most important farming region of Argentina, at least for soybeans, the survey of typical farms starts from this point. At the time of the report, three farms were studied, two of which are located directly in the Corn Belt and grow soybeans, corn and wheat. The third farm is located on the western border of the Corn Belt in the south of the Cordoba province.

The first and smallest farm studied is located in the south of the Santa Fe region (Venado Tuerto) and has a total of 250 ha of own and leased land. The farmer also uses his own direct drilling machine and pesticide sprayer for custom work of 800 ha outside of his own farm. The use of machines outside of the farm is typical for farms in this area looking

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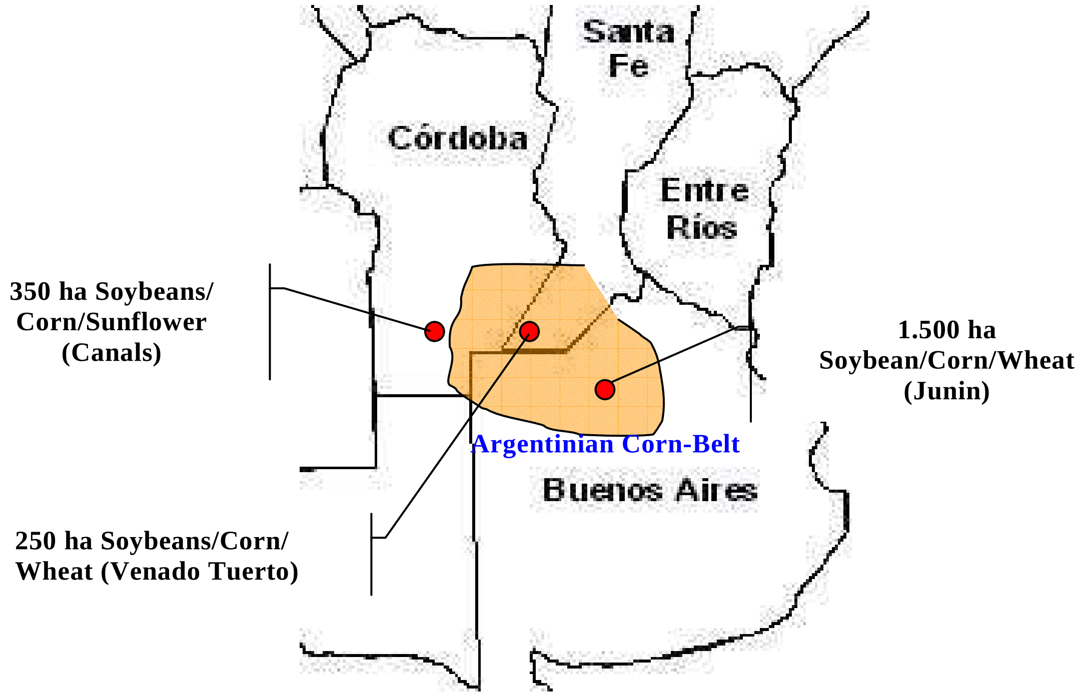
1 CREA: Consorcio Regional de Experimentacion Agricola. Group consulting with 10 to 15 farms in one production area.

2 Instituto Nacional de Tecnologia Agropecuaria: Argentinian National Agricultural Research Institute (comparable to the German Federal Agricultural Research Centre).

to expand their crop farming, but who have only some own land, and lack the financial means to buy or lease additional land.

Map 7.7: Location of the selected farms in Argentina



Source: own illustration. Park_2003-09-01

The second farm is a mixed farm in the south of the Cordoba province (Canals). The farm has a total of more than 800 ha, of which 350 ha are used for arable crop farming. In addition to corn and soybeans, this farm also grows sunflowers. Its main income is derived from dairy cattle husbandry with 350 cows.

The third farm is located in the south of the Corn Belt in the Junin area in the Buenos Aires province and farms a total of 2000 ha. For this region, this a very large farm. Of the total area, 500 ha of potential flood areas of poorer soil quality are used for suckling cow husbandry and beef fattening. This farm branch combination is typical in the Buenos Aires region.

Climate and soils at the selected locations are displayed in Table 7.2.

Table 7.2: Climate and soils at the selected locations in Argentina

	Venado Tuerto	**Canals**	**Junin**
Farm size (ha)	250 ha	800	2000
Relative soil quality	very good	very good	very good
Rainfall / mm per year	893	850	908
Rainfall distribution	prevailing in summer 2 month spring droughts	prevailing in summer 2 month spring droughts	prevailing in summer 2 month spring droughts
Average temperature °C (Min.-Max.)	16.0 (9.7 - 23.7)	16.2 (9.8 - 23.9)	16.1 (10.1 - 22.6)
Average frost days	15	24	13

Source: Own data collection. Park_2003-07-03

7.5 Production systems

In traditional Argentinian production systems, arable crop farming was closely linked with beef cattle husbandry. The typical crop sequence on arable lands was a rotation over several years of cropping without the implementation of fertiliser and then several years of pasturing with grass of alfalfa pastures. Even today this combination is found in wide parts of the country.

Already in the post World War II years, a reduction in the use of traditional systems in favour of pure arable crop farming could be observed on some appropriate locations in the Corn Belt (i. e., in the area surrounding Pergamino). Since the 1970s, inadequate fertiliser application and double cropping (soybeans, sunflowers), has resulted in a significant reduction of organic matter over the years (down from an average of five to two percent). Nutrient contents and soil fertility were exhausted and a number of signs of erosion emerged. In particular the phosphorous content of the soil was significantly reduced between 1980 and 1999 in the Pampa Humeda (DARWICH, 2000). Stagnating yields were the consequence. Since the middle of the 1990s, the system changed so that in many places direct seeding or no till practice was used. The extent of the direct seeded areas developed from 97 thousand ha in 1992/93 to 7.3 million ha in 1998/99. That is about 36 percent of the total areas under major crops (soybeans, corn, wheat, sunflowers).

Table 7.3 presents an overview of the crop rotation as well as the yield levels in the farms. Table A5.1 in the Appendix shows in detail production systems for soybeans in the three studied farms. In the following, some particularities of the systems are addressed.

Table 7.3: Crop rotations, crop shares and yields at the selected farms in Argentina

		Venado Tuerto	**Canals**	**Junin**
Farm size	ha	250 [1)]	800 [2)]	1,500 [3)]
Soil cultivation system		direct seeding	direct seeding	direct seeding (75 %) conventional (25 %)
Share:				
Soybeans [4)]	%	50	60	50
Corn	%	25	20	25
Sunflower	%	0	20	0
Wheat	%	25	0	25
2nd Soybean after Wheat	%	100	0	100
Yields:				
Soybeans	t/ha	2.8	2.4	3.2
	t/ha	(2.2) [5)]	-	(2.0) [5)]
Corn	t/ha	7.0	5.0	8.0
Sunflower	t/ha	-	1.8	-
Wheat	t/ha	2.8	-	4.2

1) Plus 800 ha custom work (direct seeding) extern. 2) where 350 ha crop land, the rest pasture for 350 cows.
3) Plus 500 ha extensive pasture for beef cattle. 4) The second soybean harvest accounted after wheat. 5) Yield of 2nd soybean crop.
Source: Own data collection and calculation. Park_2003-07-03

Crop rotations and yields

The typical crop rotation in Junin and Venado Tuerto is wheat with soybeans as a second crop, corn and soybeans as a main crop.

The rotation sunflowers-corn-soybeans as main crops marks the production system in Canals.

In the regions Venado Tuerto and Junin, a second soybean crop is planted within a year of the wheat crop. On the farm in Canal this does not take place due to the limited wheat planting possibilities (higher planting risk due to potential hail damage, partial winter dryness and a minimal yield level). Here, the main crop soybeans is generally planted after winter wheat. In Junin better conditions for the wheat crops exist resulting in higher yields. The yield difference between the primary and secondary soybean crops is greater in Junin than in Venado Tuerto because wheat is harvested later and the vegetation period for the second soybean crop is shorter than in Venado Tuerto.

Conventional planting vs. direct seeding

As previously mentioned, direct seeding, as a soil conservation measure, has increased significantly in the past several years. Conventional soil tillage with according deep soil cultivation is only carried out on damaged soil (i.e., vehicle track, compaction). Direct seeding is used almost exclusively for the second soybean crop because a) the time available is mostly inadequate for a total soil tillage and b) because wheat stubble is well-suited for direct seeding.

In both crop systems following variations can be seen:

Older conventional system: plow, 1 to 2 x harrow, fine cultivator and roller, seeding;

Newer conventional system: Deep cultivator (about 50 percent of the area), 1 to 2 x harrow, fine cultivator plus roller, seeding;

Direct Drilling: Only planting without tillage, with good stubble practice (crop rotation, plant protection).

The typical farms observed use only direct seeding for soybean production. The farm in Junin uses newer conventional practice for half of its wheat and corn fields.

Conventional seeds vs. Roundup resistant soybean seeds

Mainly Roundup resistant soybean varieties are grown in the typical farms studied. According to estimates by the Argentinian agricultural ministry, about 80 to 85 percent of the soybeans grown in Argentina are RR-soybeans.

In contrast to their U.S. competitors, farmers in Argentina are allowed to produce their own seed without paying licence fees. The ministry requires notification of this seed production. The further sale of self-produced seed is forbidden. The basis for these laws is provided by the Argentinian seed trade laws.

Crop relations between the crops

Since absolutely no product-specific support measures are provided in Argentina, the extent of crop plantings of the major crops is determined primarily through their price relations on the world market. If one compares the annual price changes of the most important crops with their crop areas in consecutive years it can be seen that:

– The price increase for soybeans in the years 1996 (+19 percent) and 1997 (+7 percent) caused an increase in planting areas of 11 %in 1996 and 8 % in the following year.

– The fall in wheat prices in 1997 (-27 percent as opposed to the previous year) caused a reduction in the crop areas of 20 percent in 1998.

– In relation to the wheat areas in the time period studied there was an overall increase of the seeding areas of soybeans, corn and sunflowers of about 20 percent each. In the same time period the crop areas of wheat were reduced by about 15 percent, interrupted by a strong increase in the seeding areas (+15 percent) following the highest priced year 1996.

Some signs of a link exist between price development/relationships and extent of seeding areas. There are also counter examples: in 1993 wheat prices increases 26 percent in comparison to the previous year, while the prices of the competitive crops changed less than one percent. In the following year, the seeding areas for wheat fell back by 4 percent, while they increased for the other crops with the exception of sunflowers (soybeans +6.5 percent, corn +10 percent, sunflowers +19 percent).

A further analysis must take the following into account:

– **Climate influences at the time of planting**. It is for example thinkable, that despite favourable price relations for soybeans, the climatic conditions during the seeding period did not permit passage over the fields.

– **Crop rotation restrictions**. Research results on crop rotations show that no restrictions exist for the typical crop rotations. According to experts, depending on location, a rotation of four- to five-years permanent pasture in time periods from 5 to 12 years are necessary to meet the goal of reconstructing the soil structure, to build up organic matter and to increase soil nutrients. Whether these effects would be achieved with targeted mineral fertilisation can not be empirically proven, since due to the relatively high fertiliser prices, mostly only fertilisation under the crop use level is carried out within the rotation as described in Chapter 7.5 (see also DARWICH, 2000).

– The studied time series are average values for all areas in Argentina. A deeper analysis must cover comparable locations and use regression-analysis methods.

– At locations outside of the Corn Belt the analysis must cover animal production practices (including dairy and beef cattle production).

7.6 Agricultural policy in Argentina

Agricultural policy such as in Europe or in the U.S. does not exist in Argentina. With the exception of sugar and tobacco production, there are no product-related subsidies. In the past the export duties for beef and grains were especially relevant for keeping the domestic prices at a low level. These were virtually eliminated during the two presidential terms of Menem. Today the following trade policy measures can be found in Argentina (AFIP, 2000; MECON, 2000):

Import duties: Argentina applies import duties to non-MERCOSUR countries on some agricultural products, which reach a maximum of 20 percent and are thus significantly lower than the maximum of 35 percent agreed to by the Uruguay Round. For oilseeds, the import duties are 11 percent, but apply only to seed. For soy oil and sunflower oil the import duties at the time of this report were from 13 to 15 percent of import value for non-MERCOSUR countries.

Export taxes: For unprocessed oilseeds (soybeans , sunflower, linseed and peanuts) an export tax of 3.5 percent of the export value is applied.

Export promotion: This include repayments of the value added tax and of various taxes and import duties on sales, which are paid in the course of the production process. This is particularly relevant for processed products, for which the raw materials are imported. For soy and sunflowerseed oil, this is in each case 1.4 to 4.1 percent of the FOB price.

Thus the agricultural policy measures can be classified as minimal. Also, in some cases agriculture appears to be disadvantaged compared with other economic sectors.

One example is the so called "renta presunta", a profit tax taken in advance which is one percent of the assets value and is later applied to the profit tax (maximally 35 percent). In agriculture, the "renta presunta" is retained by the government, even in the case where the farm shows no profit in a year.

A report published in June 2000 by the agricultural ministry studied the transfer payments from and to 72 economic sectors. Examples of these transfers are the import duties for automobiles and machines, through which the purchase prices for agriculture increase. The study reaches the conclusion that a) agriculture and the food industry carry two thirds of the costs of protection policies to the advantage of industry (including autos, steel, textiles, oil, plastic) and also that b) the competitive ability, the structural change and the readiness to invest in farming has been weakened and slowed. The total calculated net transfer from agriculture was shown at about 5 billion U.S.$ in 1999. This amount is a good two percent of the gross inland product.

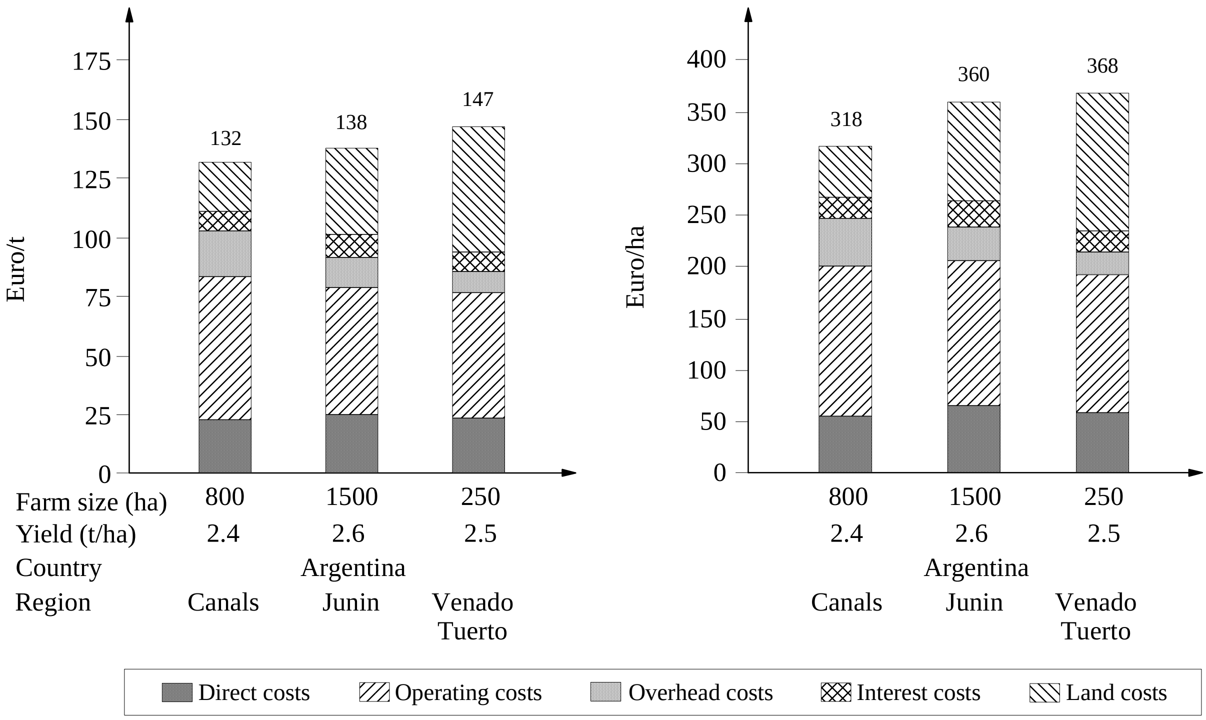
At present no fuel refund are made, but is being discussed due to the current unfavourable relationships between product and fuel costs. At present the government is negotiating with representatives from agriculture and the oil industry about conditions and the organizational requirements for the introduction of such assistance. Here the effect would be less assistance to farms as more a reduction in the transportation prices.

7.7 Production costs

Total costs

The total costs in the typical farms described here are between 132 and 147 Euro per ton, or rather 318 and 368 Euro per hectare (Figure 7.1). It must be observed that the production costs of the smaller (250 ha) and larger (2000) hectares present the weighed mean of the first and second soybean crops. If one considers the first and second soybean crop separately, it can be seen that the costs of the second soybean crop are, due to yields, between 10 and 20 percent higher as in the first crop.

Figure 7.1: Soybeans: Total production costs, 1999



Exchange rate: 1 Euro = 1.07 arg$.
Source: Own calculations.

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The largest part of the total cost disadvantage at the Venado Tuerto location can be explained with the expensive land rent rates of about 134 Euro/ha. This region is home to the best arable land in Argentina. In addition the expansion of the port of Rosario in the past few years has increased the attractiveness of arable crop farming. Many small and mid-sized farms eager to grow exert a strong demand on the leasing market. Since this squeeze in the leasing markets does not allow quick growth in large steps, many farms in this region try to find alternative income as salaried workers (see Chapter 7.4).

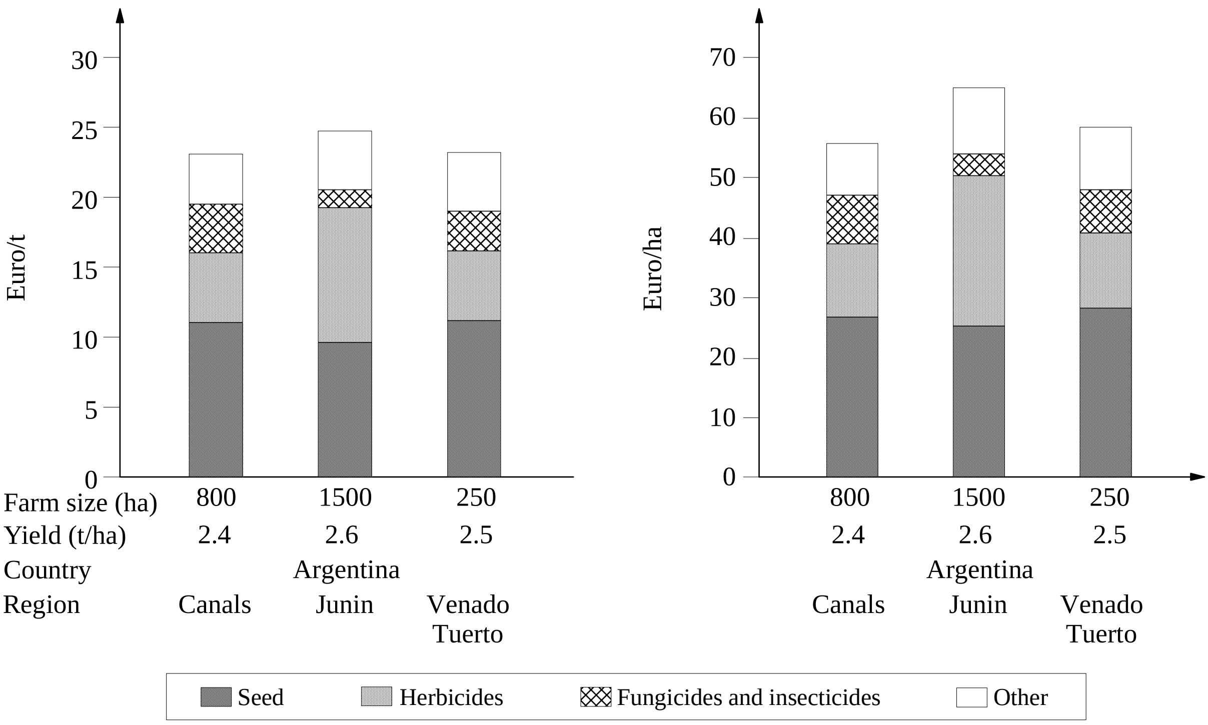
Direct Costs

All farms have similar level of direct costs with 23 - 25 Euro per ton (Figure 7.2).

In the year studied, no fertilisation took place. This is because a) fertiliser prices were so high, and b) low product prices held in the year studied. On good, solid locations, good yields can be made even without fertiliser for the short-term.

The other significant direct costs are a sales commission of 2.5 percent of the value of the goods.

Figure 7.2: Soybeans: Direct costs, 1999



Exchange rate: 1 Euro = 1.07 arg$.
Source: Own calculations.

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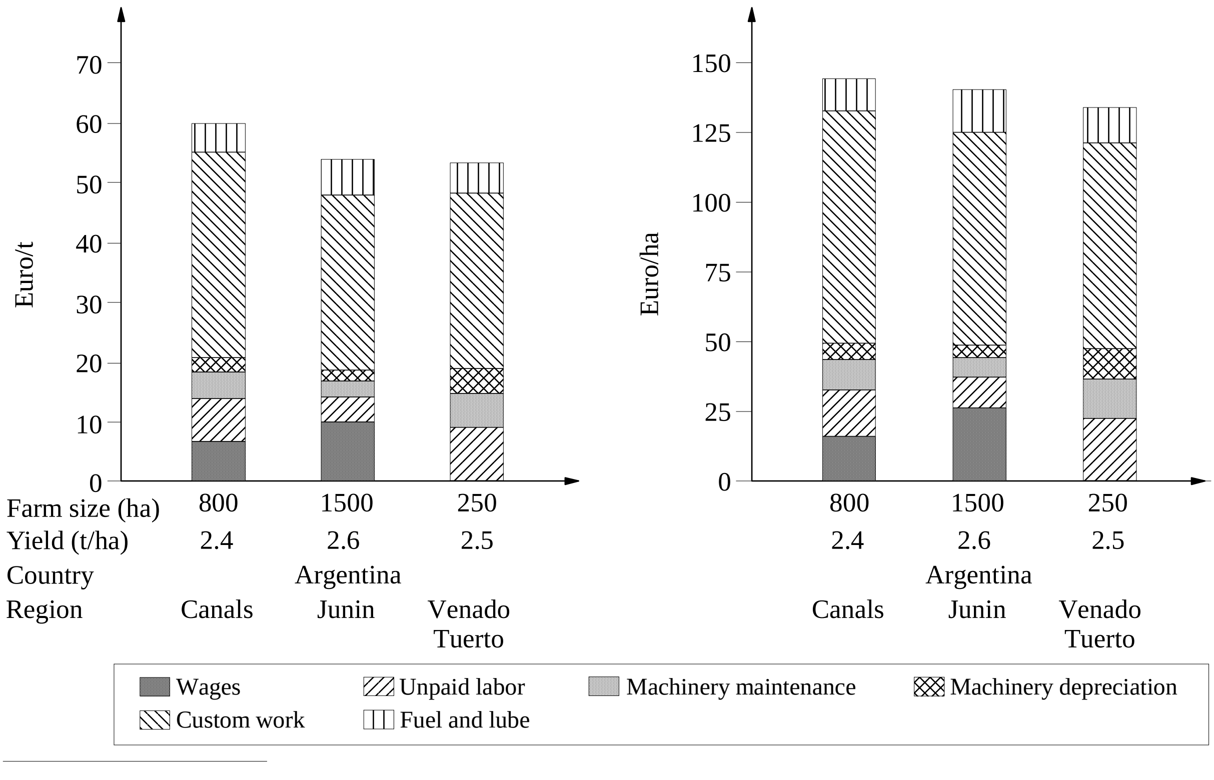
Operating costs

The soybean operating costs vary between 54 Euro per ton (250 ha farm) and about 60 Euro per ton (800 ha farm) (Figure 7.3).

The important differences can be found in labor costs, custom work and machinery hire costs. The Venado Tuerto farm, in contrast to the other two farms, uses no external laborers. For this reason it has no salary costs. Almost 50 percent of the costs come from custom harvesting (8 %) and custom transport of crops to port. Very few of the farms in the region have their own storage facilities. The harvest is generally brought directly from the field to the port. Accordingly, the drying takes place off the farm. The salary requirements for the farm in Canals (800 ha) are especially high because in addition to the harvesting, the farmer had to pay for direct seeding as well. Accordingly his expenses for fuel and lube were lower.

Figure 7.3: Soybeans: Operating costs, 1999



Exchange rate: 1 Euro = 1.07 arg$.
Source: Own calculations.

Overhead costs

Relatively large differences occur between the farms in terms of overhead costs (Figure 7.4).

Among the overhead costs are:

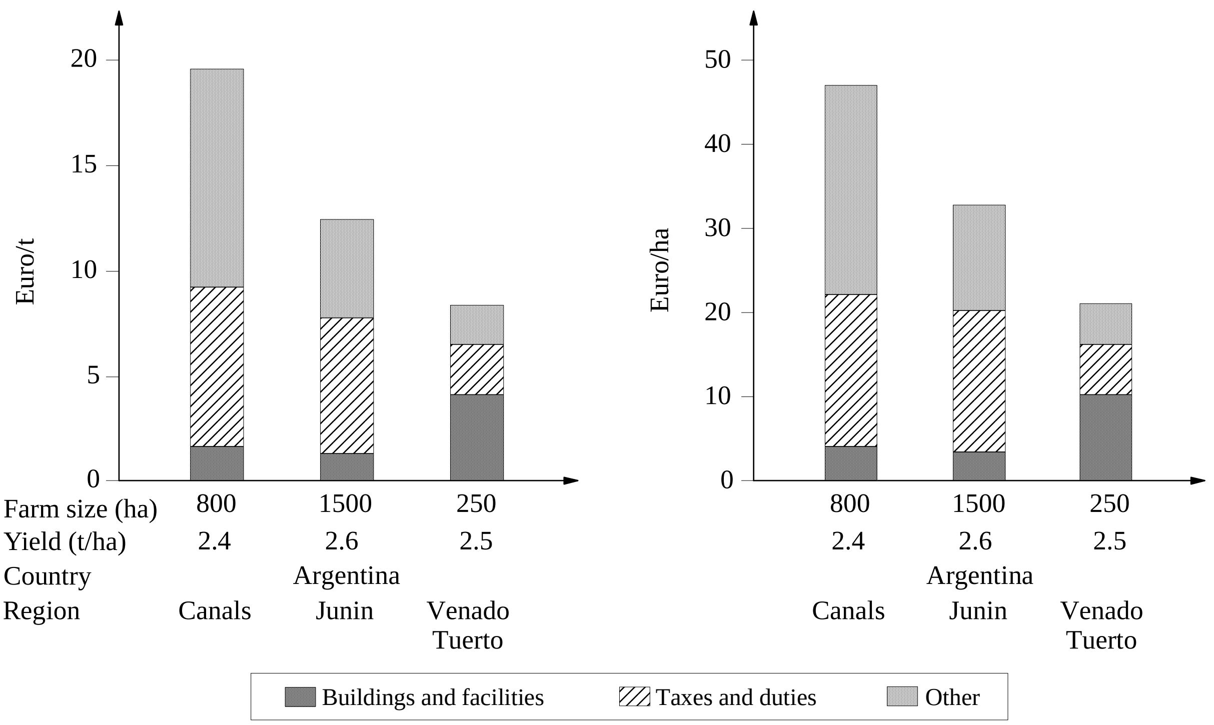
– communal taxes for the maintenance of the roadways (tasa vial). This tax is calculated on the basis of owned land. The tax levels differ among the communities;

– Provincial land tax (tasa immobiliaria). The tax is calculated on the basis of owned land. The tax levels vary between provinces;

– Property tax (impuesto patrimonio/bienes). This tax is 0.5 percent of the assets between 100,000 and 200,00 arg$ and 0.75 percent of the assets above 200,000 arg$;

– Value added tax on profits (renta presunta). This tax is explained in Chapter 7.6. It is one percent of the assets whereby the tax calculates 75 percent of the market value of the land. Since this tax is related to the profit tax, it was not calculated in order to avoid double payment.

Figure 7.4: Soybeans: Overhead costs, 1999



Exchange rate: 1 Euro = 1.07 arg$.
Source: Own calculations.

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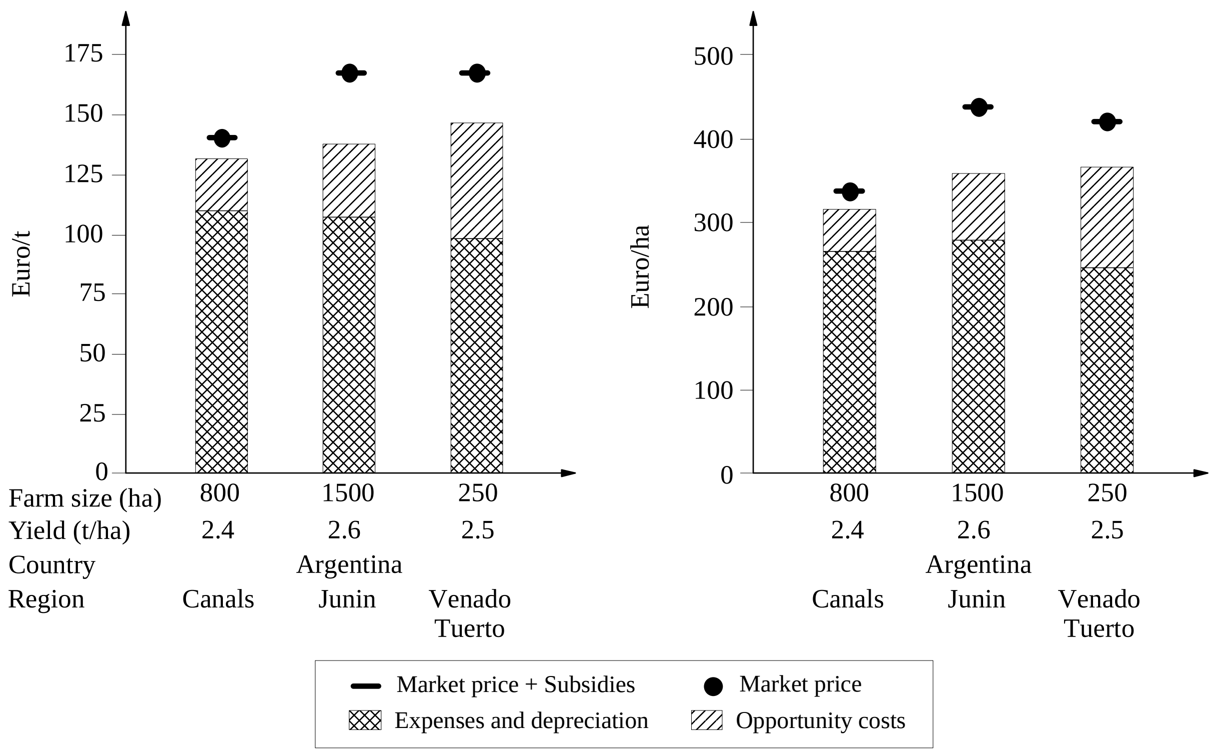
The different levels of the rented land on the farms and the regionally different tax levels explain the clearly observable difference with regard to this topic.

The interest costs for all farms are at about the same level and can only be minimally differentiated due to the composition of the loans. It can generally be noted that most farmers are very reserved about the high real interest rates of foreign loans.

7.8 Profitability

As shown in Figure 7.5, with the given product prices all of the Argentinian locations analysed made a profit with soybeans. The range was between 78 Euro/ha in Junin and 21 Euro/ha in Canals. In interpreting these values it must be kept in mind that for the above-mentioned reasons, no fertilisation took place in the year studied. Over the long term it would probably not be possible to continue production of these crops without fertiliser at any of the studied locations. It must therefore further be analysed how viable soybean crops in Argentina could be with varied product and input prices.

Figure 7.5: Soybeans Profitability of production, 1999



Exchange rate: 1 Euro = 1.07 arg$.
Source: Own calculations.

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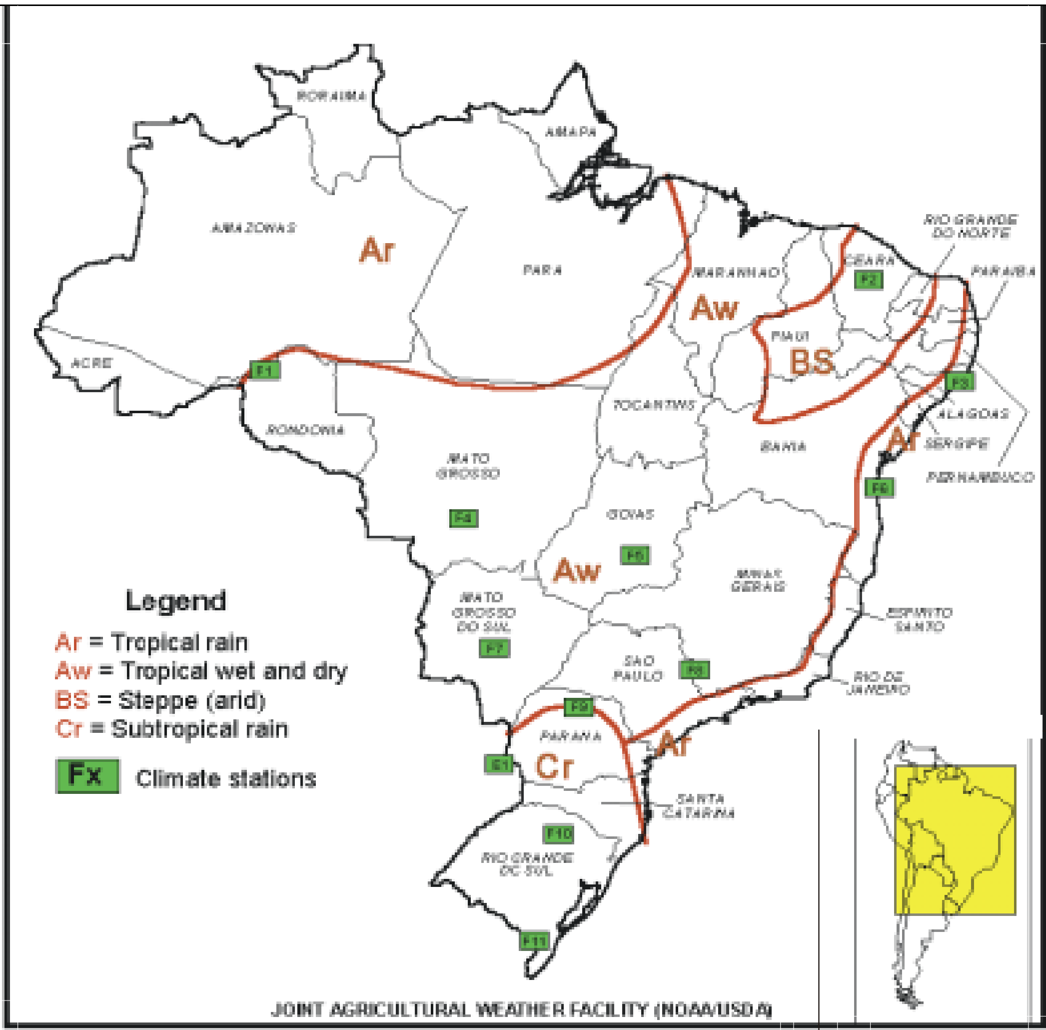
8 Soybean production in Brazil

8.1 Climate

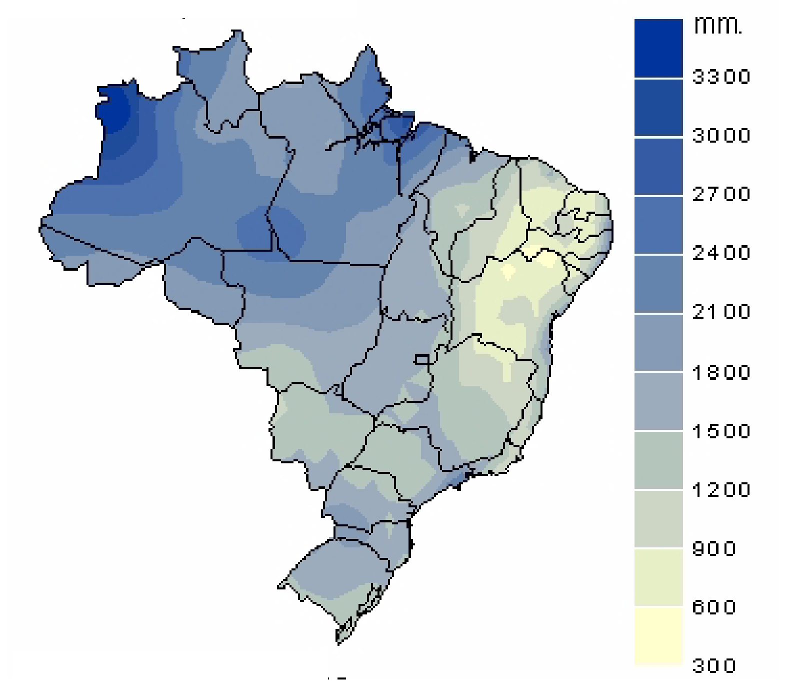
Map 8.1 shows the climate regions of Brazil. The areas relevant for oilseed production can be found in the wet to dry tropical climates (Aw) as well as the subtropical rain climate (Cr). The distribution of precipitation in Brazil can be seen in Map 8.2. Map 8.3 shows the different temperature zones within Brazil.

Map 8.1: Climate zones in Brazil



Source: Joint Agricultural Weather Facility (NOAA, USDA)

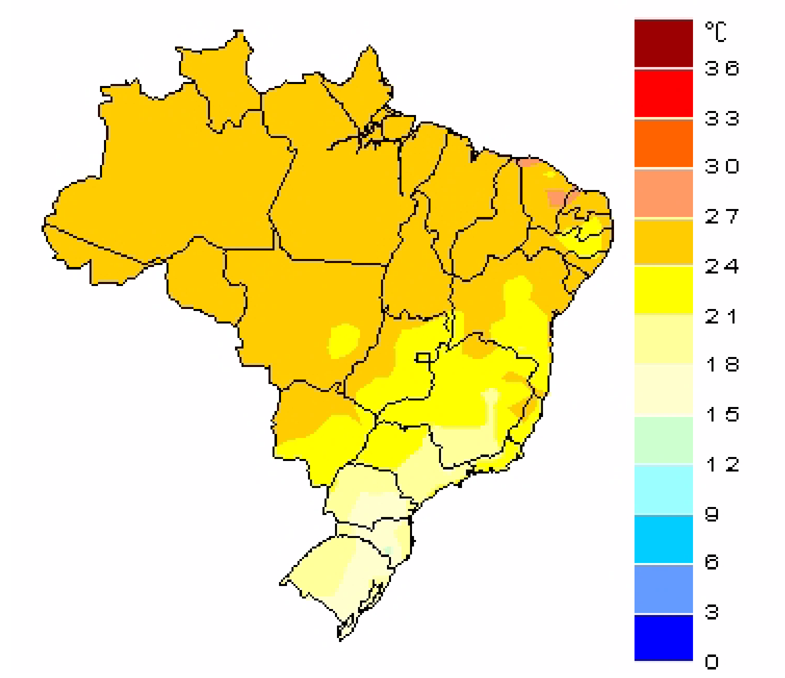
Map 8.2: Rainfall distribution in Brazil



Source: INMET 1931/1990.

Park_2000-09-01

Map 8.3: Temperature zones in Brazil



Source: INMET 1931/1990.

Park_2000-09-01

8.2 Production of soybeans and major crops in Brazil

Despite its current significance, in comparison to classic Brazilian crops like coffee, cocoa and sugar cane, soybean production in Brazil is a relatively young crop. The first commercial distribution of soybean in Brazil took place in the 1950s in the state of Sao Paulo within the framework of a promotional program by the ministry of agriculture and the oil industry.

The breakthrough for soybeans came in the 1970s when a number of favourable conditions came together: high demand and prices on world markets, favourable price relations to the competitive crop - corn, development of a national oil industry, reduction in coffee production as well as the expansion of production to new areas. In the framework of this development, the state of Sao Paulo was quickly overtaken by the states of Rio Grande do Sul and Parana in the 1970s and 1980s. Both states remain among the regions with the highest soybean production in Brazil, although the production growth in these areas seems only to be possible with an increase in yield or area shift between other crops.

In the 1980s and 1990s production extended to the states of Mato Grosso do Sul, Minais Gerais and especially Goias and Mato Grosso. Today soybean production can be found in all of the important agricultural states in the south, southeast and center of Brazil. At the same time it is a driving force for the expansion of land use in the north and north east of Brazil. Since in the above mentioned states additional land is still available, it is expected that - just as in the other central states of Brazil (Tocantins, Bahia, Piaui and Maranhao) - soybean production will be increased (GALLASSINI, 1998).

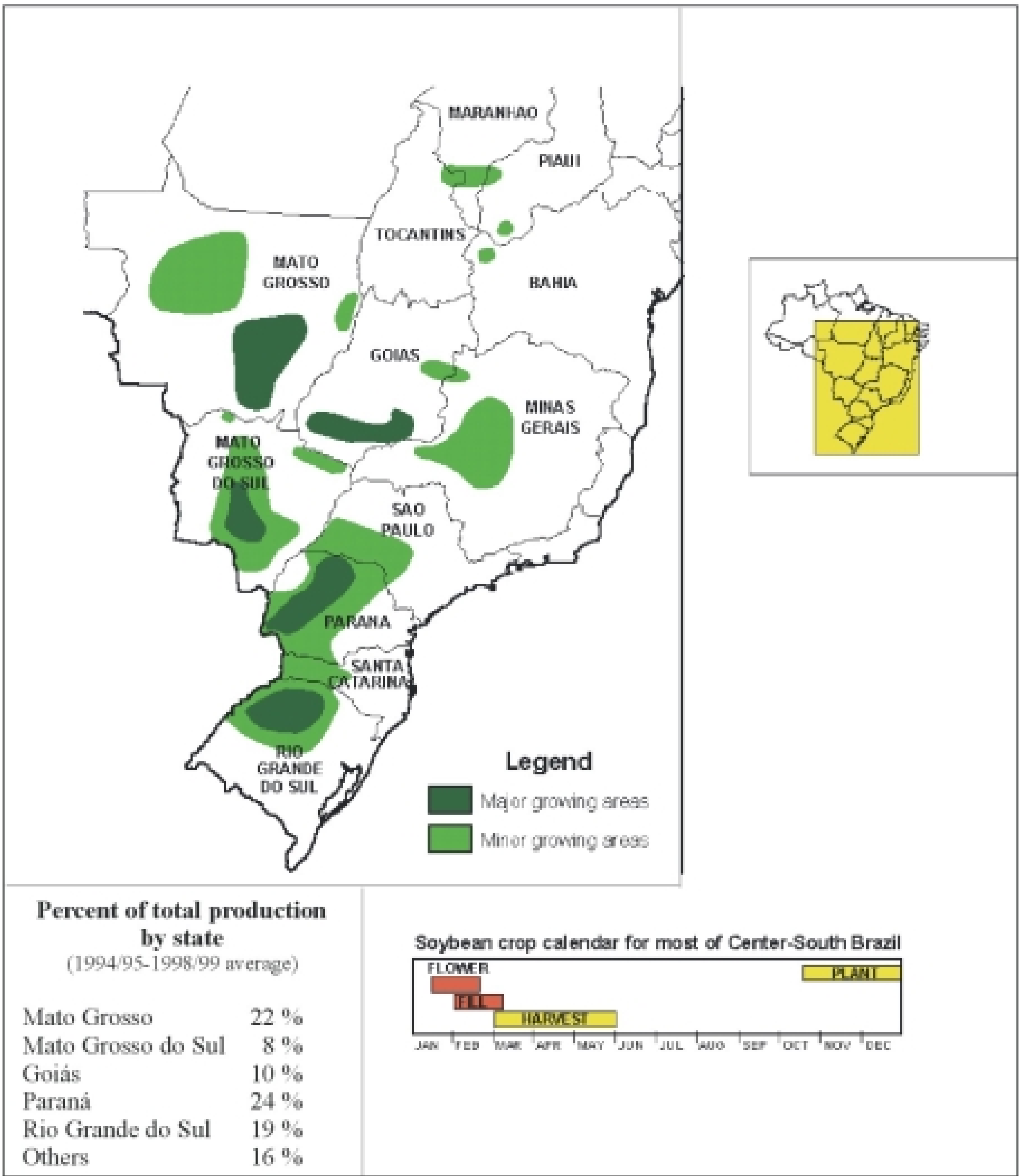
Production and areas under soybeans and major competing crops can be seen in Figures A6.1 and A6.2 in the Appendix. The enormous growth in the production of soybeans with the simultaneous reduction in corn areas since the mid 1990s is clearly illustrated. The particularly high production increase since 1996 can be explained by elimination of a tax (ICMS) on unprocessed products within the confines of "Real Plans". The latter had exerted a disadvantage export of soybeans in contrast to soybean oil and soy meal. Soy producers reacted in the production year 1997/1998 with an area expansion of 10 percent as compared with the preceding season (11.8 million ha in 1996 and 13 million ha 1997).[1]

Due to the prohibition on imports of GMO corn, and thus expected increase of domestic production prices for maize, experts, in contrast to the previous year, expect moderate increases in the production of soybeans for the season 2000/2001. (USDA, FAS, 2001b).

[1] See here also WAINIO (1998)

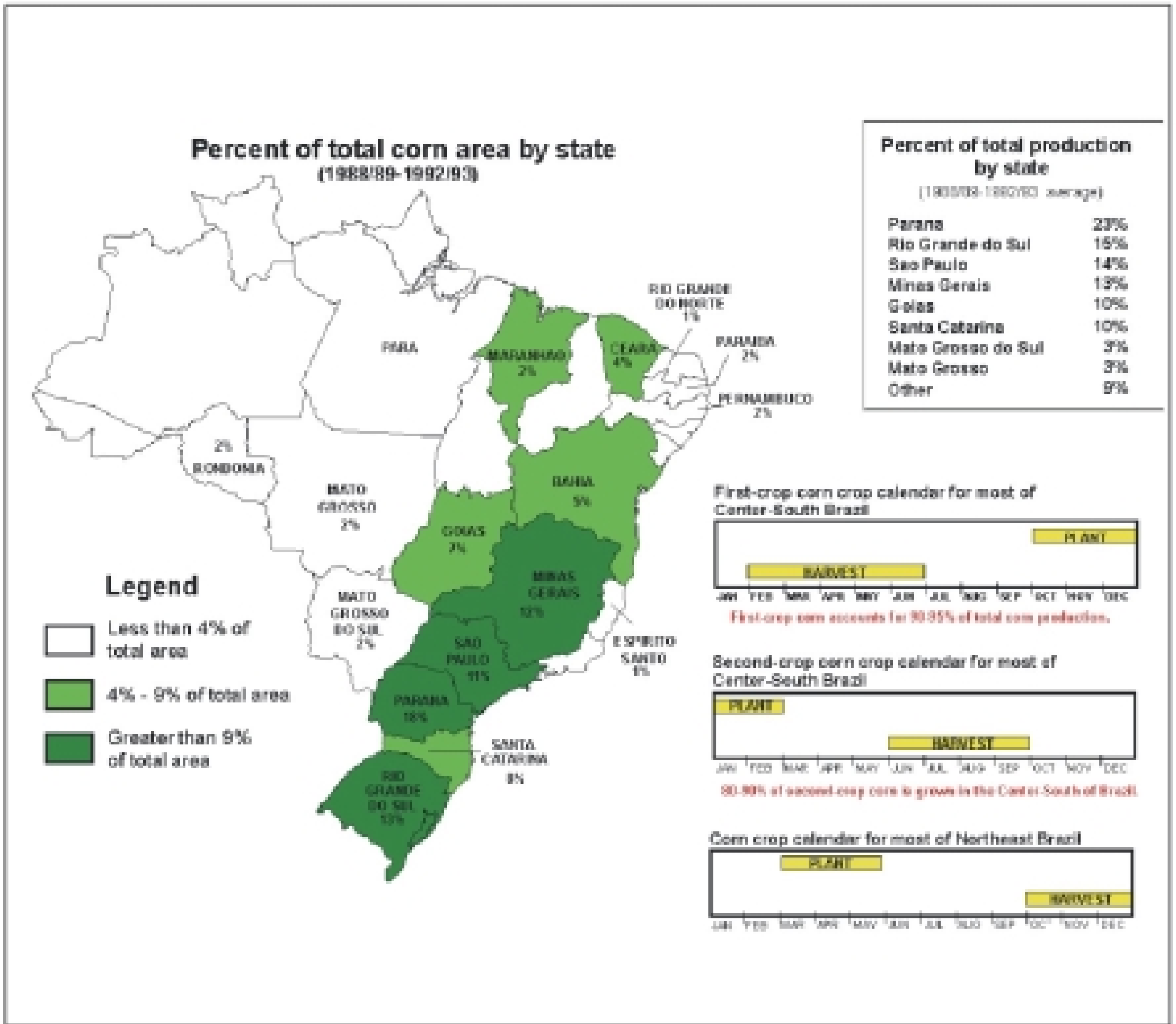
Maps 8.4 to 8.7 illustrate the major producing regions of soybeans and major competing crops in Brazil.

Map 8.4: Major soybean production areas in Brazil



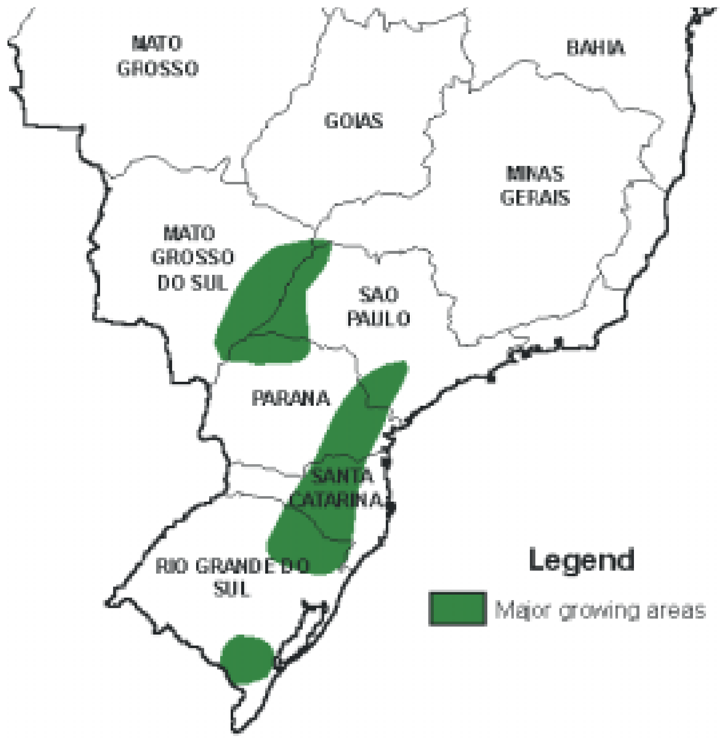
Source: USDA (1999); Table is updated according to MAA (2000). Park_2003-09-01

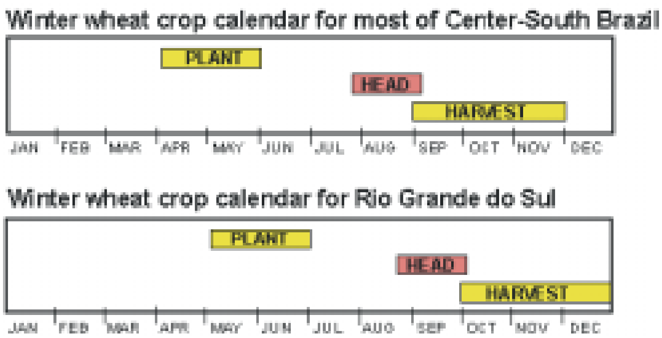
Map 8.5: Major corn production areas in Brazil



Source: USDA (1999) Park_2003-09-01

Map 8.6: Major wheat production areas in Brazil



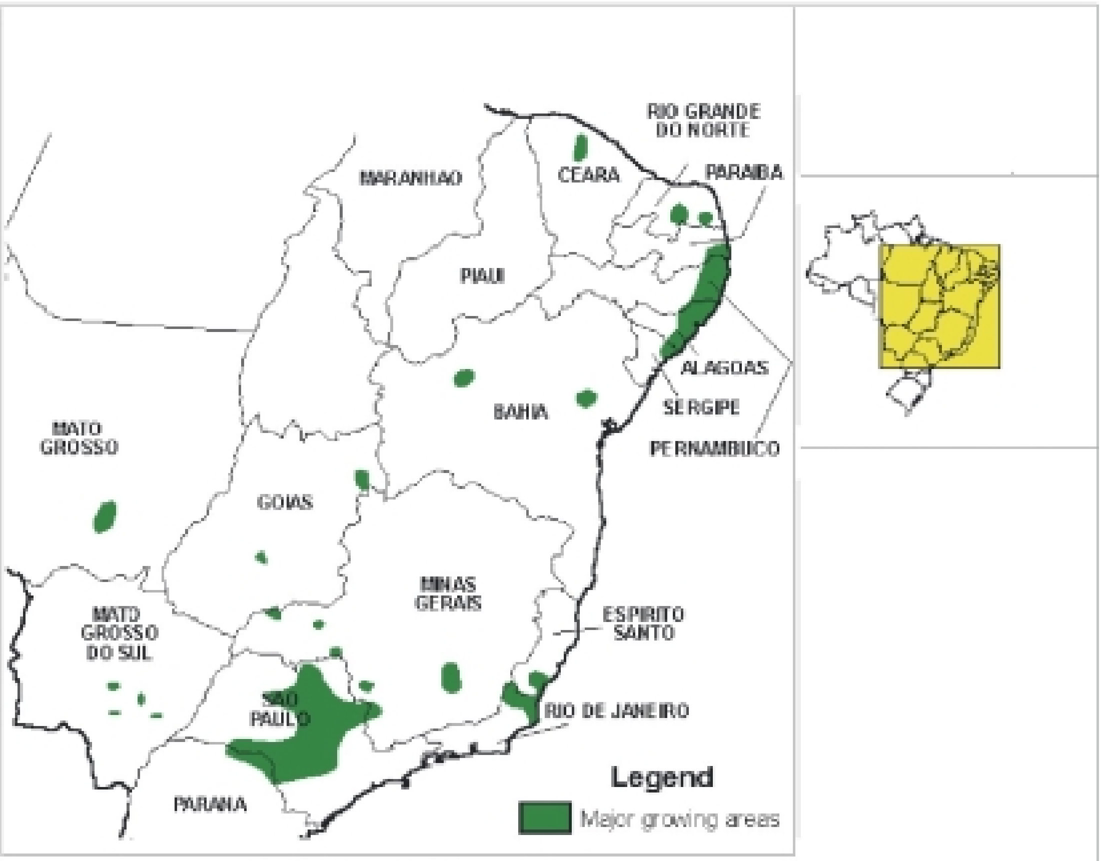


Percent of total production by state
(1994/95-1998/99 average)

Paraná	67 %
Rio Grande do Sul	27 %
Mato Grosso do Sul	2 %
Santa Catarina	2 %
Others	2 %

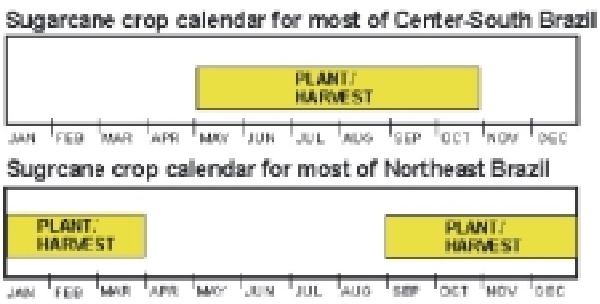
Source: USDA (1999); Table is updated according to MAA (2000). Park_2003-09-01

Map 8.7: Major sugar cane production areas in Brazil



Regional Statistics

	Center-South	Northeast
Sugarcane Production	75 - 80%	20 - 25%
Raw Sugar Production	60 - 65%	35 - 40%
Ethanol Production	80 - 85%	15 - 20%
Sugar for export	25 - 30%	70 - 75%



Percent of total production by state
(1994/95-1998/99 average)

Sao Paulo	58 %
Alagoas	8 %
Pernambuco	5 %
Paraná	7 %
Minas Gerais	5 %
Others	16 %

Source: USDA (1999); Table is updated according to MAA (2000). Park_2003-09-01

8.3 Yields

Table 8.1 shows the development of yields for soybeans, corn, and wheat in Brazil. A regional description of these values is not available.

Table 8.1: Yield of soybean and major crops in Brazil, 1990 to 1999

	Soybeans	**Corn**	**Wheat**
1990	1.74	1.84	1.15
1991	1.58	1.79	1.46
1992	2.03	2.19	0.92
1993	2.15	2.35	1.47
1994	2.18	2.34	1.55
1995	2.22	2.62	1.54
1996	2.18	2.36	1.85
1997	2.30	2.59	1.62
1998	2.38	2.65	1.57
1999	2.37	2.60	1.95
Ø 1990 to 1999	2.11	2.33	1.51
Max. 1)	2.38	2.65	1.95
Min. 2)	1.58	1.79	0.92

1) Maximum yield. 2) Minimum yield.
Source: SECEX/MDIC, CONAB; DEPLAN/SPA/MA. Park_2003-07-03

The average yields in the studied regions Minais Gerais and Goias were between 2.2 t/ha to 2.6 t/ha for soybeans and 3.8 t/ha to 5.1 t/ha for corn.

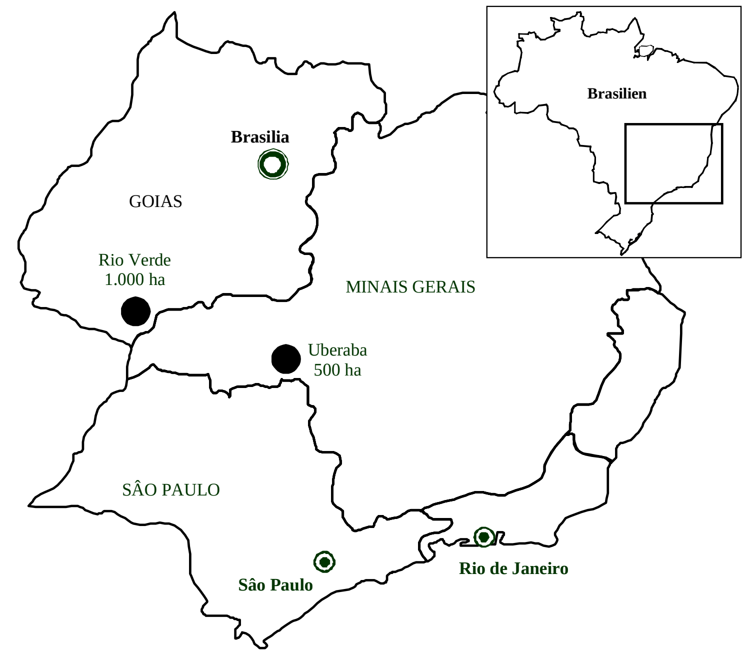
8.4 Location of the selected farms in Brazil

The two farms studied are located in the Departamento Uberaba in the southwest of the state of Minais Gerais and in the Departamento Rio Verde in the state of Goias (see Map 8.8).

Uberaba can be described as a marginal area for soybean production and competes with dairy and sugarcane. The typical farm cover a total area of 500 ha on which mainly soybeans and corn are produced as well as a covering crop (oats or sorghum) which is generally not harvested.

According to the last census from 1995/96, Rio Verde is one of the most important cultivation areas for soybeans and corn in Brazil. The typical farm works 1,700 ha, of which 700 ha are used as extensive pastures. Thus this combination is comparable with the Argentinian farm in Junin (2,000 ha). This farm also produces mostly soybeans and corn, whereby a part of the area can be used for a second crop (*Safrinha*).

Map 8.8: Location of the selected farms in Brazil



Source: Own illustration. Park_2000-09-01

Table 8.2 gives an overview of the natural conditions at the locations studied.

Table 8.2: Climate and soils at the selected farms in Brazil

Farm size (ha)	**Uberaba** 500 ha	**Rio Verde** 1,000 ha
Relative soil quality	good	medium
Rainfall / mm per year	1,334	1,708
Rainfall distribution	prevailing October - March (118 days/year)	prevailing October - March
Average temperature °C (Min.-Max.)	21.9 (16 - 29)	22.5 (20 - 23.6)
Average frost days	0	0

Source: Own data collection. Park_2003-07-03

8.5 Production systems

Table 8.3 shows the crop rotation and yields of the typical farms and Table A6.1 in the Appendix gives an overview of the production system for soybeans at both locations.

As the table shows, the yields for the farms studied are above the regional average, for soybeans somewhat higher, and for corn significantly higher.

Similar as to Argentina on some locations in Brazil two crops are planted within one year. But unlike Argentina, the crop is not soybeans, but rather where possible corn. The cultivation of the second culture is called "Safrinha" (small harvest).

The farm in Uberaba can generally not plant a "Safrinha" due to drought in the summer. Instead, the farm plants a cover crop to keep the ground covered all the time and uses the crop as a "green fertiliser". The farm in Rio Verde can plant a second crop on 80 percent of its soybean area. Here corn plays an important role.

The limiting factors for the safrinha are the climatic conditions at the end of the main crop. The safrinha should take advantage of the rainfalls at the end of the rainy season. Since the work period between the harvest and planting is very short, direct seeding or no tillage is mostly used for this crop in order to save time. With these systems it is possible to harvest the soybeans and plant the corn on the same day.

Table 8.3: Crop rotation, crop shares and yields at the selected farms in Brazil

		Uberaba	**Rio Verde**
Farm size	ha	500	1,000 [1)]
Soil cultivation system		no till	no till
Soybean share	%	60	70
Corn share	%	40	30
Share of safrinha [2)] of soybean area	%	-	60 % corn
Share of other crop of soybean area	%	100 % oats	20 % beans, beets and sorghum 20 % fallow
Share of Safrinha of corn area	%	-	42
Soybean yield	t/ha	2.4	3.2
Corn yield	t/ha	6.0	6.9 (4.5) [3)]

1) Plus 700 ha extensive beef production. 2) Safrinha = "small harvest" = second crop in the same year.
3) Yield of Safrinha.
Source: Own data collection and calculation. Park_2003-07-03

Corn and soybeans can substitute for each other as well as complement each other. Corn is an important cultivation alternative for soybeans. Also, the same machines are used for both soybeans and corn, so that the planting of a safrinha is a possibility to lower the fixed costs. Ultimately, corn cultivation with a direct seeding makes it possible to achieve a permanent soil coverage.

Experts estimate that between 50 and 80 percent of the farms in the southern part of the region Goias use a safrinha, mostly with corn.

Just as in Argentina, the Brazilian farms use no tillage (for soybeans) or rather direct seeding (mainly for the corn safrinha). No tillage consists of two tasks: harrowing and cultivating. The yields in no till systems are, according to reports, the same or better as in conventional tillage, if the soil structure is optimised before the implementation of no tillage.

In order to reduce or avoid erosion damage, farmers perform contour planting. Through contour planting, small "terraces" are created by piling the soil up to a meter in height with a special machine. The distance between these terraces, depending on the steepness of the slope, is between 10 and 100 meters. Normally, the new terraces are not needed, mostly only when severe weather conditions cause damage.

8.6 Agricultural policy in Brazil

Similar as to in Argentina, a series of to some extent protection measures, and to some extent tax measures were implemented in the past through Brazilian agricultural policy (i.e., minimum prices, import duties, export taxes). These were significantly reduced in the 1990s.

No direct payments are made to farmers. In the period of the study (1999) the following agricultural policy measures were still in place (CONAB, 2000; USDA, 2000):

Minimum prices for soybeans, corn, wheat, beans, rice, cotton and sisal. In the case of a drop below the minimum price level, the state trade organization CONAB served as purchaser. CONAB’s inventory capacity is at a very low level and the minimum price for soybeans was 9.50 R$ per 60 kg, about 40 percent of the market price.

Credit and refinancing programs: These programs are usually administrated by the CONAB and some are tailored to small and mid-sized farms.

Export credit program PROEX: In the framework of this program, particularly soybeans and coffee receive subsidized credits.

Import duties: for non MERCOSUR countries. 30 percent for dairy products (milk, dry milk powder and cheese), 12 percent on pork, 13 to 15 percent on rice and vegetable oils (unprocessed and refined), as well as 9 percent on oilseed meal. Overall, the duty level can be described as moderate.

Non tariff import limitations: These are limits on poultry, wheat and apples with special identification requirements for phyto-sanitary and epidemic reasons, fiscal policy measures as well as an import prohibition on GMO seeds in some states.

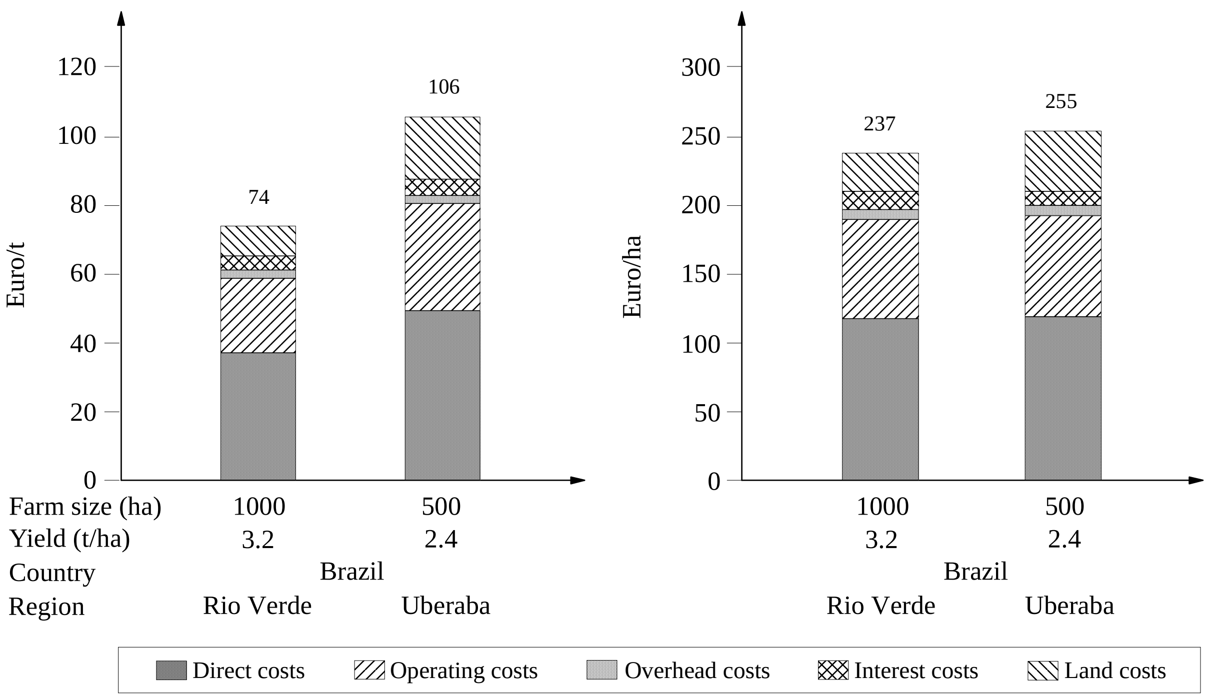
It can be assumed that these measures will be reduced or eliminated as a consequence of advancing liberalisation.

8.7 Production costs

Total costs

Considerably higher yield level at the large farm in Rio Verde gives a high cost advantage in cost per yield in contrast to Uberaba farm (see Figure 8.1). Farm size effects play only a minor role here.

Figure 8.1: Soybeans: Total production costs, 1999



Exchange rate: 1 Euro = 1.93 R$.
Source: Own calculations.
Park_2003-08-07

Land costs

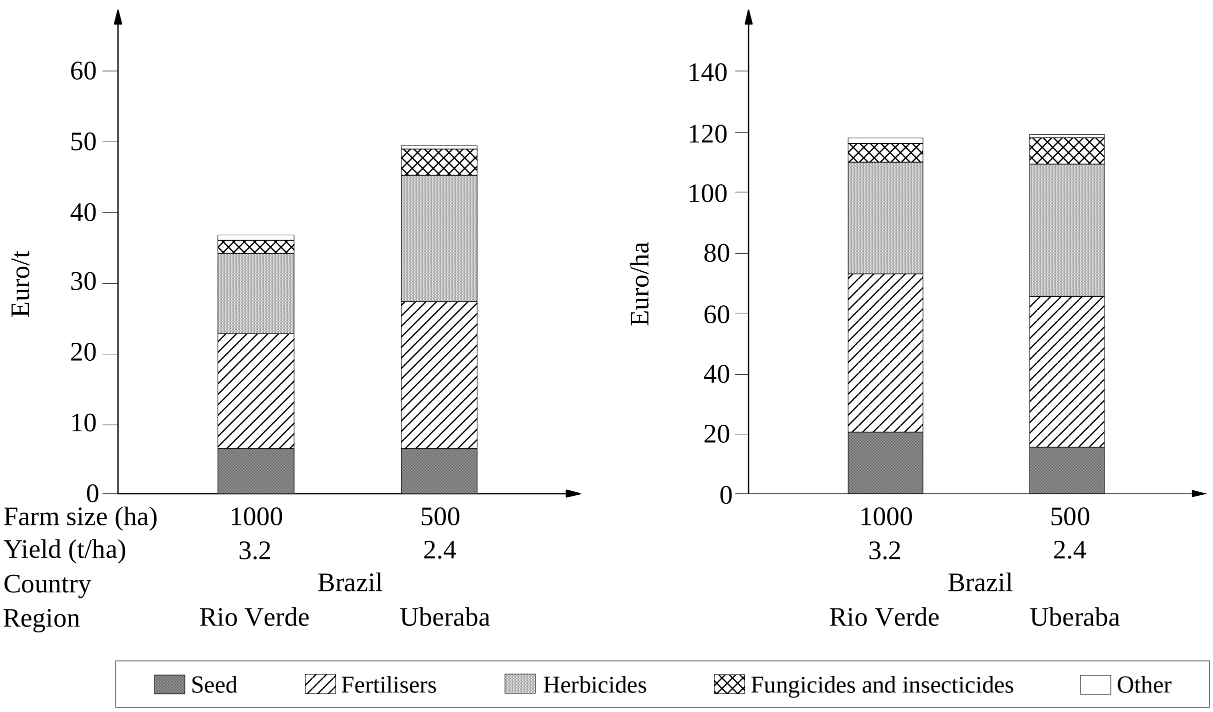
In Uberaba the land rent is almost double high (44 Euro/ha) than in Rio Verde (27 Euro/ha). The difference is to some extent explainable that in Uberaba the average farm size are much smaller than in Rio Verde. Accordingly, the competition on the regional land markets is stronger. Also, the land rents in Rio Verde is less influenced through the bordering sugarcane production as in Uberaba. Both locations are among the most important dairy production regions in Brazil, while in Uberaba more intensive production can be found. In the Uberaba region, in contrast to the Rio Verde, there are hardly any expansion possibilities for arable crop farming.

Direct costs

Per hectare, both farms have similar direct costs (ca. 118 Euro). The level of intensity hardly differs between the two locations.

The 30 percent higher natural productivity in Rio Verde causes accordingly a considerable cost advantage at the cost per yield over farm in Uberaba (see Figure 8.2).

Figure 8.2: Soybeans: Direct costs, 1999



Exchange rate: 1 Euro = 1.93 R$.
Source: Own calculations.

Park_2003-08-07

Fertiliser and herbicides make up 70 percent of the costs. Fertilizer holds the most important position under direct costs. So that a totally different picture emerges for the

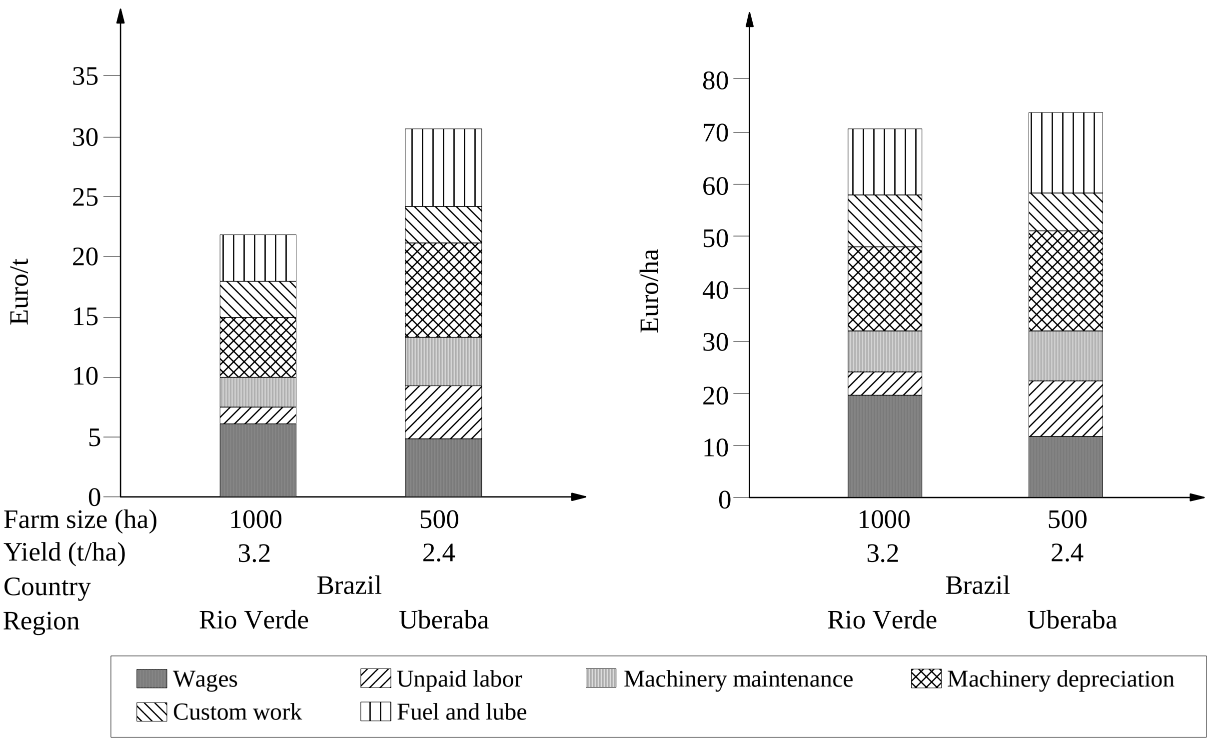
Brazilian farms as for the Argentinian farms analysed, which used no fertiliser at all in the year being studied (see Chapter 8.7). The somewhat lower fertiliser prices in Brazil can be seen as the cause of this difference. Additionally, significantly higher precipitation (400 to 900 mm more) at the Brazilian locations caused higher nutrient leaching losses, the landscape was flatter than in Argentina and had lower nutrient content.

Operating costs

A similar picture of contrasts between costs per ha and per yield emerges for the operating costs as for the direct costs. The operating costs per ha for both farms are comparably high (ca. 70 Euro/ha). However, when expressed per yield unit Rio Verde farm has a considerable cost advantage.

The somewhat higher costs for custom harvesting and custom transportation of crops from the Rio Verde farm lead to less intensive use of own machinery and thus to lower machinery depreciation, machinery maintenance and fuel costs per hectare as compared to the farm in Uberaba (Figure 8.3).

Figure 8.3: Soybeans: Operating costs, 1999

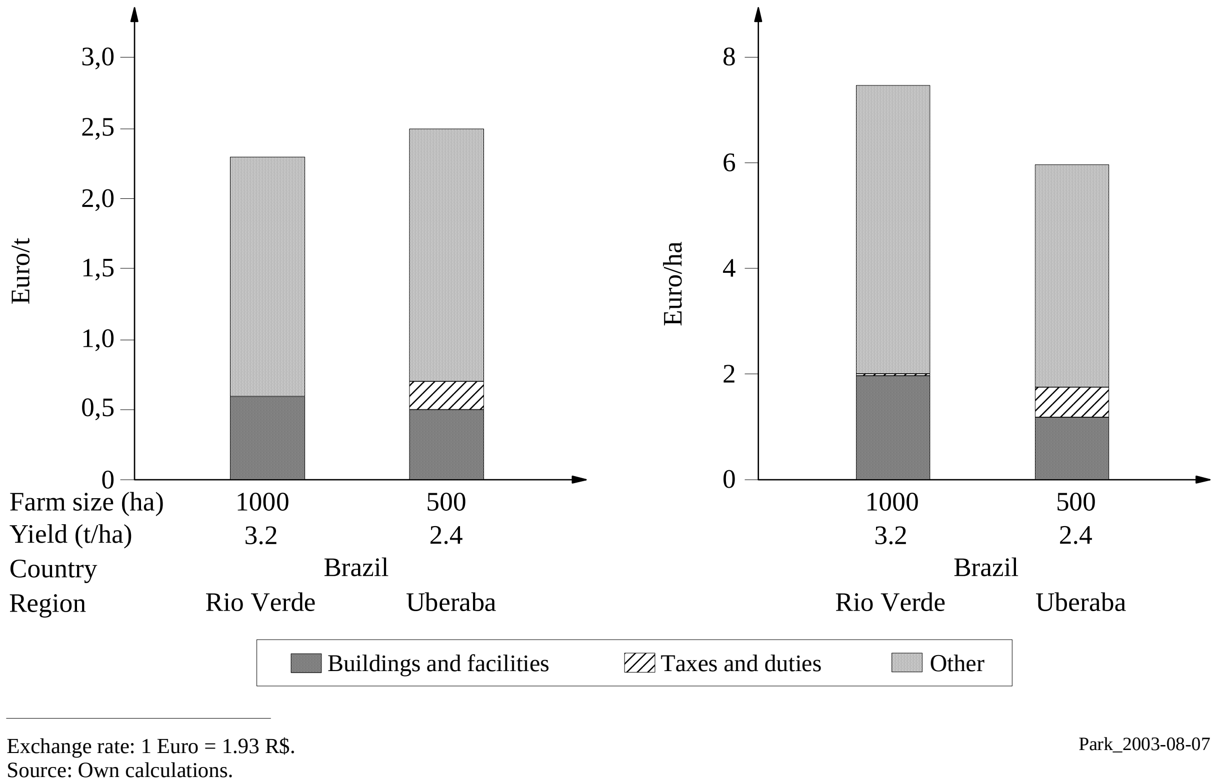


Exchange rate: 1 Euro = 1.93 R$.
Source: Own calculations.
Park_2003-08-07

Overhead and interest costs

The overhead costs in Brazil (Figure 8.4) are at a relatively low level. The cause here are the low building costs in Brazil as well as the fact that insurance, taxes and fees either don't exist or are so low that they can be left out. The interest costs for both farms are about the same.

Figure 8.4: Soybeans: Overhead costs, 1999

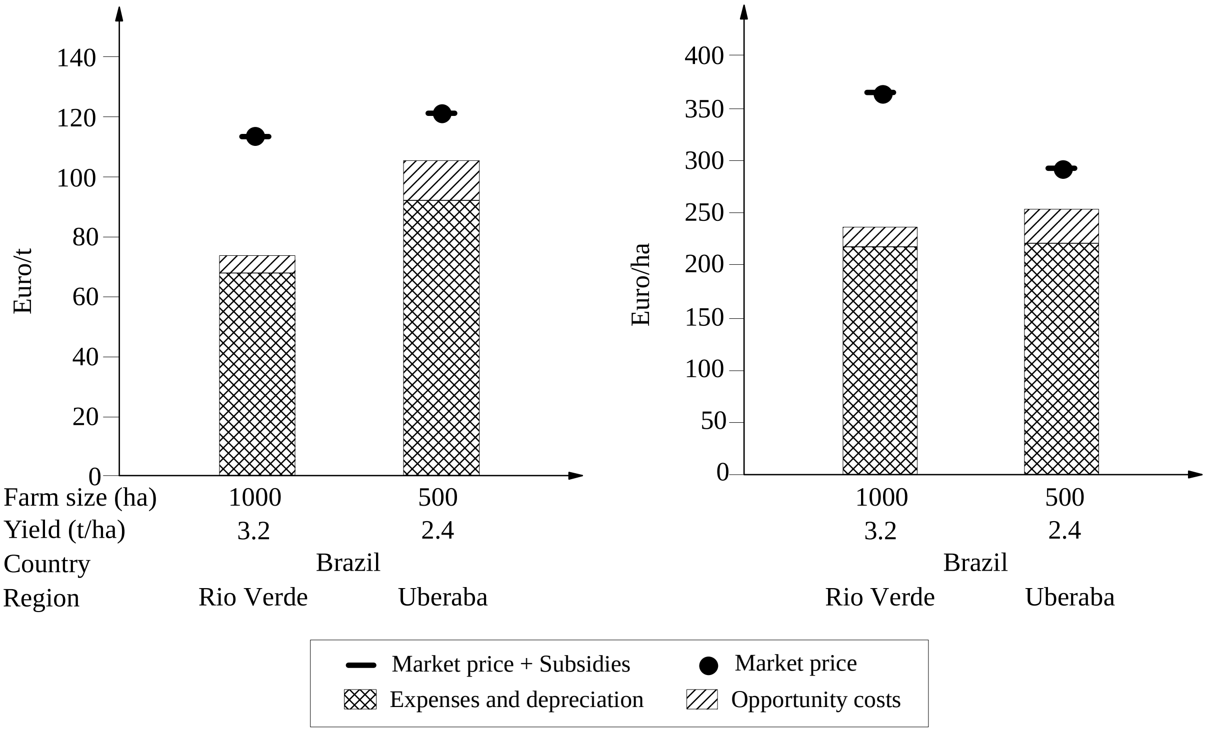


8.8 Profitability

Similar as to in Argentina, soybeans were a profitable crop for the Brazilian farms analysed here despite the relatively low world oilseed prices (Figure 8.5).

The farm in Rio Verde made a profit of almost 125 Euro per hectare. In contrast, the profit of the farm in Uberaba is significantly lower (38 Euro/ha) higher production costs are not offset by higher product price.

Figure 8.5: Soybeans: Profitability of production, 1999



Exchange rate: 1 Euro = 1.93 R$.
Source: Own calculations.

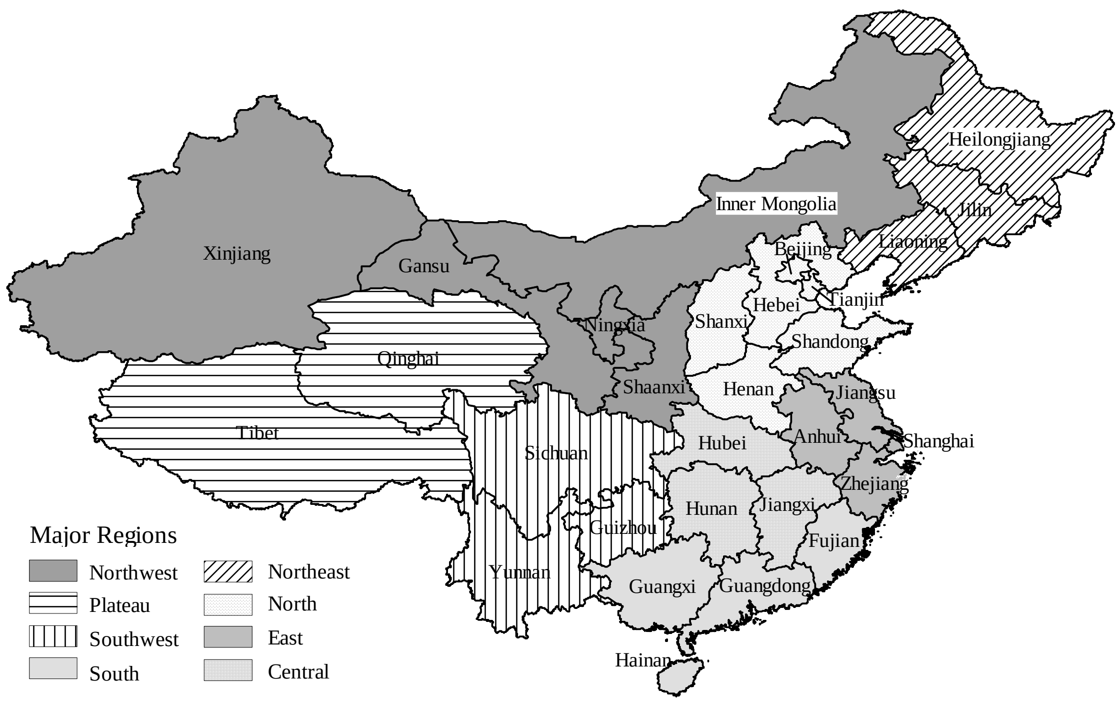
Park_2003-08-07

9 Soybean and rapeseed production in China

9.1 Climate and soils

China, the fourth largest country in the world (9.5 million sq. km), has a variety of landforms and shows highly diverse climates ranging from humid tropics in the south to continental temperate climates with extreme cold winters in the north and desert conditions in the west. The diversity in climate and geography is reflected in the land use in China. One-third of the country is covered in grassland. Forests are concentrated in the mountainous areas in northeastern and southwestern China. With the exception of a small oasis in northwestern China, farmland occurs in monsoon influenced eastern and northeastern China. The cropping pattern varies from a single crop in the northeast to three harvests a year in the south. Referring to natural conditions, as well as agricultural production in this chapter, will be referred to using the geographic regions and administrative divisions shown in Figure 9.1.

Figure 9.1: Provinces and major geographic regions



Source: IIASA, 1999a.

Park_2002-03-19

9.1.1 Climate

Relief

High mountains and plateaus dominate the western part of China. The Qinghai-Tibet Plateau is well over 4000 m and the central part of the region, the North Tibetan Plateau, has an average height of 5000 m. Towards the north and east, the mountains descend sharply to a lower altitude of 1000 - 2000 m. Basins are found with plateaus including the Mongolian Plateau, the Tarim basin, the Loess Plateau, the Sichuan basin and the Yunnan-Kweichow plateau. Most of the eastern part of China is below 400 m and composed of plains and hills, e.g. North China and Manchurian plains (see Figure 9.2). Consequently, major rivers of China, including the three longest - Yangtze, Huang He (Yellow River), and Xi Jiang (Pearl River) - flow eastwards to the Pacific Ocean (see Appendix Figure A7.1).

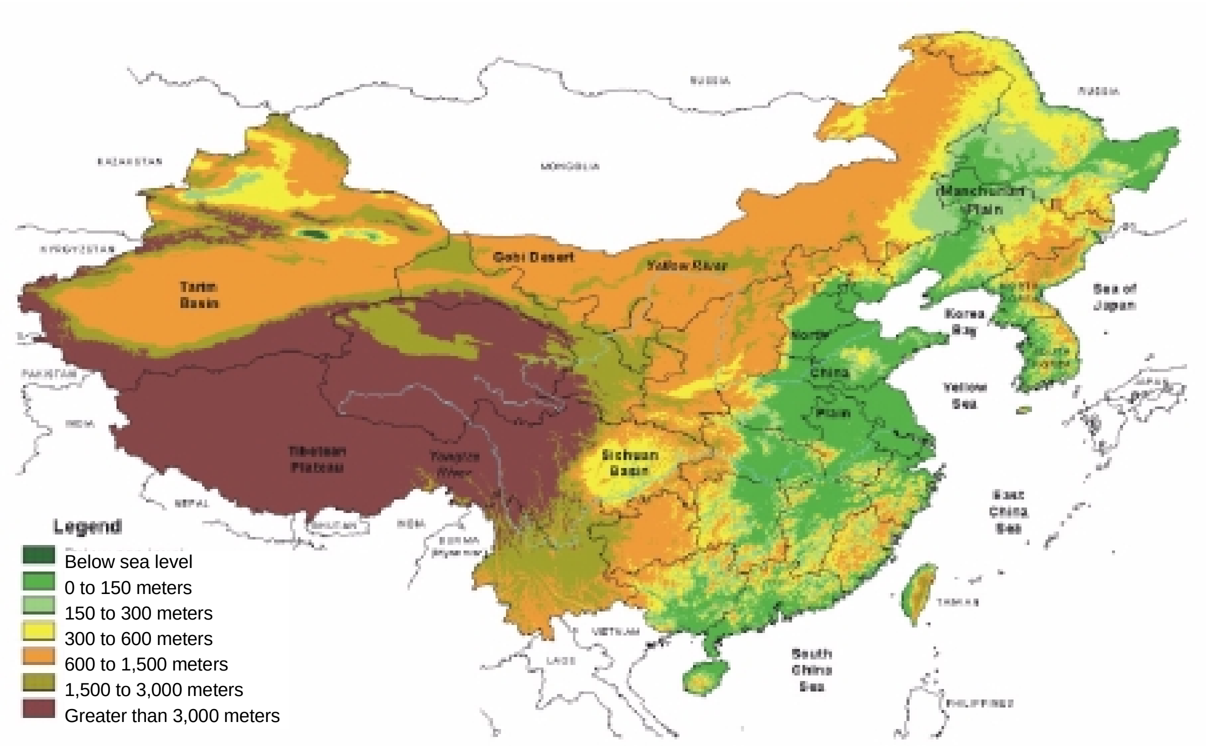
Mountains occupy 43 % of China's land; mountainous plateaus 26 %; and basins, predominantly hilly in terrain and located in arid regions, cover approximately 19 % of the area. Only 12 % of the total land is classified as plains (BRITANNICA, 2001).

Temperature

In China a range of climatic zones occurs whose main characteristics are determined by geography, latitude and the seasonal movement of air masses across the large continent of Asia towards the Pacific Ocean. In general China is characterized by two different climates. In the Northwest, the continental climate type with severe winters and hot summers is more typical. It covers Xinjinag, the Chaidam basin and Qinghai, western Tibet and the part of Inner Mongolia lying north of Helan and Yinshan mountains. The rest of China lies within the monsoon area.

"Monsoon" is a climatological phenomenon created by the change of wind directions between summer and winter (BRITANNICA, 2001). This change is due to the seasonal variation of the thermal structure of the underlying surfaces with different air masses, producing noticeable effects on the weather and climate of the areas concerned. The four distinctive seasons as well as the marked dry (in winter) and rainy (in summer) seasons in the eastern part of China are a result of this monsoon effect.

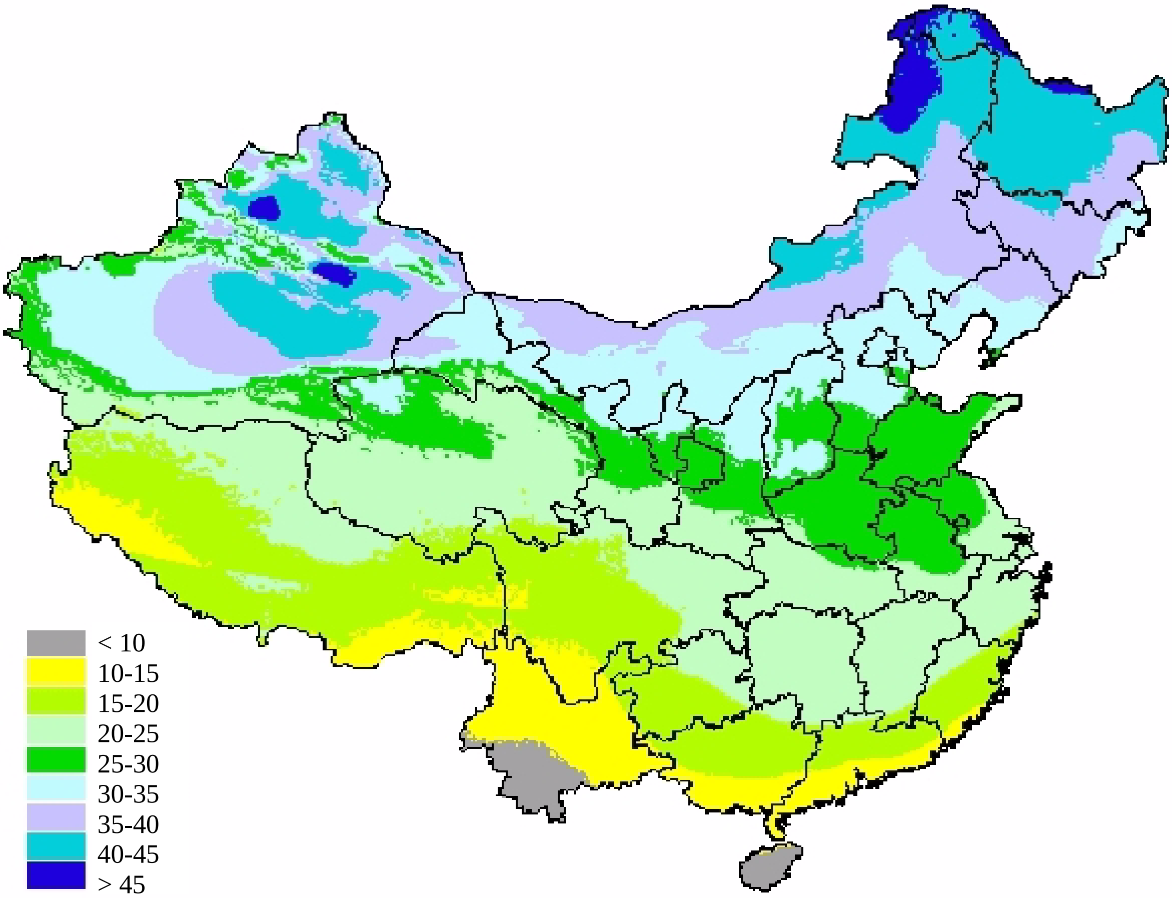
Figure 9.2: Relief



Source: USDA (2000). Park_2002-03-19

A characteristic of the monsoon climate in China is a wide range of annual temperatures. China has a colder winter and a hotter summer compared to temperatures in other parts of the world at the same latitudes. The degree of continentality, expressed as difference between July and January temperature, increases from south to north (see Figure 9.3). It is less than 10° C on Hainan Island and southwestern Yunnan and increases to over 40° C annual temperature range in northwestern and northeastern China. Far northern regions in Inner Mongolia and Heilongjiang show the largest temperature range - over 45° C (IIASA, 1999a; BRITANNICA, 2001).

Figure 9.3: Continentality degree in China - July minus January temperature, degree Celsius



Source: IIASA (1999a).

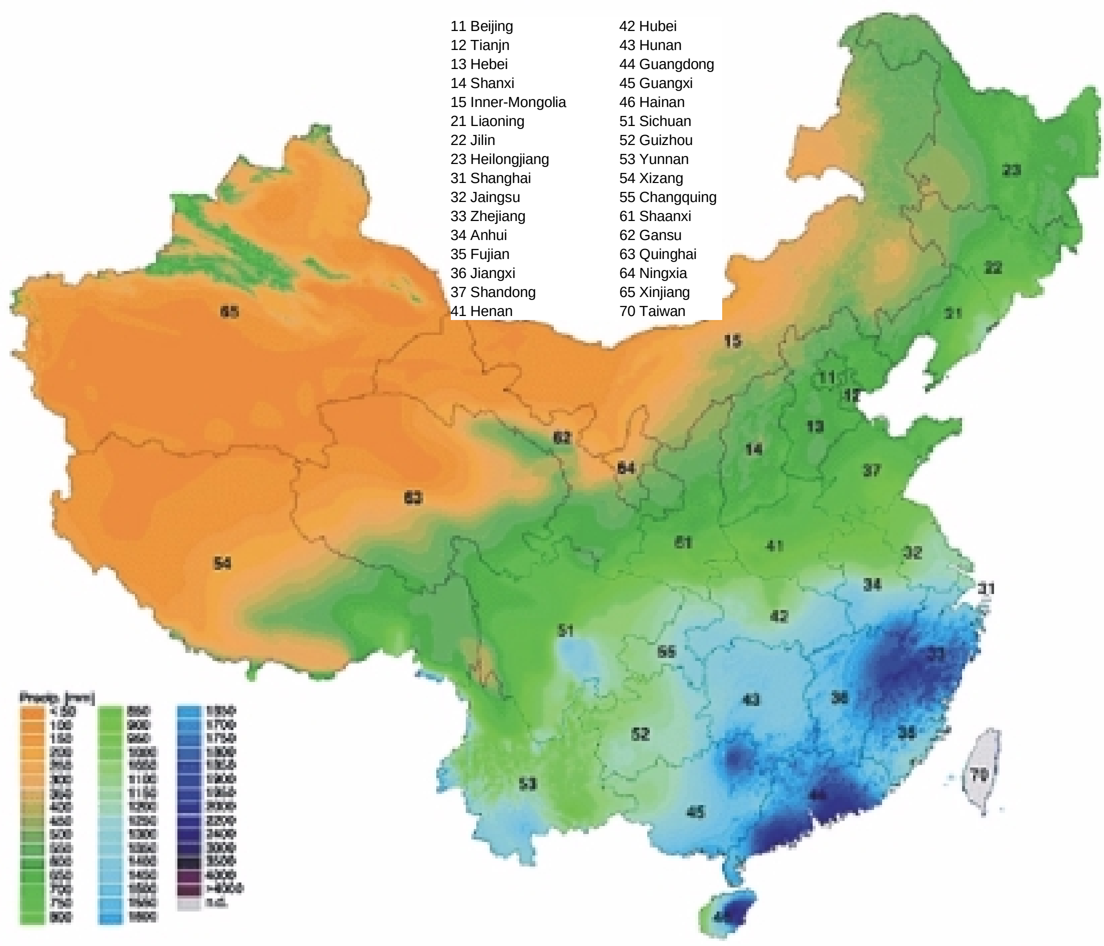
In most of the country January is the coldest month and July the warmest. The coldest climate is in the far northern parts of Northeast China, where mean December and January temperature is between -25 and –30° C. In contrast, during the winter months on southern Hainan island the average temperature is between 15 and 20° C. In July and August average temperature rise above 20° C in most of regions, except higher mountain regions. Even in those regions temperature stay above 5° C in areas below 4000 m . In eastern and southeastern regions July average temperature exceeds 25° C. The hottest area in the meantime is in northwestern China (IIASA, 1999a). Monthly average temperatures are shown in the Figure A7.2 in Appendix.

Rainfall

Rainfall varies greatly throughout China, generally decreasing from more than 1500 mm annually in the southeast to less than 100 mm in the northwest (Figure 9.4). This gradient follows the direction of movement of the summer monsoons. The total amount of precipitation diminishes as the monsoon releases its moisture as it moves inland. The hinterland in northeast China is beyond the reach of the pacific weather systems, while the northwest is blocked by the Himalayas and the Tibetan plateau influencing the southwesterly monsoon weather systems of the Indian Ocean (IIASA, 1999a, BRITANNICA, 2001).

Northwest China is the most arid region with an annual precipitation below 200 mm. This zone of hyper-arid and arid conditions includes the Gobi desert, semi-deserts in Xinjiang, the western parts of Inner Mongolia, northern Gansu province, and the cold deserts found at elevations over 2000 m on the northwestern Tibet-Qinghai plateau. In the dry northwestern Xinjiang autonomous region, the Tianshan mountain region forms an exception with annual precipitation reaching 600 mm, providing sufficient water resources for crop and livestock production.

Figure 9.4: Rainfall distribution, mm



Source: IIASA (1999 b). Park_2002-03-19

The **North China Plain** and **Northeast China** receive annual precipitation ranging from 400 to 800 mm, with the exception of the southeast coast of Liaoning, where annual precipitation exceeds 1000 mm. **Southeastern** China has predominantly sub-humid and humid climates with evergreen broadleaf forest and sub-tropical rainforest. Annual precipitation is over 1000 mm and locally exceeds 2000 mm along the southern coast of Guangdong Province and the east coast of Hainan Island.

The distribution of rainfall during the year shows the majority of precipitation occurs during the summer in most of China, with some regions receiving the majority of the precipication in the late spring or early autumn months. The winter, with the strong influence of the northerly monsoon, has the least precipitation; ranging for most parts of the country from 10 to 20 mm per month (see Figure A7.3 in Appendix; IIASA, 1999b).

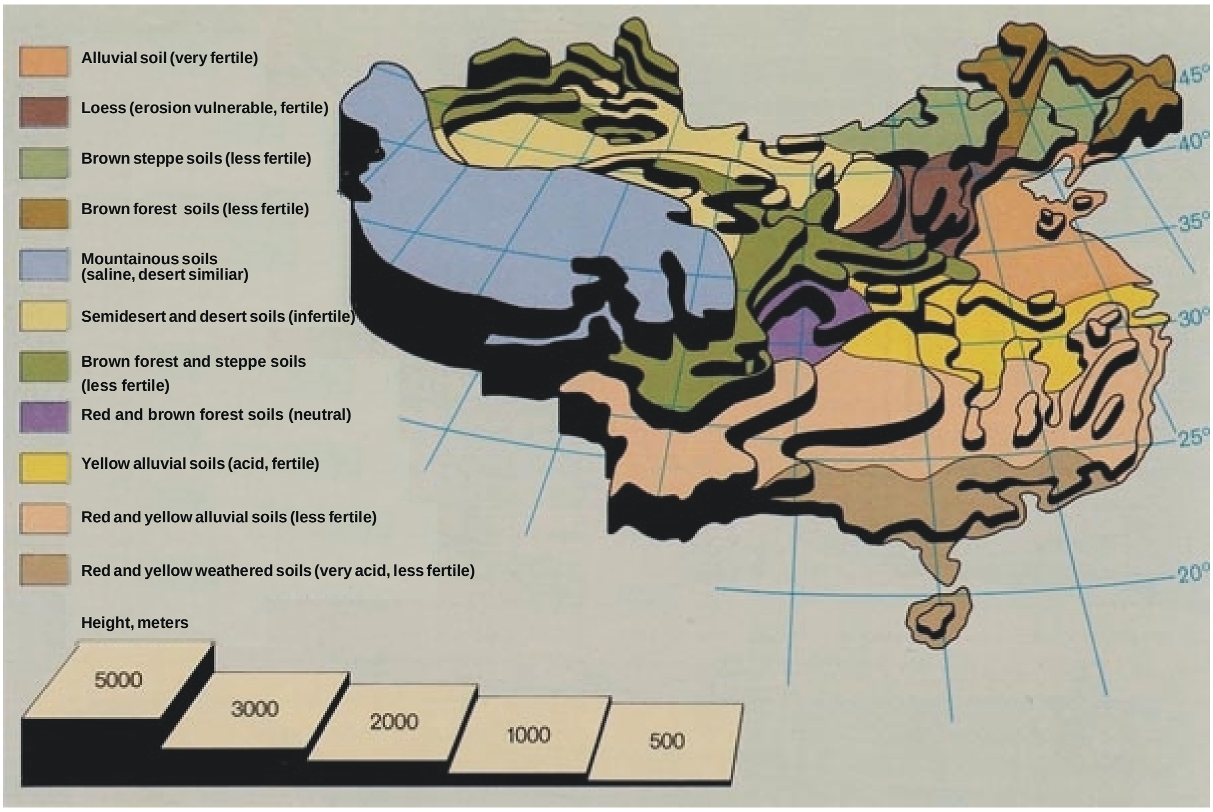
9.1.2 Soils

Because of its vast and diverse climatic and geographic conditions, China has a wide variety of soils. As a result of the climatic differences between the drier and cooler north and the wetter and hotter south, soils may be grouped into two major classifications. Generally speaking, the soils north of the Tsinling Mountain - Yellow River line are pedocals (alkaline in reaction); those south of this line are pedalfers (acid in reaction) (BRITANNICA, 2001).

Apart from the plateaus and high mountains to the southwest, soil zones are distinguishable according to differences in climate, vegetation and distance from the sea. In the East and North regions alluvial and loess soils are found. These are among the most fertile soils of China. The South, part of Central and Southwest regions are covered by the forest zone with humid and semihumid climate, where red and yellow acid soils of low fertility prevail. The Northwest region is covered with steppe zone, semidesert and desert zones with semiarid and arid climates where a range of infertile and low fertility soils can be found (e. g. grey and brown desert soils). Between these two large areas lies the forest-steppe zone, where forest soils gradually merge to steppe soils, brown, dark brown and black fertile soils are found within this region. The Northeast region is covered by forest and steppe zone with a continental climate, where brown steppe and forest less fertile soils prevail (see Figure 9.5; BRITANNICA, 2001).

Extensive forests of central and southern China were cleared for farmlands, resulting in inevitable erosion of soils from the hillsides and their deposition into valleys. Farmers have constructed terraces, supported by walls, in order to hold back water for rice fields, thus effectively controlling erosion. Wherever elaborate terraces have been built, soil erosion is virtually absent, and stepped terraces have become one of the characteristic features of the rural landscape (see Figure A7.4 in Appendix).

Figure 9.5: Soil zones



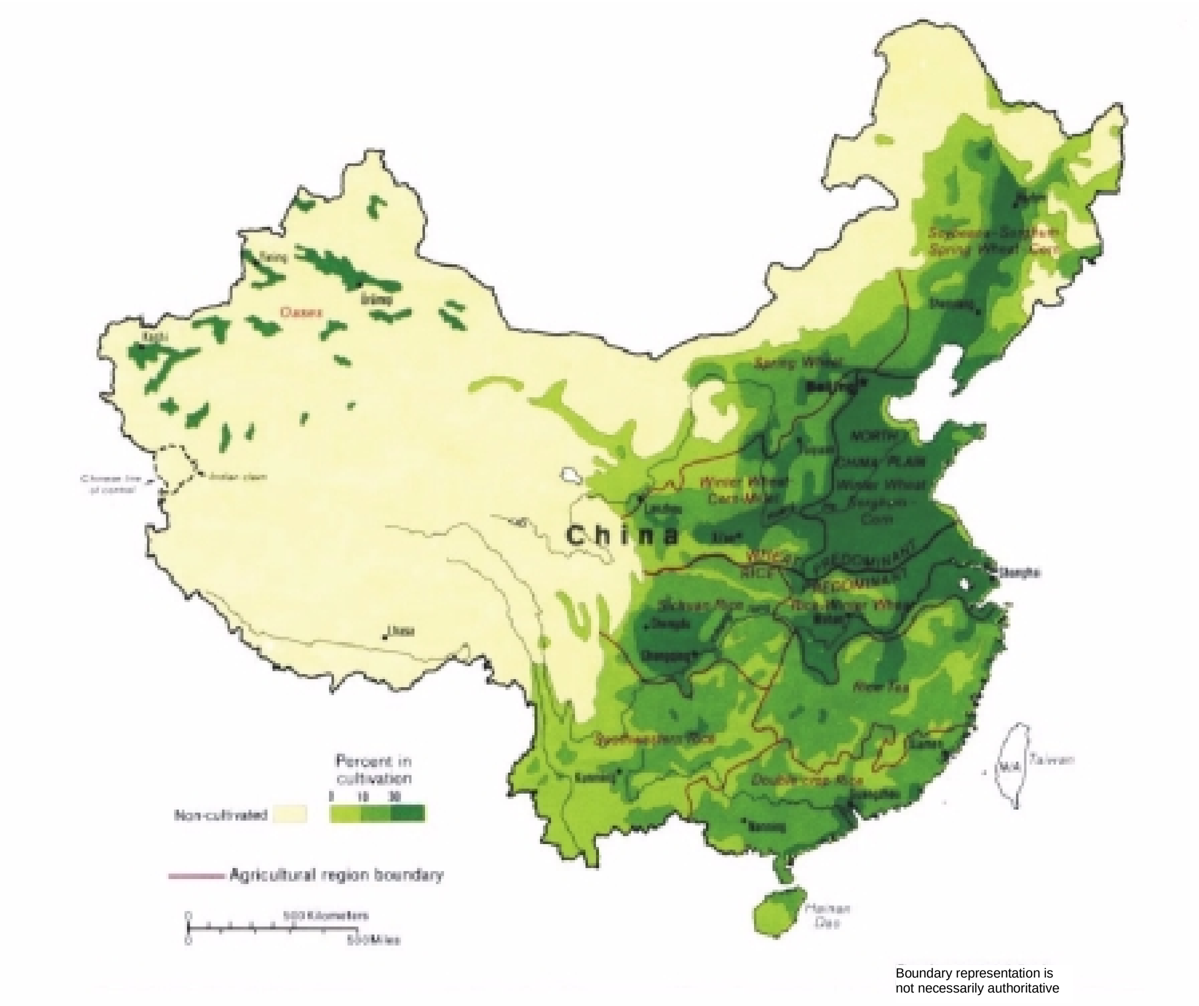
Source: Behr, A. (1988). Park_2002-03-19

9.1.3 Agricultural regions and cropping practices of major crops and oilseeds

Due to the natural, climatic and geographic conditions described above, agricultural production is limited mainly to the monsoon influenced regions of eastern and northeastern China. The combination of these conditions allow farmers to grow up to three crops a year in the South, Southwest and Central regions, whereas only one crop a year can be grown in the Northeast and Northwest regions. The ability to grow more than one crop a year is expressed using the Multi Cropping Index (MCI), which is a relation of cultivated area to sown area. Generally speaking, the MCI decreases moving from the south to north once again, reflecting the influence of the monsoon on the climate (see Figure A7.5 in Appendix).

Major crops produced for food use in China are **rice, wheat** and **corn**. **Rice**, the most important crop in China, is mainly grown in the southern provinces, where warmer climates and higher rainfall is available year-round allowing two harvests of rice annually. In the southernmost provinces, sometimes even a third crop can be harvested. In northern China, **wheat** is the dominant crop, where the cooler and dryer climate limits the growth of rice, however there is a trend towards having one crop of rice annually. Winter wheat is mainly grown in the central region, while summer crops, including spring wheat, are grown in northwest and northeast regions, where cold and dry winters will damage winter crops. **Corn** is predominantly grown in the northern and central regions, competing with wheat and soybeans (see Figure 9.6).

Figure 9.6: Agricultural regions and cropping practices



Source: CIA (1986).

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9.2 Production of oilseeds and major crops in China

9.2.1 Arable land resources and potential for expansion

As a result of climatic and topographic features described above, the area used for agricultural production is relatively small. Only 14 % (**130 million hectares**) of China's total land resources are arable lands (IIASA, 1999c). According to estimates from the

State Land Administration (SLA, 1994) the total additional land of China with cultivation potential is less then **13 million hectares**, of which only **0.4 million hectares** is of high quality and suitable for cultivation. According to a recent IIASA study, China has between **15** and **30 million hectares** of land with grain cultivation potential. This land area is located in northern China in Heilongjang and Inner Mongolia provinces and is currently used mainly for pastures (IIASA, 1999c; FAO, 2001). Unfortunately, this land will require high investment costs to improve its productivity. New technologies need to be implemented such as drought resistant varieties, highly efficient irrigation systems, (which are not available to date); moreover, the infrastructure has to be built to access these regions. Therefore, it would be probably more effective to prevent loss of highly productive arable land in other major production regions currently lost at a high rate due to wind or water erosion, salinization or transfer to other uses than expand crop production into this area of the country.

9.2.2 Grain production

Since the early 1980s, China has become the world's leading grain producer increasing its total grain[1] production from 233 million tons in 1980 to 346 million tons in 2000 (see Figure A7.6 in Appendix). Although the production increased significantly during last two decades, the land allocated to grains has declined 9 % to 85 million hectares during this same period. The positive growth of the production was achieved due to a significant increase of yields, which grew on average by 60 % for major grains over this period. (for more details see Chapter 9.2.4).

According to sown areas, the major grains in China are **rice** (35 %), **wheat** (32 %), and **corn** (27 %), **other grains** were planted on remaining 6 % of the grain area in 2000.

Sown areas to rice and wheat have fallen since 1980 contributing significantly to declining areas sown for grain. Land area for rice has dropped 11 % to 30 million hectares from 1980 to 2000; wheat sown area declined 9 % to 27 million hectares. In the meantime, corn area increased 14 % from 20 million hectares to 23 million hectares (see Figure 9.7). Major areas of expansion were in Inner Mongolia (sown area doubled), Henan (a 30 % increase), Jilin (a 30 % increase) and Anhui (corn acreage tripled).

Spring wheat accounts for 10 - 15 % of the total wheat production, with Heilongjiang, Inner Mongolia and Gansu provinces being the leading producers with over 65 % of total

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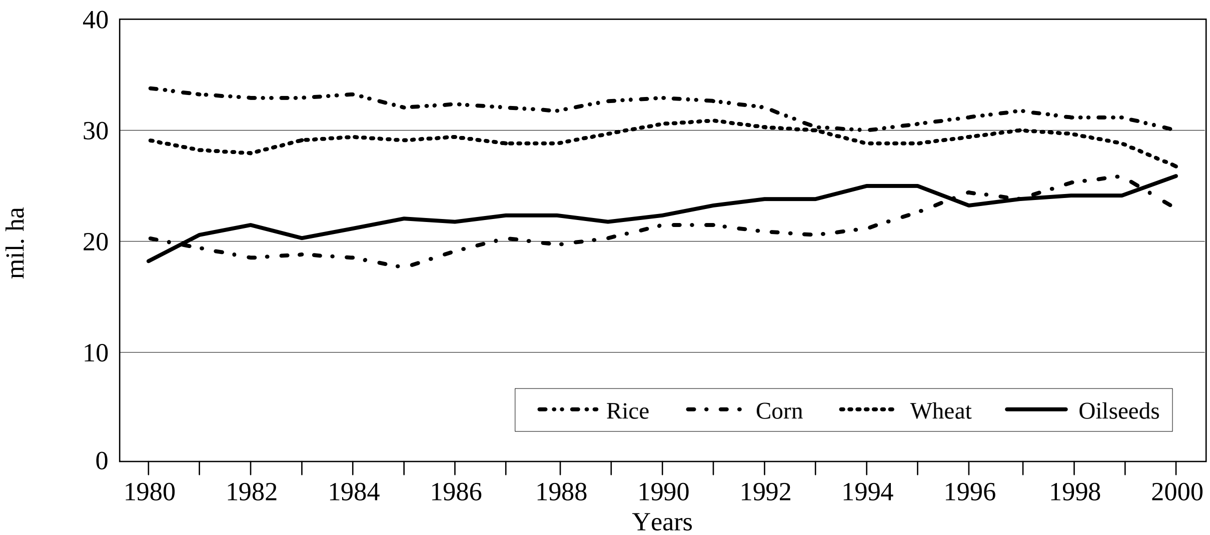
[1] China's "Grain" definition includes wheat, rice, corn, soybeans. In this paper soybeans, where possible due to data availability, will be considered as oilseed crop.

production. Leading provinces growing **winter wheat** are Shandong, Henan, Hebei and Jiangsu accounting for about 60 % of the total production (see Figure A7.7 in Appendix).

Single-crop rice accounts for 44 % - 48 % of total rice production. The production areas lie in the southern part of Heilongjiang province to the Southern region. Leading producers are Sichuan, Jiangsu, Hubei and Anhui provinces accounting for 55 % of the total production (see Figure A7.8 in Appendix). **Early** and **late double-crop rice** each accounts for 26 - 28 % of total rice production. The major production areas are located in the Eastern, Southwestern, Southern and Central regions. The leading producers of early double-crop rice are Hunan, Guangdong, Guangxi and Jiangxi provinces. The leading producers for late, double-crop rice are Hunan, Jiangxi, Guangdong and Zhejiang provinces (see Figure A7.9 in Appendix).

Corn production stretches from the northeast region to southern region with the major production areas in northeast and central regions. The leading provinces growing corn are Jilin, Shandong, Heilongjiang and Hebei, together accounting for 45 % of total production (see Figure A7.10 in Appendix).

Figure 9.7: Area under major crops and total oilseeds, 1980 to 2000



Source: USDA - PS&D (2001). Park_2002-01-11

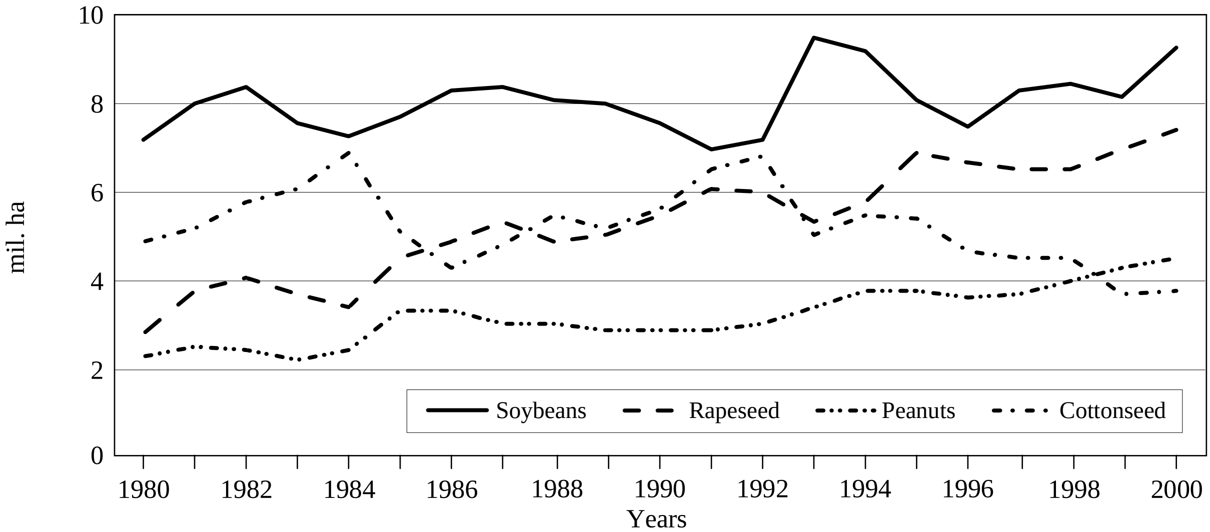
9.2.3 Oilseed production

Oilseed production soared 140 % from 19 million tons in 1980 to the historically high 47 million tons in 2000 (see Table A7.1 in Appendix). During the same time period however, land area allocated to oilseeds increased only 42 %, to 26 million hectares (see

Figure 9.7). Such an increase in oilseed production is a result of improved yields, which went up 51 - 88 % for major oilseeds (see Chapter 9.2.4).

Major oilseeds, by acreage, are s**oybeans (36 %), rapeseed (29 %), peanuts (17 %)** and **cotton (15 %), sunflower** accounted for remaining **4 %** of area allocated to oilseeds in 2000 (see Figure 9.8).

Figure 9.8: Area under major oilseeds, 1980 to 2000



Source: USDA - PS&D (2001). Park_2002-01-11

The first three crops have strongly contributed to the growth of production areas in the last two decades. Rapeseed was the leading crop with a 160 % increase in area, followed by peanuts (92 %) and soybeans (29 %) (USDA, 2001). This rapid growth in the demand for oilseed crops is explained by two phenomena: 1) a large urban population using cooking oil for instant noodles, and 2) a livestock industry where soybean meal has become a popular component of livestock feed (USDA, 2001). However production of oilseeds remained unstable under the influence of market forces (domestic and international), as well as government policy, which used different tools to influence the production of major crops. The state used to regulate production of grains by implementing production policies (e. g. "Grain Bag" Policy), providing input subsidies as well as being involved in domestic and international trade. After entering WTO in December 2001 it is widely expected that the intervention of the State in agricultural production and involvement in international trade will cease significantly in the near future (for more details see Chapter 9.4).

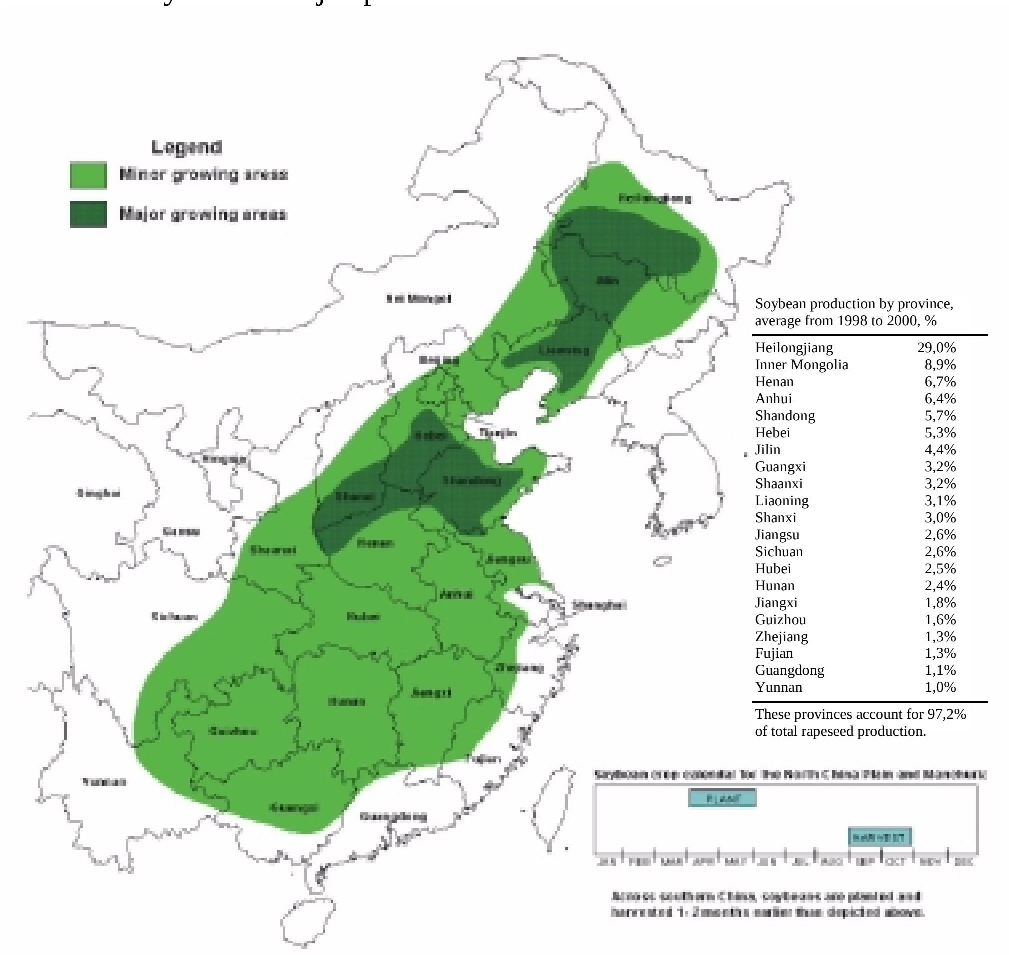
9.2.3.1 Soybeans production

Soybeans originated in China and were domesticated there more than 5000 years ago. China was the leading producer of soybeans up to the middle of the 20th century and only after the Second World War lost its leadership to the USA (MA RHU-HWA and ZHANG KAN, 1983).

Soybeans is the leading oilseed crop in China. Soybean production has almost doubled (94 %) from 7.9 million tons in 1980 to 15.4 million tons in 2000. The land area allocated to soybeans has reached one of the historically highest 9.3 million hectares in 2000, an increase of 2.1 million hectares since 1980. The soybean production area stretches from northeastern to southern region with the major production in the northeastern and northern regions (see Figure 9.9).

Heilongjiang province, located in the northeast, is the province leading production accounting for 31 % (2.9 million hectares) of the total soybean acreage in 2000 (see Figure 9.10).

Figure 9.9: Soybeans: Major production areas



Source: USDA - JAWF (2001).

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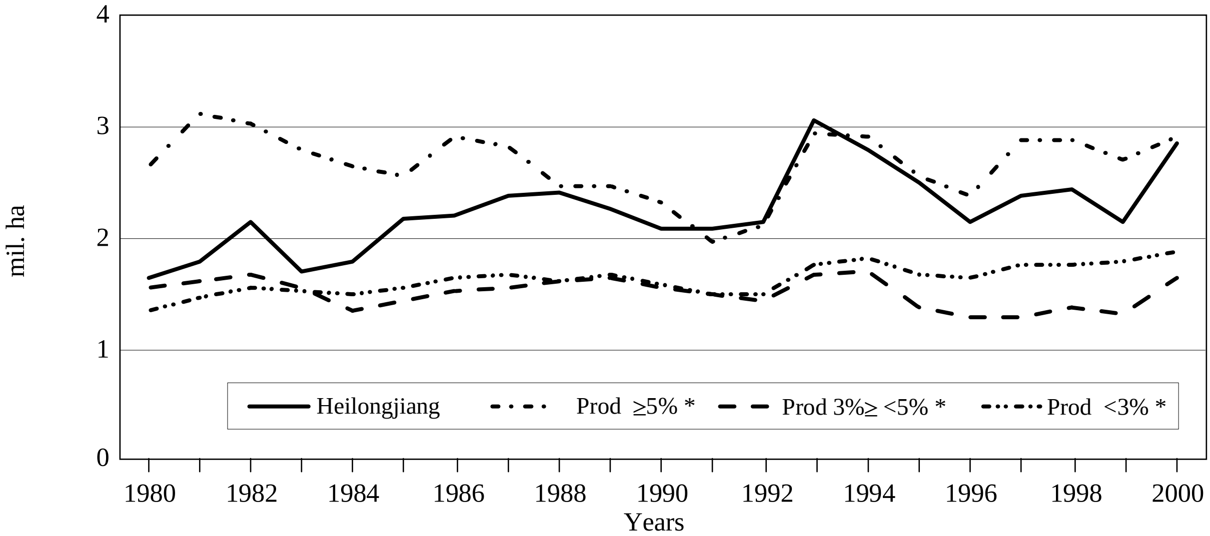
Other major soybean producing provinces accounting for than more 5 % of the total soybean area are: Inner Mongolia, Henan, Anhui, Shandong and Hebei. These provinces had an aggregated share of 31 % of the total production. Provinces producing each between 3 % and 5 % of the total area were Jilin, Guangxi, Shaanxi, Liaoning and Shanxi with an aggregated share of 18 % of the soybeans area. The remaining provinces, each having less then 3 % share of total area, accounted for 20 % of the total soybeans sown in 2000.

One must take note that the major growth and fluctuations in production are in Heilongjiang. This can be explained by the fact that in these provinces, the soybean production is commercially oriented compared to provinces with a minor share of the production where soybeans are more a part of the traditional rotation systems (USDA-FAS, 2001).

Figure 9.10: Soybeans: Acreage, grouped by province's share of the total area, 1980 to 2000

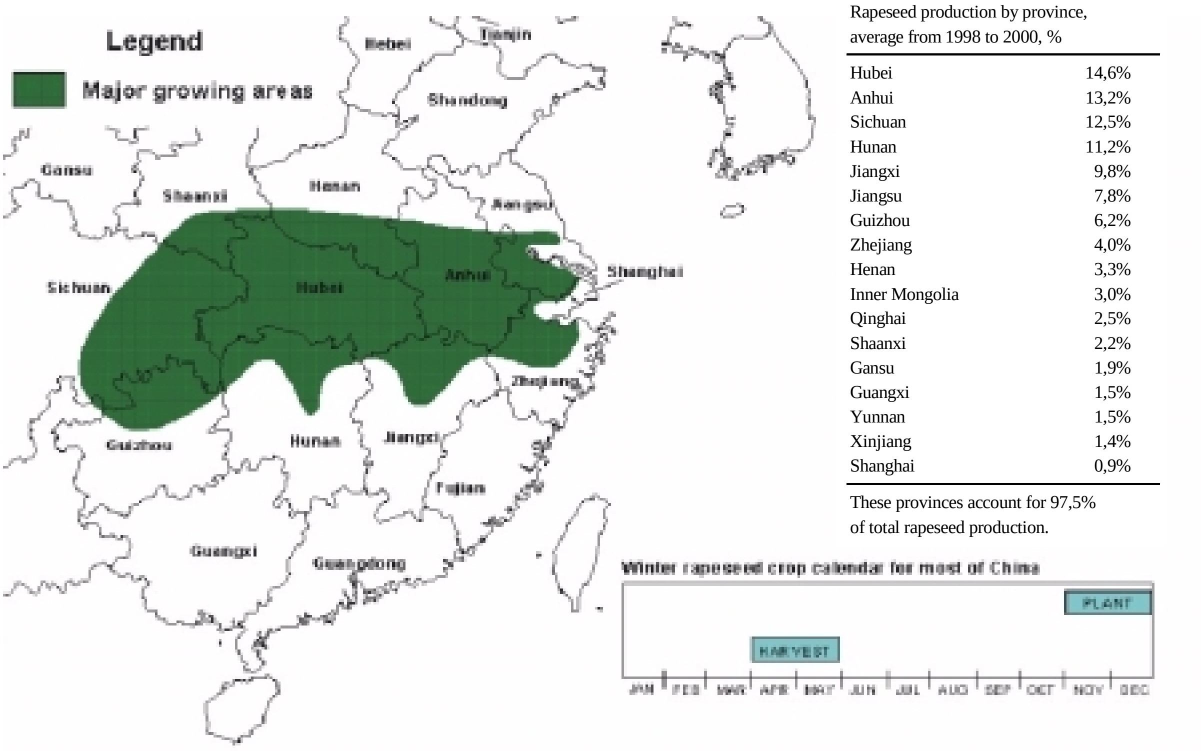


* Reference for grouping is an average from 1998 to 2000.
Prod ≥ 5% : provinces with share over 5% of total soybean production: Inner Mongolia, Henan, Anhui, Shandong, Hebei.
Prod 3% ≥ < 5%: provinces with share between 3% and 5%: Jilin, Guangxi, Shaanxi, Liaoning, Shanxi.
Prod < 3% : provinces with share less then 3%: the rest of provinces.
Source: China National Bureau of Statistics - Agricultural Yearbooks 1992-2000. Park_2002-01-11

9.2.3.2 Rapeseed production

Rapeseed production has increased by 8.6 million tons (361 %) to 11.,0 million tons. The area sown to rapeseed has more than doubled in last two decades reaching a historically highlevel of 7.4 million hectares in 2000. The major production areas are located in the Central, Eastern and Southwestern regions where it is mainly planted as a winter cash crop in rotation with rice (see Figure 9.11). The competing crop for rapeseed is winter wheat. The leading production provinces, accounting for over 10 % of the total rapeseed production area are Hubei, Anhui, Sichuan and Hunan. Together they have more than half (52 %) of the total land area sown in 2000 (see Figure 9.12). Provinces each having between 5 % and 10 % share of the total sown area are Jiangxi, Jiangsu and Guizhou. Collectively, they account for almost a quarter (23 %) of the total sown area. The rest of provinces accounted for the remaining quarter of total sown area. One must note that the major expansion of production is found in the first and second leading rapeseed producing groups. Both groups had more than tripled its sown areas, where the last two groups had moderate growth, with about 1.7 times increase each.

Figure 9.11: Rapeseed: Major production areas



Rapeseed production by province, average from 1998 to 2000, %

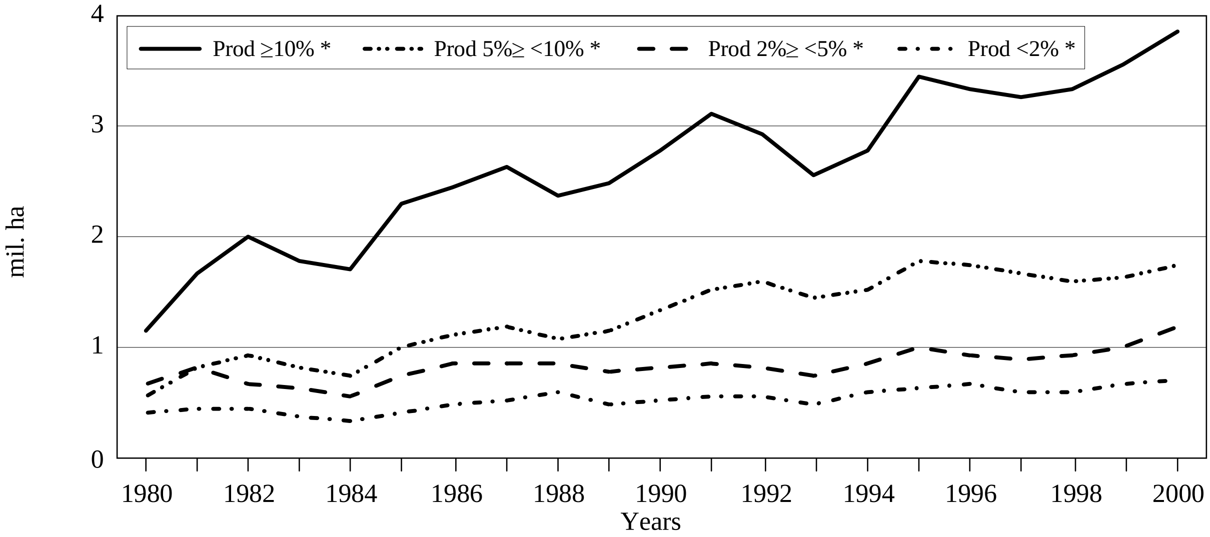
Hubei	14,6%
Anhui	13,2%
Sichuan	12,5%
Hunan	11,2%
Jiangxi	9,8%
Jiangsu	7,8%
Guizhou	6,2%
Zhejiang	4,0%
Henan	3,3%
Inner Mongolia	3,0%
Qinghai	2,5%
Shaanxi	2,2%
Gansu	1,9%
Guangxi	1,5%
Yunnan	1,5%
Xinjiang	1,4%
Shanghai	0,9%

These provinces account for 97,5% of total rapeseed production.

Source: USDA - JAWF (2001).

Park_2002-03-19

Figure 9.12: Rapeseed: Acreage, grouped by province's share of the total area, 1980 to 2000



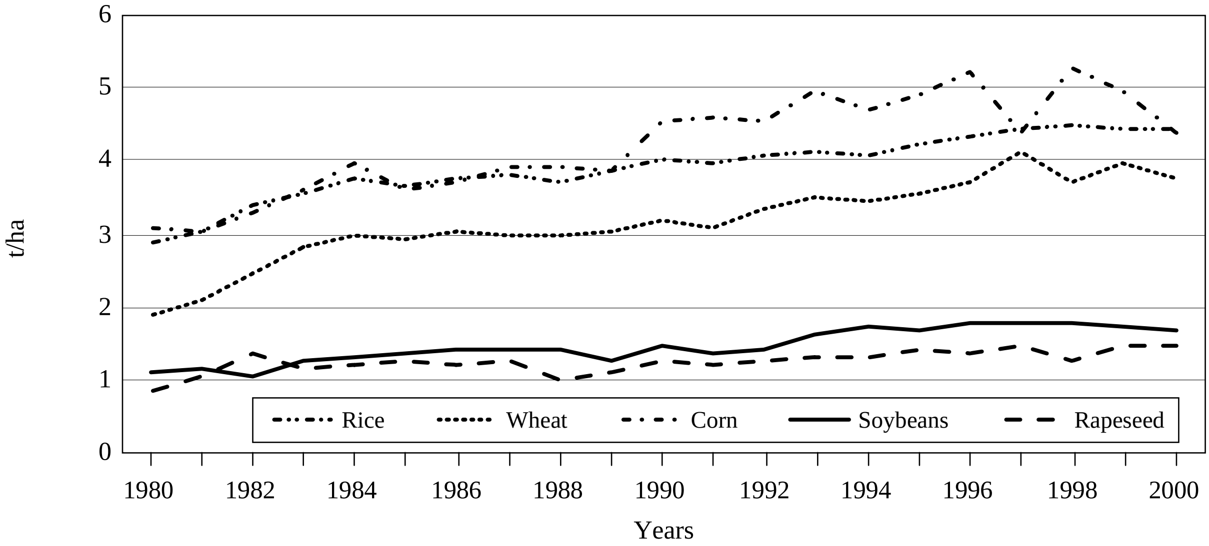
* Reference for grouping is an average from 1998 to 2000.
Prod ≥ 10% : provinces with share over 10% of total rapeseed production: Hubei, Anhui, Sichuan, Hunan.
Prod 5% ≥ < 10%: provinces with share between 5% and 10%: Jiangxi, Jiangsu, Guizhou.
Prod 2% ≥ < 5% : provinces with share between 2% and 5%: Zhejiang, Henan, Inner Mongolia, Qinghai, Shaanxi.
Prod < 2% : provinces with share less then 2%: the rest of provinces.
Source: China National Bureau of Statistics - Agricultural Yearbooks 1992 -2000. Park_2002-01-11

9.2.4 Yields

In the last two decades the average increase in yields for the major crops was 65 %. Wheat and rapeseed were the leading crops, in terms of percent yield increase, with increases of 100 % and 77 % respectively. Rice, soybeans and corn yields improved by 53 %, 51 % and 42 % respectively (see Figure 9.13). These improvements in yields for most of the crops have lead to an overall stabilization of production despite a decrease in total land area sown for many crops. In order to better observe a relative development of yields to the basis, they were indexed using a three year average from 1980 to 1982 and are displayed in Figure A7.11 in Appendix.

According to USDA-ERS (2001) such a growth in yields comes from improved incentives of farmers in agricultural production, increased application rates of fertilizers and introduction of new varieties of crops.

Figure 9.13: Yields of major crops, 1980 to 2000



Source: USDA - PS&D (2001). Park_2002-01-14

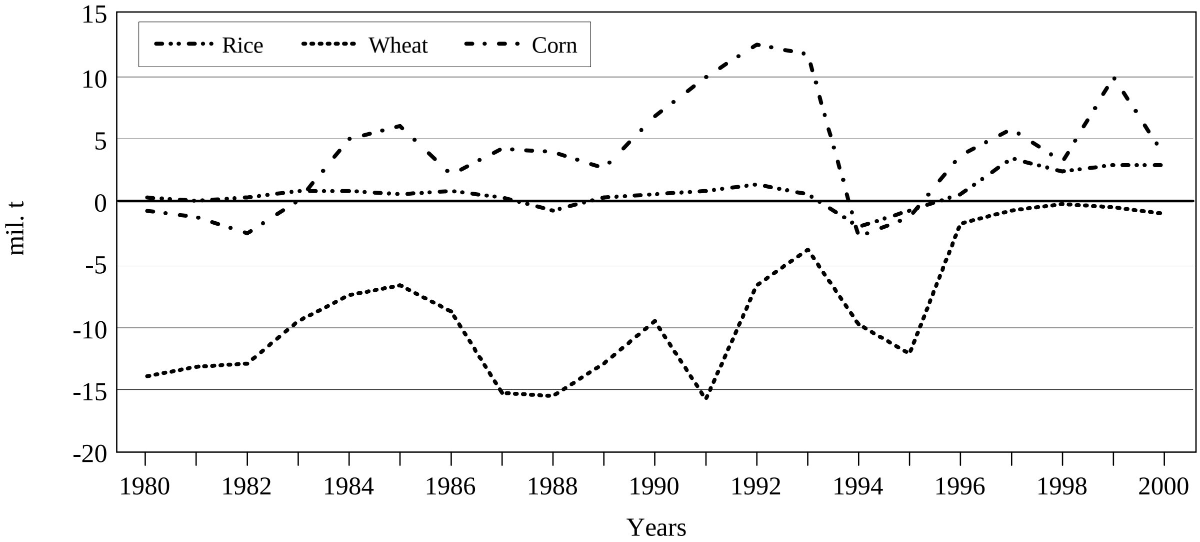
9.3 Trade of major grains, oilseeds and products

9.3.1 Grains

Before 1996, China was importing large amounts of wheat. Net trade between 1980 and 1992 ranged between 6.6 million tons and a record 15.8 million tons (1991) (see Figure 9.14). Since 1995, wheat imports have dropped significantly, which can be explained by the implementaion of the "Grain Bag" policy. This policy was introduced in 1994, to focus on stabilization of grain production and ensuring a high degree of self-sufficiency in grains (for details see Chapter 9.4).

Beginning in 1983, China had a positive balance of trade in corn, with net exports peaking at 12.6 million tons in 1992. Net exports plunged shortly in 1994 and recovered after two negative balance years. The government continues to exercise a strong control in grain trading in order to earn foreign exchange and to dump excess stocks on the international market, as well as to ensure a high degree in self-sufficiency in grains.

Figure 9.14: Net trade of grains, 1980 to 2000



Source: USDA - PS&D (2001). Park_2002-01-14

9.3.2 Oilseeds

In 2000, China, despite increased domestic production of oilseeds had a huge negative balance of trade in oilseed complex. Soybeans and rapeseed were major seeds with a drastic increase of imports in last five years (see Figure 9.15). Soybean net imports were 7.3 million tons and rapeseed imports were 2.5 million tons in 2000, slipping from the peak net imports in 1999. Before 1994, China was a net exporter of soybeans, but situation has changed significantly in recent years.

Increasing imports of soybeans and rapeseed in recent years are explained by soaring consumption of soybeans and rapeseed which had remarkably outpaced domestic production. In the case of soybeans, consumption has tripled in the last two decades while production had only doubled (see Figure 9.16). Moreover, the data show that up to the beginning of the 1990s the domestic production could satisfy the growing demand, but since 1995 the gap between production and consumption has grown at an increasing rate, thus leading to import soybeans (see Figure 9.15 and Figure 9.16). For rapeseed the data show a similar situation but to a lesser extent (see Figure A7.12 in Appendix).

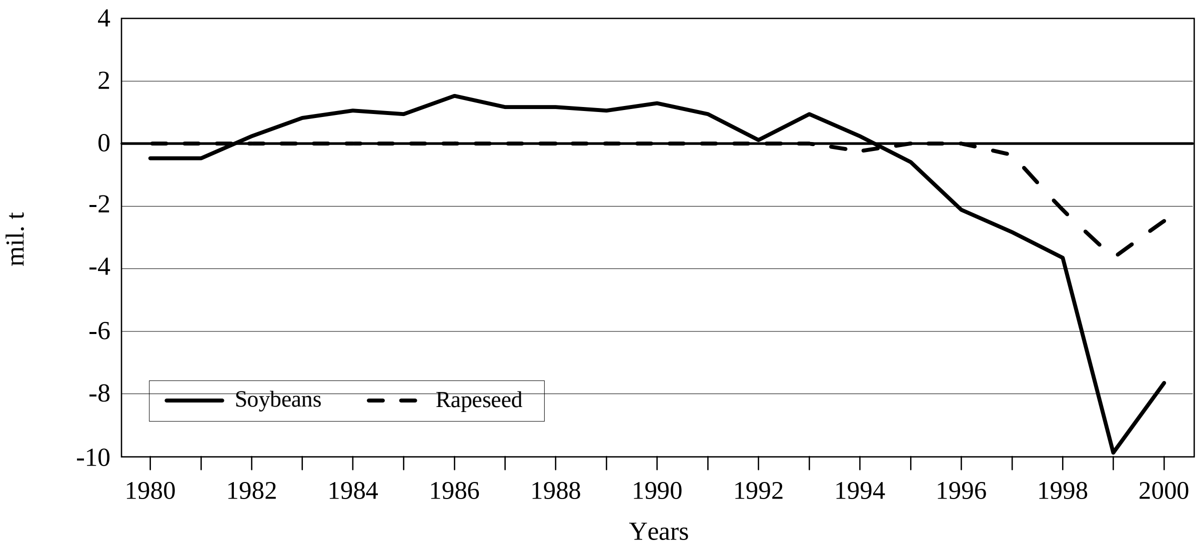
One must note the significant change in the pattern of soybean consumption during the last two decades. In the 1980s' only 18 % of the total quantity of soybeans (1.,5 million tons) were crushed, however the quantity crushed has increased ten-fold during the observed time reaching 70 % (16 million tons) of the total soybean consumption. Soybeans for food purposes as the major group of consumption has remained at the same level of about 5 million tons a year.

Such remarkable demand for oilseeds, especially of soybeans, is explained by the fast growing feed industry which needed more oilseed meal and feed grains to manufacture different kinds of feeds for livestock production. In the 1980s, there was less then 5 million tons of feed manufactured, but due to growing demand from the developing livestock industry, the annual output of feed reached more then 50 million tons in 2000 (CROOK, 2000). Major consumers of feeds were hog and poultry farms, followed by fish farms. As a results of the development of the livestock industry, the output of meat has quadrupled in the observed period, with pork and poultry leading in the production contributing 66 % and 19 % share of the total meat output (66 million tons) respectively (see Table 9.1).

Major soybean suppliers were the United States, Brazil and Argentina. The United States supplied more than a half (58 %) of the imports and latter two each about 20 % in the last five years (USDA-ERS, 2001).

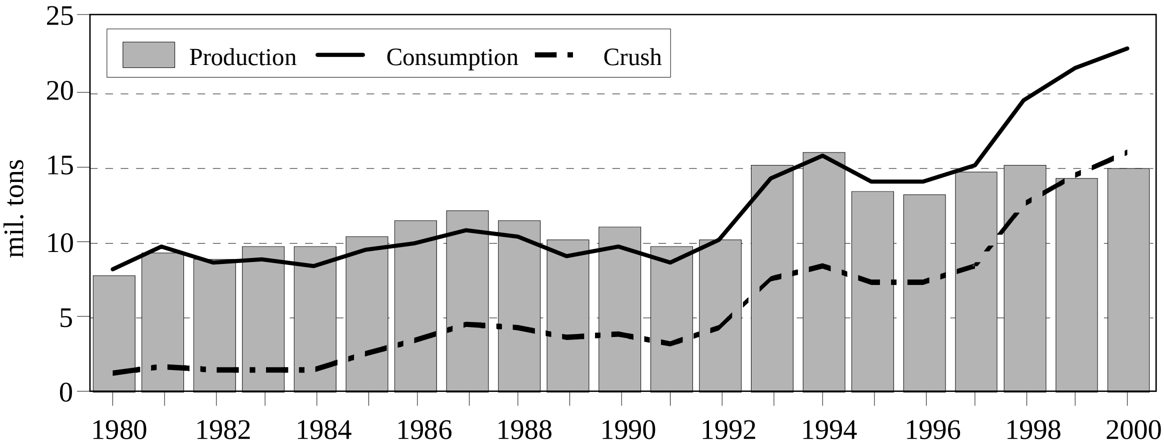
Rapeseed was mainly imported from Canada (44 %) and Australia (26 %). Some rapeseed was imported from France (13 %) and Germany (9 %) during the period 1996 to 2000 (USDA-ERS, 2001).

Figure 9.15: Net trade of soybeans and rapeseed, 1980 to 2000



Source: USDA - PS&D (2001). Park_2002-01-14

Figure 9.16: Soybean production, consumption and crush, 1980 to 2000



Source: USDA-PS&D (2001). Park_2002-03-19

Table. 9.1: Meat production in China, 1980 to 2000

	Pork	Poultry	Beef & Veal	Total
		million tons		
1980	12,1	1,7	0,3	14,8
1985	17,6	2,0	0,4	20,9
1990	24,0	3,7	1,1	30,4
1991	25,8	4,5	1,4	33,4
1992	27,6	5,1	1,7	36,4
1993	29,8	6,4	2,1	40,5
1994	32,6	7,2	2,5	44,7
1995	33,4	8,7	3,3	48,2
1996	33,0	9,0	3,3	48,3
1997	37,2	10,6	4,1	55,1
1998	39,9	11,3	4,5	59,2
1999	39,9	11,9	4,7	60,3
2000	41,4	12,5	5,0	62,8
2001	43,5	12,7	5,3	65,5
Δ1980 to 2000 (%)	258	666	1857	343
1980: % of total	82	11	1,8	
2001: % of total	66	19	8,2	

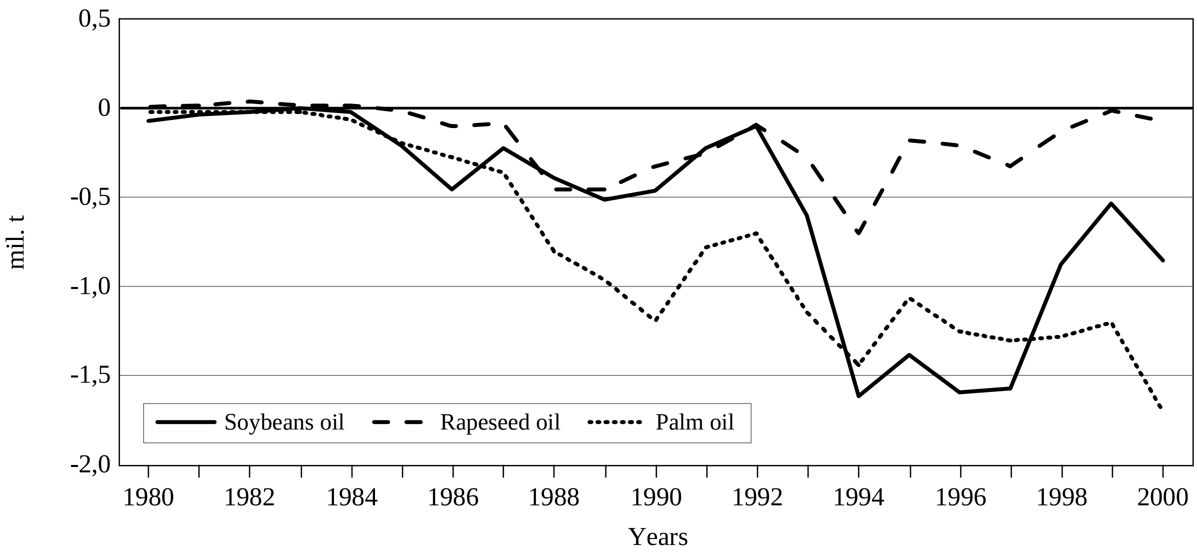
Source: FAO-STAT (2001). Park_2002-01-28

9.3.3 Vegetable oils

Since 1985, China has experienced a negative balance in vegetable oil trade. Palm, soybean and rapeseed oils were the major oils imported. More recently, soybean oil has gained in imports after 1992 (see Figure 9.17). In 2000, China imported a record 1.7 million tons of palm oil, followed by 850 thousand tons of soybean oil and some 70 thousand tons of rapeseed oil.

Major suppliers of palm oil during the last five years were Malaysia (70 %) and Indonesia (26 %). Soybean oil was mainly imported from Brazil (44 %), United States (25 %) and Argentina (24 %). (USDA-ERS, 2001).

Figure 9.17: Net trade of soybean, rapeseed and palm oils, 1980 to 2000



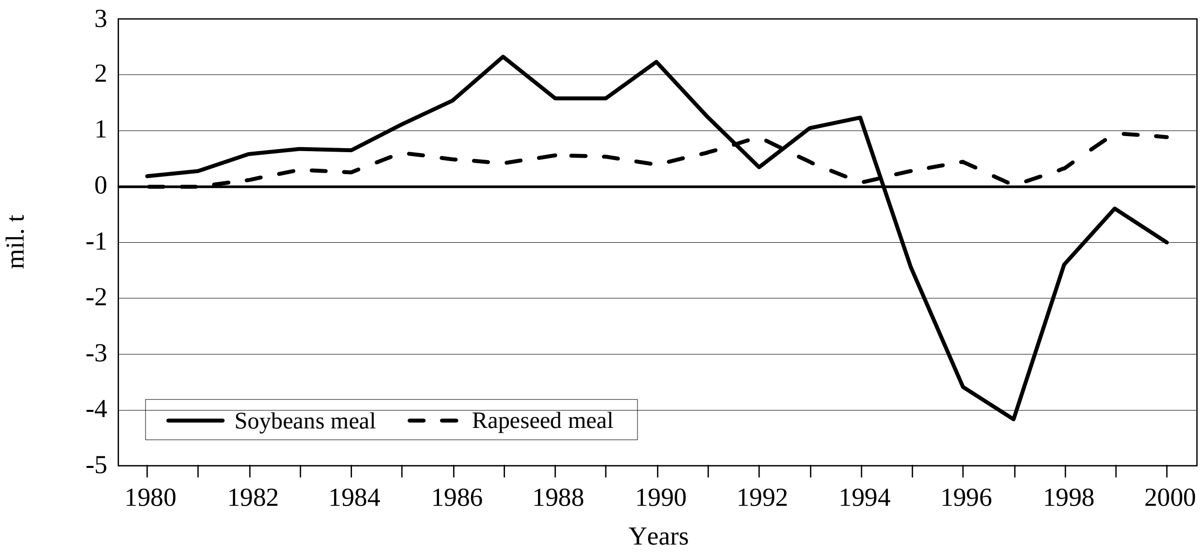
Source: USDA - PS&D (2001). Park_2002-01-14

9.3.4 Vegetable meals

Between 1994 and 1999, in order to satisfy the demand for livestock production, China peaked in soybean meal imports (4.2 million tons). Demand for soybean meal imports decreased due to a decrease demand from the livestock industry in 1998 to 99 and the re-imposition of 13 % VAT tariff in July, 1999. These changes in policy lead to the meal imports falling to 1,0 million tons in 2000 (see Figure 9.18). China has kept positive net trade in rapeseed meal, which was in an oversupply due to increasing crush for oil during last two decades.

Major suppliers of soybean meal were Brazil (31 %), Argentina (31 %) and United States (14 %) during the last five years (USDA-ERS, 2001).

Figure 9.18: Net trade of soybean and rapeseed meals, 1980 to 2000



Source: USDA - PS&D (2001). Park_2002-01-14

9.4 Political and economic framework conditions

Throughout its long history, China has been a large agrarian nation of farm households ruled by landlords and inspired by Confucian[2] philosophy. Since the establishment of the People's Republic of China in 1949, the agricultural sector has gone through a number of transformations. In the early 1950s, the land was expropriated from landlords and divided between poor households. Later, these households were united into communes. Communes were organized into brigades (about 10 in one village) with teams composed of 30 or 40 households. With this organization system, the farmers' incomes were little related to their efforts and output. As a result the agricultural output was declining compared to the growing population (USDA-ERS, 2001).

Market oriented agricultural reforms were started at the end of 1970s, when the communes were dismantled and households and rural markets were restored. The farmers got back the decision making power for agricultural production and could sell their produce to the markets. Since then, agricultural production and farm incomes have been increasing.

[2] The traditional philosophy and, until recently, the state religion of China. It was founded in the 5th century BC by Confucius (MACMILLAN ENCYCLOPEDIA, 2001).

Currently, China's agricultural sector is in a period of transition from a planned to a "social market economy", however it still remains heavily influenced by government policy.

The most **profound** policy objective, which was underlined again with the introduction of the "Grain Bag" policy in 1994, is to **maintain a high degree of self-sufficiency in grains**, which is supported by a number of measures. The state still intervenes in agricultural production, especially grains, on different levels by participating in domestic and international trade, providing subsidized inputs, and finally by introducing different policies and reforms.

Generally, **oilseeds** are considered to be a **cash crop;** hence they are produced and traded using free market conditions since the mid 1990s. S**oybeans** are considered to be a **grain,** but in recent years most of the support and control measures were eliminated for them.

Despite the fact that oilseeds are produced and traded using free market conditions, it is to be expected that the government intervention in grain production has spill over effects on oilseed production as many crops compete for the same resources. Unfortunately due to a lack of information and statistics it is difficult to quantify this statement in the frame of this study. The most important policies and reforms that spurred such immense growth of agricultural production, still influencing the agricultural production, date back to 1978 and will be reviewed in this chapter. Generally they can be grouped into (USDA-ERS, 2001):

- Institutional and production policies
- Domestic market and price policies
- Agricultural input policy
- Agricultural trade policy instruments

The other important issue expected to decrease the state intervention in the agricultural economy is the recent **entry of China** into **WTO** in December 2001. The major agreements that should influence the government involvement in the agricultural economy after the ratification of the WTO-entry will be reviewed in the last part of this chapter.

An overview of major policies, their goals and results can be found in Table 9.2.

Table 9.2: An overview of major policies, their goals and results in China

Policy Instrument	Policy Goal	Policy Result and Issues Raised
1. Institutional		
- Household production responsibility system	To increase production incentives and therefore output	Crop and livestock output increased, but lack of long term land use right impeded farmers' investment
- Extension of the farmland use right	To raise long-term investment on farmland	Results are pending and likely needs legal system to enhance the program
- Dismantling the commune system	To increase production efficiency and separate administrative and business management	Production efficiency increased and town and township industry began to develop
- Development of rural industry	To increase off-farm income and to transfer farm labour out	Off-farm income increased and 100 mil. farm labour transferred out, and competing with government enterprises in raw material use
- Grain Bag policy	To increase grain output and to stabilise stock and price	Grain output increased and stocks fell, grain market fell below government protection price, but induced misallocation of farm resources
2. Domestic market and prices		
- Procurement and retail sale prices	To increase farm income	Farm income increased, but government budget deficits also rose because of higher subsidies to urban rationing system
- Elimination of urban rationing system	To reduce government budget deficit	Government deficit reduced, but subsidies to government (state) grain enterprises going up
- Procurement contract system	To simplify method for procurement payment, to increase farmers' income by less grain procurement	Farmers' income increased through higher market price sales of farm output, contract procurement system is basically still a quota system
- Reduction of government procurement quota	To increase farmers' income	Farmers' income increase (combined results from this and the procurement contract system
- Elimination of fixed procurement prices	To liberalise meat, vegetable, and fruit markets, to deversify farm production	Production of meat, vegetables, and fruits rose, farmers' income increased, farmland devoted to grain output decreased
- Grain distribution reform	To reduce government financial burdens	Government financial burdens increased, and government resumed monopolising grain procurement
3. Foreign trade		
- The responsibility system	To expand exports and foreign hard currency	Exports and foreign exchanges increased, but government subsidies to exports also increased
- State trading system	To control exports and imports, using tariff and non-tariff barriers	Tightly control trade, particularly grain and grain products but administrative bureauscracy prevents effective trading
- Elimination of export subidy and tariff cut	To conform to WTO trade rules	Twice announced the elimination of direct export subsidies, but government still intervenes in procurement, pricing, and trading
4. Farm inputs		
- Chemical Fertilisers	To keep fertiliser prices low through dual marketing system	Was effective in the 1980's, but fertiliser prices increased signigicantly
- Water use	Building and maintaining irrigation system	good and effective before rural reform, but deteriorated after communes were abolished
5. Investment	Increased agricultural investment to expand production	Short-term investment, such as irrigation system maintenance, increased, but long-term investment, particularly research and infrastructure has not emphasised

Source: Tuan (1998). Park_2002-01-28

9.4.1 Institutional and production policies

The most important institutional and production policies that markably influenced the agricultural economy were introduction of the **Household Production Responsibility System (HPRS), development of r rural industry** and introduction of **"Grain Bag" policy.** These policies were aimed at improving stagnating agricultural production, ensuring the grain supplies, raising farmers incomes and decreasing unemployment in rural areas. With the introduction of **HPRS**, the land held in common within the communes was divided between the households according to the number of members and their ability to manage the land. These households were given the right to make their own economic decisions on what to produce on their plots under this policy. Free markets were reintroduced and surplus output could be sold after fulfilling the government quotas. As a result agricultural output grew remarkably, and farmers' incomes improved with the established link of farm returns to production

Basically, the land ownership remained with the village with farmers receiving land use rights for a 15-year period. In exchange for the land use rights, farmers had to deliver a certain amount of the grain, known as the **"procurement quota",** at a fixed price by the state. The price offered was substantially lower than the market price at the beginning of the reforms. In order to provide incentives to farmers for investing in long term productivity of the assigned land plots, land use rights were **extended** for another **30 years** and in some cases for less productive land even for **50 years** at the end of the initial 15-year period (KE and TUAN, 2000).

The major problems remaining in rural areas were high unemployment or underemployment of farmers and low incomes compared to urban areas (USDA-ERS, 2001). The government sought to resolves these issues by emphasizing the **development of rural industry**. The policy was successful, about 100 million farm workers found non-farm employment in rural industries, farmers' incomes have improved as well. As a result, in 1987, the value of outputs from rural industry has surpassed the total value output of agricultural production and continues to grow these past few years (KE and TUAN, 2000). One unique feature of the policy was the development of processing industries being restricted to rural areas.

Despite the initial success of the two above described policies in the 1980s, the State has introduced the **"governor's grain bag responsibility system"** or shortly **"Grain Bag policy"** in late 1994. It was a countermeasure to ensure a high degree of self-sufficiency in grains, which was threatened by inflation in the middle of 1990th, decreasing rates of grain production and raising concern in and outside of China about ability to produce enough grain in the future. The policy gave provincial governors specific responsibilities concerning grain supply and demand. The policy was applicable to all grain crops, especially to **wheat, corn** and **rice.** The oilseeds were not included in the policy.

However, according to USDA-FAS (2001) soybeans produced in the northeastern region were initially bound to this policy, but in recent years it was abandoned. Under the policy, governors were responsible for:

- maintaining an overall balance of grain supply and demand within province;
- stabilizing grain production area, output, and stocks;
- using local reserves to regulate markets and stabilize prices.

Thus, the control of grain production became more strict using different measures of state intervention in the production. As a result, the output and areas sown to grain crops increased for a few years. Meanwhile the land area sown to oilseeds stagnated with only a slight increase in production (see Figure 9.7 and Figure A7.6 in Appendix). Since oilseeds were not included in this policy, one would expect that oilseed production was indirectly influenced by the "Grain Bag" policy loosing some area to grains. A short review of the "Grain Bag" policy and its results is found in Table A7.2 in the Appendix.

9.4.2 Domestic and market price policy

Before reforms were introduced in 1978, the production of agricultural products was centrally planned and the state purchased all the products at fixed prices ensuring a stable supply of "cheap" food for the urban population and raw materials for the processing industry. The prices fixed by the state did not reflect the market situation and therefore, the relationship between prices that should be determined by supply and demand under the market conditions was disbalanced (AN, 1989).

With the start of the reforms at the end of 1970s, the fixed prices for most agricultural products were increased. In addition, the rural markets were allowed and some products could be traded on the markets freely. The market liberalization process had gradually decreased the government role in domestic markets. The markets for almost all **non-grain** crops, including vegetables, fruits, aquatic products and livestock products were liberalized much earlier than the grains in the early 1980s. Even **oilseeds** were freed from the procurement quotas later - in the middle of the 1990s; however, **cotton** and **soybeans,** produced in the northeast, joined this group only in recent years (USDA-ERS, 2001; HSU, 2001). With respect to grains, only in the mid 1990s, private companies were allowed to buy surplus grain from the farmers that had still to deliver a "procurement quota" to the state at the fixed prices. However, the free marketing of grains was abandoned in 1998 with the introduction of "Grain distribution reform". Due to the lack of information, it is difficult to judge if the restriction on private grain trade is still followed by provinces. The most recently introduced policy requires all grain be bought by the state grain bureaus. According to this policy, the grain bureaus had to purchase "procurement quota" grains at the fixed price and then purchase the rest of grain farmers were willing to sell at the market price or a negotiated price which was usually somewhere in between these two. The private companies could buy the grains only from the grain bureaus, thus this policy prohibited direct purchase of grain by private wholesalers (USDA-ERS, 2001).

Procurement and retail prices (subsidies to urban residents before 1994)

In the last 40 years, there were several major increases in procurement prices for grains and oilseeds. The purpose of these increases was to improve farm income. The first increase was 25 % in 1961, the second increase was about 17 % in 1966, and the third increase of 20 % followed in 1979. The fourth and fifth increases in grain procurement prices were in 1987 to 89 and 1992 to 95, which were introduced to cope with high inflation rates. In the meantime, there was little change in the retail price for consumers, mainly from urban areas. This situation lead to a growing gap between purchase price by the state and retail price to consumers. The first significant increases in retail ration prices were first in 1991 and then in 1992, each time by 50 %. The increases were the first after 25 years of stable retail prices (KE, 1995). Such a gap between the two prices has become a burden for the state budget which could not withstand the huge subsidies going for urban residents and later, observing acceptance by urban residents of increased retail ration rices, the state phased out the system in early 1994 (KE and TUAN, 2000).

Procurement quotas and pricing system (quota and above quota prices)

According to HPRS farmers, besides the agricultural taxes and village and township fees, farmers had to deliver a certain amount of grain under the "procurement quota" at a price fixed by the state for the right to use land assigned to them for agricultural production. Grains purchased under this policy amounted to 74 million tons in 1985, and the amount was gradually reduced to between 45 and 56 million tons annually after 1989. The amount and structure of procurement quotas is shown in Table 9.3. The data show that the share of procured grain has fallen to less than 12 % compared to total grain production in the later years.

The "quota" prices were defined by the government and before the mid – 1990s were substantially lower than market prices (see Table 9.4). Farmers were unwilling to deliver the grain to the state and in some years the "quota" grain was not fulfilled in full, thus the state reacted by decreasing the amount of "quota" grain as was discussed above and in order to ensure sufficient supplies of grain to urban residents and industry a **"negotiated"** price was introduced. The "negotiated" price was calculated based on the fixed and the market prices and usually lay between the two of them (USDA-ERS, 2001).

Oilseed production was liberalized in the mid–1990s, therefore only grains were much influenced by this policy. However when the quota price for grains climbed over the market prices in the late 1990s, there was to be expected some favoring of grain production over oilseeds, which remained to be traded at open markets.

Table 9.3: Grain production and procurement quotas, 1987 to 1994

		1987	1988	1989	1990	1991	1992	1993	1994
		Million tons							
Production	Total	403,0	394,1	407,6	446,2	435,3	442,7	456,5	445,1
	Paddy	174,3	169,1	180,1	189,3	183,8	186,2	177,7	175,9
	Wheat	85,9	85,4	90,8	98,2	96,0	101,6	106,4	99,3
	Corn	79,2	77,4	78,9	96,8	98,8	95,4	102,7	99,3
	Others	63,6	62,2	57,8	61,9	56,7	59,5	69,7	70,6
Quota	Total	56,9	52,2	48,9	51,8	47,5	45,3	50,6	44,6
	Paddy	19,8	19,7	19,6	20,2	19,1	17,3	18,8	16,7
	Wheat	17,7	17,1	16,9	17,0	15,1	17,8	18,6	17,0
	Corn	17,2	13,5	10,8	11,8	11,1	9,3	11,1	8,6
	Others	2,2	1,9	1,6	2,8	2,3	1,0	2,0	2,3
Quota in % of production	Total	16,2	15,2	13,8	13,3	12,5	11,7	12,6	11,4
	Paddy	16,2	16,6	15,5	15,2	14,8	13,3	15,1	13,6
	Wheat	20,6	20,0	18,6	17,3	15,7	17,5	17,5	17,2
	Corn	21,7	17,4	13,7	12,2	11,2	9,7	10,8	8,7
	Others	3,5	3,1	2,8	4,5	4,1	1,7	2,9	3,3

Source: Ke (1998). Park_2002-01-24

Table 9.4: Quota and market prices for major crops, 1985 to 1997

Year	Wheat		Corn		Rapseed[2)]	Soybeans[2)]
	Quota	Market	Quota	Market		
	Yuan / tonne [1)]					
1985	430	466	310	370		
1986	440	517	320	450	941	798
1987	440	576	330	500	983	808
1988	470	705	340	570	1124	898
1989	510	979	370	780	1315	1083
1990	510	896	380	690	1499	1073
1991	510	795	380	600	1422	1071
1992	590	776	420	630	1298	1313
1993	660	810	460	730	1537	1612
1994	890	1140	690	1010		
1995	1080	1690	860	1580		
1996	1460	1740	1220	1490		
1997	1470	1630	1230	1170		
Δ1985 to 1993 (%)	50	57	44	62	63	102
Δ1985 to 1997 (%)	242	250	297	216		

1) 1 US-$ = 8.3 RMB (1997)
2) national average price of fixed, negotiated, and open market prices, as well as for various standards, grades and qualities.

Sources: Ministry of Agriculture: China Agricultural Development Report (1996).
Information Centre of the Ministry of Agriculture: Unpublished Report.
China Price Statistics Yearbook (1992/1994) Park_2002-01-24

Corn production favored over soybeans

According to HSU (2001) the government's emphasis on self-sufficiency in grains lead to corn production being favored over soybeans in recent years. As soybeans and corn are mainly grown in the northeastern region, and are competing for the same resources, the price ratio between procurement prices for soybeans and corn has decreased from 2.23 in 1994 to 1.84 in 1999, thus placing the soybeans-to-corn returns at a disadvantage (see Table 9.5). The reverse situation is found in the USA where the soybean production is favored to corn and the ratio was holding at 2.78 in recent years (see Table 9.5; for more details on the U.S. agricultural policy see Chapters 5.6 and 6.8). Despite procurement of soybeans being abandoned in recent years, this situation may stay in power as far as the procurement price for corn remain higher as market price, thus favoring the corn production over soybeans.

Table 9.5: A comparison of price support between China and the United States, 1990 to 1999

	China's procurement prices			U.S. loan rates		
	Soybeans	Corn	Ratio	Soybeans	Corn	Ratio
	Yuan/kilogram			Dollar/bushel		
1990	0.83	0.38	2.18	4.50	1.57	2.87
1991	0.88	0.38	2.32	5.02	1.62	3.10
1992	0.91	0.42	2.17	5.02	1.72	2.92
1993	1.04	0.46	2.26	5.02	1.72	2.92
1994	1.54	0.69	2.23	4.92	1.89	2.60
1995	1.81	0.86	2.10	4.92	1.89	2.60
1996	1.95	1.06	1.84	4.97	1.89	2.63
1997	2.28	1.23	1.85	5.26	1.89	2.78
1998	2.23	1.23	1.81	5.26	1.89	2.78
1999	2.10	1.14	1.84	5.26	1.89	2.78
2000	na	na	na	5.26	1.89	2.78
2001	na	na	na	5.26	1.89	2.78

Note: na = not applicable.
Sources: Hsu (2001).
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9.4.3 Agricultural inputs policy and government agricultural expenses

Chinese input policies have faced liberal changes along reforms in agricultural commodities. Markets for machinery and equipment, pesticides and insecticide, fuel, and animal feeds now allow some competition (USDA-ERS, 2001). However the government has retained a major stake in manufacturing of major agricultural inputs, which are marketed through so-called "agricultural materials companies" (AMCs) to lower-level

AMCs and Supply and Marketing Cooperatives (SMC), which in turn retail goods to farmers (CROOK, 1998). In this way the government has retained a firm control in handling of agricultural inputs through the supply system inherited from vestiges of the planned economy, so when the "Grain bag" policy (see above) was introduced, the provincial government was given authority to manage the sales of key agricultural inputs to farmers sometimes at lower fixed prices to encourage production of grains (USDA-ERS, 2001; CROOK, 1998). Additionally, the production and distribution enterprises of most agricultural inputs were granted an exemption from value added taxes (VAT) (TUAN and CHENG, 1999).

Irrigation and water conservancy systems intensively established during the 1950s and the 1960s are used at low fees by farmers and the government continues subsidies for water and electricity supplies (VERMEER, 1997).

Due to the lack of detailed statistics and information on each policy, a general overview of major agricultural expenditure groups in the government budget, is given in the Table 9.6. One observes that major items in the budget are support for agricultural production and operating expenses as well as expenses in capital construction accounting for 54 % and 40 % respectively. Public research was neglected in comparison to other expenditure groups accounting for a mere 1 % of total agricultural expenses.

Table 9.6: Total and agricultural expenditures of China, 1987 to 1999

Year	Total Expenditures	Agric. Expenditure	% of total	Support for Ag. Production and Operating Expenses	Capital Construction	Science and Technology	Rural Relief
				billion US-$*			
1987	60	5.2	8.7	3.5	1.2	0,06	0.3
1988	66	5.6	8.6	4.2	1.0	0,06	0.3
1989	74	7.0	9.4	5.2	1.3	0,07	0.4
1990	60	6.0	10.0	4.3	1.3	0,06	0.3
1991	64	6.6	10.3	4.6	1.4	0,06	0.5
1992	69	7.0	10.0	5.0	1.6	0,06	0.4
1993	81	7.7	9.5	5.7	1.7	0,05	0.3
1994	70	6.4	9.2	4.8	1.3	0,04	0.3
1995	82	6.9	8.4	5.2	1.3	0,04	0.4
1996	96	8.4	8.8	6.1	1.7	0,06	0.5
1997	111	9.2	8.3	6.8	1.9	0,07	0.5
1998	130	13.9	10.7	7.6	5.6	0,11	0.7
1999	159	-	-	8.2	0.0	-	0.5
1987: % of ag. expend.				69	24	1,2	6,4
1998: % of ag. expend.				54	40	0,8	5,1

Note: * converted using official annual exchange rate.
Source: China Statistical National Network (2001), IMF, International Finance Statistics, various issues, own calculation.

Park_2002-03-25

Unfortunately there are not details on the nature of these expenses. One can presume that a large part of expenses are going to irrigation, water conservation, afforestation and land reclamation projects, expansion of existing facilities or building of new ones for production of key agricultural inputs (fertilizer, chemicals, plastics) and machinery as well as to pay up the subsidies for higher procurement prices, storage of procured grains and the whole management of this system.

The share of agricultural expenditure to the total has remained stable and varied between 8 % and 10 % despite the decreasing importance of agricultural revenues to the whole economy (USDA-ERS, 2001).

9.4.4 Agricultural trade policy instruments

During the last two decades, the economy of China has become more open and competitive, however there are remain many tools controlling trade since the time of a planned economy. The major distortions impacting trade are:

State Trade Enterprises

Most important agricultural commodities are still traded by state owned trade enterprises (STEs), including wheat, rice, corn, cotton, oilseeds and their byproducts. The system enables the government to manage the level and direction of the flow of trade of these and other commodities (USDA-ERS, 2001).

Import tariffs and value-added tax (VAT)

Currently China's average tariff rate for agricultural products is 21 %; raw materials are taxed at 16 %; semi-finished 24 %; and finished at 27 % (USDA-ERS, 2001).

In-quota tariffs (see WTO-entry: TRQ) for most oilseeds and oilseed products range between 0 and 40 % in 2000. Soybean tariff at 3 % was low compared to rapeseed at 12 %. The soybean and rapeseed oils were taxed at 13 % and 20 % respectively. There was no tariff for soybean and rapeseed meals in 2000.

Out-of-quota tariffs were much higher ranging between none and 122 % (for soybean oil).

In addition to tariffs, imports of agricultural products are subject to a value-added tax (VAT) which ranges between 13 % and 17 % and is collected at the border. Soybeans and rapeseed, as well as respective oils, including palm oil, were subject to 13 % VAT, soybean meal was added to this list after 1999. Rapeseed meal was imported VAT-free. (see Table A7.3 in Appendix).

The VAT was used by the government as one of the tools to manage trade of selected commodities. In 1995, for example, VAT on imported soybean meal was eliminated to encourage imports, however it was reimposed in 1999 in order to reduce imports and support the crushing industry with rising domestic prices (HSU, 2001).

Export subsidies

Direct export subsidies and VAT rebates for exporters were the main tools to promote exports of agricultural products. Since 1991 direct subsidies were abolished and in 1997 China assured WTO members that they will not implement them again. However some grain exports may still benefit from indirect subsidies, where for example STEs purchase lower-price procurement quota grains and sell it on the world markets at higher price. (OECD, 2000).

9.4.5 WTO-entry

After 15 years of negotiations, China's entry to WTO was approved in December 2001. In the frame of the agreement between major trading countries China has agreed to liberalize intervention in its agricultural economy, the major agreements include:

– Trading rights: the trading rights for commodities should be expanded to non-government entities, however STEs will still remain major players in grain trade;
– Tariff binding: China committed to eliminate all non-tariff barriers, leaving tariffs as the only measure affecting imports. Other measures like inspection, testing, and domestic taxes should comply with WTO rules;
– Tariff rate quota administration: tariff-rate quota (TRQs) are established for major bulk commodities, including wheat, corn, rice, cotton and soybean oil. Oilseeds TRQs should be established soon. The commodities imported within agreed amount of TRQ are subject to lower import tariffs.
– Export subsidies: China commits not to use export subsidies for farm products;
– Domestic support: China commits to reduce trade-distorting domestic subsidies. (OECD, 2000)

9.4.6 Quality standards and GMO

There are no details available about requirements on quality of oilseeds, but according to USDA-FAS (2001), the processors of soybeans and rapeseed prefer imported seed from United States as South America due to their superior quality and reliable supply compared to domestic producers.

No GMO oilseeds are allowed to be grown in China so far. This restriction was further imposed on imports of GM soybeans last year and had a significant impact on trade with the USA, where most of exported soybeans are GM modified and the annual exports to China are about US- 1 billion. The new rules should be published in the near future on how to apply for a safety certificate, but so far the imports have halted (SOYATECH, 2002). This can be one more example of how China may use non-tariff barriers to protect its agricultural markets from foreign competitors.

9.5 Description of selected regions and production systems

9.5.1 Selected regions, location of the farms and climate

After a review of statistics and communication with colleagues from the Research Center for Rural Economy (RCRE), three major oilseed producing provinces were selected for this study. Heilongjiang and Shandong provinces were selected for soybean production and Anhui province for rapeseed production, one farm in each region was selected for the analysis. As shown in Figure 9.10, Heilongjiang is a leading soybean producing province with one-third share of the total area and production. Shandong province accounts for only 5 % of the total area, but the province belonged to the second largest group of provinces each accounting for over 5 % share of the total land area sown to soybeans which plays a significant role in total soybean production (see Figure 9.10). In addition, it was selected to reflect the differences in climate and production systems, hence Heilongjiang has one year rotation system with commercial soybean production which is prevailing in the northeast region, while Shandong soybean production is a traditional system with two crops a year which is to find in the central and the further southern regions. Table 9.7 and Figure 9.19 reveal additional details on the differences in the natural climate conditions between the chosen regions (see also Chapter 9.1). Another advantage of selecting a farm from Heilongjiang is that the northeastern region is considered to be a major potential region for expansion of soybeans production as well as other crops.

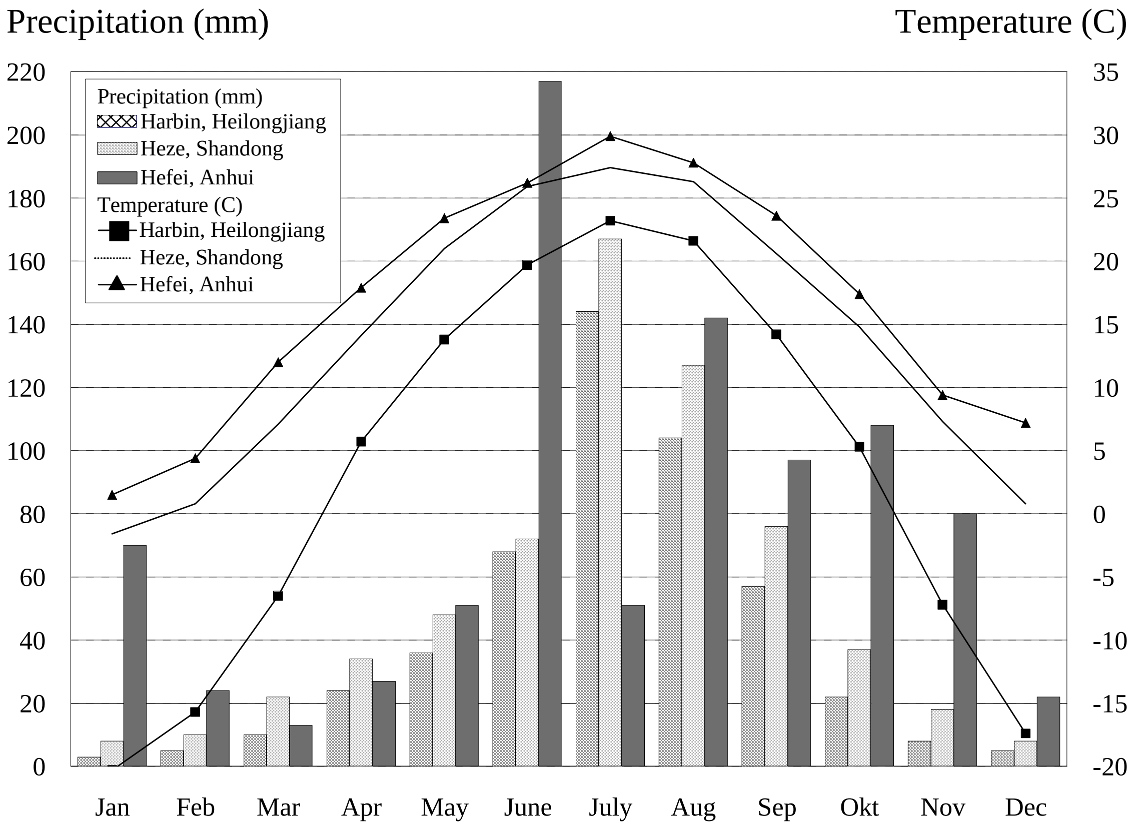
Table 9.7: Climate and soils at the selected locations in China

Region Farm size	**South Central Heilongjiang** **4,3 ha**	**North Central Shandong** **1,2 ha**	**Central Anhui** **0,34 ha**
Soil type	Brown steppe soil	Alluvial soil	Alluvial soil
Relative soil quality	good	very good	good
Rainfall / mm per year	410 to 440	570 to 600	890 to 920
Rainfall distribution	prevailing Jun to Sept (75 %)	prevailing Jun to Sept (70 %)	prevailing Jun to Oct (70 %)
Average temperature °C	3,0	13,7	17,5
Average frost days	more 200	less 100	less 100

Source: Own data collection, Anhui and Shandong Statistical Yearbooks (2001) Park_2002-01-24

Anhui province was selected for a rapeseed analysis, which is one of the four leading provinces producing rapeseed with an over 10 % share of total rapeseed area incuding a major expansion in recent years (see Figure 9.12). Winter rapeseed has about 90 % share of total rapeseed production, which is mainly concentrated in the central, eastern and southwestern regions (see Figure 9.11) with similar climate conditions. The production system is not that much different between provinces as it is the case for soybeans, thus accounting for a limited time and possibilities only one farm with rapeseed production was included in the study.

Figure 9.19: Monthly rainfall and temperature in the selected regions



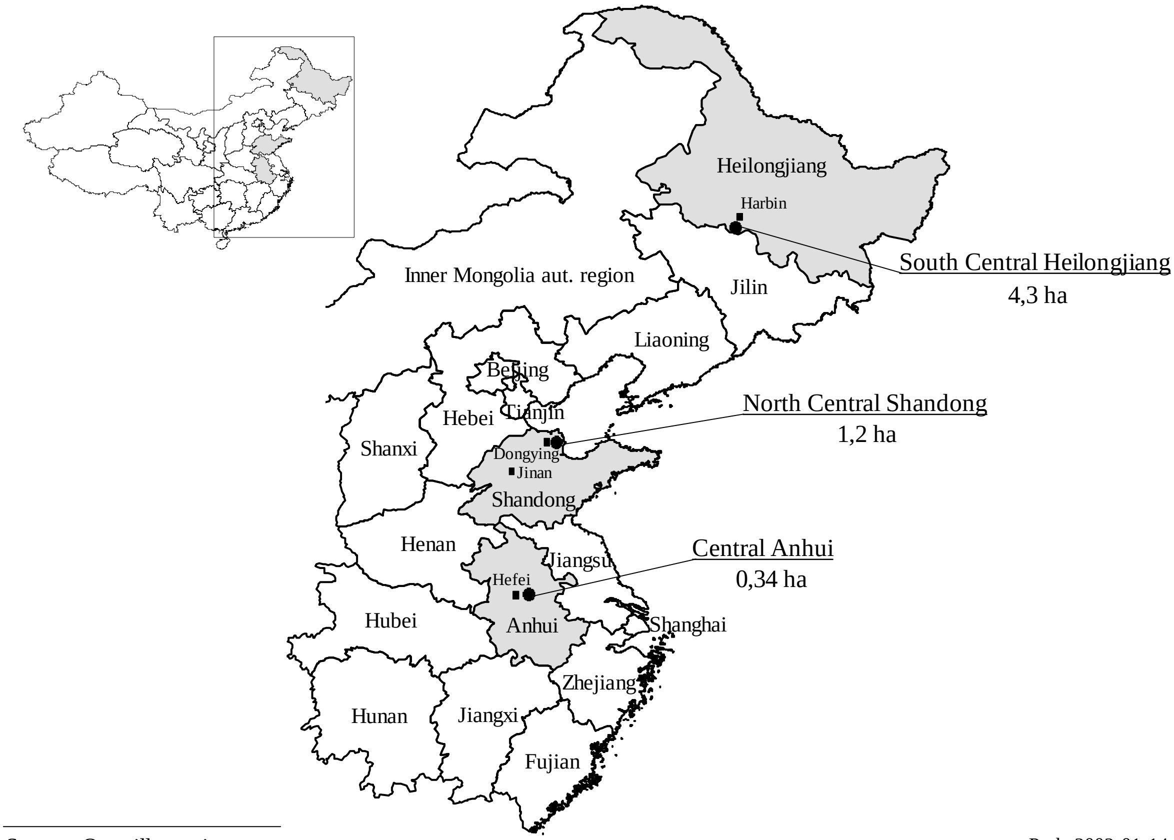
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Okt	Nov	Dec	
Temperature (C)													**Average**
Heze, Shandong	-1,6	0,8	7,1	14,1	21,0	25,9	27,4	26,3	20,6	14,8	7,3	0,8	13,7
Harbin, Heilongjiang	-20,3	-15,7	-6,5	5,7	13,8	19,7	23,2	21,6	14,2	5,3	-7,2	-17,4	3,0
Hefei, Anui	1,5	4,4	12,0	17,9	23,4	26,2	29,9	27,8	23,6	17,4	9,4	7,2	16,7
Precipitation (mm)													**Total**
Heze, Shandong	8	10	22	34	48	72	167	127	76	37	18	8	627
Harbin, Heilongjiang	3	5	10	24	36	68	144	104	57	22	8	5	486
Hefei, Anhui	70	24	13	27	51	217	51	142	97	108	80	22	902

Source: USDA - JAWF (2001); own illustration.. Park_2002-03-19

The Figure 9.20 displays the location of the farms in the selected regions.

A short review of crops grown in the selected provinces and development of the land area planted to these crops during the last twenty years is intended to illustrate the trends (or changes) in agricultural production since the introduction of agricultural policy reforms.

Figure 9.20: Location of the selected farms

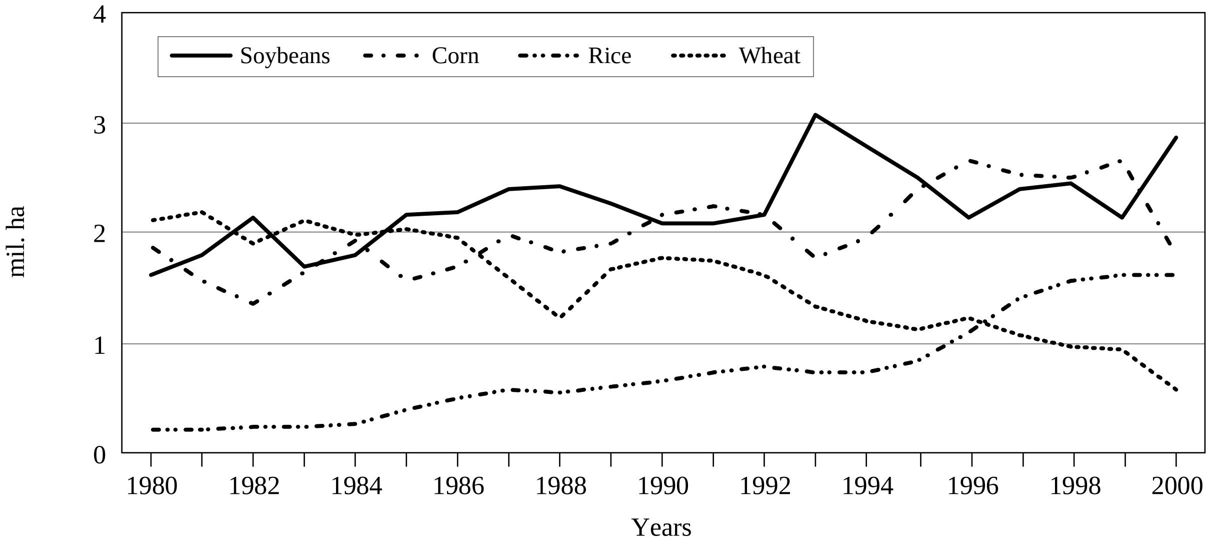


Source: Own illustration.

Heilongjiang

In 2000, the major crops grown in Heilongjiang were **soybeans** (2.9 mill. ha), **corn** (1.8 mill. ha), **rice** (1.6 mill. ha) and **wheat** (0.6 mill. ha) (see Figure 9.21). During the last two decades as agricultural reforms were implemented, soybean and rice land areas have increased, while corn and wheat land areas have decreased compared to 1980 land area totals. Major expansion is observed in rice production that soared up by 1.4 million hectares (663 %) followed by soybeans with an increase of 1.2 million hectares (73 %) during the same period. The trend in the robust expansion of land areas for rice took place after 1994 coinciding with the introduction of the "Grain bag" policy. Interestingly enough soybeans areas stagnated after the initiation of the policy and only began to recover in 2000. Corn acreage fell by 4.4 %, while wheat acreage plunged by 1.5 million hectares (72 %) over the last two decades. Such a decrease in wheat sown areas is explained by the substitution of single-rice which is in high demand by consumers due to it being of better quality and the state, as well as consumers, are willing to pay a premium price for this quality (PERSONAL COMMUNICATION, 2001; HSU, 2000).

Figure 9.21: Area under major crops in Heilongjiang province, 1980 to 2000



Source: China National Bureau of Statistics - Agricultural Yearbooks 1992-2000. Park_2002-01-11

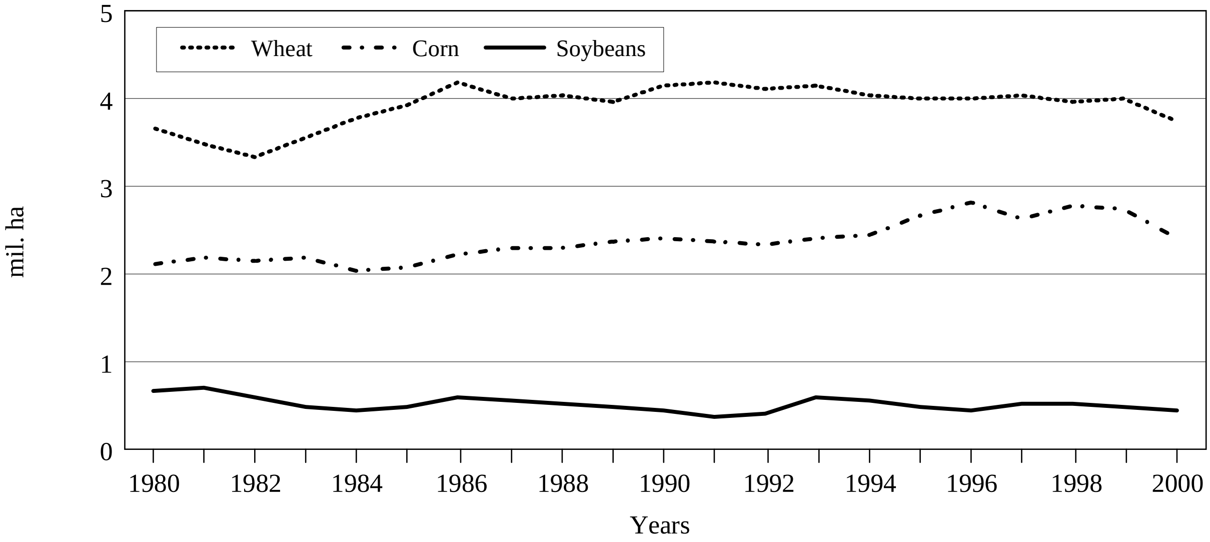
Shandong

In 2000, the major crops in Shandong were **wheat (3.8 mill. ha)** and **corn (2.4 mill. ha)**. **Peanuts** and **soybeans sown** areas were much lower at **0.9 mill. ha** and **0.5 mill. ha** respectively (Figure 9.22). Grain crops had moderate growth, with corn leading the expansion by 0.3 million hectares (13 %). In the meantime, peanut area expanded by 0.3 million hectares (48 %), while soybean area detracted by 0.2 million hectares (34 %) since 1980 to 2000. It seems that the traditional cropping pattern was little influenced with the introduction of the reforms.

Anhui

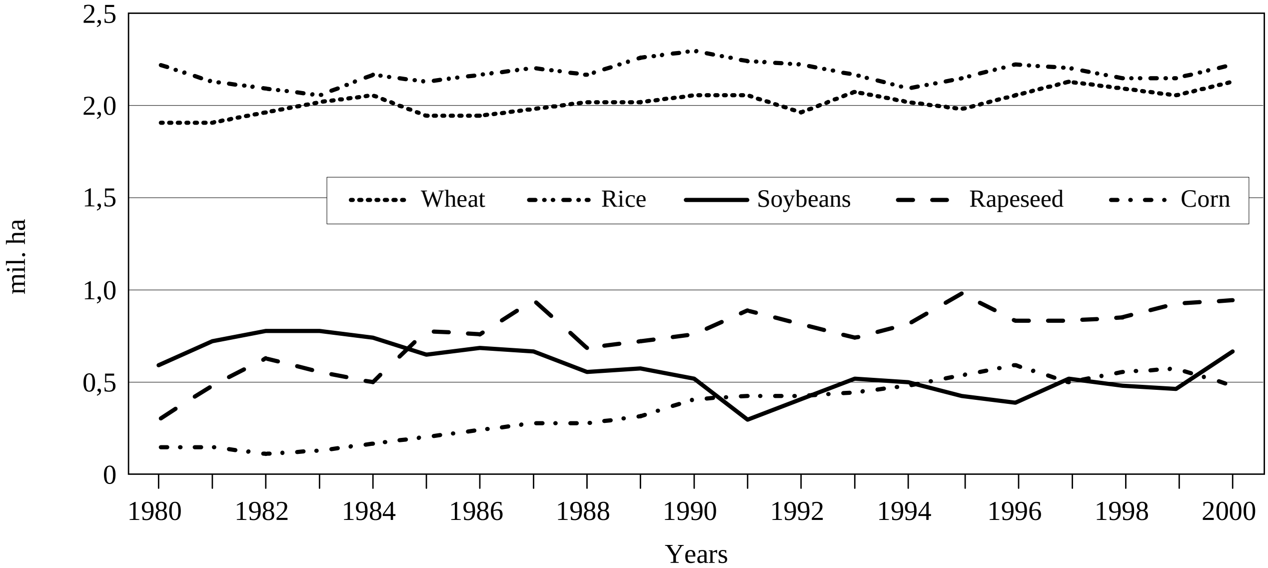
Rice (2.2 mill. ha) and **wheat (2.1 mill. ha)** were major crops in Anhui province, followed by **rapeseed (1.0 mill. ha), soybeans (0.7 mill. ha) and corn (0.5 mill. ha)** in 2000 (see Figure 9.23). During the period researched, corn and wheat areas had expanded by 0.3 million hectares (300 %) and 0.2 million hectares (11 %) respectively crops, while rice areas remained on the same level. Oil crops during this period of time, rapeseed and soybeans in particular expanded as well, rapeseed areas soared by 0.7 million hectares (more then tripled), while soybeans increased just by 70 thousand hectares (12 %).

Figure 9.22: Area under major crops in Shandong province, 1980 to 2000



Source: China National Bureau of Statistics - Agricultural Yearbooks 1992-2000. Park_2002-01-11

Figure 9.23: Area under major crops in Anhui province, 1980 to 2000



Source: China National Bureau of Statistics - Agricultural Yearbooks 1992-2000. Park_2002-01-11

9.5.2 Description of the farms, natural conditions and production systems

Since the introduction of the reforms and dividing the commune land between households, the average farm size has remained very small less than 0.5 ha per household (CHINA STATISTICAL NATIONAL NETWORK, 2001). That was mainly due to policy barriers limiting emergence of larger farms. One obstacle was "household registration" (hukou) system, which was limiting free migration of rural labor, the other was that farmers did not have full ownership rights of the land they farmed and could not transfer the right to manage the land without the approval of the village (BRYAN LOHMAR, 2001; USDA-ERS, 2001). As a result of these policies, about one half of the total cultivated land was farmed by households ranging in size between 0.2 and 0.6 hectares, 12 % was farmed by households even less then 0,2 hectares and the remaining 20 % was allocated to farms between 1 hectare and 6.6 hectares (see Table 9.8). Despite the concentration of land in small sized households, a regional difference in farm size is observed between the north and the south (especially the coastal areas) of China. In the north, where the population density is less than in the south, the farm size is larger compared to south and southeastern regions. For example an average household (assuming 3 members) in Heilongjang farms about 1,6 hectares of land while in Anhui a similar household farms only 0.3 hectares (CSIN, 2001).

Table 9.8: Distribution of cultivated land by household size, 1999

	Total	**Grain** [1)]	**Oil crops**
		million hectares	
Total	**123**	**100**	**8,8**
Houshold size:		share of total (%)	
under 0.2 ha	12	12	12
0.2-0.6 ha	50	50	52
0.6-1 ha	16	16	16
1-1.4 ha	6,6	6,8	5,8
1.4-2 ha	4,9	5,1	4,3
2-3.4 ha	5,8	6,1	5,9
3.4-6.6 ha	2,6	2,7	2,8
6.6-10 ha	0,5	0,5	0,4
10-13.4 ha	0,1	0,2	0,1
13.4 ha & over	0,3	0,3	0,7

Note: 1) soybeans are cosidered as grain as well as some other tuber crops.
Source: China Statistical Information Network (2001), own calculations. Park_2002-04-09

As a result of the structure of land usage in different areas of the country, the farms selected for this study vary in size according to the selected region. A soybean farm in Heilongjiang has 4.3 hectares, while farms from Shandong and Anhui provinces are only 1.2 hectares and 0.34 hectares respectively. Due to small scale of the farms, manual labor is the predominant method of working the farms. There is limited mechanization on the farms included in this study. More details on the production system are given in the Table A7.4 in Appendix.

The farms usually plant a limited number of crops with little change in cultivating patterns. In the northeast one observes that farmers may respond positively (shift between crops) to a change in prices for competing crops like corn, soybeans, wheat and rice (see Figure 9.21 for documentation) where a larger share of the crops will be sold on the market; however, on the smaller size farms in the central and eastern regions, a bigger share of the harvest (mainly grains) is held for household consumption, thus a smaller change in acreage was observed in Shandong and Anhui (see Figure 9.22 and Figure 9.23).

A detailed description of the selected farms, their crop rotation, yields and farm size is found in Table 9.9.

Table 9.9: Crop rotation, share of crops and yields for the selected farms

		South Central Heilongjiang	**North Central Shandong**	**Central Anhui**
Farm size	ha	4,3	1,2	0,34
Soil cultivation system		some mechanization	some mechanization	manual + buffalo
Share of:				
Soybeans	%	36	83	-
Corn	%	64	-	-
Winter wheat	%	-	83 [1)]	-
Cotton	%	-	17 [2)]	-
Rice	%	-	-	100
Winter rapeseed	%	-	-	100 [3)]
Yields:				
Soybeans	t/ha	1,95	2,25	-
Corn	t/ha	6,00	-	-
Winter wheat	t/ha	-	5,25 [1)]	-
Cotton	t/ha	-	3,75 [2)]	-
Rice	t/ha	-	-	8,88
Winter rapeseed	t/ha	-	-	2,11 [3)]

Notes:
1) second crop after soybeans (double cropping).
2) one crop a year.
3) second crop after rice (double cropping).
Source: IFCN data collection and calculation. Park_2002-01-24

9.5.2.1 Soybean production system

Soybean production in China is generally divided into three regions, based on annual rainfall, mean temperature during the growth period, duration of frost-free days, photoperiodic response, and crop rotation systems (see Figure 9.24).

Figure 9.24: Soybean production regions

I Northern Single Cropping, Spring Planting Region
- I_1 Northeastern Sub-region
- I_2 Northern Plateau Sub-region
- I_3 Northwestern Sub-region

II Northern Double Cropping, Summer Planting Region
- II_4 Hai Valley Sub-region
- II_5 Huang and Huai Valley Sub-region

III Southern Multiple Cropping, Multiple Planting Region
- III_6 Chang-Jiang Sub-region
- III_7 Southeastern Sub-region
- III_8 Mid-southern Sub-region
- III_9 Southwestern Plateau Sub-region
- III_{10} Tropical Sub-region

Source: Gai Jun Yi (1984). Park_2002-03-19

Spring-sown soybean region in the north includes Inner Mongolia, Heilongjiang, Ningxia and Xinjiang and the northern parts of Hebei, Shanxi and Gansu provinces. Spring-sown soybeans in the northeastern provinces are concentrated mainly on the Songhua jiang and Liaohe Plains which, form one of the major soybean production areas.

The region has **one crop a year** - a full season crop. Soybeans are planted from late April to mid-May and harvested in September. The growth period varies from 105 to 155 days. The cultivars used in this region are not day-length sensitive, but respond to temperature and have an indeterminate growth habit. The main rotation system is corn-soybeans-small grain, or soybeans-spring wheat-corn. (PERSONAL COMMUNICATION, 2001; MA RHU-HWA and ZHANG KAN, 1983)

Summer-grown, multiple cropping soybean region along the Huang he and Huai he basins include Shandong, Henan, and the northern parts of Jiangsu and Anhui, and is another major soybean production area. This is the major winter wheat production area of the North China Plain, where soybeans usually are planted after winter wheat. Generally, soybeans are planted in June and harvested at the end of September. The growing period ranges from 95 to 110 days (PERSONAL COMMUNICATION, 2001; MA RHU-HWA and ZHANG KAN, 1983).

A multiple-cropping soybean region in the south is located in the southern part of Huai River and the Qinling mountain range where there is abundant rainfall and high temperatures. Rice is the main crop with corn and sweet potatoes as dry-land crops; and cotton, hemp and rapeseed are cash crops. Because of the long period of frost-free days, usually more than 240 days, this cropping system is characterized by two or three crops a year, or three crops in two years, or even five crops in three years.

Soybeans can be sown in spring, summer, or fall. Generally, they are rotated with rice or winter wheat, or interplanted with maize or sweet potatoes.

Domestic cultivars prevail in plantings. So far, no GMO soybean seed has been allowed to be planted in China.

The major diseases and insects damaging soybeans are mosaic virus, cyst nematode, rust, aphids, soybean podborer, root miners, stem flies, small velvet chafer beetles, sphynx moths, three-spotted pentatomids and bean blister beetles (GAI JUN-YI et al., 1987).

9.5.2.2 Rapeseed production systems

Rapeseed production is generally divided into two regions: spring-sown and fall-sown rapeseed regions.

The spring-sown rapeseed region is located in the western and the northeastern part of China. This region has less then 10 % of total rapeseed production.

The fall-sown rapeseed region is located south of Yellow river and accounts for 90 % of the total rapeseed production (USDA-JAFW, 2001). Winter rapeseed production is mainly concentrated in Anhui, Hubei, Sichuan, Jiangsu and Hunan provinces (see Figure 9.12). The main rotation systems are double/single crop rice-rapeseed, or soybean-rapeseed, and cotton-rapeseed. Such established systems, as for example rice – winter rapeseed in the selected region in Anhui province, are used on the same plots for many years without any change. According to communication with experts there is little problem with deseases or pest for rapeseed crop (PERSONAL COMMUNICATION, 2001). In the rice rotation system, in order to make sure that the rapeseed plant is sufficiently developed to survive winter, it is practiced to plant the seed in a nursery in the middle of September and then transplant seedlings to the field in October after the rice harvest is finished. The harvest of rapeseed is in April.

Although there is an increasing number of improved cultivars of rapeseed being planted, to date, GMO rapeseed is not allowed for planting (USDA-FAS, 2001).

9.6 Production costs and profitability of soybeans and rapeseed

This chapter will focus on the results of the economic analysis of the selected farms. Figures 9.25-9.29 represent the production costs and profitability of soybeans and rapeseed. All figures are in Euro per hectare or Euro per yield unit for 2000. The soybean figures are converted into rapeseed equivalent to enable direct comparison of all three farms domestically and later to include them into the intenational comparison (see Chapter 11). The method of calculation of the rapeseed equivalents for different crops is described in the Chapter 3.2.2.

It is found that major cost groups are operating, land and direct costs. However, due to the difficulties in collection of the detailed information the results produced in this study should be interpreted cautiously. Some assumptions had to be made in order to define land costs and labour costs on the selected farms. Further, it will be explained how double cropping and figures on fertilizer and plant protection were dealt with.

Land cost can be estimated a) with the help of economic models, b) rent prices defined by market forces. As use of economic models is often limited by available information and resources, second method is usually used for IFCN analysis. As it was mentioned in the Chapter 9.4 the land is not easily transferrable between households and only in a few regions exist some land markets. This was the case in Heilongjiang province were farmers could rent additional land from the village in free bidding for the available plots. Thus this rent prices are some approximation of market value of the land. However the figures should be interpreted cautiously as there are still many limitations and land markets are not established. In Anhui and Shandong provinces the land is even more scarce and there was very limited possibilities to increase farm size in addition to HPRS land.[1]

Labor is one of the largest inputs in crop production in the selected regions. On all three farms mainly family labour was used for crop production. Though this unpaid family labour does not receive a wage, it does have economic cost. Generally, in order to determine this economic cost the opportunity cost of off-farm work or the return available in the next best alternative use of this labour maybe used. As there exist unemployment in rural areas and opportunities for off-farm employment are still limited for farmers it was decided not to use off-farm wages to define opportunity cost of unpaid labour in order not to overstate the opportunity cost of family work. Another method was used to define the value of unpaid labour. As there is a practice to hire seasonal workers for peak times like harvesting or planting it was chosen to estimate how many days the hired worker will need to complete the work and then multiply the amount of days with a daily payment. A

[1] HPRS land - the land assigned according to the Household Production Responsibility System. The HPRS is explained in the chapter 9.4.1

daily rate for hired worker is about 15 RMB (2.0 Euro). The number of days needed to farm one hectare of the specified crops was taken from the National Cost of Production Survey Data (CHINA RURAL STATISTICAL HANDBOOK, 1994) and was adjusted for the selected regions and specific situation during the discussions with the chinese partner.

The Shandong and Anhui farms benefit from **cost savings** of **double-cropping**. The cost of land for both farms and water fee for Anhui farm are shared between two crops grown in one year, thus reducing the production costs. Irrigation is not used intensively in oilseed production, therefore only a small partion of the irrigation fee was assigned to rapeseed at the Anhui farm. A fraction of the fertilizer cost (P, K) of winter wheat was allocated to the soybeans at the Shandong farm, accounting for a carry over effect of nutrients applied to the first crop and remaining available for the second crop.

Additionally, the double cropping inceases the **farmer's yearly income** significantly, where the first crop (a grain) is mainly produced for own consumption and the second crop (an oilseed) is sold on the market or to the purchase station.

The information on **fertilisation** and **plant protection** figures should be interpreted carefully. Figures on fertilization were complemented with available statistics and discussions with experts. The most of chemicals were herbicides with some intsecticides used on all farms. No fungicides or growth regulators were used on the farms.

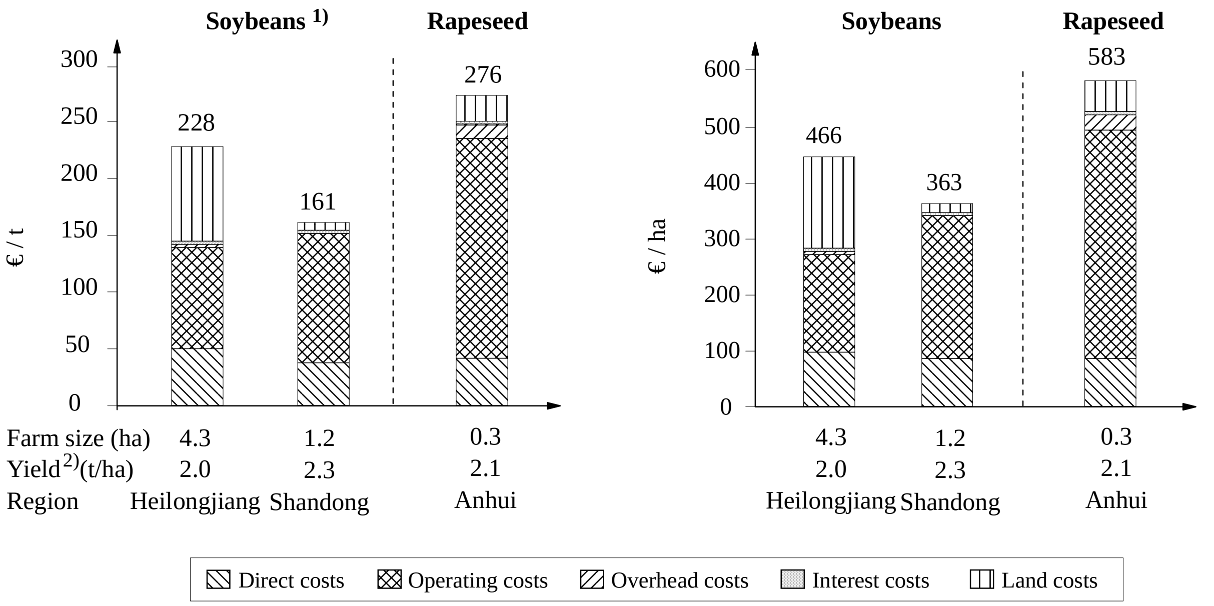
9.6.1 Production costs

The Shandong and Heilongjiang farms are low cost producers (see Figure 9.25). Lower direct and land costs at the Shandong farm combined with considerably higher yield result in the cost advantage per yield unit over other farms. Anhui farm had the highest production costs with operating and overhead costs contributing the major part to the cost disadvantage.

Land costs

Anhui and Shandong farms have significanly lower land costs compared to Heiljongjiang farm (162 Euro per hectare) due to double cropping (see Figure 9.25).

Figure 9.25: Soybeans and Rapeseed: Production costs, 2000



Exchange rate: 1 € = 7.66 RMB
Park_2003-09-10
1) Soybean figures are given in the rapeseed equivalent. The neutral results are multiplied by 0.996.
2) Yields are expressed in natural measures.
Source: Own calculations.

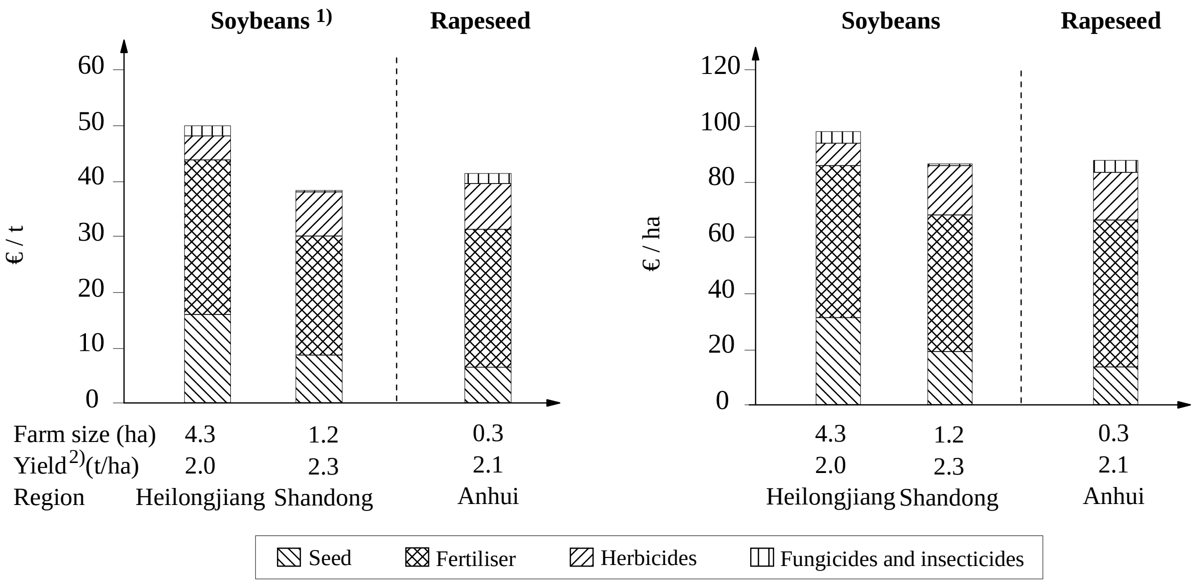
Direct costs

Direct costs are of slight difference in total production costs and range from 38 Euro per t (Anhui) to 50 Euro per t (Heiljongjiang) (see Figure 9.26).

Higher **seed** and **fertiliser costs** have put Heilongjiang farm at a disadvantage to the Shandong and Anhui farms. Higher seed costs at the Heilongjiang farm is to explain that the farmer used certified seed for planting (0.52 Euro per kg) while the Shandong farmer used own seed (0.26 Euro per kg). As to Anhui farm, the farmer used certified rape seed (1.2 Euro per kg), however due to a small amount needed for planting the seed cost remained very low (Table A7.4 in Appendix).

The **fertiliser costs** contributed more than a half to direct cost on all the farms. At the Heiljongjiang farm complex fertiliser was applied, where at the Shandong and Anhui a combination of complex and nitrogen fertilisers was used.

Figure 9.26: Soybeans and Rapeseed: Direct costs, 2000



Exchange rate: 1 € = 7.66 RMB

Park_2003-09-10

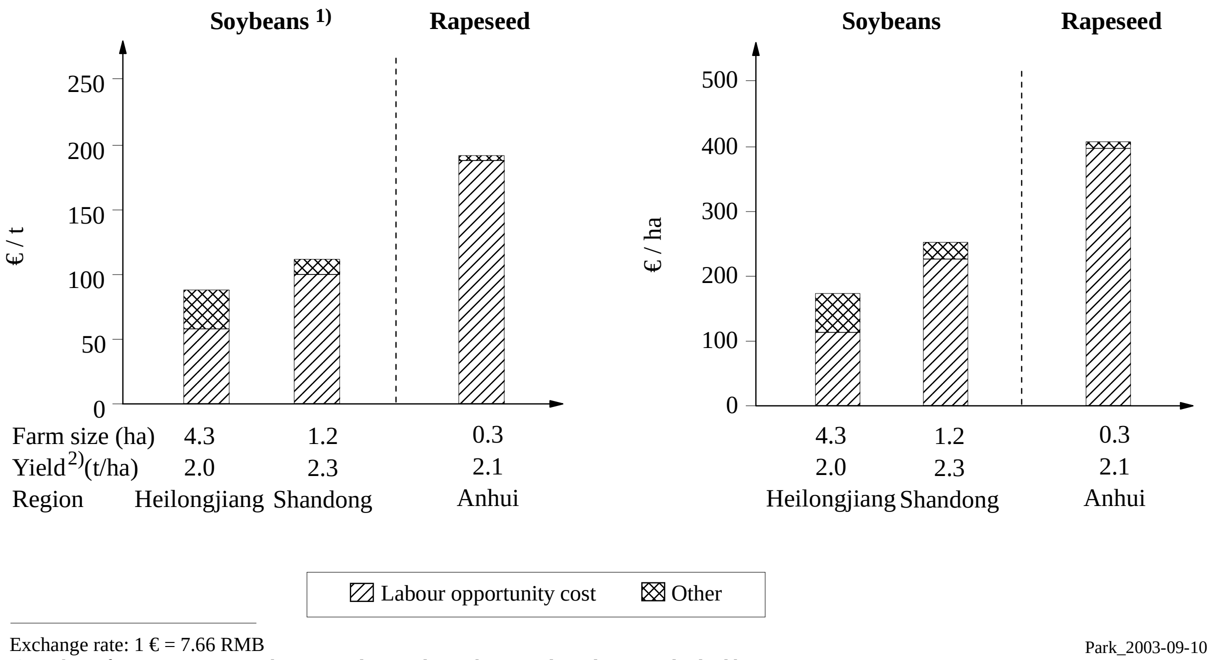
1) Soybean figures are given in the rapeseed equivalent. The neutral results are multiplied by 0.996.
2) Yields are expressed in natural measures.
Source: Own calculations.

Operating costs

Operating costs have contributed the largest share (40 %-70 %) to the production costs on all three farms and ranged between 89 Euro per t (Heilongjiang) and 192 Euro per t (Anhui) (see Figure 9.25 and Figure 9.27). Most notably is that very high opportunity cost of labour made almost 70 % of the Heilongjiang and over 90 % of the Shandong and Anhui operating costs. The reason for this lie in the production system of the selected farms. In Heiljongjiang where some machinery and custom work is used for crop production (substituting the manual work) the labour cost is lower (58.1 Euro per t) compared to Shandong (100 Euro per t) and Anhui (188 Euro per t) farms, where most of work is done manually. Under the current production system the Anhui farm needed three times and the Shandong farm two times more hours to manage one hectare of rapeseed or soybeans respectively compared to Heilongjiang (see Table 11.1).

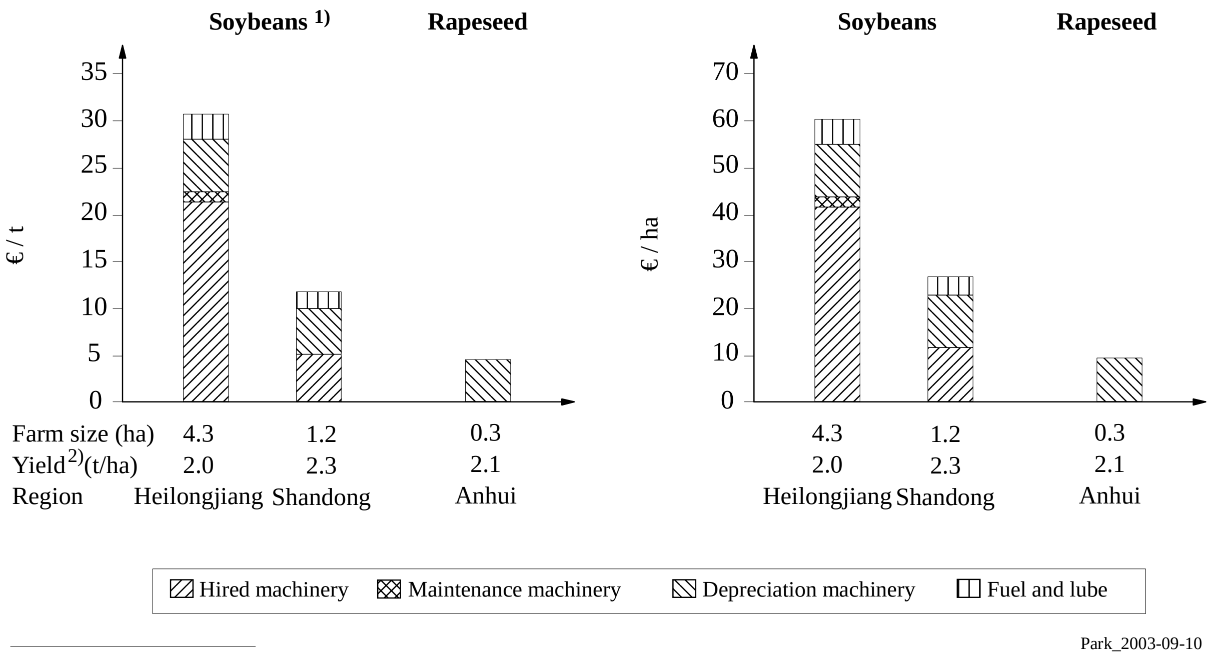
Figure 9.28 display the operating cost excluding the opportunity cost of labour. One may note that the highest operating cost are at the Heilongjiang farm (31 Euro per t) followed by the Shandong (12 Euro per t) and the Anhui (5 Euro per t) farms. The reason for such situation was desribed above and is mainly due to very little subsitution of manual work with machinery, especially on smaller in size the Shandong and Anhui farms.

Figure 9.27: Soybeans and Rapeseed: Operating costs, 2000



Exchange rate: 1 € = 7.66 RMB
1) Soybean figures are given in the rapeseed equivalent. The neutral results are multiplied by 0.996.
2) Yields are expressed in natural measures.
Source: Own calculations.

Figure 9.28: Soybeans and Rapeseed: Operating costs excl. Labour opportunity costs, 2000

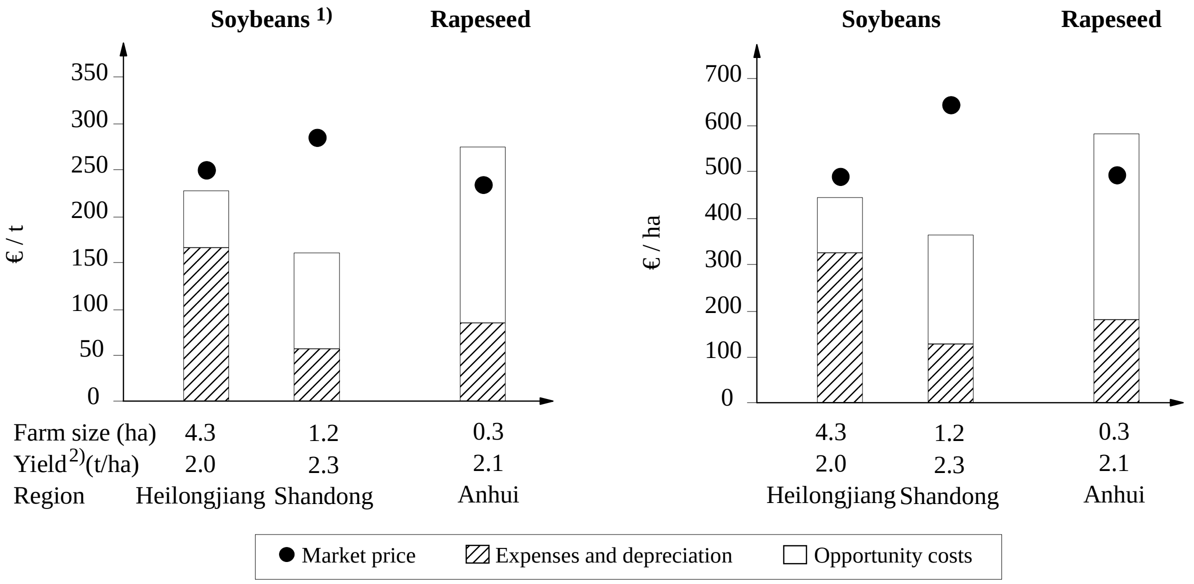


Exchange rate: 1 € = 7.66 RMB
1) Soybean figures are given in the rapeseed equivalent. The neutral results are multiplied by 0.996.
2) Yields are expressed in natural measures.
Source: Own calculations.

9.6.2 Profitability

Figure 9.29 displays the cost of production divided into budget based expenses and depreciation, and opportunity costs against market returns from sale of soybeans and rapeseed in the selected regions.

Figure 9.29: Soybeans and Rapeseed: Profitability of production, 2000



Exchange rate: 1 € = 7.66 RMB
1) Soybean figures are given in the rapeseed equivalent. The neutral results are multiplied by 0.996.
2) Yields are expressed in natural measures.
Source: Own calculations.

Park_2003-09-10

All three farms were able to generate positive family farm income (returns minus expenses and depreciation), which ranged between 83 Euro (Heilongjiang) and 228 Euro (Shandong) per ton of yield unit. On the per hectare basis the family farm income ranged between 162 Euro and 516 Euro for the respective farms.

Most notably is that the **opportunity costs** for both smaller size farms (from Shandong and Anhui) contributed almost 70 % to the total production costs, while at the Heilongjiang farm the opportunity cost had contributed only 28 % to the total. That is the major reason why the Shandong and Anhui farms could generate that higher family farm income where opportunity costs are not considered. Referring to **entrepreneurial profit**, where all costs are accounted, the Shandong and Heilongjiang farms could generate a positive profit of 126 Euro and 27 Euro per ton respectively, where the Anhui farm had a negative profit of 42 Euro per ton.

Another important reason for a higher profit of the Shandong farm is the higher price (36 Euro per t higher) for the sale of soybeans compared to the Heilongjiang province. The reason for this is the regional difference in prices, which tend to increase from the northeast to the southern coastal regions where are the major demand for soybeans. So this difference expresses the cost of transportation of soybeans from the northeast to the cental and southern regions (USDA-FAS, 2001).

10 Oil palm production in Indonesia and Malaysia

Introduction

The recent two decades have witnessed an increasing dominance of palm oil in the world's oils production and trade. During the past two decades, production of palm oil has increased five-fold from 5 million tons (1980) to 24 million tons (2000), meanwhile total production of oils increased only two and half times from 36 million tons to 89 million tons in the respective period. There has been even more prolific expansion of palm oil on the world oil markets, where during the last two decades palm oil has increased its export share from 30 % in 1980 (3,4 million tons) to 50 % in 2000 (18 million tons). Malaysia and Indonesia are the major producers of palm oil together contributing 82 % of the total 23 million tons of palm oil produced in 2000. Malaysia alone produces half of the total palm oil. Around 80 % of produced palm oil in Malaysia is destined for exports, whereas Indonesia uses a large part of produced oil for domestic markets and around 30 % is exported.

Palm oil is a very distinctive crop and remains unknown for many people in Europe. Thus, the following chapter will introduce palm oil, starting with its origin, history, botany, ecological requirements and production systems. After the introduction, two detailed chapters on major producers and exporters of palm oil, Malaysia and Indonesia, will follow. At the end a comparison of selected farms will give an overview on economics of palm oil production in Indonesia and Malaysia.

10.1 Introduction into oil palm

10.1.1 Origin and distribution

The oil palm is found in wild, semi-wild and cultivated states in the equatorial regions between 10^{o} N and 10^{o} S of three continents. Fossil and historical evidence suggests that Africa, probably West Africa, is the original home of the oil palm. It was introduced to South America with the advent of the slave trade in the early seventeenth century and abundant groves are found in Brazil (HARTLEY, 1988). Oil palms were grown in European botanical gardens in the 18^{th} century and brought from there as ornamental tree to Calcutta, Mauritius, Java and Singapore. Regular trade in palm oil and palm kernels between West Africa and Europe started early in the 19^{th} century with the industrial revolution (HENDERSON et al., 2000). Oil and kernels were produced by traditional extraction methods from fruits collected in the semi-wild palm groves.

The first commercial plantings for production of edible oil were made in Sumatra and Malaysia in 1911 and 1917, respectively (HARTLEY, 1988). By 1938, there were

90 thousand hectares planted in Sumatra, and 30 thousand hectares in Malaysia. After World War II, production increased considerably, especially in Malaysia and Indonesia, where large areas of rubber plantations were replanted with oil palm in addition to new plantings in forest areas. These two countries have become leading producers and exporters of palm oil and products. Other important producers of palm oil are Nigeria, Ivory Coast and Cameroon (Africa), Thailand (Asia), Papua New Guinea (Oceania) and Colombia and Ecuador (South America).

10.1.2 Botany

Morphologically, the oil palm comprises an extensive fibrous root system extending from the prominent bole of the base, an erect stem of 0.3 to 0.6 m in diameter which can exceed 16 m in height if more than 30 years old, and a crown nesting on top with 25 to 40 pinnate leaves.

The palm has one terminal growing point and leaves are produced continuously. On average, twenty to thirty leaves are produced per year. A bud emerges at the axil of every leaf that can develop into male or female inflorescence. Male and female flowers occur separately on the same plant. After pollination by wind or insects, the fruit bunch develops in 5 to 6 months. A bunch may contain 500 to 2000 fruits with an individual weight of 3 to 30 g (HARTLEY, 1988).

The fruit is a sessile drupe varying in shape from nearly spherical to ovoid or elongated. In length it varies from about 2 to 5 cm. The fruit consist of a thin exocarp or skin, an oily pulp or mesocarp, a hard stony endocarp or shell, and an endosperm or kernel. The endocarp (shell) and the endosperm (kernel) constitute the seed. Oil occurs in both the mesocarp and kernel. Palm oil is extracted from the mesocarp and palm kernel oil from the kernel.

The oil palm, Elaeis guineensis Jacq., belongs to subfamily Cocoidae of Palmae, which also includes the coconut. The classification (HARTLEY, 1988) of oil palms is mainly based on shell thickness. There are three major varieties:

a) Dura has hard-shelled palm nuts. The average type has a shell of 2 to 5 mm in thickness, which reach 45 % of the weight of the fruit. The mesocarp is thicker, varying between 2 to 6 mm and reaching 45 % of the total weight.

b) Pisifera is almost shell-less. The kernel is extremely tiny (1 %) and the mesocarp is very thick (99 %) - but the fruit is generally small.

c) Tenera has a shell of 0,5 - 4 mm thick (5 - 20 %) with a large portion of mesocarp (70 - 90 %). The Tenera is a hybrid of the Dura and Pisifera forms, often named “D x P”.

Currently, all modern, commercially planted material consists of Tenera palms, which are obtained by crossing thick-shelled Dura with shell-less Pisifera. The reproduction of oil palms is by seed. Clonal oil palms offer the potential for greater productivity because it is possible to establish uniform tree stands comprising identical copies (clones) of a limited number of highly productive Tenera oil palms (CORLEY, 1983). In addition, improved standards of field agronomy have a greater effect on productivity. However, after a boom in clonal research in the 1970s, the problems of flowering abnormality as well as technical problems are still hindering the scaling up of clone production for commercial planting. So far only several thousand hectares have been planted in Southeast Asia with clonal palms (MUTERT et. al, 1999).

10.1.3 Yields

The yield of fruit bunches depends on climate, planting material, management system, and other factors. The two main components of the oil yield per hectare are yield of fresh fruit bunches and the yield of oil per bunch. The yield of fresh fruit bunches depends on (HARTLEY, 1988):

- Number of palm trees per hectare. A standard of 148 trees per hectare was determined to be the density where the cumulative yield per palm multiplied with the number of palms is optimum. Because the frond of the palms are arranged spirally, a triangle planting system gives the best distribution in the field. The number of palms per hectare decreases through disease during the lifespan of a plantation.
- The number of bunches per tree depends on leaf production, sex ratio, the abortion of bunches and the number of bunch failures. Generally, the number of bunches produced annually per tree declines with age from 15 to 25 bunches in the 4th year to about 10 bunches in the 12th year. After that, the number of bunches decreases slowly.
- Bunch weight increases with the age of tree from about 5 kg in the 4th year to 20 to 25 kg in the 14th year.

As a result the production of fruit bunches increases rapidly from the beginning of production in the 4th year to a maximum around the 10th year after the planting. After that, the yield gradually declines to 60 - 80 % of the maximum yield at the age of 25th year.

The yield of oil per bunch is determined by:

- Fruit to bunch ratio that is dependent on the pollination. Ratios are about 55 to 70 %.
- Mesocarp to fruit ratio that is mainly dependent on the genetic form of the palm. For Tenera palms the ratios are about 70 to 90 %.

- Oil to mesocarp ratio is dependent on ripeness of the fruits. The ratios are about 45 to 55 %.

Table 10.1 displays the potential of yield components of palm trees on middle quality land in Indonesia. These estimations are of similar order for Malaysian palm oil trees. One should note that cloned trees have much higher potential of oil yields (PERSONAL COMMUNICATION, 2000).

Table 10.1: Yields of fresh fruit bunches (FFB), crude palm oil (CPO) and palm kernels (PK)

Age	Yield FFB	Extraction of		Production	
		CPO	PK	CPO	PK
	ton per ha	%		ton per ha	
1	-	-	-	-	-
2	-	-	-	-	-
3	8	16	2.5	1.3	0.20
4	15	18	3.0	2.7	0.45
5	17	19	3.5	3.2	0.60
6	18	21	3.5	3.8	0.63
7	20	22	3.5	4.4	0.70
8	21	23	3.5	4.8	0.74
9	23	23	3.5	5.3	0.81
10	25	23	3.5	5.8	0.88
15	30	23	3.5	6.9	1.05
20	25	23	3.5	5.8	0.88
25	16	23	3.5	3.7	0.56
Average	22.9	22.2	3.4	5.1	0.8
Total	526	-	-	118	18.3

Note: FFB - fresh fruit bunch, CPO - crude palm oil, PK - palm kernel.
Source: PPKS (1999). Park_2003-04-03

10.1.4 Ecological requirements

As to ecological requirements, the oil palm needs a humid tropical lowland climate. According to Hartley (1988), there are a number of essentials for high production of oil palm:

- The most important element of climate for the growth of oil palm is rainfall. An average annual rainfall of 2000 mm and above, with even distribution throughout the year is optimal. A period of three months with rainfall less than 100 mm is considered the maximum acceptable deviation.

- Mean maximum temperatures of 29 - 33 Celsius, and mean minimum temperatures of 22 - 24 Celsius, are optimal. A mean minimum temperature below 18 Celsius is unfavorable as growth stops and yields are reduced at a later stage.
- Sunshine for at least 5 hours per day throughout the year.
- Temperature in the tropics can be a limiting factor in areas at higher altitudes and in areas further away from the Equator than 13oN and 12oS latitude with a colder season.
- Oil palms can grow on wide range of soils. An adequate supply of soil moisture is more important than nutrient supply. The water-holding capacity of the soil becomes important as rainfall becomes only marginally suitable. Certain soils are unfavorable for the oil palm and must be avoided: poorly drained soils, lateric soils containing concretionary ironstone, very sandy coastal soils and deep peat. Oil palms tolerate periods of flooding provided they are not prolonged.

10.1.5 Production of fruit bunches

Before the harvesting of fruit bunches can start, a period of 3 - 4 years is needed for field establishment. The establishment phase includes all measures necessary from planting of a new oil palm field until onset of the productive phase. In general, these measures consist of preparation of the land area, raising of seedlings, and care of the field. Aside from the time expenditure for land preparation and raising of seedlings, this phase extends over an average of three years.

10.1.5.1 Establishment phase

Nursery

Seedlings are grown in nurseries from seeds. They remain in the nurseries for about 12 months, until transplanting. The objective is to grow strong and healthy plants from quality seeds of known origin. The selection of the appropriate growing method for seedlings plays an important role in the length of the juvenile phase of oil palms. At the same time, in addition to selecting the appropriate seeds, the foundation for high yields is laid here. The better the growth, and the larger the leaf surface of plants during the juvenile phase, the higher the initial yields of the new plants. Large estates, as a rule, have their own nursery where the plant material is grown which is needed for new plantings or replantings. Frequently these nurseries offer grown plant material to smallholders and plantations without nurseries.

Watering is done daily to maintain appropriate soil moisture. Weed and pest control is carried out regularly manually. Chemicals are only applied when necessary.

Land preparation

While nursery seedlings are being raised, activities are underway to prepare fields for planting of the nursery palms. Usually land preparation will start with a land and soil survey where the layout of blocks, roads, drains and fertiliser requirements will be determined. A range of works in land preparation for the new field will depend much on the previous land utilization. In general, the source of land is classified as following:

- primary clearing after logging and timber extraction;
- clearing of secondary forest, wasteland, swamp, and alang alang land;
- clearing of land previously planted with rubber, coconut, cacao, or oil palm (replanting)

Often, clearing of an area will be done by a contractor who will have all necessary heavy equipment and an experienced team to conduct the work. The activities consist of felling the forest or previous crop, cutting the trees and burning them. Terracing of land is done where necessary. In recent years, due to environmental problems caused by burning, Malaysia and Indonesia have introduced strict laws prohibiting the burning. The so-called "zero-burning" practice is gaining importance. The trees are collected along a line, chipped and left for decomposition.

Field planting

After the land preparation is completed, field planting can begin. It starts with lining of the field and preparation of the holes for the transplanted seedlings. The trees are planted in a triangular order. The planting scheme, location of harvesting path and collection points are displayed in Figure 10.1. The density of planting varies between 122 and 148 trees per hectare.

Cover crop

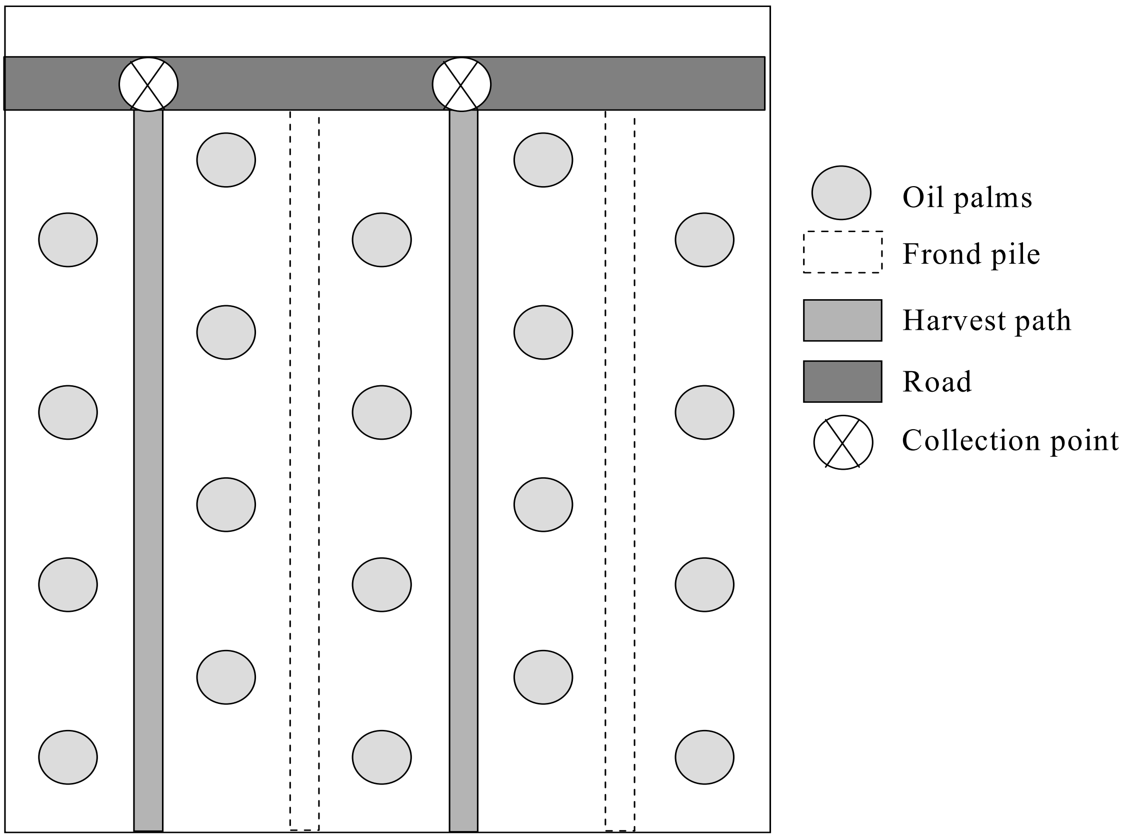
After the field is established, soil conservation is a primary concern. The planting of cover crops and the establishment of inter-row vegetation is considered the best way to minimize soil erosion and to improve chemical and physical properties. Usually legumes are used as cover crops, but other crops like cassava, banana or peanuts can be used as well (Hirsinger, 1999).

Drainage and terracing

Where oil palms are planted on alluvial soils or peat, some degree of drainage is always necessary to remove excess water during periods of heavy rain, but the intensity of drainage depends on the relief of the area, the permeability and water retention capacity of the soil.

Where terrain is not flat, the necessity for conservation practices depends on the steepness of the land. On undulating to rolling terrain (2 - 12° slope), terracing is generally not necessary, although with sandy loams, silt pits are advisable. Where the terrain is hilly (12 - 20° slope), or steep (20 - 25° slope), terracing is necessary, particular for the steeper land. On very steep land (>25° slope) although palms can be satisfactorily established, this is restricted to soils with deep profiles (Stewart, 1968).

Figure 10.1: Scheme of harvest paths, frond piles and palm trees in the field



Source:Own illustration. Park_2003-02-25

Transportation system

For all field operations of planting, upkeep, and harvesting, an efficient system of communications is necessary. Both road and rail systems are used for transportation. However, in recent years transportation by trucks has gained favour as it is considered to be cheaper.

10.1.5.2 Productive phase

The productive phase starts from the 3rd or 4th year and usually lasts up to the 25th year. During this phase, care should be taken of plants including weed, pest and disease control, pruning and fertilizing.

Plant protection

Compared to other crops, established oil palms rarely require the use of chemicals. However, management is vigilant to detect and monitor early signs of pest and disease attack and take prompt action to contain it. On large plantations, plant protection specialists are given task of evaluating, monitoring and planning the operation or outside advisors are consulted.

One of the most essential prerequisites for efficient plant protection and disease control is pest census and monitoring.

Considerable advances in the field of biological pest control have been made in recent years, including the use of barn owls for rat control, and viral pathogens on leaf eating caterpillars. Fortunately, pest and disease problems are so far not very serious in the main oil palm growing areas, although at times, losses can be very high in limited areas. Main losses are due to leaf-eating pests such as nettle caterpillars, bagworm, and grasshoppers. Occasionally the Oryctes rhinoceros beetles can be a problem where good breeding grounds (rotting wood) exist. Porcupines, rats and wild pigs, and occasionally even elephants, can be major pests for young palms.

Among diseases, basal stem rot, caused by a number of species of Ganoderma, is the only pathogenic disease of real significance in Southeast Asia. Diseases, particularly those affecting roots, are potentially more serious than pests. Severe infection would result in the permanent loss of the infected palm. Considering the economic life span of an oil palm of over 20 years, the consequence is evident.

Fungicides are virtually never used in mature plantations. It is not that there are no diseases, but the applications did not prove to be successful.

Herbicides are generally used to keep a clear access path and a clean circle at the palm base for recognizing and collecting loose fruits. In addition to this, competition for nutrients and water is reduced. Of particular importance is the control of noxious weeds in the fields that are very difficult to control by manual hand weeding.

Fertilizing

On a modern plantation, consumption of agrochemicals and final output are carefully monitored. A soil survey, an exact mapping of soil conditions, precedes the establishment of a plantation. Soil samples are taken to determine the actual nutrient status. Palms receive regular doses of NPK fertilizer during their lifetime. Initially doses are small and applied alternate monthly, then less frequently, until mature palms are given two heavy applications a year. In the mature phase, the fertiliser quantity to be applied is adjusted according to the results of leaf analysis.

Over the past decades, much research has been done to obtain reference values about nutrient deficiencies and nutrient requirements of oil palms, depending on local conditions and on palm age. The resulting recommendations for fertilizer application have a very broad range.

Generally, fertilizers are applied at the beginning of the rainy season in order to avoid losses from leaching. Fertilisers are spread manually in the field. A simple cup method is used where the fertilizer is measured manually with a cup and spread directly on the palm circle. In some estates, fertilizer is applied mechanically with tractor and an attached spinner.

Pruning

A desirable objective of pruning is to retain as much photo-synthetically active tissue as possible, while providing sufficient access for cultural practices such as weed and pest control, harvesting.

For palms not yet bearing fruit, at about 18 months, the lowest whorl of leaves is removed to facilitate circle weeding and castration. After three to four years, pruning should be confined to those fronds that obstruct bunch cutting and loose fruit collection. The most common practice is to leave at least one whorl of leaves below the ripe fruit bunch.

10.1.6 Harvesting and processing

10.1.6.1 Harvesting

Although the quality of palm oil is affected by several field factors, harvesting forms a most critical part of oil palm production, because all preceding operation can be largely negated if harvesting is not carried out efficiently. The principal products of the oil palm are palm oil and palm kernels; palm kernel oil is later extracted from the kernels leaving palm kernel cake as a by-product. The objective of harvesting is to obtain as high a quantity of oil as feasible. Hitherto, consumer requirements of palm oil reaching ports of destination are that it should have low amounts of dirt and moisture, and a free fatty acid (f.f.a) content of less than 5 %. Since a margin must be allowed for a slight increase in f.f.a. during shipment, it is desirable that palm oil leaving producing countries has an f.f.a. content of less than 3 %. A discount is levied if f.f.a. exceeds 5 %, while a small premium may be awarded if it is below this level.

The harvesting of oil palm fruit bunches has to contend with three factors. Firstly, fruit ripening does not take place evenly on all palms, and secondly, ripening within a fruit bunch is also uneven. These two conditions make it impossible to harvest all fruit bunches which have maximum oil content of high quality. Bunches varying in ripeness are therefore harvested and the pragmatic approach is to obtain an optimal amount of oil of good quality. The third factor is that fruit bunch production is also not even throughout the year, the peak month having about 12.5 % of the total annual crop while the lowest month may have only 4 % of the total. This means that a flexible system of labour and transport organisation should be available to ensure that ripe fruit does not deteriorate in quality.

As the fruit in the bunch ripens, the colour changes from deep purple to reddish orange and the oil content increases in the process. When the oil content reaches a maximum, the fruit becomes loose and falls to the ground. As a result of uneven ripening, it takes about 16 - 20 days for all fruitlets in a bunch to ripen; hence the impossibility of getting all fruitlets of the same ripening stage. When the fruitlet falls to the ground, the f.f.a. content rises rapidly, because the enzyme lipase present in the fruitlet causes the splitting of fatty acids from the glycerides.

Thus, the fruit can neither be harvested in an under-ripe nor an over-ripe stage. However, there is no exact criterion for optimal ripeness, and it is common practice bred from experience to harvest when there are two loose fruitlets on the ground per estimated kilograms of bunch weight, e.g., 40 loose fruitlets for 18 kg bunch. As fruit ripening is not even, it is not economical to harvest daily and the usual interval between harvesting is 10 - 14 days as a practical compromise between quantity and quality.

Cutting of fruit bunches

The implements used comprise chisels, axes, and knives on bamboo poles, depending on the accessibility of bunches as determined by the height of the palm. Generally, chisels are used from first harvesting until ripe bunches are produced at about 3 - 4 meters height, after which knives on bamboo poles are used.

Collection of bunches and loose fruits

There are a number of ways to collect cut bunches and loose fruits, but the most acceptable appears to be to have adult male workers perform the cutting and carrying of bunches while the women and young workers gather loose fruits. The bunches and loose fruits are carried to a collecting point near the roadside or rail by hand or transported with carts, by tractor or four-wheel-drive vehicle. From the collecting points, fruits are transported by tractor plus trailer, lorry or railway to the factory. Where a railway system exists, fruits are loaded directly onto tipping trunks or steriliser cages.

The harvested fruit should be transported on the same day to the factory where the fruit should be processed within 24 hours in order to avoid oil deterioration. This means that field harvesting and factory operations ought to be co-ordinated to ensure that processing of fruit is not unduly delayed. In general, it must be the aim to process all fruits not more than in 48 hours after harvesting.

10.1.6.2 Processing of fruit bunches

Various aspects of the processing of FFB to the stage of crude palm oil and palm kernels will be described in this section.

10.1.6.2.1 Production of fruit bunches, scale of processing mill and technology

Transport cost of fresh fruit bunches to the mill is a major factor in the determination of site and size of the processing mill. Oil and nuts represent only 20 - 30 % of the fruit bunches, so a mill should be situated amidst production fields to minimize transportation costs. Fields with a low yields are a disincentive for large scale processing mills, as the bunches for the mill must be transported further and further as the mill becomes larger and larger. There is a relation between the scale of the processing mill and level of technology, in the sense that small mills use simpler technologies than larger ones. In practice, we see that in areas with semi-wild palm groves, the processing mills are small, apply a simple technology and produce oil with a quality suitable only for local consumption. Large high-technology mills are situated in highly productive plantations and have an output of narrowly specified crude oil for the world market (MOLL, 1987).

Technology

In Malaysia and Indonesia, the most of palm oil is processed by high-technology processing mills. The processing capacity of the mills varies from 6 to 60 tons of FFB per hour. The major stages of fruit processing are as follows:

Sterilisation: Most sterilisers are of the horizontal cylinder type and sterilisation is carried out by steam under pressure. Steriliser cages charged with fruit bunches are entered into the steriliser and steam is gradually introduced until the pressure and temperature are at 2 kg/cm^3 and 130^o C respectively and these conditions are maintained for about 40 - 55 minutes. The total time of sterilisation is 60 - 75 minutes. Usually, a steriliser can hold 2 or 4 cages, each of which has a capacity of 2.5 tons of fruit. The primary objective of sterilisation is to loosen fruitlets on the bunch to facilitate subsequent stripping but at the same time, the fat splitting enzyme lipase is destroyed.

Stripping of fruitlets from bunches: The fruitlets are separated from the bunch stalk and spikelets in a rotary drum. The rotary drum is made of horizontal metal bars with adequate space between them to permit the stripped fruitlets to fall through onto conveyor which takes them to the digester. The empty bunch waste is carried out at the other end of the drum.

Digestion: The purpose of digestion is to press out the oil from the mesocarp of the fruit, and this process is therefore most important. Heat is provided in order to assist in the loosening of oil containing cells from the fibre in the mesocarp. Digestors are steam jacketed cylindrical vessels with a central rotating shaft. The fruitlet is mashed by pairs of stirring arms attached to the shaft. Steam pressure is maintained so that the mash exits the digester at about 90^o C.

Oil extraction: There are four methods of extraction, but pressing with the screw-press is most widely used method. The capacities of the screw presses vary from 3 to 15 tons of fresh fruit bunches per hour. Digested fruit enters a perforated shaft in which a screw rotates, pressing the mass and forcing the oil through the perforations. The pressed fibre and nuts leave the shaft at the other end. This is a continuous process.

In the past hydraulic presses and centrifuges were used for processing which were lately replaced with screw presses. Solvent extraction was mainly used in the laboratories to determine the amount of oil lost in waste material for the computation of the extraction efficiency.

Clarification is done to minimize levels of moisture and dirt, important to minimize deterioration in oil quality during storage through oxidation.

Storage of crude palm oil. Storage tanks are available with a capacity of 2 to 4 weeks of production.

Kernel extraction: The deoiled fiber/nut cake from the screw press passes to an air separation system, which separates the fiber from the nut. The nuts are dried in silo dryers and then cracked using centrifugal crackers. The kernel is removed from the shell using air and water separation systems. Kernels are further dried in silo dryers and stored awaiting shipment to processor. Dried kernels account up to 6 % of the FFB weight and contain from 40 to 50 % oil.

Treatment and use of residues: The empty bunches are burned in an incinerator and the ash is used as fertiliser.

The fiber and the kernel shells are dried and used as fuel for the power supply of the mill. Sludge effluent results from the use of water, partly in the form of steam, in the production process. About 1.5 m^3 of water is required for the processing of 1 ton of FFB and considerable amounts of contaminated water leave the mill. Strict laws were introduced in Malaysia and later in Indonesia on effluent disposal, and new technologies are being developed to deal with this in an orderly manner and to use part of the effluent as a feedstuff.

10.1.6.2.2 Mill installation

Mills with a capacity to 3 tons of FFB per hour are generally built in areas with a sufficient supply of bunches. The machinery can be installed in a period of few months and operation can start. The management of such a mill generally buys the fruit bunches from the producer.

The situation is completely different for large estates where the processing mill is an integrated part of the enterprise. The mill is installed in several stages in line with the progress of production of bunches on the estate and the final capacity of the mill is based on production of bunches in the peak month of the peak year of the estate. The following factors determine production of bunches of the estate and thus the installed capacity.

- Yield expectation over the years.
- Rate of planting. Large estates can be planted in annual stages and this reduces production in the peak year of the estate.
- Production during the year. Seasonal fluctuations of climatic conditions result in an uneven production of bunches per month during the year. Even in areas with a fairly constant climate such as in West Malaysia, it is estimated that 15 % of the annual production is produced in the peak month.

The first two factors result in the expected production of bunches throughout the years. The required installed capacity can than be calculated as follows:

Required installed capacity in tonnes FFB per hour = A_p x P_p/O_t

where,

A_p, maximum annual production in tonnes FFB.

P_p, proportion of annual production in peak month

O_t, maximum operation time of a mill per month in peak periods, usually set at 500 hours.

Processing of bunches in the first years of production or processing of part of the peak production by third parties results in delayed installation and/or a reduced required maximum capacity of the mill. An example of estate development and stages of mill capacity is given in Table 10.2.

Table 10.2: An example of estate development and stages of mill capacity

Year	Planting	Expected yield FFB	Estate production	Capacity mill Required	Stage	Total
	ha	ton per ha	1,000 ton FFB per yr	ton per hr	Nr.	ton per hr
1	2000	-	-	-	-	-
2	2000	-	-	-	-	-
3	1000	8	16	3.8	I	12.5
4		15	60	14.4	II	25.0
5		17	85	20.4		25.0
6		18	90	21.6		25.0
7		20	100	24.0		25.0
8		21	105	25.2	III	37.5
9		23	115	27.6		37.5
10		25	100	24.0		37.5
11		26	130	31.2		37.5
12		30	150	36.0		37.5
20		25	125	30.0		37.5
25		16	80	19.2		37.5

Source: PPKS (2000), Moll (1987) and own calculations (2002). Park_2003-04-03

10.2 Indonesia

Indonesia is the most populous state in Southeast Asia with 210 million people (WORLD BANK, 2002). The total land area of 1.9 million square kilometres is spread over 13,000 islands (according to some sources up to 18,000 islands), only 6,000 of which are inhabited. There are five main islands (Sumatra, Java, Kalimantan, Sulawesi and Irian Jaya), two major archipelagos (Nusa Tenggara and the Maluku) and 60 smaller archipelagos (LIBRARY OF CONGRESS, 2002). Java is the most densely populated island, with almost 900 people per square kilometre, and a total population of 117 million. The population density on other islands is much lower.

Agriculture is the third sector of the economy, contributing 17 % of GDP and 44 % of the total employment (WORLD BANK, 2002).

Intensive agricultural cultivation is restricted to Java, Bali, Lombok and certain areas of Sumatra and Sulawesi. Rice, corn, cassava, sweet potatoes, peanuts and soybeans production dominate on small farms. Cash crops like palm oil, rubber, tobacco and coffee are grown on plantations as well as by smallholders. Most of the palm oil area (over 75 %) is located on the Sumatra island.

10.2.1 Climate and soils

The climate of Indonesia is controlled by its island structure and position astride the equator, which assure high, even temperatures, and by its location between the two landmasses of Asia and Australia, which strongly influences the monsoon rainfall patterns.

Relief

Sumatra extends from the northwest to southeast with a length of more than 1600 kilometres and a maximum width, including offshore islands, of about 500 km and is bisected by the equator. The island is divided into four main physical regions: the narrow coastal plain along the west; the Barisan Mountains, which extend the length of the island close to its western edge and include 10 active volcanoes; an inner non-volcanic zone of low hills grading down toward the stable platform of the Asian mainland; and the broad alluvial lowland, as broad as 250 km wide and no more then 30 meters above sea level, that constitutes the eastern half of the island (see Figure 10.2; BRITANNICA, 2002).

Much of eastern Sumatra is a low-lying swampy forest that is difficult to penetrate, seriously impeding the development of the inland area. The mountain watershed is close to the west coast, and much of the soil cover in the hills and lowland is built up by debris from the volcanoes (BRITANNICA, 2002).

Temperature

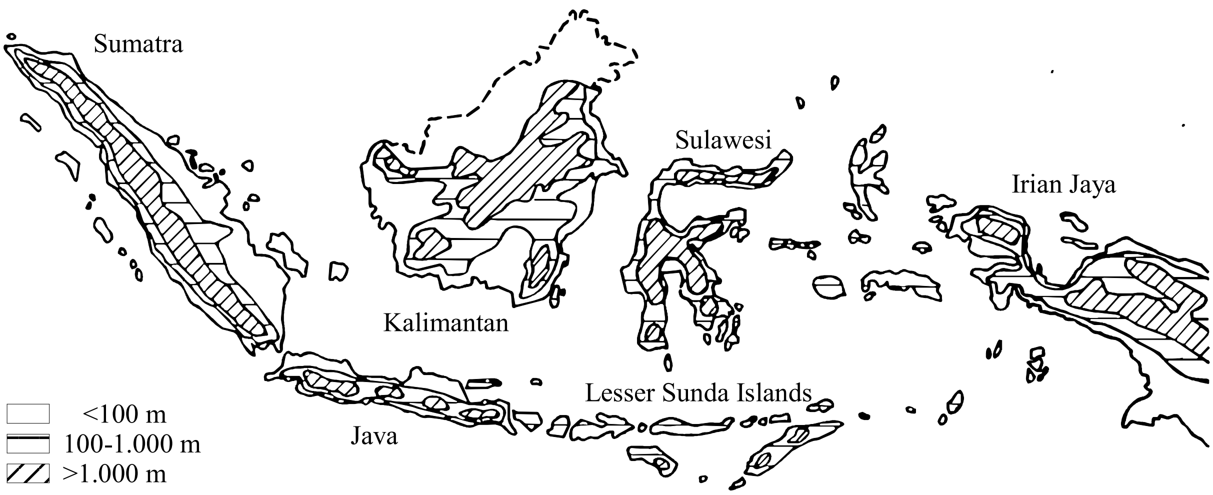
Temperatures are uniformly high and are a function of elevation rather than latitude. They are highest along the coast, where mean annual temperatures range from 23 to 31 Celsius and are moderated considerably above 600 meters. In general, temperatures drop approximately $1^{o}C$ per 90 meters increase in elevation from sea level.

Rainfall

Rainfall is more varied in extremes and distribution compared to temperatures. Seasonal variations are caused by monsoonal Asian air drifts and the convergence of tropical air masses from both the north and the south of the equator along an inter-tropical front of low pressure. The monsoon pattern in any given part of the archipelago depends on location of the intertropical front (LIBRARY OF CONGRESS, 2002). There are five distinguished climate zones that are described in detail below:

Extremely wet climatic zone: The rainfall average in this zone is over 2750 mm with more than 200 rainy days per year. Dry months (average rainfall less 60 mm) do not exist in this zone. Some parts of western Sumatra, all islands on the Indian Ocean, a great part of the Irian Jaya Province and a small part of West Kalimantan are characterized by this climatic zone.

Figure 10.2: Relief in Indonesia



Source: after Lingen (1981) and Hamidon (1980). Park_2003-02-25

Wet climatic zone: Annual rainfall average in this zone is between 2250 and 2750 mm and the rainy days average 150 to 250 days per year. Less than one dry month may occur during the year. The traditional palm oil growing region in North Sumatra, Aceh, a small part of Riau and Jambi provinces are located in this climatic zone. This climate is optimal for oil palm production, where the optimal rainfall is equally distributed during the year. Two peaks of rainfall exist in this zone, especially from September to December (heavy rain) and from April to June (moderate rain).

Slightly wet climatic zone: The annual rainfall average in this region is between 1750 to 2250 mm and there are about 100 to 150 rainy days per year. Dry months may occur during the year. Most of the oil palm plantations in new development areas, for instance in the greater part of Riau, Jambi, South Sumatra, East Kalimantan, and South Sulawesi are located in this climatic zone. The total rainfall is suitable for oil palm, but the monthly rainfall is not equally distributed. Two peaks of rainfall occur in the climatic zone, where maximum rain occurs from October until November and moderate rain from April until May.

Slightly dry climatic zone: An annual rainfall average of 1250 to 1750 mm and 75 to 100 rainy days per year are common for this climatic zone. Three consecutive dry months may occur during the year. The plantations at new development areas, such as in South Sumatra, Lampung, West Java and Middle Sulawesi are located in this climatic zone. Water deficits of about 200 to 400 mm a year which can occur, could limit the oil palm growth and its production. One rainfall peak occurs, especially from September until December.

Dry climatic zone: The annual rainfall average in this zone is less than 1250 mm and the average number of rainy days is less than 75 days per year, while a dry period of more than 3 months may occur. Oil palm plantations in dry climatic region are occasionally found in Southeast Sulawesi and in the small part of Lampung and West Java. The annual water deficit of this area may exceed 400 mm, and this condition strongly restricts the growth and production of oil palms. The peak of the rainy season normally occurs only from September to December. Rainfall in the rest of the year is low to very low, which is defined by less than 60 mm rainfall per month. Sometimes there is no rain at all.

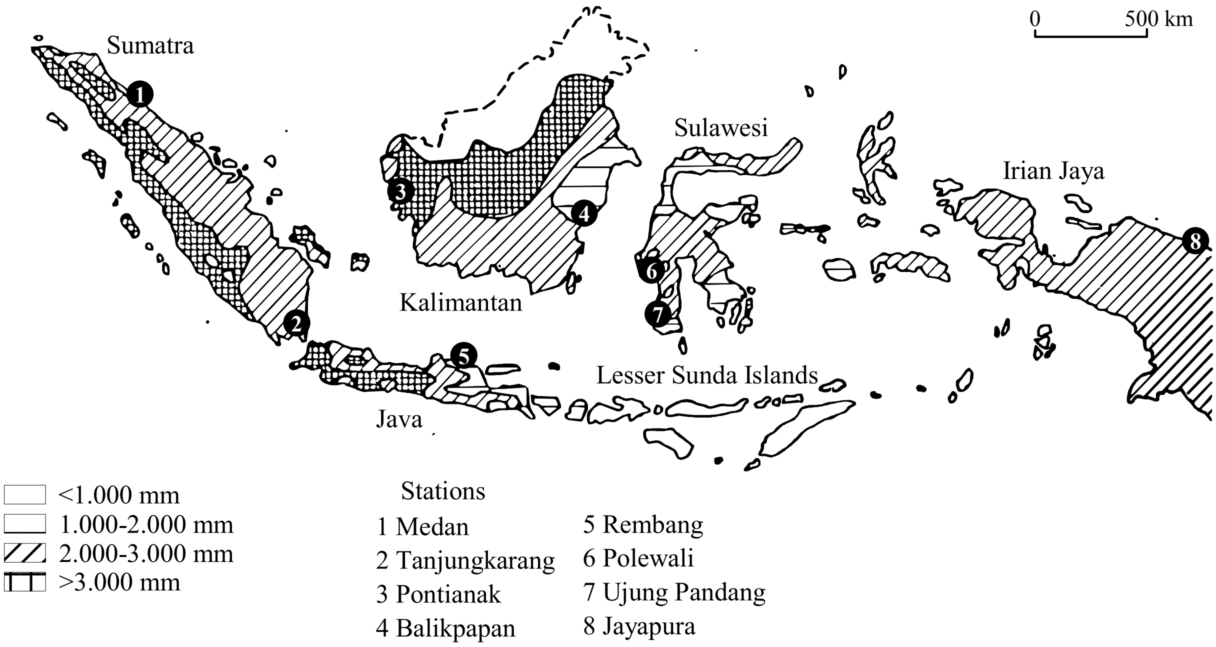
The average annual rainfall is shown in Figure 10.3. Table A8.1 in Appendix gives a detailed overview of rainfall distribution within a year for selected stations (see Figure 10.3).

Soils

The soils in the traditional palm oil area around Medan are sandy loams suitable for oil palm cultivation, if hard layers or gravel and stones are absent. Information about other areas is not available (MOLL, 1987).

In general, climatic conditions are suitable in extensive areas of South Sumatra, Kalimantan, Sulawesi and Irian Jaya, and in parts of West Java (LUBIS et al., 1996). This statement is also supported by rapid expansion of palm oil areas in mentioned regions during the past years. However, soil surveys are required in those areas to determine the suitability of specific sites for palm oil cultivation.

Figure 10.3: Rainfall in Indonesia



Source: after Lingen (1981) and Hamidon (1980). Park_2003-02-25

10.2.2 Crop production

The agricultural area was 42 million hectares in 1999, which had expanded 10 % from 1970 to 1999. Arable land had remained at about 18 million hectares, and area allocated to permanent crops had soared more than 60 % from 8 million up to 13 million hectares during the same period. The above-mentioned increase of agricultural land was mainly due to an expansion of perennial crops, which in turn was mainly due to rapid growth of palm oil areas (FAO, 2002; DIRECTORATE GENERAL OF ESTATES, 2001).

Major crops

Major crops grown in Indonesia are rice, corn, cassava, sweet potatoes, peanuts and soybeans, as well as fruits and vegetables. These crops are mainly grown on small subsistence farms. Palm oil, coconuts and rubber are major perennial cash crops that are grown on plantations as well as by smallholders (see Table 10.3).

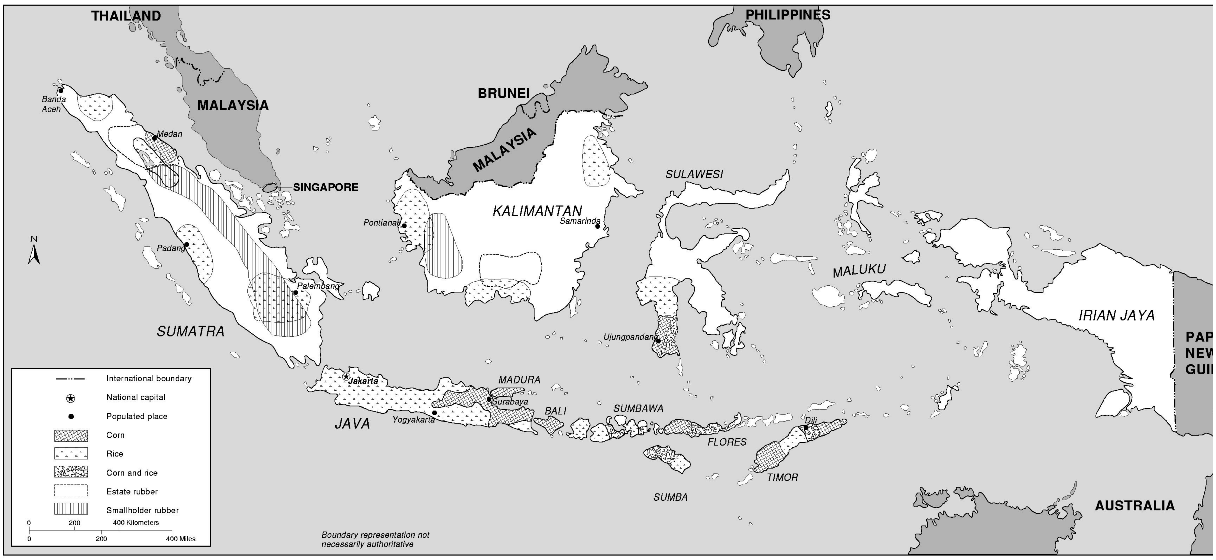
Major production areas of rice, corn and rubber are shown in the Figure 10.4.

Table 10.3: Major crops in Indonesia, 1,000 hectares, 1970 to 2000

Crops	1970	1980	1980-85	1986-90	1991-95	1996-00	% of AL (Ø1996-00)	Δ (Ø1980-85 to Ø1996-00)
	1,000 ha						%	%
Cereals	11,074	11,740	12,081	13,272	14,162	15,141		
Rice	8,135	9,005	9,367	10,217	10,914	11,583	27	29
Maize	2,939	2,735	2,713	3,055	3,248	3,558	8.4	30
Roots and Tubers	2,009	1,793	1,678	1,621	1,686	1,637	3.9	-9
Fruits	487	519	595	644	759	882	2.1	70
Vegetables	590	588	685	873	787	799	1.9	36
Palm oil	133	295	410	860	1,644	2,824	6.7	859
Coconuts	1,258	1,803	1,918	2,138	2,436	2,607	6.2	45
Rubber	1,391	1,612	1,626	1,818	2,045	2,215	5.3	37
Agricultural land (AL)	38,400	38,000	38,034	43,686	41,768	42,164	100	11

Source: FAO (2001). Park_2002-08-15

Figure 10.4: Major growing areas of rice, corn and rubber in Indonesia



Source: FAO (2002). Park_2002-11-23

10.2.3 Palm oil

10.2.3.1 History

The first palm oil seeds were introduced to Java in 1848. Palms were generally planted for ornamental purposes. Despite publicity on the usefulness of the plant, no industrial plantation was fully established until 1911. This lack of interest in oil palm was due to unprofitable palm oil industry and a lack of processing technology. At that time, palm oil could not compete with coconut oil (PAMIN, 1998).

The first palm plantations producing edible oil palm were established around 1911. In 1938, the palm oil area expanded up to 90,000 hectares. However, during the Japanese invasion, the development of industry was disrupted and many trees were cut for food crops (PAMIN, 1998; MOLL, 1987). The first 20 years after World War II were generally unfavourable for the development of the estate sector. The struggle for independence, the nationalization of Dutch-owned, and later all foreign-owned estates, and the imposition of unrealistic production targets all contributed to this.

10.2.3.2 Expansion of palm oil industry in the past

The Indonesian oil palm sector has experienced remarkable growth since the late 1960s. The area of palm oil plantations increased from 106,000 to 3.6 million hectares from 1967 to 2001, implying an average growth rate of 11 percent annually (see Table 10.4). Until the 1980s, the growth rate of oil palm areas was moderate while state and private plantations were major producers. Since the early 1980s, the government has encouraged expansion of palm oil through various policies which have led to a rapid increase of oil palm areas under private estates and a new producer group, smallholders, have gained in importance in the production of palm oil. More details on palm oil groups are given in the following chapters.

Table 10.4: Area and production of palm oil and by-products by group of producers, 1,000 hectares, 1967 to 2001

	Oil Palm				Crude Palm Oil				Palm Kernel			
	Smallholders	Government estates	Private estates	Total	Smallholders	Government estates	Private estates	Total	Smallholders	Government estates	Private estates	Total
	1,000 ha				1,000 ton							
1967	-	66	40	106	-	109	59	168	-	22	13	34
1970	-	87	47	133	-	147	70	217	-	33	15	49
1980	6	200	89	295	1	499	322	821	-	90	38	128
1985	119	335	144	597	43	861	339	1,243	9	179	71	258
1990	291	372	463	1,127	377	1,247	789	2,413	75	249	179	504
1995	659	405	962	2,025	1,001	1,614	1,864	4,480	196	384	362	942
1996	739	427	1,084	2,250	1,134	1,707	2,058	4,899	233	397	454	1,085
1997	813	449	1,254	2,516	1,293	1,800	2,287	5,380	280	423	526	1,229
1998	891	489	1,409	2,789	1,348	1,857	2,435	5,640	292	432	560	1,284
1999	1,038	516	1,617	3,172	1,544	1,846	2,615	6,005	258	440	595	1,293
2000	1,094	523	1,776	3,393	1,598	1,924	2,749	6,271	365	451	639	1,455
2001	1,144	534	1,906	3,584	1,730	2,005	2,815	6,550	370	464	650	1,485
Δ 1980 to 2001 (%)	18,432	167	2,046	1,117	224,548	302	776	698		417	1,602	1,061
Δ 1990 to 2001 (%)	293	43	312	218	359	61	257	172	391	86	263	195
% of total (1980)	2	68	30		-	61	39		-	70	30	
% of total (2001)	32	15	53		26	31	43		25	31	44	

Source: Directorate General of Estates (2001). Park_2002-08-23

10.2.3.3 Production and exports of palm oil and palm kernels

With increasing oil palm areas, production of palm oil and palm kernels has correspondingly increased from 168,000 tons in 1967 to 6.5 million tons in 2001 (see Table 10.5). Private estates became leaders in production in the mid- 1990s, and in 2000 contributed about 43 % of total production, followed by state estates (31 %) and smallholders (26 %).

A large part of the produced palm oil was consumed domestically, where a strong demand from a huge population existed. Exports varied strongly, influenced by government policy interventions and relations between domestic and international prices.

Table 10.5: Production and exports of palm oil and palm kernels, 1,000 tons, 1967 to 2001

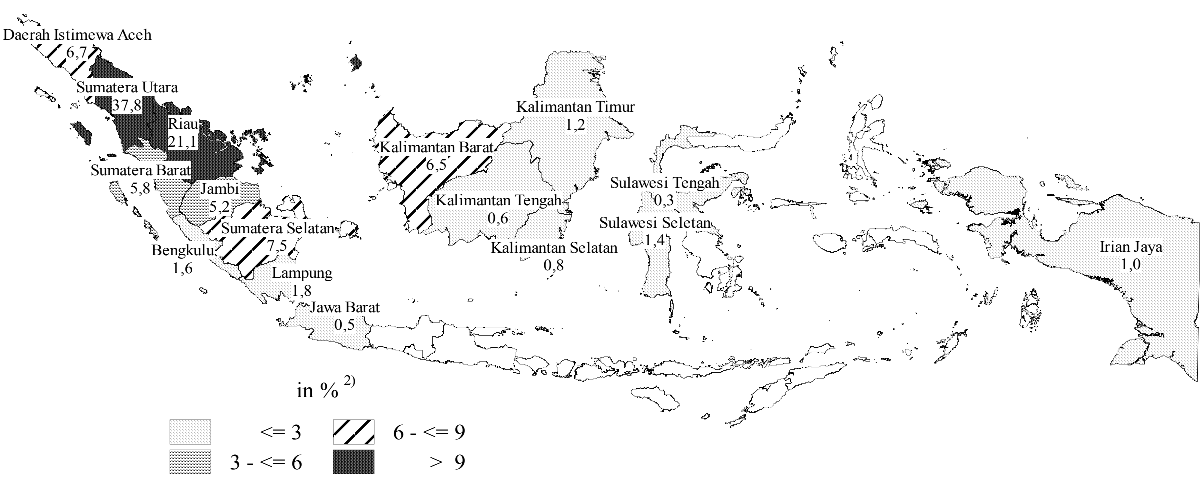
Years	Production		Exports		3 of 1
	CPO	PK	PO	PKO	
	1	2	3	4	5
	1,000 ton				%
1967	168	34			
1970	217	49	157	-	72
1975	397	81	386	-	97
1980	821	128	503	-	61
1985	1,243	258	519	98	42
1990	2,413	504	816	158	34
1995	4,480	942	1,265	311	28
1996	4,899	1,085	1,672	341	34
1997	5,380	1,229	2,968	503	55
1998	5,640	1,284	1,479	347	26
1999	6,005	1,293	3,299	598	55
2000	6,271	1,455	4,110	579	66
2001	6,550	1,485	-	-	-
Δ 1980 to 2000 (%)	664	1,037	717	-	-
Δ 1990 to 2000 (%)	160	189	404	266	-

Note: CPO - Crude Palm Oil, PK - Palm Kernel, PO - Palm Oil, PKO - Palm Kernel Oil.
Source: Directorate General of Estates (2001). Park_2003-04-03

10.2.3.4 Regional distribution

Figure 10.5 illustrates the regional production of palm oil in 2001. More than 80 % of the palm oil is produced on the island of Sumatra. The leaders in production are provinces of Sumatera Utara (38 %), Riau (21 %), Sumatera Selatan (7.5 %), Kalimantan Barat (6.5 %), Sumatera Barat (5.8 %), and Jambi (5.2 %). While Sumatera Utara is perceived as a traditional area of palm oil production since Dutch colonial times, the remaining provinces are areas of new development, having experienced rapid growth in the last decade.

Figure 10.5: Regional distribution of palm oil production in Indonesia, 2001[1)]



1) Total Palm Oil production of 6,5 million tons (2001).
2) As a share of total Palm Oil production in %.
Source: Directorate General of Estates (2001).
Park_2002-08-20

10.2.3.5 Yield of palm oil and palm kernels

The national average palm oil yield was 2.9 tons per hectare in 1999 (see Table 10.6).

Table 10.6: Area, production and yields of palm oil by group of producer and development scheme, 1999

	Area			Crude Palm Oil		Amount of
	Immature	Mature	Total	Production	Yield	households
		1,000 ha		1,000 ton	ton per ha	
Smallholders	315	723	1,038	1,544	2.1	418,585
State estates	102	414	516	1,846	4.5	
Private estates	669	949	1,617	2,615	2.8	
Total/average	1,086	2,086	3,172	6,005	2.9	418,585

Source: Directorate General of Estates (2001). Park_2003-04-03

State-owned plantations had the highest yields of 4.5 tons per hectare, followed by privately owned plantations with an average yield of 2.8 tons per hectare, and smallholders' yields were the lowest with 2.1 tons per hectare. The higher yields of state-owned plantations can be explained by the location of state-owned plantations on more suitable land then privately owned or smallholders’ plantations, the availability of long-year expertise in the management of palm oil production, and better planting material (PERSONAL COMMUNICATION, 2002; DGE, 2001).

10.2.3.6 Palm oil producer groups

With the growing role of palm oil industry in the economy of Indonesia, the government has facilitated the growth of the industry through various schemes. This has led to a development of three major categories of producers:

- state-owned estates,
- private-owned estates and
- smallholders.

The state-owned estates were leading in palm oil production until end of 1980s (see Table 10.4). Most of them were established by the Dutch colonialists in the beginning of 1910s and were later nationalized by the government at the end of 1950s. State-owned estates had experienced strong growth since 1968, after the government had arranged financial and technical assistance from the World Bank and the Asian Development Bank for rehabilitation and development projects (CASSON, 2000; MOLL, 1987). By early 1997, nine out of fourteen state-owned plantation companies produced palm oil. Most of these plantations were found in Sumatra, primarily Sumatera Utara. However, the government had begun to expand state-owned plantations into Kalimantan and Irian Jaya in the late 1980s (CASSON, 2000).

The smallholders’ palm oil area expanded after 1979 through government assistance projects with the support of the World Bank. Some of the schemes were linked to transmigration project from Java. Among the schemes were Proyek Rehabilitasi dan Peremajaan Tanaman Ekspor, PRPTE (Estate Crops Rehabilitation and Replanting Projects), the Perkebunan Inti Rakyat, PIR/NES (Nucleus Estate and Smallholder Scheme). Especially PIR/NES schemes have contributed to the rapid expansion of smallholders’ area. Under this scheme, private developers (known as Inti or Nucleus) prepared plots of land for smallholders located nearby. As these plots matured, usually after three years, the operations were transferred to the smallholders (known as Plasma), who operated the fields under the supervision of the Inti developers. Inti developers were then required to purchase oil palm fresh fruit bunches (FFB, from which oil palm is extracted in the mill) from the smallholders. Since PIR/NES schemes were introduced, the non-existent smallholders area in 1978 has rapidly soared to 1.1 million in 2001 and production of oil palm jumped to more than 1.7 million tons in the respective period (Table 10.4). In 2001, most of the smallholder areas were located in Riau, Sumatera Selatan, Jambi, Kalimantan Barat, Sumatera Utara and Sumatera Barat (Table A8.2 in Appendix).

Privately owned estates have experienced rapid growth since 1986. By 2001, 1.9 million hectares of palm oil area were planted by privately owned companies. They exceeded state-owned estates in palm oil areas by 1989, and in production by 1994 (Table 10.4). This rapid expansion of privately -owned estates was mainly linked to a booming of palm oil prices, which reached their highest level of US-$ 951 in May 1984, and encouragement to invest in the palm oil sector through subsidized loans by the government (PAMIN, 1998; CASSON, 2000).

10.2.3.7 Expansion potential for palm oil industry

In general, climatic conditions and soils are suitable in extensive areas of Sumatra, Kalimantan, Sulawesi and Irian Jaya. According to recent study of CENTRE FOR SOIL AND AGROCLIMATE RESEARCH (1997) there is around 47 million hectares of land potentially suitable for oil palm cultivation. Where 25 million hectares have high potential, 3 million hectares have moderate potential and 19 millions hectares have low potential for oil palm cultivation. The most of potential land is located in Kalimantan and Irian Jaya. Even though the Indonesian government encourage expansion of oil palm areas in those areas, in recent years most of growth took place mainly in Sumatra, where necessary infrastructure and well-disciplined estate workers are available.

10.2.4 Political and economic framework conditions

The government plays a dominant role in the palm oil industry. Firstly as one of the main producers, secondly through the regulation of market, financial and export sectors, and thirdly through planning and implementation of development plans.

The tree crops sector occupies a strategic niche in Indonesian agriculture and development, providing a valuable source of foreign exchange earnings and generating incomes for millions of smallholder's families (LARSON, 1992).

During the last two decades, the role of industry as both a vehicle of development for areas other than Java, and as a supplier of inexpensive cooking oil throughout Indonesia, has been explicitly directed through government ownership of estates and varying degrees of market interventions. Increasingly, as observed in Table 10.4, the production capacity has become more concentrated in private estates, smallholders and government interventions have been reduced. In fact, the history of the palm oil industry in Indonesia is one of evolution from government-sponsorship and marketing interventions to private-sector initiative responsive to international prices signals.

The evolution of the market from public to private sector, while substantial, is incomplete. Interventions that still remain in the sub-sector are designed primarily to limit the negative effects of rising international prices on domestic consumers. This is mainly achieved using: 1) export taxes; and 2) direct sales of palm oil produced by state estates to domestic markets at allocation prices which are at times below market prices. The private estates and smallholders are allowed to sell palm oil independently.

The most severe government intervention in export policies was observed during the financial crisis at the end of 1990s. In mid-1997, the value of the Rupiah currency had collapsed, which prompted local producers to increase their sales to the export markets, resulting in a substantial drop in a local supply. At first, the government reacted with the introduction of an export quota (late 1997), later on with an export ban (early 1998) on palm oil exports. With time, the export ban was replaced with very high export taxes of 40 % (April 1998) and later of 60 % (July 1998). Under pressure from the national and international community, and a desire to promote the palm oil industry, the government had to reduce the export tax to a level that was not prohibitive for trade. The export tax was gradually reduced, and since 2001 (up to the date of preparation of this report) it was 3 % for crude palm oil (CPO). Export taxes for palm oil and products and export check prices (HPE) that serve as a basis for calculation of export tax are given in Tables A8.3 and A8.4 in Appendix. The HPE is issued by decree of the Minister of Finance and reviewed monthly.

Since February 1999, the government has lifted the foreign investment ban and encouraged investors to develop estates in Eastern Indonesia. This reform was in line with a government desire to expand the palm oil industry further. Starting in the 1960s, the government has always either directly invested or provided incentives for new palm oil plantations.

Although palm oil production in Indonesia is highly profitable, and investments are very attractive for foreign developers due to vast land resources and inexpensive labour, domestic and foreign companies see a few impediments to further investment including (LARSON, 1992): 1) there is uncertainty associated with the land procurement process and land titlement; 2) in some areas the transportation infrastructure is inadequate; 3) many investors, especially foreign investors, are uncertain about the extent of current and future government interventions in the palm oil market.

10.3 Malaysia

Since the 1970s, Malaysia's economy has gone through a major transformation. From an economy relying on exports of raw materials such as rubber, tin and iron ore, it has evolved into one of the most diversified economies of Southeast Asia. The country has refocused on export-oriented manufacturing and processing, exploiting its comparative advantage of a skilled and productive workforce, well-developed infrastructure and a favorable currency exchange rate in recent years.

Agriculture remains important for the economy. In the 1970s, the sector contributed one third of the gross domestic product (GDP). Although its share of GDP has decreased to one fifth, it still provides employment for one fourth of the workforce (AGRI-FOOD CANADA, 2001; BRITANNICA, 2002).

The agricultural sector is dominated by the plantation sector. Oil palm and rubber currently account for more than a half of all agricultural land use. Rice and coconut are other major crops in Malaysia.

Palm oil and palm oil products are mainly produced for exports. Exports of palm oil accounted for over 80 % of total production.

Since the 1970s palm oil production has expanded rapidly in Malaysia. In 2000, Malaysia was the major producer and exporter of palm oil in the world. The reasons for such a rapid increase of palm oil production is to find in highly suitable natural framework conditions, technological developments in planting material as well as changed economic conditions and government policy in 1960s and consequent years (KHERA, 1976, MOLL, 1987).

10.3.1 Climate and soils

The characteristic features of the climate of Malaysia are its uniform temperature, rich rainfall, high humidity and abundant sunshine. The climate is influenced by seasonal changes in wind, which in turn define four distinguished monsoon seasons, namely southwest, northwest and two shorter inter-monsoon seasons.

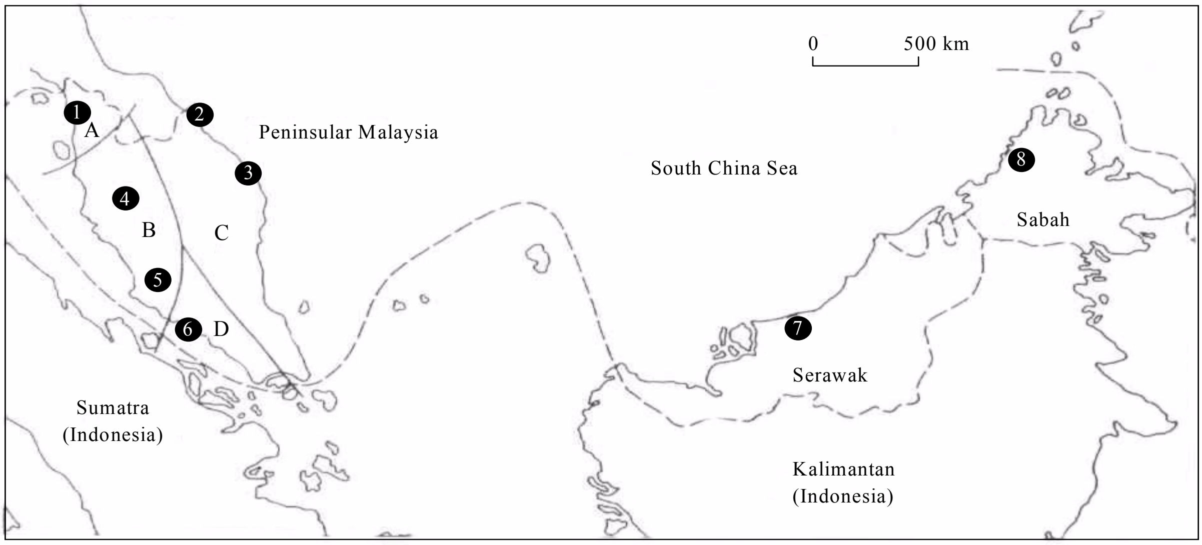
The southwestern monsoon usually begins in the latter half of May or early June and ends in September. The northeastern monsoon usually commences in early November and ends in March. The inter-monsoon seasons fall between these two major seasons, and the equatorial climate remains mild during that time (MMS, 2001).

Rainfall

The seasonal changes of wind flow pattern, coupled with topographic features, determine rainfall distribution over the country and to a lesser extent, temperature distribution (MMS, 2001).

West Malaysia can be divided into four parts with different rainfall patterns (see Figure 10.6). The western part has two rainy seasons and two relatively dry periods with total rainfall varying between 1800 and 3600 mm per year, and minimum rainfall in any month of the year is 75 mm, which is quite suitable for palm oil production. In the northwestern part, there are more distinct dry periods and palm oil production depends more on the water holding capacity of soils. In the east there is single-peak rainy period with annual rainfall between 2500 and 3500 mm. The area is less suitable to palm oil production compared to the western part due to unbalanced distribution of rainfall. The less suitable part of Malaysia for palm oil production with regard to rainfall is the southwest, where total annual rainfall reaches only 1750 mm. An exception is a belt of 20 - 25 km wide along the coast (MOLL, 1987). Detailed monthly rainfall distribution within a year for selected sections are given in Table A8.5 in Appendix (Figure 10.6).

Figure 10.6: Rainfall in Malaysia



A	North West	1	Alor setar	5	Kuala Lumpur
B	West	2	Kota Bharu	6	Muar
C	East	3	Kuala Trengganu	7	Mukah
D	South West	4	Ipon	8	Kota Kinabalu

Source: Hamidon (1980); Williams and Hsu (1970).

Temperature

As an equatorial country, Malaysia has uniform temperatures throughout the year. The annual variation is less than 2 Celsius, except in the east coast areas of Peninsula

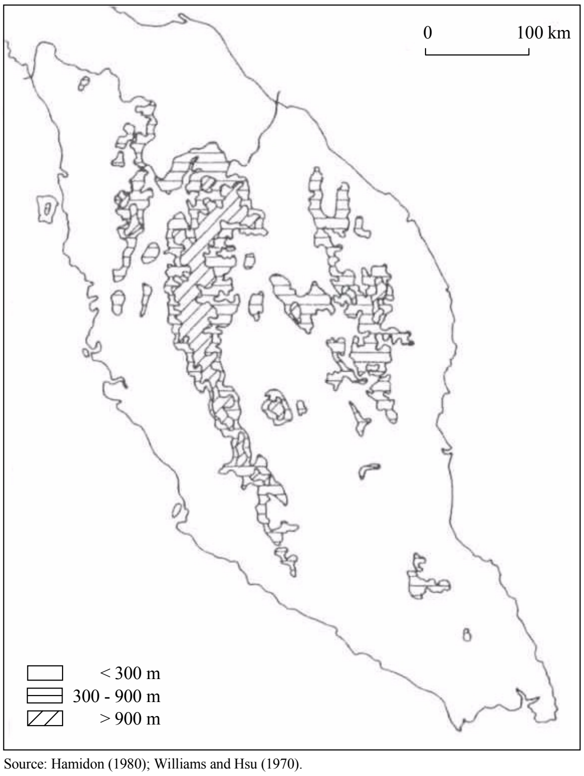
Malaysia, which are often affected by cold surges originating from Siberia during the northeast monsoon. Even there, the annual variation is below 3 Celsius (MMS, 2001).

Average monthly maximum temperatures range from 29 to 34 Celsius, and the average monthly minimum temperature lies between 21 and 24 Celsius in the lowlands of Peninsula Malaysia. In general, the temperature is suitable for palm oil production at altitudes below 500 meters on Peninsula Malaysia.

Relief

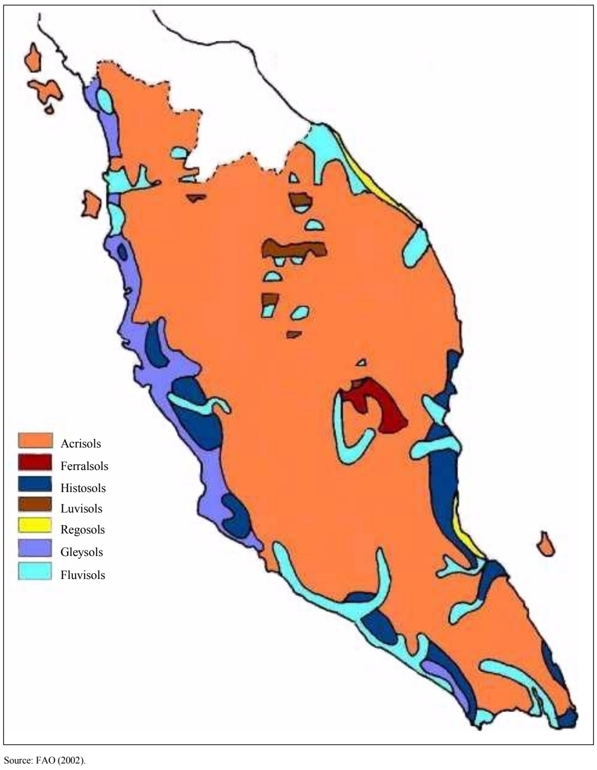
The natural relief where the climate is suitable for oil palm growing is generally flat or undulating and thus is appropriate for palm oil production. Coastal areas may have poor natural drainage, therefore draining is needed to improve the yield potential of oil palms (MOLL, 1987). Relief of the West Malaysia is displayed in Figure 10.7.

Figure 10.7: Relief in Malaysia



Source: Hamidon (1980); Williams and Hsu (1970).

Figure 10.8: Soils in Malaysia



Source: FAO (2002).

Sunshine and solar radiation

As a maritime country close to the equator, Malaysia naturally has abundant sunshine, and thus solar radiation, which at lower altitudes are more than 2100 hours annually and is suitable for oil palm (MMS, 2001; MOLL, 1987).

Soils

According to the FAO classification, more than a half of Malaysia's soils are acrisols (red yellow podsolic soil) (see Figure 10.8). These soils are the most extensive in the oil palm industry and comprise soils derived from igneous, sedimentary and older alluvial deposits. Parent rocks range from granites, quartzites and sandstones, sandy shales, and older alluvia. In most cases they range from deep (>1 m), sandy loam to sandy clay loam in texture, have a friable to loose consistence and free drainage. They are characterized by good physical conditions of depth, porosity and satisfactory water holding capacity, but are chemically low in organic matter, phosphorus, potassium and magnesium and cation exchange capacity. These soils are thus deficient in all major nutrients and production of palm oil on these soils should be supported by well-managed manuring program.

Histosols and gleysols, mainly located on the west coast of peninsular, are another group of soils that are very suitable for oil palm production (see Figure 10.8). They are of heavy texture with a naturally high water table but with artificial drainage, they are the most productive soils in Malaysia. These soils are characterized by a moderate acid pH of 4.5 to 5.5, high cation exchange capacity and high magnesium and potassium status and moderate to high phosphate status. Generally these soils are highly productive and require less fertilizer than inland soils.

Climate of Eastern Malaysia

Eastern Malaysia, the Sabah and Sarawak states, has plenty of rainfall with total annual precipitation ranging between 2000 and 4000 mm. February and March are a little drier, but months with an average rainfall of less than 100 mm are rare. Annual variation of temperature is very low in the lowlands. Monthly maximum temperatures range from 29 to 33 Celsius, and monthly minimum temperatures range from 23 to 24 Celsius. The mean sunshine ranges from 1800 to 2600 hours. Although there is a lack of detailed climate information about East Malaysia, climate conditions are very suitable for oil palm growing in both states (MOLL, 1987).

10.3.2 Crop production

The agricultural sector of Malaysia is dominated by the plantation sector, where palm oil and rubber account for more than half of all agricultural land use. In 2000, about 8 million hectares of land were used in agricultural production, which was a quarter of total land area. Over half of a land area is allocated to forest. In the last two decades, the use of land for agricultural purposes has increased almost 50 %. The major contributor of this expansion was oil palm (MPOB, 2001; FAO, 2001).

Rice, coconut and cocoa were other important crops and accounted together for about 1 million hectares (over 10 % of cropland). Production of root and tuber crops, fruits and vegetables was on less than 0.2 million hectares and used a mere 5 % of total cropland (see Table 10.7).

Table 10.7: Major crops in Malaysia, 1000 hectares, 1960 to 2000

	1960	1970	1980	1980-85	1986-90	1991-95	1996-00	% of AL (Ø1996-00)	Δ (Ø1980-85 to Ø1996-00)
				1,000 ha				%	%
Palm Oil	55	296	1022	1230	1811	2310	3071	39	150
Rubber	1753	2019	2007	1592	1598	1547	1414	18	-22
Rice	468	717	717	676	665	684	687	8.7	2
Coconuts	246	354	354	343	314	278	202	2.6	-41
Cocoa	1	35	35	69	225	248	125	1.6	82
Fruits	40	55	61	56	93	97	93	1.2	65
Roots and Tubers	n.a. [1]	na	51	52	52	54	51	0.6	-2
Vegetables	na	na	22	20	20	26	29	0.4	40
Agricultural land (AL)	4200 [2]	5059	5059	5365	6568	7763	7890	100	47

1) n.a - not available
2) for 1961

Source: FAO (1992), FAO (2001), MPOB (2001), own calculations Park_2002-03-12

10.3.3 Palm oil

10.3.3.1 History

Development of Malaysia's palm oil industry can be divided into three stages. The **first** started in 1875 and lasted until 1916. This period witnessed introduction of oil palm seeds from different sources, plantings of oil palm for decorative purposes and experimentation with the suitability of oil palm for cultivation. The **second** period commenced with the commercial plantings of oil palms in 1916 and lasted up to the 1960s. During this period, the palm oil industry gradually increased in importance and laid the foundation for its rapid "take off" in the sixties. The oil palm area reached 54,000 hectares in 1960, but it remained of minor importance compared to rubber, which occupied 1.8 million hectares. The **third** stage started in the 1960s when the production of palm oil witnessed a remarkable change in the rate of development compared to other agricultural crops. In the 1950s, the Malaysian economy was heavily dependent on exports of rubber, tin and iron ore and imported consumer goods and supplementary food. The need for diversification was already seen in that time, however, high prices for rubber discouraged the shift to oil palm until 1960s. The situation changed tremendously in the 1960s, when rubber prices showed a declining trend and competition from synthetic rubber resulted in pessimism about the future of rubber production. With a growing demand for edible oils, and optimistic estimations of profitability of palm oil production based on expected market prices, the attention of estate companies as well as of the government had shifted from rubber to palm oil. Estate companies reacted to this situation with a remarkable substitution of rubber with oil palms, government reaction was opening up large areas of virgin forest in order to provide employment opportunities for individual farmers grouped into different schemes (KHERA, 1976; MOLL, 1987).

10.3.3.2 Expansion of oil palm industry in the past

The trend of outstanding growth can still be observed in Malaysia, where the area under oil palm has more than tripled (230 %) from 1980 to 2000 (see Table 10.8).

Table 10.8: Area under palm oil (mature and immature) and rubber, 1,000 hectares, 1975 to 2000

Year	Palm Oil												Rubber
	West Malaysia			Sabah			Sarawak			Malaysia			
	Mature	Immature	Total	Mature	Immature	Total	Mature	Immature	Total	Mature	Immature	Total	
	1000 hectares												
1975	340	228	569	41	18	59	5	10	14	386	256	642	1992
1980	701	206	907	63	30	94	13	10	23	777	246	1023	2007
1985	1086	207	1292	95	66	162	20	8	29	1201	281	1482	1953
1990	1512	186	1698	203	73	276	31	24	55	1746	283	2029	1837
1995	1747	157	1903	418	100	518	78	41	119	2243	297	2540	1689
1996	1741	185	1926	512	114	626	100	40	140	2353	339	2692	1644
1997	1780	180	1959	612	147	759	122	54	175	2513	380	2893	1624
1998	1810	177	1987	683	159	842	104	145	248	2597	481	3078	1620
1999	1856	195	2052	773	168	941	228	93	320	2857	457	3313	1465
2000	1832	213	2046	869	132	1001	241	90	330	2942	435	3377	1431
Δ 1980-00 (%)	162	4	126	1269	333	965	1721	841	1352	278	77	230	-28
% of resp. total (1980)	90	84	89	8	12	9	2	3,9	2	76	24		
% of resp. total (2000)	62	49	61	30	30	30	8	21	10	87	13		

Source: DOA (2001), MPOB (2001), MRB (2001), own calculations. Park_2003-01-21

However, observing detailed statistics for reasons of such immense growth in Table 10.8 it can be seen that West Malaysia played a major role in the expansion of oil palm areas from the 1960s to 1980s, but in the last two decades, the major expansion areas have shifted to East Malaysia, especially to the Sabah state, where the growth rates and share of total areas are very remarkable. So that from a total 2.3 million hectares increase of oil palm area in the last two decades, West Malaysia accounted for 1.1 million, Sabah for 0.9 million and Sarawak for 0.3 million hectares. Thus the Sabah and Sarawak oil palm areas increased more then ten-fold, while the West Malaysia's areas had a little more then doubled. Such rapid growth in the last two decades in East Malaysia resulted in a remarkable 40 % share of total oil palm areas, which had soared from a mere 10 % in 1980s (see Table 10.8). Furthermore, observing the immature oil palm stands of West and East Malaysia it can be seen that the share of the East has increased significantly in past twenty years from 16 % to 50 % of total immature stands in 2000. Considering that the immature stands are direct indicators of the expansion, it is to be expected that strong growth will take place in the East Malaysia in the future. According to different sources, there are land resources available and suitable climate for palm oil to support the expansion (PERSONAL COMMUNICATION, 2001).

10.3.3.3 Production and exports of palm oil and by-products

The production of palm oil and palm kernels has soared on par with the area expansion. Palm oil production increased four-fold from 2.3 million (1980) to 10.8 million tons (2000). Palm kernel and palm kernel oil production has grown about six-fold, reaching 3.2 and 1.4 million tons respectively (see Table 10.9).

Table 10.9: Production and exports of palm oil and by-products, 1,000 tons, 1975 to 2000

Year	Production				Export							Share of			
	CPO	PK	CPKO	PKC	CPO	PPO	PO (5+6)	CPKO	PPKO	PKO (8+9)	PKC	6 of 1	5 of 1	9 of 2	10 of 3
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					1,000 ton							%			
1975	1,258	233	108	n.a	957	216	1,173	n.a.	n.a.	109	n.a.	93	17	n.a.	n.a.
1980	2,573	557	222	279	198	2,074	2,271	n.a.	n.a.	219	260	88	81	98	93
1985	4,134	1,212	512	633	13	3,421	3,434	409	28	437	684	83	83	85	108
1990	6,095	1,845	827	1,038	94	5,634	5,727	297	393	690	869	94	92	83	84
1991	6,141	1,785	782	955	90	5,483	5,573	256	415	671	819	91	89	86	86
1992	6,373	1,874	812	984	72	5,493	5,565	100	356	456	843	87	86	56	86
1993	7,403	2,266	966	1,183	59	6,058	6,117	89	463	552	931	83	82	57	79
1994	7,221	2,204	978	1,223	55	6,695	6,750	51	410	461	961	93	93	47	79
1995	7,811	2,396	1,037	1,293	17	6,496	6,513	37	355	391	910	83	83	38	70
1996	8,386	2,489	1,107	1,383	69	7,143	7,212	71	394	465	994	86	85	42	72
1997	9,069	2,638	1,165	1,435	31	7,459	7,490	18	379	397	1,088	83	82	34	76
1998	8,320	2,429	1,111	1,345	41	7,424	7,465	66	396	462	1,217	90	89	42	90
1999	10,554	3,026	1,339	1,624	262	8,651	8,914	84	466	550	1,245	84	82	41	77
2000	10,842	3,163	1,385	1,639	398	8,683	9,081	20	500	520	1,350	84	80	38	82
Δ 1980 to 2000 (%)	321	468	523	488	102	319	300			138	420				

Note: CPO - Crude Palm Oil, PK - Palm Kernel, CPKO - Crude Palm Kernel Oil, PKC - Palm Kernel Cake, PPO - Processed Palm Oil, PO - Palm Oil, PPKO - Processed Palm Kernel Oil, PKO -Palm Kernel Oil.

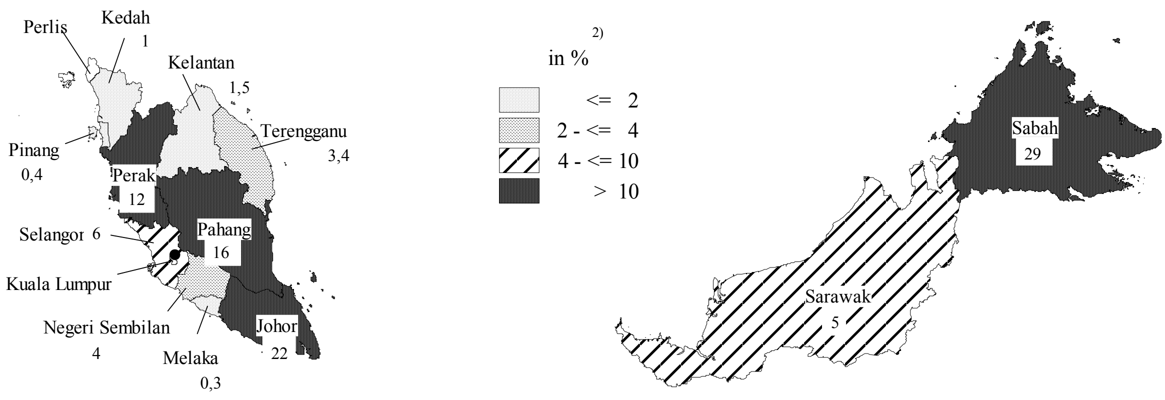
Source: MPOB (2001), own calculation Park_2003-01-21

The larger portion of produced palm oil and by-products is destined for export. More than 80 % of the total production was exported to a number of countries in Southeast Asia and Europe. The structure of exports has changed significantly. In the 1960s and 1970s, crude palm oil and palm kernels were mainly exported, but due to changed government policy and the introduction of tax incentives, most of the palm oil is processed inland and then exported to the markets. In recent years, efforts were applied to develop the oleochemical industry in order to diversify the range of products available from palm oil. The value of oleochemical product exports was growing rapidly.

10.3.3.4 Regional distribution of production

Figure 10.9 illustrates the regional production of palm oil in year 2000. Three states in the West Malaysia, namely Johor, Pahang and Perak lead in palm oil production, contributing half the total production (5.4 million tons). The East Malaysian states produced one third (34 %) of the total palm oil (3.6 million tons). The share of the Eastern states in total production is a little lower than their share in the area. The reason for that can be found in the lower yields in Sarawak. As the expansion of palm oil took place in recent years, most of oil palms are still young and have not yet reached their optimal productivity (PERSONAL COMMUNICATION, 2001).

Figure 10.9: Regional distribution of palm oil production in Malaysia



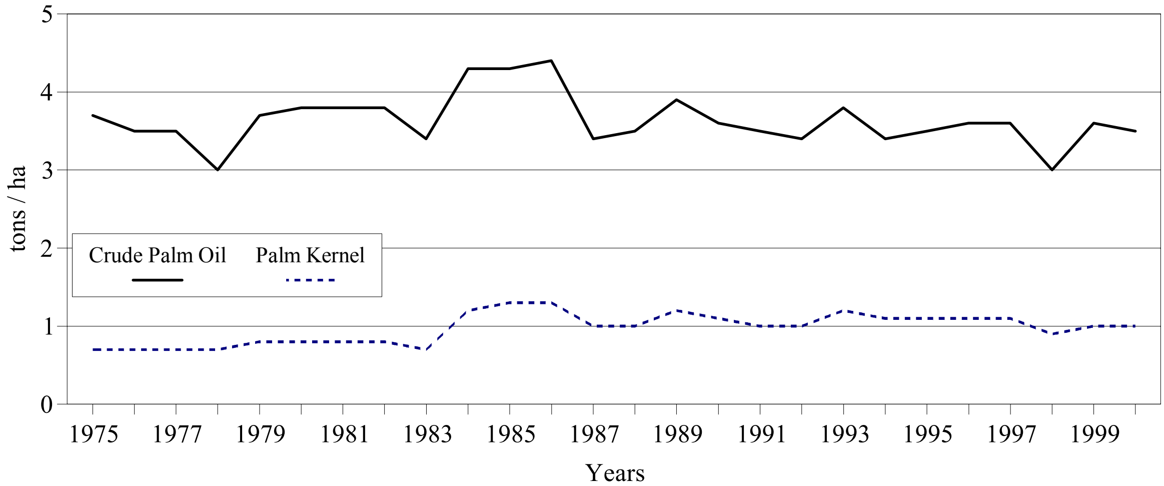
1) Total Palm Oil production of 10,8 million tons (2000).
2) As a share of total Palm Oil production in %.
Source: MPOB (2001).

10.3.3.5 Yield of crude palm oil and palm kernels

The leading position of Malaysia in the production and exports of palm oil is well supported by one of the highest palm oil yields in the world. The yields of palm oil and palm kernel have not changed drastically during the observed period from 1975 to 2000 (see Figure 10.10). A short-term rise in the yields of palm oil and palm kernels took place from 1984 to 1986, but the effect was not long lasting. One of the reasons for such a rapid increase in yields was an introduction of weevils in 1984 that has improved pollination. However, the effect was not lasting and the yields have slipped back to the level of the previous years. One positive effect of the weevil introduction can be observed on palm kernel yield, even though it went back after the peak in 1984 - 86, it has remained at a higher level compared to the previous years.

The highest palm oil yields were achieved in the states of Melakka (4.6 tons/hectares/yr), Perak (4.0 tons/hectares/yr) and Sabah (3.9 tons/hectares/yr). For more details on the monthly palm oil yields for the states in 2000, see Table A8.6 in Appendix.

Figure 10.10: Yield of crude palm oil and palm kernels, 1975 to 2001, ton per ha



Source: MPOB (2001).

10.3.3.6 Palm oil producers

Three main systems of management are practiced in the oil palm sector in Malaysia. These are the estate, organized smallholders and the unorganized smallholders types of management. The estate type of management, which is generally considered to be the most efficient of the three systems, is practiced by corporate or privately owned estates. The organized smallholder-type of management is adopted by two major government schemes, FELDA and FELCRA, and to a certain extent by the RISDA mini estates. The unorganized smallholders are the independent smallholders.

a) Estate type management. This type of management is practised by the estates in the plantation sector. The estates are owned by large conglomerates or private companies and they are run by trained professionals. This type of management is considered to be most efficient and hence, the yields from the oil palm plantations are high.

b) Organized smallholders. The organized smallholders sub-sector comprises statutory bodies such as FELDA, FELCRA and RISDA. Except for the RISDA, the decision-making is done by the smallholders themselves. Expertise in the cultivation of the crop and the marketing of the product are provided by the central management. However, field operations are carried out by the farmers or hired workers. The level of technology practised by the farmers is lower than that of the private sector.

Consequently, the performance of the oil palms is not comparable to that of the estate sector.

c) Unorganized smallholders. The system of management by the unorganized, independent smallholders is the least efficient of the three systems as the smallholders generally lack know-how and management skills that are necessary to obtain high yields. They are also hampered by a lack of capital to purchase inputs and often, do not plant authentic seedlings. Consequently, the yields are generally low compared to estates or organized smallholders. (PORIM, 1993)

In 2000, 2 million hectares of palm oil areas were under plantation estates and 0.6 million hectares under FELDA schemes (see Table 10.10). In the last two decades, the estates have increased their share in palm oil areas from 53 % to 60 % of the total. In Table A8.7 in the Appendix a more detailed distribution of the palm oil areas by the states and production systems can be found.

Table 10.10: Area under oil palm per group of producers, 1,000 hectares, 1960 to 2000

Year	Estates	Smallholders	FELDA 1	FELCRA 2	RISDA 3	State Schemes	Others 4	Total
	1,000 ha							
1960	55	-	-	-	-	-	-	55
1970	214	-	65	-	-	-	17	296
1980	546	-	308	-	22	-	146	1022
2000	2024	321	598	154	37	242	-	3377
% of total (1980)	53	-	30	-	15.0	-	14	
% of total (2000)	60	10	18	4.6	1.1	7.2	-	

1) Federal Land Development Authority.
2) Federal Land Consolidation and Rehabilitation Authority.
3) Rubber Industry Smallholders Development Authority, figures refer to blockplantings only.
4) State schemes and individual smallholders.
Source: MPOB (2001), Moll (1987), own calculations. Park_2002-03-12

10.3.3.7 Expansion potential for palm oil

There are several possibilities to increase production of palm oil:

a) open new areas;

b) convert land used for other crops;

c) increase productivity of the oil palm trees.

In 1993, Palm Oil Research Institute of Malaysia (PORIM) conducted a study to estimate potentially suitable land for palm oil cultivation on Peninsula Malaysia. The result of the study was 7.2 million hectares of land suitable for palm oil cultivation. The land which was estimated to be available for potential expansion for palm oil in 1993 was 3 million hectares which was subdivided into four major categories:

a) forest land with slopes less than 20 degrees (1.9 million hectares);

b) swamp land (0.9 million hectares);

c) scrub land (0.2 million hectares); and

d) grass land (50,000 hectares).

Detailed estimates on suitable and available land by the states in West Malaysia can be found in the Table A8.8 in Appendix.

Oil palm areas may expand not only from the above mentioned land resources, but also from the continued conversion of rubber and other crops to oil palm.

The last, but not the least, possibility is to improve productivity of oil palms. There are few factors that can influence productivity significantly a) careful selection of planting material, b) well-managed agronomical practices and c) very prudent replanting. Some experiments show that clonal palms have the potential to achieve very high oil yields of over 10 tons per hectare. This will mean that the production of palm oil can be doubled using new planting material without expanding the area used.

It is widely expected that the large expansion potential of oil palm lie in East Malaysia in the states of Sabah and Sarawak (PERSONAL COMMUNICATION, 2001).

10.3.4 Political and economic framework conditions

Generally, the government provides no direct cash subsidy or equivalent incentives for producers of palm oil. Market forces of supply and demand govern the price of palm oil paid to the producer.

However the government plays a substantial role in production, processing and marketing of palm oil and by-products through several agencies, by regulation and licensing and by supporting research.

The government is involved in the palm oil industry through several agencies. The largest of them are the Federal Land Development Authority (FELDA), Federal Land Consolidation and Rehabilitation (FELCRA) and Rubber Industry Development Authority (RISDA). The palm oil area allocated to the government and state schemes was over 1.0 million hectares in 2000 (see Table 10.10).

FELDA is responsible for opening virgin land, establishing the plantation and its young oil palms, and for constructing the scheme buildings, including the settler's houses. Settlers are brought into the scheme and begin working it three years before the harvest, during which time they receive a FELDA loan for income support. About 70 % of the costs of establishing a scheme are recovered from the settlers over a 15 years period through deductions from the settler's sale of FFBs to the FELDA mill. During this 15-year period, FELDA maintains firm managerial control over the scheme to ensure its coherence as a single unit of production so as to exploit the scheme's economies of scale (PLETCHER, 1991).

FELDA, the largest single producer of palm oil, is involved in the processing and refining of palm oil. It controls several subsidiaries and joint ventures in fertilizer production, manufacturing of processing equipment and marketing as well.

In 1977, the Palm Oil Registration and Licensing Authority (PORLA) was established. PORLA had responsibility for regulating and coordinating all activities relating to supply, sale, storage, trade and quality of palm oil, and of collecting and supplying information on the industry. Its powers included registering, licensing, regulating, and enforcing all activities in its scope. These powers have become even more significant since the responsibilities of PORLA were expanded by a 1982 amendment that put all palm products, from seeds and seedlings to fully refined palm and palm kernel oil, in its purview.

In 1979, the Palm Oil Research Institute of Malaysia (PORIM) was established, which took over research by the oil palm branch of Malaysian Agricultural Research and Development Institute (MARDI). The main areas of activity of PORIM were research in chemistry and technology of extraction, processing and end-use of oil, on techno-economic studies in the Malaysian palm oil industry, and the marketing of palm oil and other oils and fats on the world market.

In 1998, PORLA and PORIM were merged into the Malaysian Palm Oil Board (MPOB). The new established board has taken over all responsibilities of both organizations. The MPOB is governed by a board in which government, producers and the refining industry are represented. The board is financed through a cess of 11 RM per ton (3.5 Euro per ton) of crude palm oil to be paid by the producer.

Even though no subsidies exist for the palm oil producers, the government announced an incentive scheme to replant palm oil fields aged over 25 years. About 350,000 hectares were targeted by this scheme for replanting with a 1,000 RM per hectare (285 Euro/hectares) payment. The scheme was introduced in order to reduce palm oil production during very low price periods (at that time palm oil prices plunged to as low as

600 RM per ton) and to replant the averaged fields with new clones that have superior productivity. However, the government stopped the scheme when the prices soared to 1,.600 RM per ton. About 170,000 hectares were replanted in the framework of this scheme (SOYTECH, 2002).

10.3.5 Quality of palm oil

Since the largest part of produced palm oil is destined for the international markets, strict rules exist for the quality of exported palm oil and palm oil products that are vigorously implemented by MPOB. The major factors that determine the quality of palm oil are following:

- Content of free fatty acid. Free acids are formed by enzyme action from the moment of harvesting when fruits are bruised, until sterilization or boiling. A low content of free fatty acids facilitates the refining of palm oil and end products have longer shelf life.
- Oxidation. A low degree of oxidation is important for the refining process, as this improves bleachability and results in a longer shelf life for the final product. Degree of oxidation is expressed in peroxide value (PV) and (a235 + a270), both values refer to laboratory tests.
- Bleachability. Refined palm oil is used together with other fats and oils in manufacturing a variety of products and individual oil must be colorless before blending. Good bleachability of palm oil results in relatively low refining costs and it improves its competitive position over other oils. Several laboratory tests are in use to express the bleachability.
- Contents of moisture and impurities. A low content of moisture and impurities is important for the stability of the oil during storage.
- Contents of heavy metals. Metallic promoters of oxidation, such as copper and iron have a negative effect on the keeping quality of oil.

Several grades and quality specifications exist for palm oil. Unfortunately it was difficult to obtain the latest standard from MPOB, thus older standards are given in a Table 10.11 as an example.

Table 10.11: Quality specifications for Malaysian palm oil

	Standard quality	Special quality
f.f.a (%)	3.0 ± 1	1.8 ± 0.2
Heat bleach	0.7 ± 0.3	0.5 ± 0.3
Mixed bleach	1.2 ± 0.6	1.1 ± 0.2
Moisture (%)	0.1 ± 0.03	0.1 ± 0.03
Impurities (%)	0.01	0.01
Iron (ppm)	3.5 ± 1	3.5 ± 1
Copper (ppm)	0.2	0.2
PV (mEq/kg)	4.5 ± 2	3.0 ± 1
100 (A235 + A 270)	15.0 ± 3	10.0 ± 2

Source: MPOPA (1973). Park_2003-02-26

10.4 Comparison of selected farms in Indonesia and Malaysia

10.4.1 Location of farms

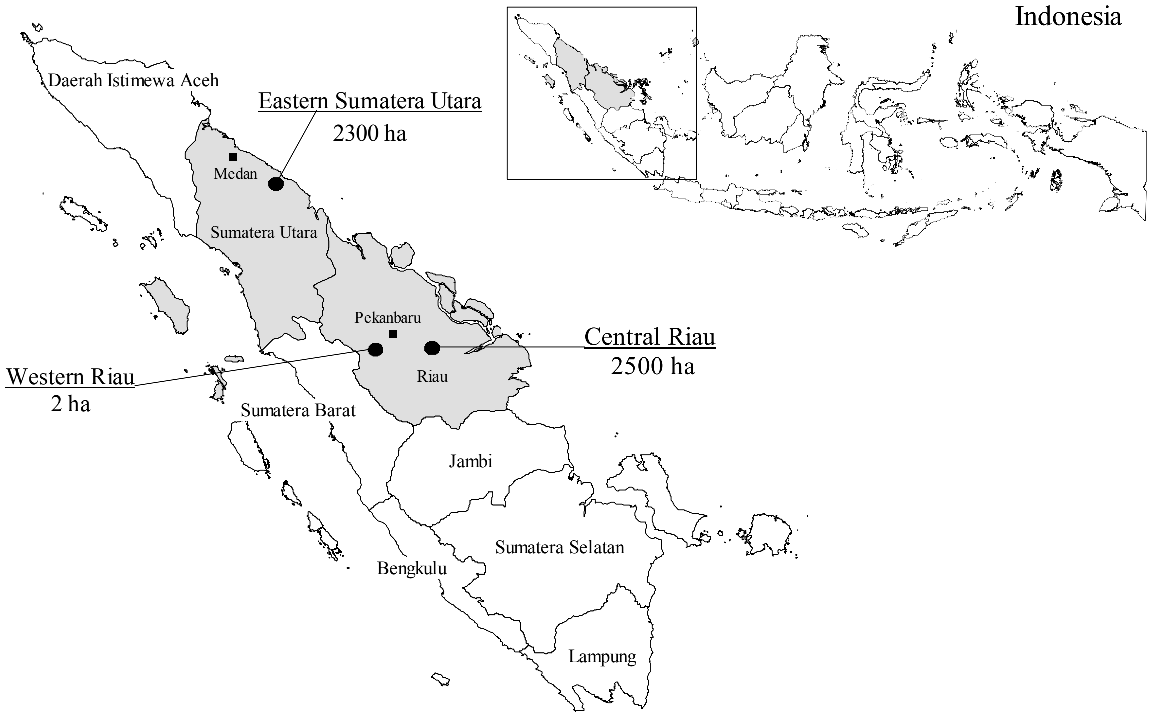
One independent smallholder and two plantations, one state and one private, are chosen for the farm level analysis in Indonesia that reflects three major producer groups. The private estate is located near Medan, in the eastern part of North Sumatra (Sumatera Utara). The estate has a long history of palm oil production and the province is the major producer of palm oil. The independent smallholder and the state estate are located in the middle of Riau province (see Figure 10.11). The province is second largest producer of palm oil with highest rates of further expansion.

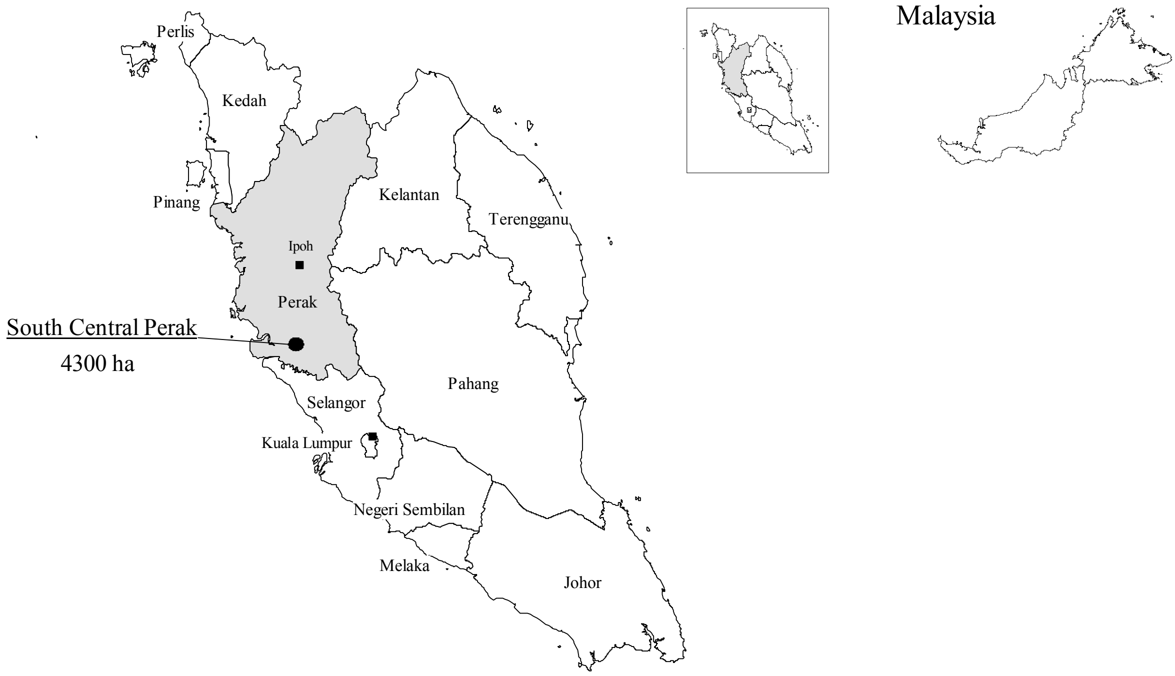
Private estate from Malaysia should provide first insight for the situation in the important producing region. The estate belongs to a large plantation company that is specialized in the plantation sector producing palm oil and coconuts. The estate is located in the south of Perak state (see Figure 10.11). This is a traditional area of palm oil production in the West Malaysia.

10.4.2 Climate and soils

Climate and soil conditions are quite suitable for the oil palm production at the selected locations. A short summary is given in Table 10.12.

Figure 10.11: Location of the estates and smallholder farm in Indonesia and Malaysia





Source: Own illustration.

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Table 10.12: Climate and soil conditions at the selected locations in Indonesia and Malaysia

Region	Western Riau	Central Riau	Eastern Sumatera Utara	Southern Perak
Estate size (ha)	2	2500	2300	4300
Soil type	-	-	Sandy loam	Allivial soil / Inland soils
Relative soil quality	good	good	very good	very good / good
Rainfall / mm per year	above 2000	above 2000	above 2000	above 2000
Rainfall distribution	two rainy seasons April to May Oct. to Nov.	two rainy seasons April to May Oct. to Nov.	two rainy seasons April to June Sept. to Dec.	two rainy seasons March to May Oct to Dec
Average temperature °C	above 20	above 20	above 20	above 20
Average frost days	none	none	none	none

Source: Own data collection (2001) Park_2003-01-25

10.4.3 Production systems

The state and private estates have to some extent similar production systems that are adjusted to local conditions. According to some sources state estates are less efficient (higher inputs and less outputs) compared to private estates, which maybe caused by differences in management organization (PERSONAL COMMUNICATION, 2002).

The most work, now as before, is done by manual labor despite various efforts to mechanize the work processes. Labor distribution within the estate is organized hierarchically. Most of employees are simple harvesters or field workers without special qualifications. Harvesting, care of plantings, and maintenance of drainage system and roads are the most important service areas of the workers. The respective assistant manager is responsible for organizing and coordinating all work. The great demand for the labor on the estates results in a need to locate a large part of the work force on the estate. Cost occurred for infrastructure, houses and other facilities are covered by the estate.

Smallholder farmer rely mainly on family workforce, where all field activities are done manually. The major expenses faced by the smallholder are the establishment of the field and fertilizer costs. Chemicals are seldom applied.

All selected estates in Indonesia and Malaysia are specialized in palm oil production and have a pure oil palm stand. Malaysian estate has the highest FFB yield due to a very suitable ecological conditions and good management. The lowest FFB yield achieves the smallholder on less suitable soil due to lack of expertise and poor planting material (see Table 10.13).

Table 10.13: Crop rotation and yields for the selected estates and smallholder plot

		Indonesia			Malaysia
		Western Riau	Central Riau	Eastern North Sumatra	Southern Perak
Estate size	ha	2	2500	2300	4300
Soil cultivation system		manual labour	mechanization + manual labour	mechanization + manual labour	mechanization + manual labour
Share of:					
Oil Palm	%	100	100	100	100
Yield:					
FFB	t/ha	15,4	19,1	21,2	23,3
CPO	t/ha	3,4	4,2	4,9	5,1
PK	t/ha	0,4	0,9	1,0	1,4

FFB - Fresh Fruit Bunches, CPO - Crude Palm Oil, PK - Palm Kernels Park_2003-02-19
Source: own data collection.

A detailed description of the production system at the selected estates and smallholder is given in the Table A8.9 in Appendix.

10.4.4 Production costs and profitability of FFB and CPO production

Production of palm oil is quite different from production of annual oilseeds. To account for these differences, two additional cost groups appear in the cost classification: field establishment and processing costs. Field establishment costs are related to the first three years of the establishment phase and include all measures necessary from the planting of a new oil palm field through the onset of the productive phase. In general, these measures consist of the preparation of the land area, raising of seedlings, and care of the fields.

Processing of the fruit bunches is integrated into the palm oil production on the large estates in Indonesia and Malaysia, and thus has to be included into the cost classification as well. Crude palm oil (CPO) and palm kernels (PK) are the final outputs of the estates that are sold for further refining/processing. To use the full capacity of the mills, additional FFBs are purchased from the smallholders.

Smallholders sell FFB to a wholesaler at the farm gate or directly from the field. The wholesaler delivers FFB to a nearby mill (state or private) for further processing. Therefore, the processing costs are irrelevant for the smallholders who are sometimes put at a disadvantage due to price disbalance between FFB and CPO.

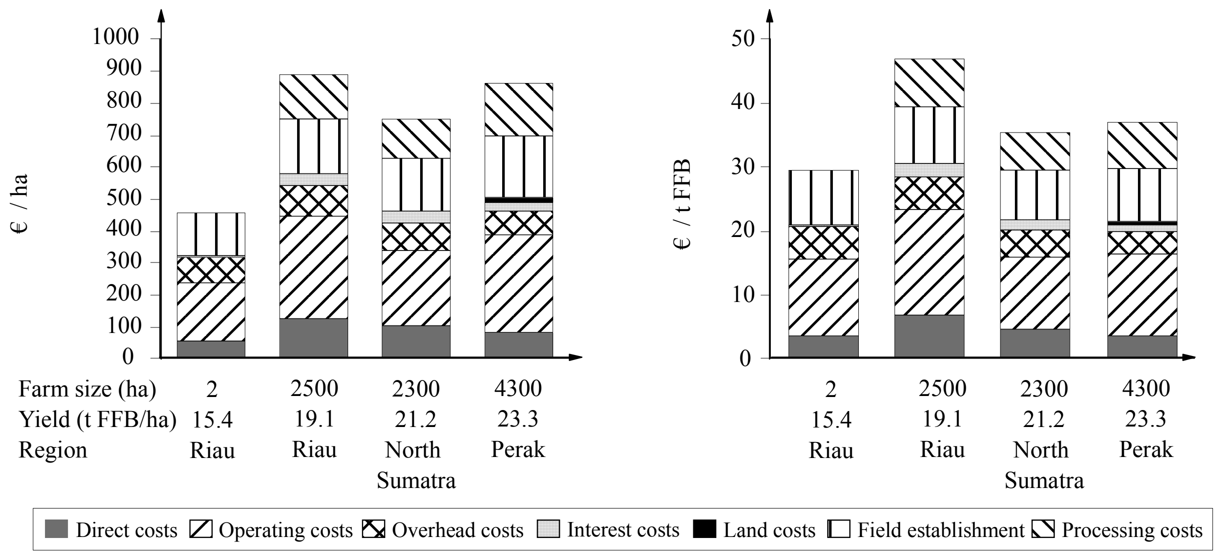
In order to keep cost results compatible for the comparison between the estates and the smallholder, the figures are expressed in Euro per hectare and per ton of FFB.

Due to the fact that profitability of CPO production on the estates is determined by sale of CPO and PK and not FFB, profitability analysis is done in Euro per hectare and per ton of CPO accounting for additional PK revenues. For details see relevant section.

10.4.4.1 Production costs

The smallholder in this comparison is the absolute low cost producer particularly on per hectare basis (see Figure 10.12). He has the lowest costs per hectare (456 Euro) followed by the private estate (752 Euro per hectares) and the state estate (893 Euro per hectares). Malaysian estate has slightly lower costs (863 Euro per hectares) than the state estate.

Figure 10.12: FFB: Production costs, 2000



Exchange rate: 1 € = 7756 RP; € = 3.51 RM
Source: Own calculations.
Park_2003-03-03

Despite the lowest yield, the smallholder keeps its leading position when the costs are expressed on the FFB basis (30 Euro per tons FFB). It is followed by private estate (36 Euro per tons FFB) and the state estate (47 Euro per tons FFB). The Malaysian estate has slightly higher costs (37 Euro per tons FFB) than the private estate. The difference in the costs with Indonesian private estate is narrowed due to higher productivity of the Malaysian estate (23.3 ton FFB vs. 21.2 ton FFB per hectares).

When the results are compared without processing costs Malaysian estate has the lowest costs of 29.2 Euro per ton FFB, followed by the private estate and the smallholder (29.6 Euro per ton FFB) and the highest costs has the state estate (39.4 Euro per ton FFB).

The major cost groups contributing to the total costs were operating costs (ranging between 32 % to 41 %), field establishment costs (from 19 % to 29 %), processing costs excluding the smallholder (ranging between 16 % to 19 %), overhead costs (from 9 % to 17 %) and direct costs (from 10 % to 14 %).

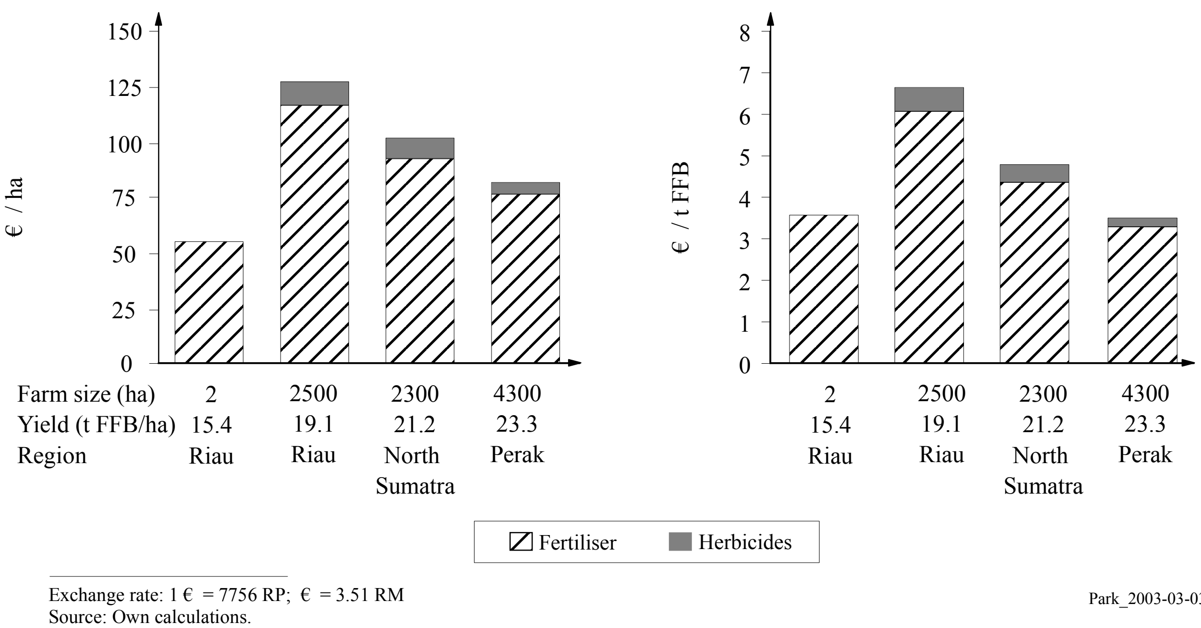
A detailed discussion of these groups is given in the following part.

Direct costs

Direct costs range from 55 Euro (smallholder) to 128 Euro per hectares (state estate) (see Figure 10.13). Direct costs of the smallholder are about a half of the estate costs. This cost advantage is due to lower input of fertiliser and herbicides that related to a) lower productivity of smallholder oil palms and b) smallholders tend to apply fewer inputs (fertiliser, chemicals etc.) due to lack of capital and insecurity of revenues from FFB production. Expressed on the yield basis, the smallholder kept its leading position with 3.6 Euro per tons FFB followed by the private estate (4.8 Euro per tons FFB) and state estate (6.7 Euro per tons FFB). The Malaysian estate has the lowest direct costs of 3.5 Euro per tons FFB.

The major cost item for all estates and the smallholder was fertilizer input, with potassium and nitrogen fertilizers contributing the largest part. Malaysian estate applied higher amount of nitrogen and similar amount of potassium per ton of FFB, lower prices for fertilizer give the major cost advantage for the Malaysian estate (see Table 11.1).

Figure 10.13: FFB: Direct costs, 2000



Exchange rate: 1 € = 7756 RP; € = 3.51 RM
Source: Own calculations.

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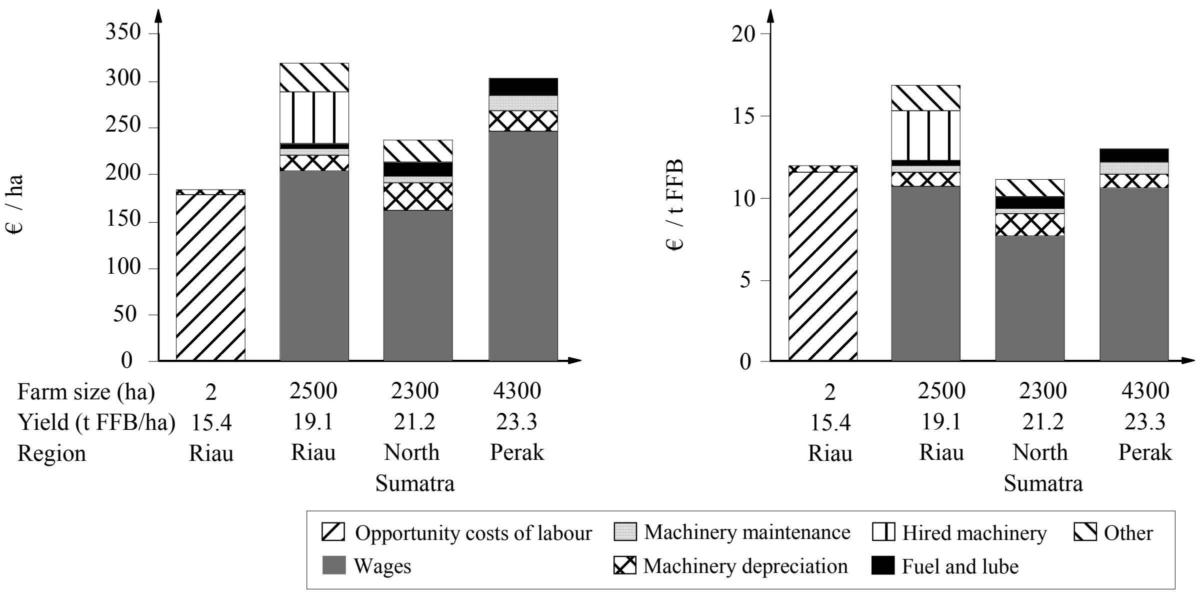
Operating costs

Operating costs contributed the largest share (32 % to 41 %) of the total production costs and ranged between 185 Euro (smallholder) and 320 Euro per hectares (state estate) (see Figure 10.14). Expressed on the yield basis, the state estate comes out with the highest operating costs of 17 Euro per tons FFB, followed by the smallholder (12 Euro per tons FFB) and private estate with the lowest 11 Euro per tons FFB. The Malaysian estate has slightly higher operating costs (13 Euro per tons FFB) than the private Indonesian estate. Most notable is that labour was the major cost factor in this group, accounting for 96 % for the smallholder and over 60 % for both Indonesian estates. For the Malaysian estate, the labor costs contributed 81 % of the total operating costs. When disaggregated into price and amount components Malaysian estate had to face the highest wages of 0.97 Euro per Lhr followed by state (0.7 Euro per Lhr) and private (0.5 Euro per Lhr) estates (Table 10.1). The smallholder unpaid wage was about 0.2 Euro per Lhr. The highest labour productivity has Malaysian estate that needs about 11 Lhr to produce one ton of FFB compared to 13 - 14 Lhrs on Indonesian estates and the highest 58 Lhr the smallholder.

Costs for machinery were the second most important cost factor for all estates.

Figure 10.14: FFB: Operating costs, 2000



Exchange rate: 1 € = 7756 RP; € = 3.51 RM
Source: Own calculations.

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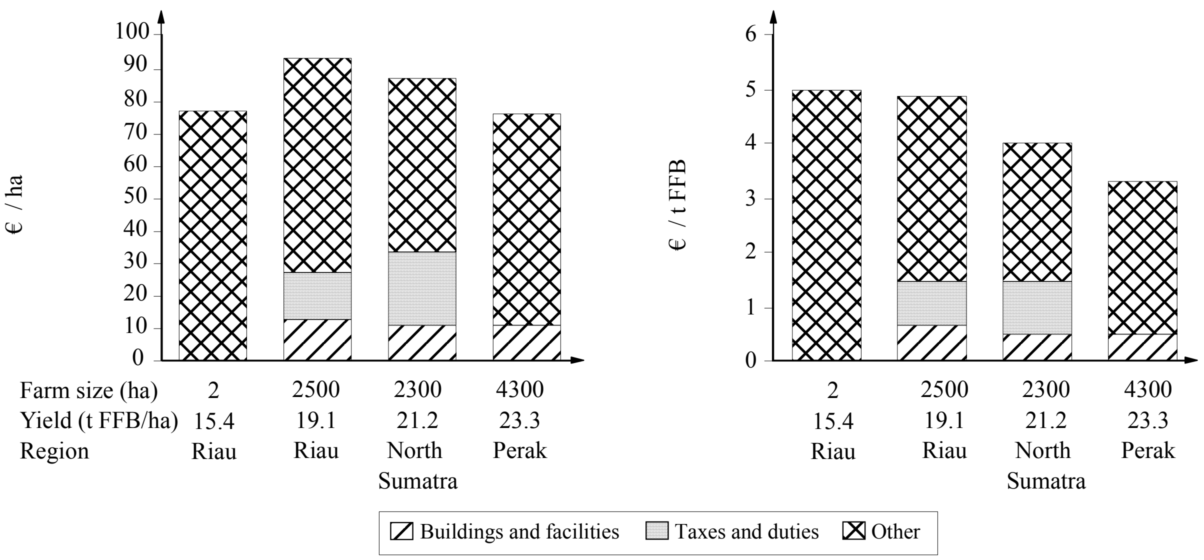
Overhead costs

Overhead costs ranged between 76 Euro (Malaysian estate) to 93 Euro per hectares (state estate) (Figure 10.15). The private estate had the lowest cost per yield unit of 4.1 Euro per tons FFB, followed closely by the state estate with 4.9 Euro per tons FFB and the smallholders had the highest overhead costs with 5.0 Euro per tons FFB. The Malaysian estate had the lowest overheads of 3.3 Euro per tons FFB.

For the smallholder one major item, a membership fee in the co-operative, contributed to the high overhead costs. For the estates, costs for buildings, taxes and fees have contributed a part of the overhead costs, other major items were maintenance of the road and drainage, security, water, electricity, office and some other expenses.

Figure 10.15: FFB: Overhead costs, 2000



Exchange rate: 1 € = 7756 RP; € = 3.51 RM
Source: Own calculations.

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Field establishment costs

Field establishment costs ranged from 133 Euro (smallholder) to 194 Euro per hectares (Malaysian estate) (see Figure 10.12). Expressed on a yield basis, the private estate has the lowest establishment costs of 7.7 Euro per tons FFB, followed by the smallholder (8.7 Euro per tons FFB) and state estate (9.0 Euro per tons FFB). Malaysian estate costs were slightly below (8.3 Euro per tons FFB) of the Indonesian smallholder.

Estimates of field establishment costs available from respective estates and smallholder were used for this analysis. Interest was calculated at a standard rate of 12 % for Indonesia and 9 % for Malaysia applied to half the field establishment costs as an approximation of the average book value. The sum of depreciation and charged interest were allocated to this cost group.

In general, about 50 % of the total costs occur in the first year of establishment when old trees have to be cut, new plants have to be planted and care should be taken of the planted trees. Costs occurring in the following years consist mainly of fertilizer application, care of the plants and general charges. Major cost items of the total field establishment are labour costs (about 30 % to 40 %), fertilizer costs (around 12 %) and general charges (about 20 % or more).

Processing costs

Processing costs ranged from 124 Euro (private estate) to 166 Euro per hectares (Malaysian estate) (see Figure 10.12). The smallholder had no processing costs. Expressed on the yield basis, the private estate had the lowest processing costs of 5.8 Euro per tons FFB, followed by the state estate with 7.3 Euro per tons FFB. The Malaysian estate, due to its high productivity, had slightly lower processing cost (7.1 Euro per tons FFB) of the Indonesian state estate.

Estimates of processing costs from respective estates were used for the analysis. Few details were available on the structure of these costs. In general, spares and material contribute over 50 % of the total cost, and the second largest cost group is labor, contributing about 20 % to 30 % of the total costs.

Land costs

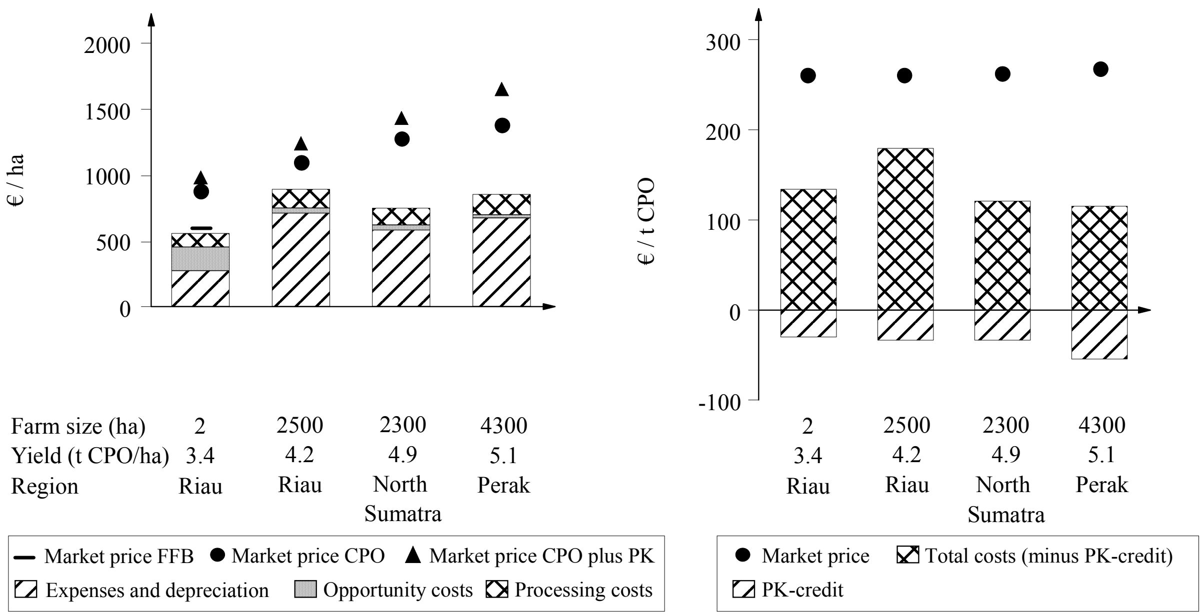
Land costs are difficult to define, as there exist no land market. State estates in Indonesia belong to the government thus occur no land costs. Private estates receive land for a long-term use and pay some relative low fee to the government. This fee varies between provinces and location and was difficult to separate from the overhead costs. In Malaysia similar situation is observed. Many independent smallholders in Indonesia have received their land for free from the government to produce cash crops and later have planted their fields with oil palm during high world palm oil prices in hope to improve their incomes.

10.4.4.2 Profitability

The left side of Figure 10.16 displays the costs of production divided into budget based expenses and depreciation, opportunity costs and processing costs against market receipts. In order to show an additional gain from sale of CPO and PK, both revenues are displayed in the profitability per hectare graph a) revenue from CPO sale and b) revenue from CPO plus PK sale. As CPO and PK are two different products that are difficult to aggregate in order to display the profitability per yield unit, the revenues from PK (PK-credit) are deducted from the total costs per hectare and the remaining costs are divided by CPO yield. PK-credit is divided by CPO yield as well and displayed as negative costs of CPO production.

In order to estimate the production costs of CPO for the smallholder an average processing costs of the analysed Indonesian estates are added to the production costs of FFB. Sale prices of CPO and PK are set equal to the state estate in Riau province. Such situation could be possible if smallholders would organize to start a new mill to process their own FFB and gain from the sale of CPO and PK. On other hand estates (private and state) purchase the FFB from smallholders for relative low price and process them. They benefit a good processing margin from processing of smallholders FFBs.

Figure 10.16: Palm oil: Profitability of production, 2000



Exchange rate: 1 € = 7756 Rp; 3.51 RM (2000).
Source: Own calculations.

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All Indonesian producers generated positive entrepreneur's profit (returns minus total costs) with the private estate showing double profit per hectare of the state estate. The Malaysian estate generated the highest entrepreneur's profit of 790 Euro per hectares. When expressed as profit per ton of CPO, the private estate had the highest profit of 140 Euro per tons CPO followed by the smallholder (126 Euro per ton CPO) and state estate with (82 Euro per tons CPO). The Malaysian estate had the highest profit of 154 Euro per tons CPO. The results included PK-credit. In Malaysia highest PK-credit was a result of higher prices for PK and higher extraction rate.

For the smallholder, opportunity costs (mainly labour) have contributed about one third of the total costs, deducting them from the total costs results in family farm income of 612 Euro per hectares. For the estates, opportunity costs contributed less than 5 % of the total costs, and were mainly attributed to interest costs for operating capital.

Even though in the year 2000 the price of CPO sank significantly (around 260 Euro per ton CPO) compared to the previous years (with a peak of 700 US-$ per ton CPO in 1998), the palm oil production remained a quite a lucrative activity for all producers.

11 International comparison

Production of soybeans, rapeseed and oil palm are studied in eight countries. The details on climate, soils, competing crops, agricultural policy, production costs and profitability of produced oilseeds are to find in the respective country chapters. These country chapters form a basis for international comparison of results.

The review of the results starts with comparison of productivity of crops that strongly influence the level of production costs per yield unit. After that follows comparison of production costs and profitability with detailed analysis of reasons for their differences. As products have to be delivered to a common market and delivery costs differ considerably between countries a comparison of inland and transport costs is done additionally to farm-level production costs. Sensitivity analysis studies how different exchange rates and rapeseed equivalent rates influence the end result of comparison.

11.1 Crop yields

Productivity of selected crops varies considerably between countries and crops. It depends on two major factors a) biological productivity and b) intensity of production system which at large depend on ecological conditions of the region (climate and soil productivity). Soybeans and rapeseed have similar level of biological productivity, whereas under the current production systems considerable differences are observed between countries. In Canada rapeseed yields (1.4 ton per hectare) are just around one third of German yields (4 ton per hectare). Water deficit, soil erosion and short vegetative period sets crop production at risk and leads to extensive production systems. Rapeseed in Canada is a summer crop and cannot realize its yield potential compared to winter crop in Germany or China.

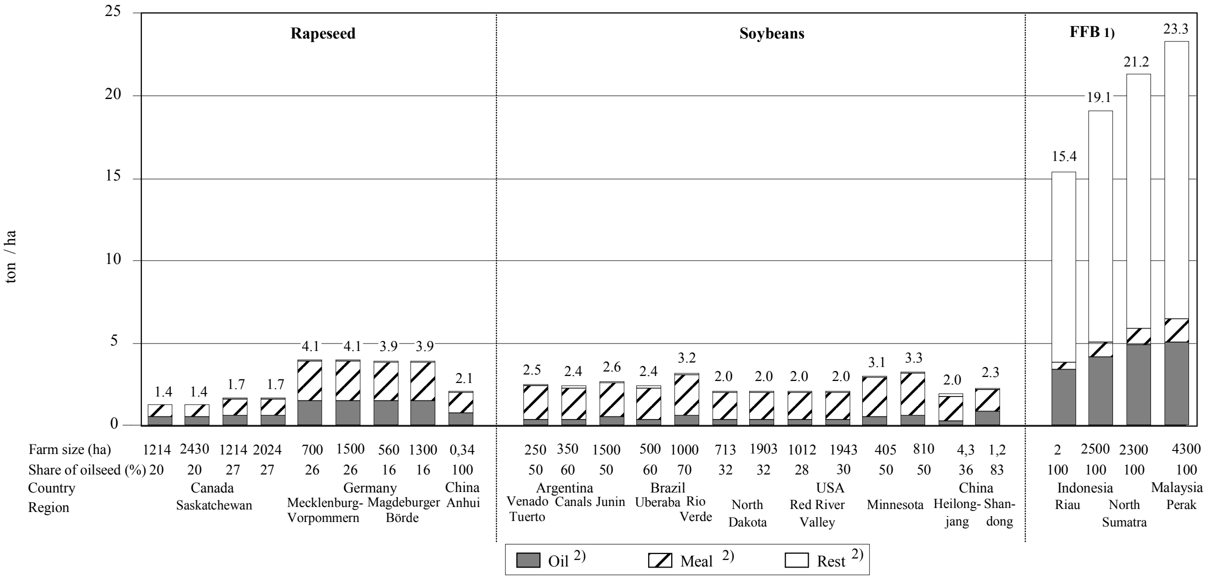
Soybean yield differences are moderate between countries, Brazil and Argentina being ahead. Farms in southern Minnesota are able to achieve the highest soybean yields between analyzed farms due to relative favorable climate and soil and respectively intensive production system.

Oil palm is a perennial tree with very different production system and very high biological productivity. In very favorable tropical climate Malaysian plantation harvests 23 ton FFB per hectare per year, which in terms of oil yield is over three times higher of German oil yield (see Figure 11.1).

This considerable difference in productivity levels of selected crops reflects strongly in the production costs expressed per ton of yield.

Additional biological specificity of the crops is their different oil and meal content. Based on extraction coefficients real yield at the selected farms is divided into oil, meal and rest components and displayed in Figure 11.1. The details on how this problem is solved for economic analysis are given in Chapter 3.2.2.

Figure 11.1: Oil crops: Yields in selected countries, ton per ha (oil, meal and rest components)



1) For Indonesian and Malaysian large plantations real figures are applied.
2) Oil and meal figures are based on average content of oil and meal in the respective crop. For details refer to Table 3.2 in Chapter 3 of this report.
Source: Own calculations.

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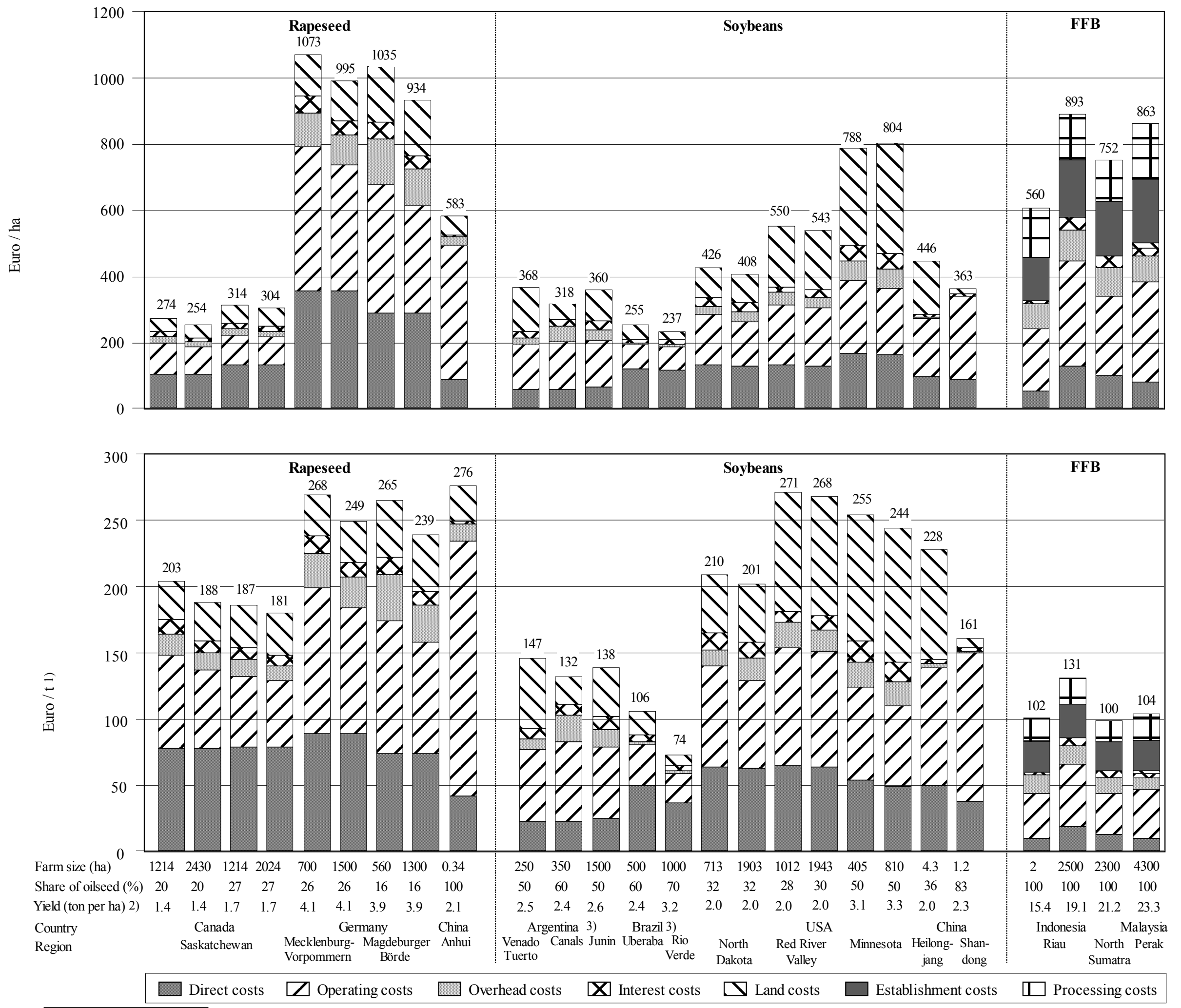
11.2 Production costs

Total **costs per hectare** for the analyzed farms range between 237 Euro (Rio Verde, Brazil) to 1.073 Euro (Mecklenburg Vorpommern, Germany) (see Figure 11.2; Tables A9.1). The German farms have the highest production costs, for three of them exceeding 1.000 Euro per hectare. Farms in Canada and South America have the lowest production costs (237 - 368 Euro per hectare), where the lowest are one fourth of the German figures. Production costs per ha of the FFB on the large plantations in Malaysia and Indonesia are slightly below of German level and range from 753 Euro to 893 Euro per hectare. The costs of the FFB producers include establishment and processing costs to account for specificity of production.

Figure 11.2: Oil crops: Total production costs, 2000



1) Costs are displayed as rapeseed equivalents. Costs of soybeans and fresh fruit bunches (palm oil) are multiplied by 0.996 and 2.806 respectively. For rapeseed the factor is 1.0;
2) Yield: ton per hectare of raw output;
3) Reference year 1999.
Exchange rate: 2000 : 1 Euro = 1.96 DM; 0.92 US-$; 1.37 CAN-$; 7.66 RMB; 3.51 RM; 7,756 Rp
1999 : 1 Euro = 1.06 ARG-$; 1.92 R-$.
Source: Own calculations.

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When converted to a **cost per ton** of yield, ranking of the low and high cost producers shifts significantly. The reasons for that are:

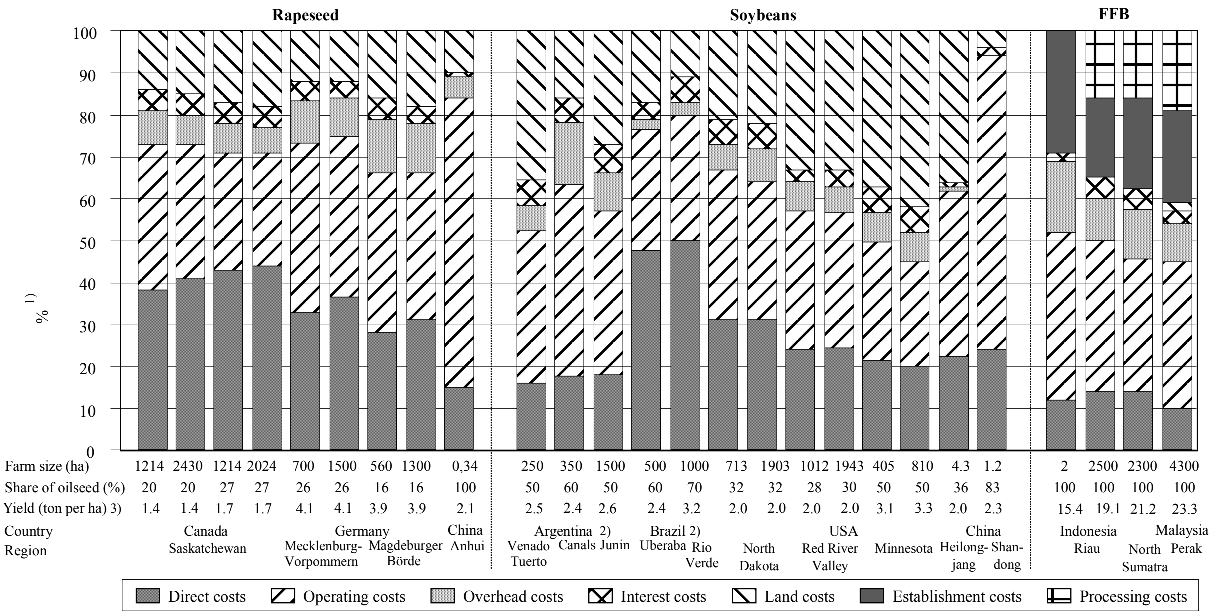
a) very different levels of output per hectare;

b) rapeseed coefficient used for conversion of cost figures is higher for palm oil (2.81) compared to rapeseed (1.0) or soybeans (0.996) (see chapter 3.1).

China (Anhui) come out to have the highest production cost per ton of rapeseed (276 Euro), followed closely by German (240 - 268 Euro) and US farmers (197 - 268 Euro) (Figure 11.2 and Table A9.2). Producers in South America (74 - 147 Euro) and Southeast Asia (84 - 131 Euro) have the lowest costs. German and especially Southeast Asian producers benefit considerably from very high productivity of their crops. German farmers are able to significantly reduce cost difference to other producers and Southeast Asia shifts from high to low cost producer, when the cost figures are expressed per yield unit.

Reviewed production costs show great differences between countries and crops. Reasons for such differences are manifold. Figure 11.3 displays relative importance of the cost groups in the total costs. It reveals that operating costs, direct costs and land costs are the largest cost items for the most of farms. However, their importance in the total varies from country to country and from crop to crop. Cost structure exhibit similar pattern of cost distribution within the same countries for the same crops.

Figure 11.3: Relative importance of the cost groups in the total production costs, %



1) Share of cost group of the total costs.
2) Reference year 1999.
3) Yield: ton per hectare of raw output.
Source: Own calculations.

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Further analysis will focus on the cost groups and components comprising them in order to find reasons for their differences and interpret them. Where necessary and possible costs will be disaggregated into price and quantity components.

Operating costs

Operating costs are the largest cost item for the most of farms that contribute about 24 to 46 % of the total cost. China is an exception with 70 % of the total.

Costs related to the mechanization of the farms, such as depreciation and maintenance of machinery, custom work, fuel and lube contribute around 70 % of the operating cost in Canada and South America. Their share exceeds 50 % in Germany and the United States.

The lowest share of these costs is on the small farms in China (5 - 10 %) and Indonesia (1 %). Consequently, share of labor costs on these farms is very high (over 90 %), where the smallholders complete most of the work manually.

The rapeseed farms in **Germany** and **China** (Anhui: 406 Euro) have the highest operating **costs per hectare** (328 - 439 Euro) (Figure 11.4). With very intensive production German farms have cost disadvantage in almost all cost components: a) costs for machinery and fuel are the highest among all countries, b) labor costs are the highest as well, with an exception of large plantations in Southeast Asia and small farms in China (Anhui, Shandong). When the **costs** are expressed **per yield unit** the difference range of costs is reduced considerably. High yields on German farms (84 to 110 Euro per ton) compensate their high costs per ha and result in costs per ton similar to the US farms (61 to 89 Euro per ton).

Chinese farms have a sole cost disadvantage in labor opportunity cost. The reason for this is very low labor productivity on all Chinese farms, where most of work is done manually. Farmers need between 237 (Heilongjang) to 767 (Anhui) hours, an equivalent of about 52 - 96 days, to produce one ton of soybean or rapeseed. Whereas, in Canada or Germany about 1.1 – 3.2 hours needed per ton of rapeseed. Consequently, despite the lowest labor wage among the countries of about 0.2 Euro per hour, when multiplied with very high labor input this results in very high labor cost per hectare of 113 Euro (Heilongjang) to 396 Euro (Anhui) (see Table 11.1). Discussion on labor opportunity costs in China is to find in Chapter 9.6.1 and in sensitivity analysis.

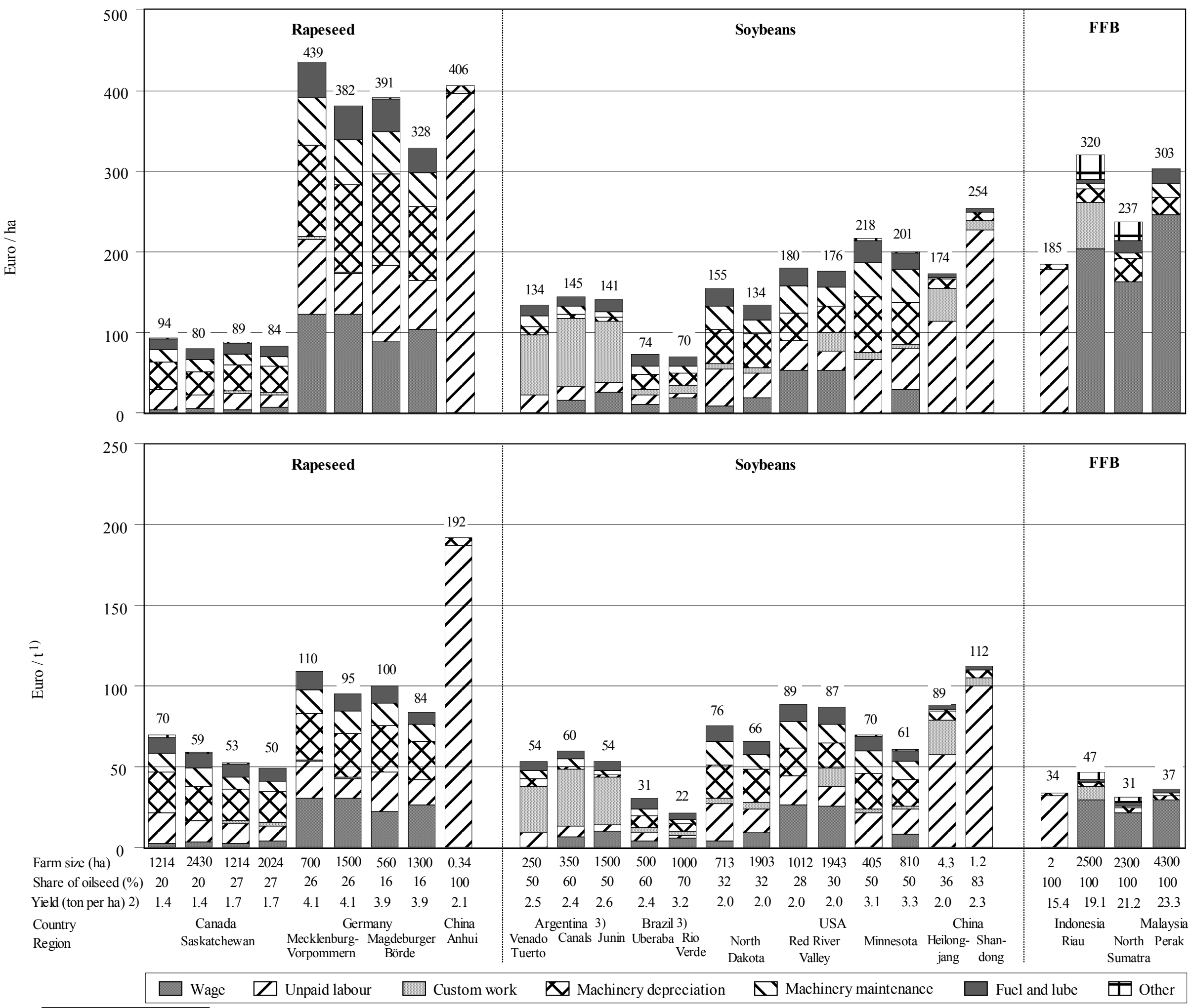
Moderate yields on Chinese farms cannot compensate very high operating costs per ha and as result China turns out to have the highest costs per yield unit (89 to 192 Euro).

When **labor costs** are disaggregated into price and quantity components German, Canadian and U.S. farmers face the highest labor costs per hour (11.6 - 15 Euro) (see Table 11.1). The level of wages and opportunity costs for family labor on these farms is strongly influenced by a) relative high wages existing outside of agriculture, b) regulations on minimum wage and benefits for employees and c) additional costs related to social contributions.

Very high labor costs per hour on these farms are partially offset with relative high productivity of labor, where machinery is used intensively to substitute high labor input.

Very high operating costs **per hectare** (237 - 303 Euro) of large plantations in **Southeast Asia** are mainly attributed to very high labor costs (over 65 % of the total). FFB production is very labor intensive, where field activities and harvest is very difficult to substitute with machinery. Therefore, about 11 - 14 hours is needed to produce one ton of FFB, for the smallholder the labor input is even higher of 58 hours. Indonesian wages (0.5 – 0.7 Euro per Lhr) are lower of the Malaysian (1.0 Euro per Lhr), taken into account that labor productivity is on the similar level in both countries this gives cost advantage for Indonesia (see Table 11.1). As most of the work is done manually, there are relative low costs for machinery on all plantations, which do not exceed 116 Euro per hectare. When costs are expressed **per yield unit** Indonesia and Malaysia come out to have the lowest operating costs per ton (31 to 7 Euro) on the level of Brazilian farms.

Figure 11.4: Oil crops: Operating costs, 2000



1) Costs are displayed as rapeseed equivalents. Costs of soybeans and fresh fruit bunches (palm oil) are multiplied by 0.996 and 2.806 respectively. For rapeseed the factor is 1.0;
2) Yield: ton per hectare of raw output;
3) Reference year 1999.
Exchange rate: 2000 : 1 Euro = 1.96 DM; 0.92 US-$; 1.37 CAN-$; 7.66 RMB; 3.51 RM; 7,756 Rp
1999 : 1 Euro = 1.06 ARG-$; 1.92 R-$.
Source: Own calculations.

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The lowest operating costs **per hectare** in **Brazil** and **Canada** (70 - 94 Euro) are attributed to cost advantage in almost all cost components. Labor costs in both countries are on similar level (22 - 30 Euro), however for different reasons. In Canada high labor productivity (1.1 - 1.4 Lhrs per ton) and high imputed wages (12 Euro per hour) lead to a similar level of labor cost as in Brazil, where it is a result of lower labor productivity (4.3 - 11.6 Lhrs per ton) and lower imputed wages (1.4 - 1.8 Euro per hour) (see Table 11.1).

Table 11.1: Input prices, intensities and productivity of oilseeds production

		1	2	3	4	5	6	7	8	9	10	12	13	14	15	16	17	18	19
Crop		Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans	Palm oil	Palm oil	Palm oil	Palm oil
Country		Canada	Canada	Germany	Germany	China	Argentina	Argentina	Argentina	Brazil	Brazil	USA	USA	China	China	Indonesia	Indonesia	Indonesia	Malaysia
Region		Saskatchewan	Saskatchewan	Mecklenburg Vorpommern	Magdeburge Börde	Anhui	Venado Tuerto	Canals	Junin	Uberaba	Rio Verde	Red River Valley	Minnesota	Heilongjang	Shandong	Riau	Riau	North Sumatra	Perak
Key name		CA-2430BR	CA-2020BL	DE-1500MV	DE-1300MB	CN-1ANH	AR-250ASF	AR-350CO	AR-1500BA	BR-500UB	BR-1000RV	US-1940RRV	US-810MN	CN-4HEI	CN-1SHA	ID-2RI	ID-2500RI	ID-2300NS	MY-4300PE
Farm size	ha	2430	2024	1500	1300	0.34	250	350	1500	500	1000	1943	810	4.3	1.2	2	2500	2300	4300
Share of oilseed	%	20	27	26	16	100	50	60	50	60	70	30	50	36	83	100	100	100	100
Land	ton per ha	1.4	1.7	4.0	3.9	2.1	2.5	2.4	2.6	2.4	3.2	2.0	3.3	2.0	2.3	15.4	19.1	21.2	23.3
	€ per ha	39.0	54.2	156.9	168.0	56.8	133.8	49.8	96.0	44.4	27.2	154.9	284.7	162.1	15.4	n.a	n.a	n.a	n.a
	€ per t	28.9	32.2	39.2	43.1	26.9	53.5	20.8	36.9	18.5	8.5	76.7	86.8	83.1	6.9	n.a	n.a	n.a	n.a
	€ per t RE 1)	28.9	32.2	39.2	43.1	26.9	53.3	20.7	36.8	18.4	8.5	76.4	86.5	82.8	6.8				
Labour	Lhrs per ha 2) 3)	1.9	1.9	12.6	11.3	1,618	11.7	10.9	11.6	15.8	13.7	5.4	4.5	463	926	900	273	266.1	252.8
	Days per ha	0.2	0.2	1.6	1.4	202.2	1.5	1.4	1.5	2.0	1.7	0.7	0.6	57.9	115.8	150.0	45.6	44.3	42.1
	Lhr per ton	1.4	1.1	3.2	2.9	767	4.7	4.5	4.5	6.6	4.3	2.7	1.4	237	412	58	14.3	12.6	10.85
	€ per Lhr 4)	11.6	12.0	13.8	14.6	0.2	2.0	3.0	3.2	1.4	1.8	12.0	15.0	0.2	0.2	0.20	0.7	0.5	0.97
	€ per ha	22.5	23.1	173.4	164.8	396.1	22.9	33.2	37.4	22.3	24.2	65.5	67.9	113.4	226.8	178.2	178.6	142.2	246.1
	€ per t	16.7	13.7	43.4	42.3	187.7	9.2	13.8	14.4	9.3	7.5	32.4	20.7	58.1	100.8	11.6	10.7	7.7	10.6
	€ per t RE 1)	16.7	13.7	43.4	42.3	187.7	9.1	13.8	14.3	9.2	7.5	32.3	20.6	57.9	100.4	32.5	30.0	21.5	29.6
Fertiliser																			
Nitrogen	kg N per ha	22	84	280	200	46								17.5		37	67.2	56	114
	kg N per t	16.3	50.0	70.0	51.3	22.0	-	-	-	-	-	-	-	9.0	-	2.4	3.5	2.6	4.9
	€ per kg N	0.37	0.30	0.26	0.29	0.70								1.01	-	0.50	0.48	0.48	0.31
	€ per ha	8.04	25.44	73.01	58.43	32.69	-	-	-	-	-	-	-	17.61	-	18.49	31.98	26.65	34.78
	€ per t	5.95	15.14	18.25	14.98	15.49	-	-	-	-	-	-	-	9.03	-	1.20	1.67	1.26	1.49
Phosphorus	kg P per ha	17	25	53	30	21				70	70	39	19 5)	26.2	42,2 6)	14	27.0	39	19
	kg P per t	12.6	14.9	13.3	7.7	10.0	-	-	-	29.2	21.9	19.3	5.8	13.4	18.8	0.9	1.4	1.8	0.8
	€ per kg P	0.34	0.36	0.41	0.37	0.62				0.45	0.48	0.37	0.39	1.03	0.82	0.51	0.48	0.48	0.27
	€ per ha	5.8	9.0	21.9	11.2	12.9	-	-	-	31.5	33.3	14.6	7.3	26.9	34.7	7.1	13.0	18.8	5.2
	€ per t	4.3	5.3	5.5	2.9	6.1	-	-	-	13.1	10.4	7.2	2.2	13.8	15.4	0.5	0.7	0.9	0.2
Potassium	kg K per ha			45	29	17				70	63		17 5)	17.5	30 6)	94	192	173	207
	kg K per t	-	-	11.3	7.4	8.1	-	-	-	29.2	19.7	-	5.2	9.0	13.3	6.1	10.1	8.2	8.9
	€ per kg K			0.26	0.24	0.41				0.26	0.31		0.23	0.59	0.47	0.31	0.28	0.27	0.14
	€ per ha	-	-	11.5	7.0	7.0	-	-	-	18.4	19.5	-	4.0	10.3	14.1	28.9	54.7	46.8	29.4
	€ per t	-	-	2.9	1.8	3.3	-	-	-	7.7	6.1	-	1.2	5.3	6.3	1.9	2.9	2.2	1.3
Total NPK	€ per ha	13.9	34.4	106.5	76.7	52.6	-	-	-	50.0	52.8	14.6	11.3	54.8	48.8	54.5	99.7	92.3	69.5
Total fertiliser	€ per ha	18.2	40.8	154.7	90.3	52.6	-	-	-	50.0	52.8	17.2	19.6	54.8	48.8	55.3	117.1	93.7	76.7
	€ per t	13.5	24.3	38.7	23.2	24.9	-	-	-	20.8	16.5	8.5	6.0	28.1	21.7	3.6	6.1	4.4	3.3
	€ per t RE 1)	13.5	24.3	38.7	23.2	24.9	-	-	-	20.7	16.4	8.5	5.9	28.0	21.6	10.1	17.2	12.4	9.2

1) Costs are converted into rapeseed equivalents (RE). Costs of soybeans and fresh fruit bunches (palm oil) are multiplied by 0,996 and 2,806 respectively. For rapeseed the factor is 1,0;
2) Total labour input including family labour, full- and part-time emploees. 3) Excluding manager and office emploees on large FFB (palm oil) producing farms in Southeast Asia.
4) For compatibility reasons average for all employees and family labour is calculated based on labour cost per hectare and total labour input (Lhrs); 5) Fertiliser applied in corn; 6) Fertiliser applied in wheat.

Source: Own data collection and calculations (2002).

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In both countries extensive production systems (no-till or direct seeding techniques) result in lower use of machinery and hence fuel and machinery costs per hectare are low. Relative high soybean yields in Brazil further reduce costs and result in the lowest operating **costs per yield** unit of 22 to 31 Euro.

Direct costs

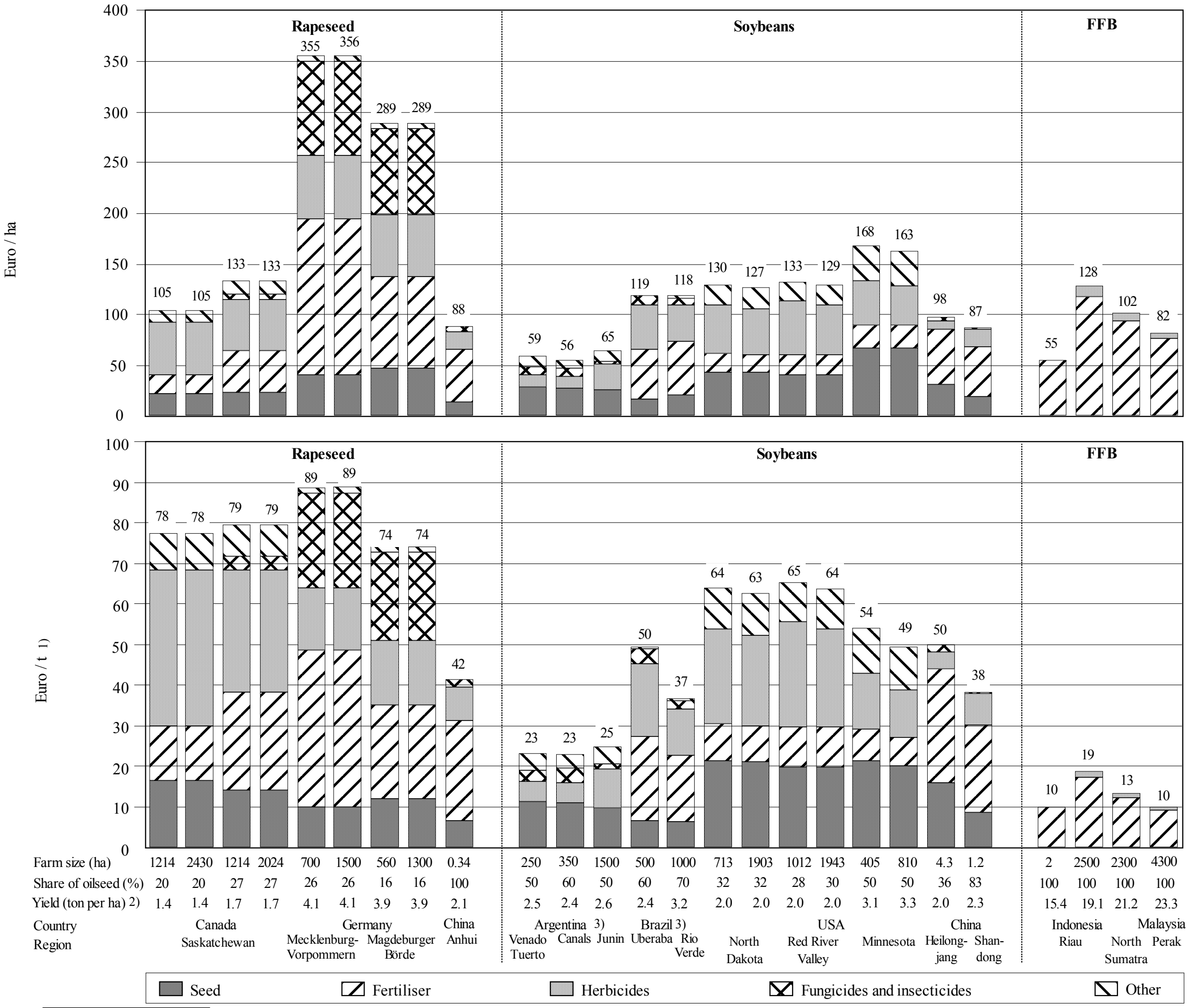
Direct costs vary from 10 to 50% of the total costs and are the largest cost item for soybean farms in Brazil (50 %) and rapeseed farms in Canada (40 %). In Germany they make one third, in the United States and China (for soybeans) over one fifth of the total costs. In Argentina and Southeast Asia direct costs contribute less than 20 %. However, with regard to the FFB producers, a large share of the direct costs is allocated into the establishment costs group that is dealt separately.

Direct costs include cost items, which are directly attributable to specific crop production, such as seed, fertilizer, chemicals, etc. An intensity of input application (fertilizers, chemicals) is directly related to expected yield.

The highest direct **costs per hectare** are on German farms (289 - 356 Euro), where the highest yields are achieved within rapeseed and soybean producers (see Figure 11.5). However, when converted to a **cost per ton** of yield the difference range is reduced considerably. Both German and Canadian rapeseed producers have the highest direct costs per yield unit (78 - 89 Euro). Their cost disadvantage is attributable to considerably higher: a) fertilizer costs (14 - 39 Euro per ton) and b) plant protection costs (33 - 39 Euro per ton). Considerable advantage for soybean producers is that soybean is an annual legume and can fix nitrogen itself. Hence no nitrogen is applied in North and South Americas. Low amounts of phosphorous are applied in the United States, Germany and Canada with prices per kg of nutrient on similar level (see Table 11.1). No fertilizer at all was applied in Argentina, however it seems to be a short-term strategy due to high prices. Only in Brazil quite high amount of phosphorous and potash is applied for soybeans with prices of fertilizer slightly higher of Germany or Canada.

For **FFB** producers fertilizer costs (9 - 17 Euro per ton) attribute over 90 % of the total direct costs (10 - 19 Euro per ton). Very high amount of potash (94 - 207 kg per hectare) is applied in Southeast Asia, followed by nitrogen (37 - 114 kg per hectare) and phosphorous (14 - 27 kg per hectare). Higher amounts of nitrogen and potash fertilizers are applied in Malaysia compared to Indonesia. However, with lower prices for fertilizers and higher yield Malaysia manages to keep fertilizer costs per yield unit lower of Indonesia (see Table 11.1). The lowest direct costs per yield unit for Malaysia and Indonesia are result of relative low fertilizer costs, plant protection and high yields. Additionally, a large share of direct costs that are related to establishment phase (seed costs, fertilizer and plant protection etc.) are allocated to a establishment costs group that is dealt separately.

Figure 11.5: Oil crops: Direct costs, 2000



1) Costs are displayed as rapeseed equivalents. Costs of soybeans and fresh fruit bunches (palm oil) are multiplied by 0.996 and 2.806 respectively. For rapeseed the factor is 1.0;
2) Yield: ton per hectare of raw output;
3) Reference year 1999.
Exchange rate: 2000 : 1 Euro = 1.96 DM; 0.92 US-\$; 1.37 CAN-\$; 7.66 RMB; 3.51 RM; 7,756 Rp
1999 : 1 Euro = 1.06 ARG-\$; 1.92 R-\$.
Source: Own calculations.

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Costs of **plant protection** for rapeseed production (33 - 39 Euro per ton) are considerably higher of soybeans (6 - 22 Euro per ton) mainly due to different production systems. Rapeseed producers in Canada and Germany have plant protection costs on similar level, however for different reasons. In Canada plant protection costs are attributed mainly to herbicide application to manage weed control, where mechanical control is of limited use due to risk of soil erosion and damaging water holding capacity of soil. Fungicides are used only for seed treatment in Black Soil zone farms. In Germany only a half of plant protection costs are attributed to herbicide application, whereas the rest is fungicide and insecticide costs.

In Southeast Asia plant protection costs are very low (below 10 % of the direct costs) due to: a) a considerable share is allocated to establishment costs group, b) a part of weed and pest control is done manually, c) trees are regular monitored by field workers and problems are managed locally that prevent pest to spread.

Overhead costs

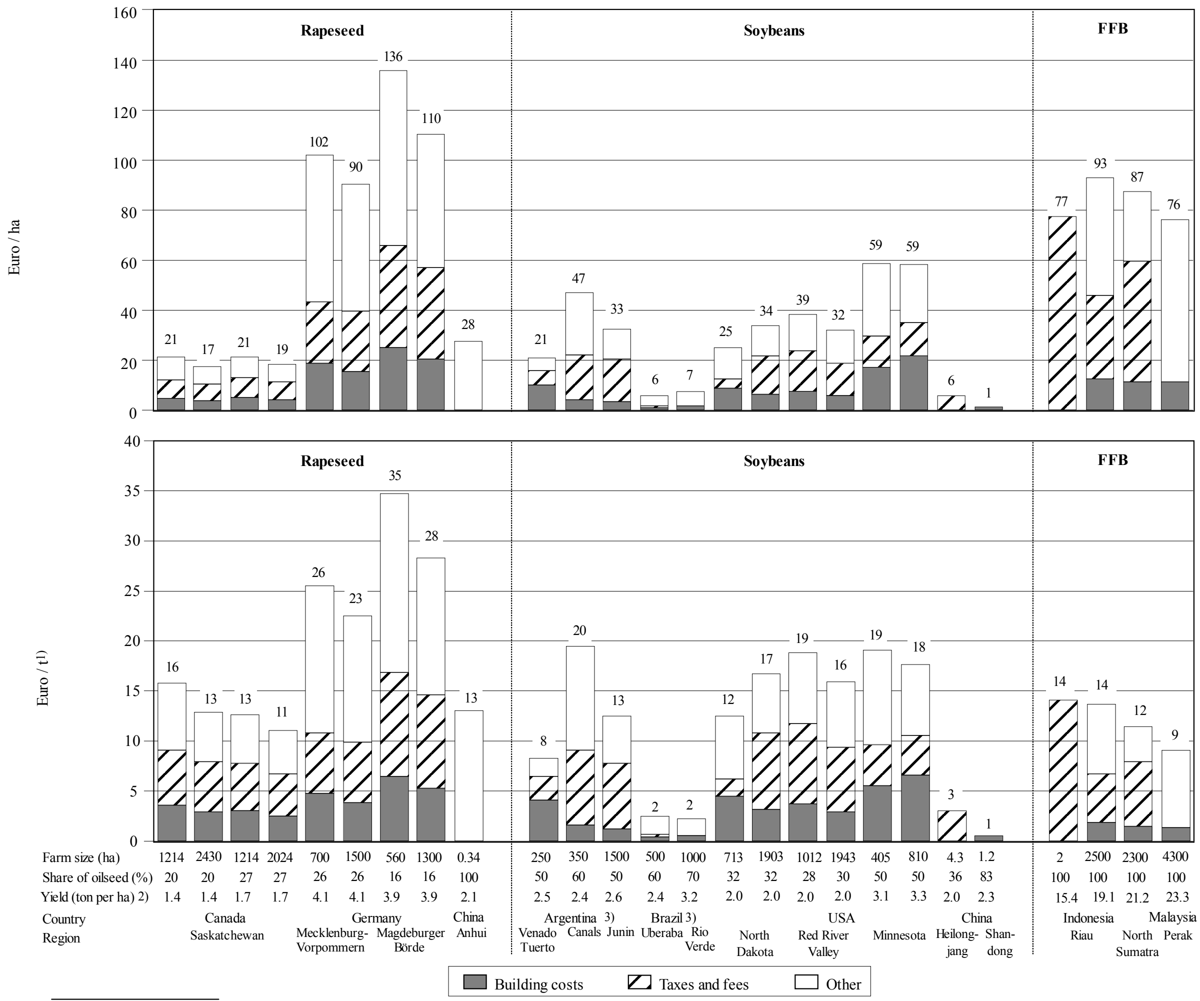
Overhead costs range between 0,3 to 17 % of the total. In China and Brazil they are at the lowest and remain below 5 %. In North America they are below 10 % and only in Germany, Argentina and Southeast Asia they exceed for some farms 10 % level reaching maximum of 17 % for smallholder in Riau Province in Indonesia.

The highest overhead **costs per hectare** are in Germany (90 - 136 Euro) and Southeast Asia (77 - 93 Euro) (see Figure 11.6). In **Germany** taxes and fees (24 - 41 Euro per ha) attribute about one third of the overhead cost and are strongly influenced by government regulations. Producers have hardly influence on their level. Building costs (16 - 25 Euro per ha) contribute about one fifth of the overhead costs and are result of relative large and expensive storage capacities and farm infrastructure. Remaining **other costs** (51 to 70 Euro per ha) contribute about **half** of the overhead costs and include farm insurance, invalidity insurance, consultant fees, water and energy. This cost group is too partially influenced by government regulations. Even when the costs are converted into per yield unit they are not offset by relative high yields. German producers have the highest overhead costs per ton (23 to 35 Euro) among analyzed countries.

For the FFB (palm oil) producers taxes and fees contribute over one third of the overhead costs (33 - 48 Euro per ha). Even though for Malaysian estate this cost item was not possible to separate from the other costs its contribution should be high. Various federal and provincial taxes have played major role there. Building costs contribute about 15 % of the overhead costs (11 - 13 Euro per ha). An intensive infrastructure should be built on the estate that include not only facilities related to palm oil production, but estates also provide living infrastructure for the employees and workers. Due to relative large size of the estates the building costs are reduced considerably. Other costs have a considerable contribution to the overhead costs of the estates and included maintenance of the road and drainage, security, water, electricity, office and some other expenses. For the smallholder one major item, a membership fee in the co-operative, contributed to the high overhead costs (77 Euro per hectare). Relative high yields offset relative high cost per ha and result in the **cost per ton** (9 to14 Euro) that are on the level of the US and Canadian producers.

The lowest overhead costs per ha and per ton are in Brazil (6 - 7 Euro per ha or 2 Euro per ton) and soybean producing farms in China (1 - 6 Euro per ha or 1 to 3 Euro per t). In Brazil and China taxes and fees are very low, whereas in China some fees are classified as land costs. Building costs are very low in both countries as relative few and inexpensive buildings (shed, fuel tank in Brazil) are used in the crop production.

Figure 11.6: Oil crops: Overhead costs, 2000



1) Costs are displayed as rapeseed equivalents. Costs of soybeans and fresh fruit bunches (palm oil) are multiplied by 0.996 and 2.806 respectively. For rapeseed the factor is 1.0;
2) Yield: ton per hectare of raw output;
3) Reference year 1999.
Exchange rate: 2000 : 1 Euro = 1.96 DM; 0.92 US-$; 1.37 CAN-$; 7.66 RMB; 3.51 RM; 7,756 Rp
1999 : 1 Euro = 1.06 ARG-$; 1.92 R-$.
Source: Own calculations.

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Land cost

Land cost is the third largest cost group after the direct and operating costs for the most of farms and range from 4 to 40 %. Indonesian and Malaysian producers are excluded. For both countries land costs are allocated into overhead costs and due to specificity of production difficult to disaggregate. Soybean producers from the United States and Argentina (except Canals) have the highest share of the land costs in the total and range between 22 % (North Dakota) to the highest 40 % (Minnesota). For rapeseed producers land cost share is distinctly lower and range between 10 % (Anhui, China) to 18 % (Magdeburger Börde, Germany).

The highest land **costs per hectare** are to find in Germany (125 - 168 Euro) and the United States (89 - 334 Euro). In both countries high subsidies and support programs set expected returns high from using the land, thus land lent, reflecting this situation, is relative high compared to other countries.

When compared without land **costs on yield basis** soybean producers in the United States (143 - 182 Euro per ton) have similar cost level as in Canada (152 - 174 Euro per ton) and the cost disadvantage to South American competitors is decreased considerably.

German rapeseed producers have sole cost advantage in land costs (31 - 43 Euro per ton) compared to the United States (44 - 101 Euro per ton).

Establishment and processing costs

Production of FFB (palm oil) is quite different from production of annual oilseeds (for details see respective chapters on production systems of selected crops). To account for these differences, two additional cost groups appear in the cost classification: field establishment and processing costs. Field establishment costs are related to the first three years of the establishment phase and include all measures necessary from clearing the field, planting of a new oil palm field through the onset of the productive phase. In general, these measures consist of the preparation of the land area, raising of seedlings, and care of the fields. The total of the costs occurred during the establishment stage is depreciated during the rest of the productive phase.

Processing of the fruit bunches is usually integrated into the palm oil production on the large estates. FFBs are transported from the field to the mill and processed into crude palm oil and palm kernels. Palm oil and palm kernels are sold at the farm gate. Thus, processing cost has to be included into the cost classification as well.

Establishment and processing costs contribute over one third of the total costs of FFB (palm oil) production. Establishment costs contribute about 19 to 29 % and vary between 22 to 25 Euro per ton. Processing costs, which are related to the large plantations, range from 16 to 19 % (16 - 20 Euro per ton).

11.3 Profitability

After review of the production costs and detailed component analysis of oilseed production at the selected locations, further analysis will focus on profitability of production. Budget based expenses and opportunity costs (imputed cost for owned land, unpaid labor and owned capital) are displayed against revenues (see Figure 11.7). Revenues consist of a) sale of produced outputs and b) additional revenues from government support programs.

For the purpose of homogeneous comparison both cost and revenue figures are converted into rapeseed equivalents according to the procedure described in detail in the Chapter 3.2.2 The same procedure was applied to convert cost figures in the previous cost comparison chapter. Revenues for FFB (palm oil) producers are the result of market sales of a) crude palm oil and b) by-product of processing - palm kernel. Hence, for the purpose of comparison it is assumed that revenues **per ha** are the total of CPO and palm kernels (PK) sale and revenues **per ton** are calculated using rapeseed equivalent method. Additional adjustment is made for the smallholder in Indonesia. Average processing costs of Indonesian estates are added to farm level costs and revenues are assumed to be from sale of CPO and PK and equal to the state estate in Riau Province (for details see Chapter 10).

In 2000, producers in Southeast Asia, South America, Germany, China (soybeans) and North Dakota, USA were able to generate positive entrepreneur’s profit (total revenues minus total costs). The highest profit margin per ton of output display farm in Shandong, China (126 Euro), large estates in Indonesia and Malaysia (46 to 86 Euro), and farms in Mecklenburg Vorpommern, Germany (74 to 85 Euro). Profitable margins of German farms were solely based on high subsidy levels of production in range of 111 to 140 Euro per ton. Without subsidies none of the German farms were able to generate positive profits. United States is the second country with very high levels of government support. The total estimated support was only about a half of the German level in range of 61 to 81 Euro per ton including decoupled (AMTA) and direct (LDPs) payments. Despite high level of the government support US farms were not able to cover total production costs, with exception of North Dakota's farms. The sole reason for that was very high land rent in the Red River Valley and the southern Minnesota. Higher land rents for both location are attributed to strong nonfarm demand for farmland, higher productivity of cropland in southern Minnesota that result in higher returns and government payments and high profitability of sugar beets in Red River Valley (KRUPA et al., 2001).

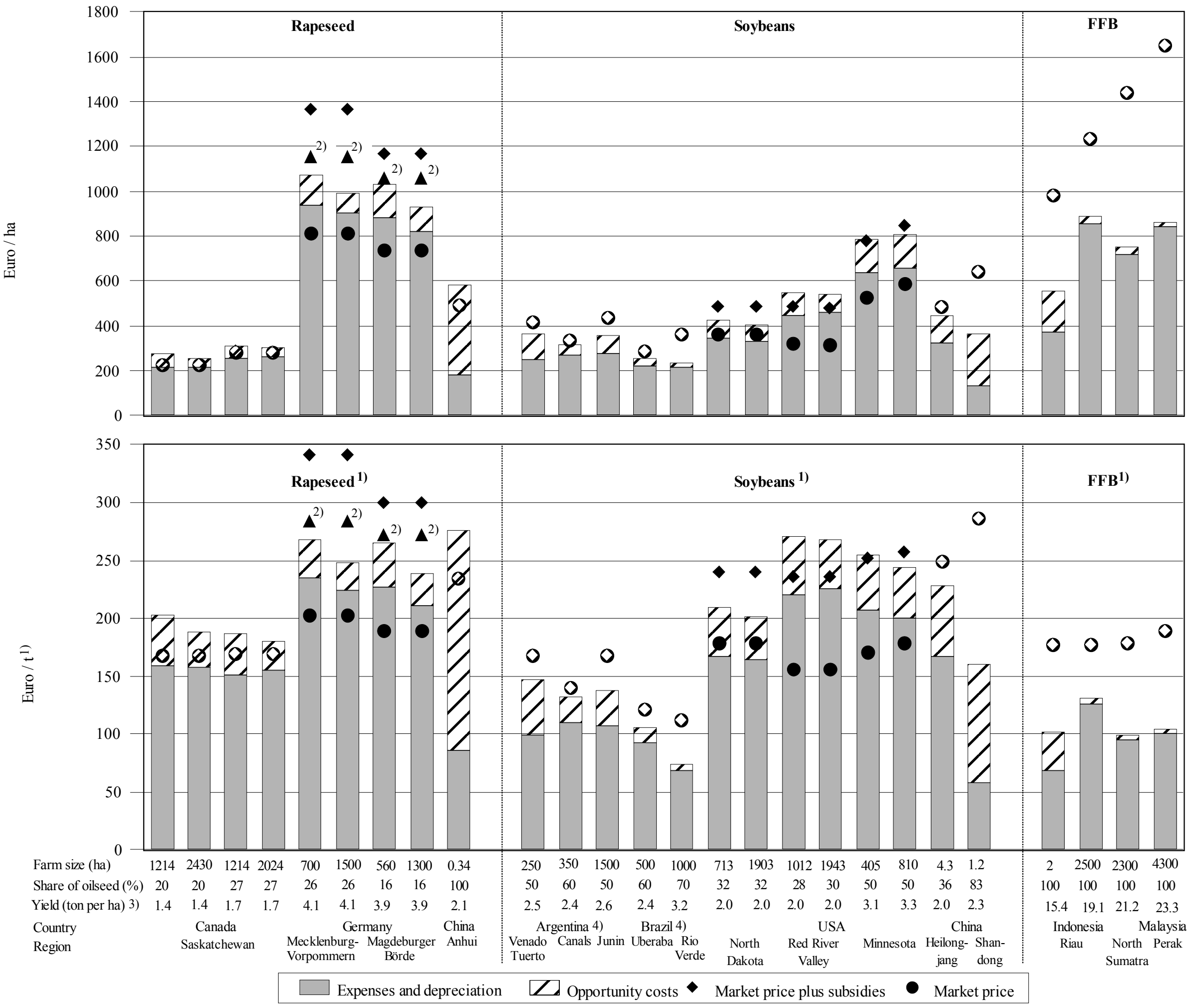
The influence of Agenda 2000 on profitability of rapeseed production in Germany is displayed in a simplified form in the Figure 11.7. Market price received in year 2000 is shown in combination with compensation payment for year 2000 and 2002. It is to observe that farm in Mecklenburg has considerably higher revenues in year 2000 that drop to the level of farms in Magdeburger Börde in year 2002. The major reason for such discrepancy is to look in the difference of regional yields for rapeseed and grains between the states that serve as a basis to determine the compensation payments (for more details look for Agenda 2000 in Chapter 6.7). Market prices between states do not differ considerably.

The highest opportunity costs are in China (61 - 190 Euro per ton), where on smaller size farms they contribute around 70 % of the total costs. Very high unpaid labor is a major contributor on all farms. The problem of the correct assessment of opportunity costs for labor and land, especially in China has already been mentioned in chapter 9.6.1 and will be further dealt with in chapter 11.5.

Market prices vary considerably between countries where a trend is observed that export oriented countries have lower prices compared to importers. The lowest price is for soybeans in Brazil (113 - 121 Euro per ton), followed by Argentina (140 - 168 Euro) and the United States (156 - 180 Euro).

The highest market price for soybeans and rapeseed is achieved in China (234 - 286 Euro per ton), where a strong regional difference of prices is observed between net producing and consuming regions. The Heilongjang price were 15 % lower of Shandong.

Figure 11.7: Oil crops: Profitability of production, 2000



1) Figures are given as rapeseed equivalents. Costs of soybeans and fresh fruit bunches (palm oil) are multiplied by 0.996 and 2.806 respectively. For rapeseed the factor is 1.0.
2) Market price plus Agenda 2000 (2002 Payment).
3) Yield: ton per hectare of raw output.
4) Reference year: 1999.
Exchange rate: 2000 : 1 Euro = 1.96 DM; 0.92 US-$; 1.37 CAN-$; 7.66 RMB; 3.51 RM; 7,756 Rp
1999 : 1 Euro = 1.06 ARG-$; 1.92 R-$.
Source: Own calculations.

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11.4 Marketing, transportation and processing costs

International market competitiveness in simple terms can be defined as ability to deliver a product at the lowest cost- i. e., with the lowest combined farm-level production, marketing and transportation costs. After review of the farm level costs in the previous chapters further analysis will deal with marketing and transportation costs exporter nations face in order to move their products from the farm to the export destination. For this purpose a common export destination should be chosen. European Union and China are two major importers of oilseeds and oilseed products. However, necessary information to account for internal marketing and transportation costs in China is hardly available. Therefore, European Union is chosen to be a common destination of exports of soybeans from Argentina, Brazil, the United States and palm oil from Malaysia and Indonesia. Rotterdam is the leading port of entry of both commodities into EU and price quotations for this port are readily available to allow this analysis. Canada is not included as most of canola exports go to Japan and China.

Internal marketing and transport costs from farm gate to port are estimated by calculating the average monthly spread between farm-level soybean prices and the FOB (free on board) port prices during calendar year 2000. The difference should reflect costs for transportation, handling, drying, taxes and other costs related to movement of soybeans from farm to port of embarkation. For Argentina and Brazil price series were failing, therefore other sources were used to estimate them. Internal marketing and transportation costs for both countries were estimated by RANDALL (2001) and are used for this study after necessary adjustments. Farm-level prices were from Minnesota in USA, Parana and Mato Grosso states in Brazil and Buenos Aires and Santa Fe in Argentina. Port prices were from the US Gulf, port of Rio Grande in Brazil and Rosario in Argentina.

For Indonesia and Malaysia internal marketing and transport costs were obtained from the estates (PERSONAL COMMUNICATION, 2001 and 2002).

As rapeseed produced in Germany is mainly destined for the domestic market hence only internal marketing and transport costs to the nearby mill were estimated (PERSONAL COMMUNICATION, 2003).

To account for transportation costs from port of embarkation to port of destination a difference between FOB prices of the selected countries and the CIF Rotterdam is calculated. The difference should include ocean freight rate, insurance and other costs.

Basis for calculation of ocean freight rate for palm oil is FOB Malaysia and CIF Rotterdam of RBD palm olein. For Indonesia the same ocean freight rate is assumed due to proximity of both countries in the distance.

The resulting figures are converted into rapeseed equivalents with respective coefficients.

Both oilseeds and processed products are traded intensively in the international markets. The EU has a large processing capacities and process a large amounts of soybeans and rapeseed. Soybeans are mainly imported from the USA and South America, rapeseed is supplied by domestic producers. On the other hand, palm oil and not the FFBs are exported by Indonesia and Malaysia, which has to be processed locally. Farm level production costs of palm oil include processing costs and cannot be separated due to integrity of production. Hence, in order to achieve some order of compatibility between soybeans, rapeseed and palm oil processing costs have to be included into comparison.

FFB processing costs were readily available from the analyzed estates in Southeast Asia. Rapeseed and soybeans are dominantly processed at large mills on industrial level and these figures are hardly to find for the purpose of analysis. Therefore a rough estimation of processing costs for rapeseed and soybeans was based on the Gross Crush Margins (GCM) for both commodities (OILWORLD, 2003). GCM is the meal plus oil revenue per ton of oilseed processed minus value of oilseed (per ton) price.

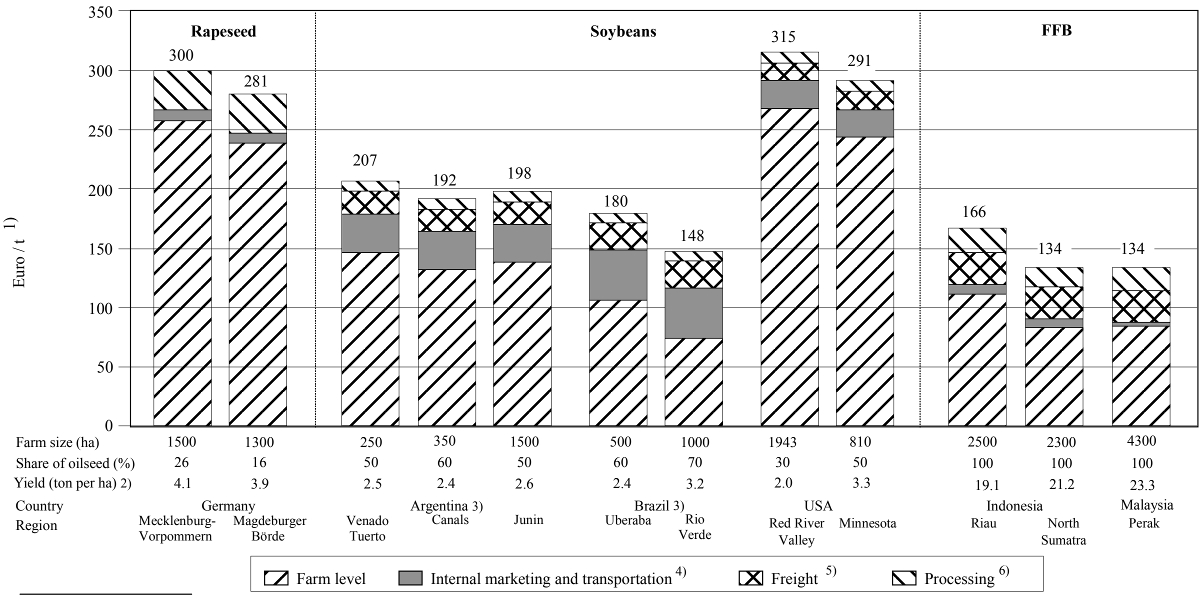
Farm level costs, internal marketing and transportation costs, freight costs to Rotterdam and processing costs are displayed on an example of selected farms in the Figure 11.8. The highest costs of delivery from farm gate to port of destination are for soybeans in Brazil (65 Euro per ton) and Argentina (51 Euro). The major cost disadvantage for Brazil is due to relative high inland costs, where soybeans have to be moved for very long distances from the major producing regions to port of embarkation. The United States, Indonesia and Malaysia have considerably lower delivery costs (farm gate to destination port) of 30 - 38 Euro per ton. Major cost advantage of the United States is to find in lower inland costs due to very intensive and efficient infrastructure compared to South America. It is to emphasize that in recent years inland costs in South America were reduced considerably due to very intensive investment in infrastructure and improving government policies that support expansion of exports.

Delivery costs from farm gate to port of destination contribute the highest share of the total costs in Brazil (36 to 44 %), Argentina (25 to 26 %) and Southeast Asia (22 to 26 %). United States have the lowest share of 12 - 13 %.

Processing costs contribute considerable share of the total costs in Malaysia and Indonesia (12 to 15 %). The major reason for that is to look in economy size effects. Rapeseed and soybeans are crushed at large industrial mills that result in considerably lower costs compared to FFB processing at the estates.

Relative high processing costs for rapeseed is possibly due to overestimation of GCM. According to experts (PERSONAL COMMUNICATION, 2003) rapeseed processing costs should not be considerably higher of the soybeans' costs as most of mills may process both oilseeds. The discrepancy between rapeseed and soybean GCM is to look at the less active trade of rapeseed and rapeseed products that served as a basis for GCM estimation.

Figure 11.8: Oil crops: Farm level, inland, freight and processing costs, 2000



1) Figures are displayed as rapeseed equivalents. Soybeans and FFB (palm oil) figures are multiplied by 0,996 and 2,806 respectively. For rapeseed the factor is 1,0.
2) Ton per hectare of raw output.
3) Reference year 1999.
4) Internal transport and marketing costs for USA are the average spread between farm prices and FOB for 2000; for Argentina and Brazil estimation of these costs from Randall (2001) was used after adjustements; for Germany, Indonesia and Malaysia estimations of local experts have served for the basis.
5) Calculated as the average spread between FOB port prices for each country and the CIF port price in Rotterdam for year 2000; for Indonesia the same freight rate is assumed as from Malaysia due to proximity of both countries.
6) FFB is processed locally; soybeans and rapeseed are processed in the EU and processing costs are based on Gross Crush Margins.
Exchange rate: 2000 : 1 Euro = 1.96 DM; 0.92 US-$; 3.51 RM; 7,756 Rp
1999 : 1 Euro = 1.06 ARG-$; 1.92 R-$.
Source: Randall (2001), Oilworld (2003), Personal communication (2000, 2002, 2003); Own calculations.

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11.5 Sensitivity analysis

As it was described in Chapter 3 the economic results for all farms refer to the crop year 2000 and are converted from the national to a common currency (Euro) with an average exchange rate for the year 2000 for the purpose of comparison. For Argentina and Brazil production costs refer to year 1999 and are converted with respective average exchange rate of 1999. It was not possible to update the South American figures to the year 2000 (for details see Chapter 11.6).

In order to reflect the differences between crops cost and revenue figures are adjusted with rapeseed equivalent coefficients.

Both conversions influence strongly end results of comparison. Thus, this part will focus to estimate the influence of fluctuations of exchange rates and different rapeseed equivalents.

Additionally, the problem of correct assessment of labor opportunity costs in China is discussed due to its considerable share in the total costs.

11.5.1 Exchange rate

Table 11.2 displays exchange rates of the selected countries from 1998 through 2002. For all countries they fluctuated considerably in the observed period. One may observe that national currencies of Argentina (before August 2002), Canada, China and Malaysia follow the US-$ trend of development due to the fact that some countries pegged their currencies to US-$ and others depend strongly on the trade with the USA. From 1998 through 2001 national currencies for the above mentioned countries were appreciating compared to the Euro. Thus, assuming no change in production costs (price and quantity kept constant), when the costs are converted into the Euro the countries loose their cost competitiveness.

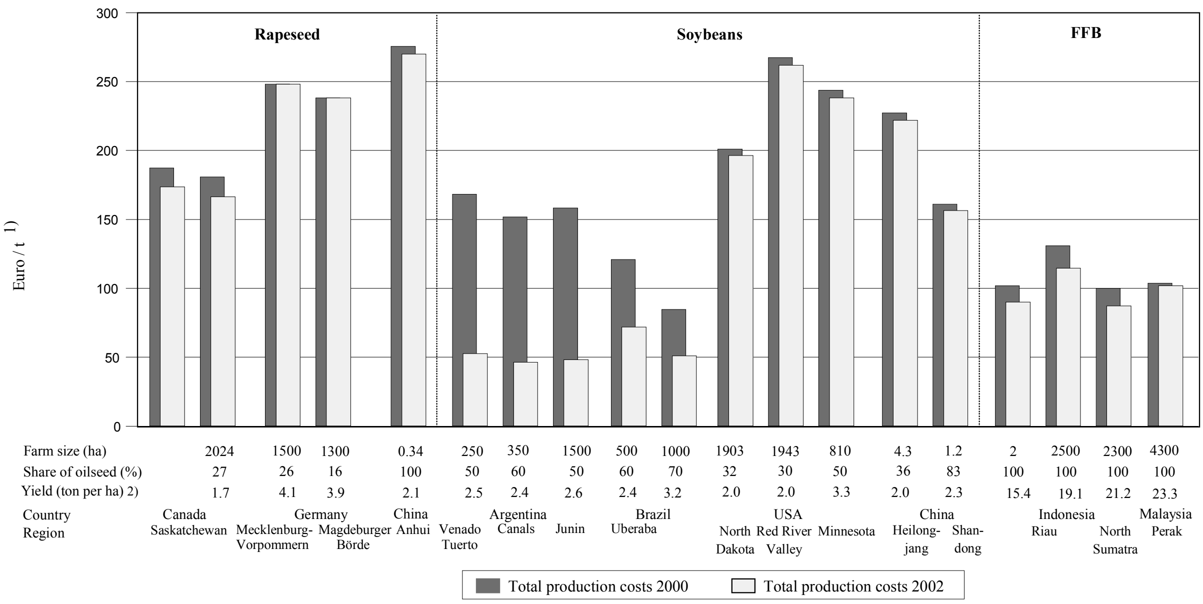
Table 11.2: Average exchange rates of selected countries from 1998 to 2002, Local currency per Euro

	ARG-$	R-$	CAN-$	DM to EURO	US-$	RMB	RM	Rp
1998	1.12	1.30	1.67	1.97	1.12	9.30	4.41	11519
1999	1.07	1.93	1.59	1.96	1.07	8.83	4.05	8422
2000	0.92	1.69	1.37	1.96	0.92	7.66	3.51	7756
2001	0.90	2.13	1.39	1.96	0.90	7.42	3.41	9213
2002	2.97	2.83	1.48	1.96	0.95	7.84	3.60	8821
Min 1)	0.83	1.21	1.26	1.96	0.83	6.86	3.15	6086
Max 2)	3.79	3.98	1.89	1.99	1.23	10.16	5.10	18184
Δ 98 to 99	-5.0	48.3	-4.9	-0.9	-5.0	-5.1	-8.0	-26.9
Δ 99 to 00	-13.3	-12.6	-13.4	-	-13.3	-13.3	-13.3	-7.9
Δ 00 to 01	-3.1	26.0	1.2	-	-3.1	-3.1	-3.0	18.8
Δ 01 to 02	231.8	32.8	6.9	-	5.5	5.6	5.6	-4.3
Δ 00 to 02	**222**	**67**	**8.2**	**0.0**	**2.3**	**2.4**	**2.3**	**13.7**

1) Minimum in the observed period; 2) Maximum in the observed period.
Source: OANDA (2003); Own calculations. Park_2003-08-22

Reverse is to observe when the currency is depreciating. Under such assumption depreciation of currency for 10 % results in decrease of production costs for 10 %. Figure 11.9 illustrates this on example of selected farms for the years 2000 and 2002. For the considered example all currencies depreciated against Euro with Argentina and Brazil experiencing the strongest depreciation resulting in lower costs in 2002 for all countries compared to 2000. Depreciation of Argentinean and Brazilian currencies is result of financial crisis in the both countries and high inflation. Thus, it is to expect that high inflation resulted in increase of input prices and respective response by farmers in input use. It is evident that updating of price and quantity data is of very high importance for such kind of analysis. Unfortunately, due to the dimension of the study and not yet completely established network update of the data was not possible (see Chapter 12).

Figure 11.9: Oil crops: Total production costs under different exchange rates, 2000 and 2002



1) Costs are displayed as rapeseed equivalents. Costs of soybeans and FFB (palm oil) are multiplied by 0,996 and 2,806 respectively. For rapeseed the factor is 1.0.
2) Ton per hectare of raw output;
Exchange rate: 2000 : 1 Euro = 1.37 CAN-$; 1.96 DM; 7.66 RMB; 0.92 ARG-$; 1.69 R-$;0.92 US-$; 7.756 Rp; 3.51 RM;
2002 : 1 Euro = 1.48 CAN-$; 1.96 DM; 7.84 RMB; 2.97 ARG-$; 2.83 R-$;0.95 US-$; 8.821Rp; 3.60 RM;
Source: Own calculations.
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11.5.2 Rapeseed equivalent

On the other hand production costs of soybeans and FFB per yield unit are adjusted with rapeseed equivalent (RE) coefficients to account for the difference between analyzed crops. Coefficients used for conversion may strongly influence the results. The RE coefficient for soybeans and FFB are dependent on: a) the content of oil and meal in the raw seed; b) fluctuation of the price for oil and meal within time period chosen for the calculation of the RE and c) ratio between aggregated value of analyzed crop (soybeans, FFB) and reference crop (rapeseed) (for more details see Chapter 3). The content of oil and meal in the seed is rather stable and may shift in the long-term due to technological advances and desire of breeders to increase share of oil or meal in the seed. The second factor, prices for oils and meals vary considerably and play a considerably role in the level of RE. The prices are influenced by market forces and other numerous factors such as government policies, consumer preferences, substitutability degree between commodities and others. Thus, the aim of this part is to estimate how different RE coefficient maybe if based on prices for the different time period. The basis for the calculation of RE used throughout the study were average prices for the reference year 2000. Alternative RE is calculated based on the average prices for long-term period to avoid a short-term seasonal fluctuations. The time period chosen is from 1990 to 1999.

Table 11.3 displays the RE coefficients for soybeans and FFB calculated for different time periods. Rapeseed was the reference crop thus remained in both cases equal 1. It is to observe that RE coefficients calculated for an alternative time period fluctuated considerably and actually shifted in different directions for both crops. Using alternative RECs for adjustment of the costs will result for soybeans in 9 % higher costs whereas for FFB it will result in 10 % lower costs.

Table 11.3: RE coefficients for rapeseed, soybeans and FFB (Palm Oil)

Reference year	Rapeseed	Soybeans	FFB (Palm Oil)
Ø2000 (basis)	1.0	0.996	2.806
Ø1990-99	1.0	1.090	2.521
Δ (Ø2000 to Ø1990-99) (%)		9.4	-10.1

Source: Uhlmann (2000), MPOB (2001); Own calculations. Park_2003-08-22

11.5.3 Opportunity costs of labor on Chinese farms

High farm-level production costs of oilseeds in China are disputable due to very high share of opportunity costs. Labor costs contribute most and may vary considerably depending on assumptions made for their calculation. One may argue that labor is very "cheap" in China and with relative high unemployment in rural areas the opportunity costs of labor on the Chinese farms should be very low and tend to equal zero. Under such assumption production costs will fall 30 - 70 % and China may become very competitive in oilseed production.

Though family labor is not paid, it does have an economic cost. To determine this economic cost the opportunity cost of off-farm work, or the return available in the next best alternative use of this labor should be used.

Farmers have several such alternatives: a) earn money outside of agriculture in a city as a worker at factory or construction site or in nearby rural industry; b) switch to labor intensive crops like vegetables or fruits which bring higher returns for labor.

High growth rates of Chinese economy and expansion of industry (in cities and rural areas) supply employment opportunities for migrating farmers. Additionally, statistics show that in recent years farmers switch or diversify their production resources from grain crops (land-intensive) to fruits, vegetables and livestock production, which bring higher returns for their own resources. Changing government policies with regard to grain production and recent entry of China into WTO supports this trend. Thus, it is to expect that unpaid family labor has economic value and will be increasing with time under such conditions.

11.6 Conclusion for further research

This analysis is a first attempt to conduct a comprehensive international comparative analysis of production systems, framework conditions and production costs of oil crops in major producing regions of the world. The following issues were considered during the conceptual design of the study:

- Include the major oil crop producing countries;
- Select major producing regions within the selected countries;
- Carry out detailed analysis of framework conditions and production systems of oil crops in the selected regions;
- Design typical farms for the selected regions;
- Collect and analyze data with homogenous methods;
- Develop an approach for the comparison of the different commodities (rapeseed, soybeans and fresh fruit bunches);
- Analyze the above-mentioned factors to determine the reasons for production costs differences between regions and to assess future developments of competitiveness.

The results of the investigation brought new insights into the competitiveness of oil crop production in the major producing regions of the world. To that extent the selected organizational and methodological approach proved to be appropriate.

In view of a future, possibly continual and detailed research work it is however important to refer to the restrictions of the research concept. In the course of the investigation in particular the following problems became obvious.

Sustainability of the network

The economic calculations are based on data from the years 1999 to 2001. In the context of the study it was not possible to develop a sustainable research network in the countries of investigation. Therefore the presented results:

- are based on a single year (see Chapter 11.5.1 on exchange rate fluctuations);
- and data verification, correction or complementation is often only possible at prohibitive additional costs.

After the completion of this thesis co-operation of the scientists and advisors within the ad hoc network will be terminated and the establishment of a new network (e.g. to investigate new problems or commodities) will be burdened with high “set up” costs.

In 1999, accounting for this problem, IFCN Dairy has started to work on the sustainability of the network. Efforts were made to develop a new concept of long lasting cooperation within the network where analyzed products and used methods are clearly defined with a permanent organizational and financial structure. In the year 2000, the first Dairy report was published and thereafter a dynamic development of the network has been observed. In the meantime 27 countries participate, which cover more than three quarters of the world milk production. Main events of the co-operation are the annual meeting of all Dairy experts in spring and the publication of the Dairy report in fall. IFCN Beef is currently working to adopt the successful concept of IFCN Dairy in order to establish a sustainable network too.

The above-mentioned problem of the analysis maybe possibly solved in the future by adopting the successful concept of IFCN Dairy and Beef for further studies in crop farming.

Total cost of production analysis in multiple enterprise farm

In the core of the study is the analysis of total costs of production. In contrast to variable costs, which are directly attributable to the enterprise production, total cost of production account for all costs which have to be met over the time if the farm is to remain in business. Special emphasis is made on estimating opportunity costs of owned production factors such as family labor, land and capital.

However, the total cost approach causes problems especially in multiple enterprise farms because it is difficult to correctly allocate overhead costs between different enterprises. While for specialized dairy or beef farms the inaccuracy is relative small, it is more serious for arable farms producing several crops with oilseeds having only a relative small share in the crop rotation. An exception forms the palm oil production with a high degree of specialization.

In further research following issues have to be accounted for in order to improve the quality of the results:

- detailed data on competing crops within the farm should be collected and possible crop rotation adjustments should be analyzed at alternative framework conditions;
- farm internal opportunity costs of different crops should be analyzed especially for countries where land costs are difficult to estimate (e.g. China);
- analysis of total production costs should not be the ultimate objective of the investigation but rather serve as basis for further research (simulation of future developments of cropping patterns etc);
- the potential advantage of the IFCN method (present and critically discuss model results within panels and if needed correspondingly adjust them) should be used more intensively.

Valuation of family labor

During the investigation it became clear that in China as well as on small farms in other countries family labor contribute the largest part of the total costs of production. Especially the opportunity cost of family labor is difficult to estimate correctly (see Chapter 11.5.3).

A possible solution to this problem maybe shifting from production costs analysis to modeling of alternative farm strategies and observing farmer reactions to price shifts under given framework conditions.

Disaggregation of price and quantity components

The cost disadvantage of a given region is a result of the combination of high input prices or/and high application rates of inputs. The region may select different strategy to reduce cost disadvantages by adjusting a) intensity of input application (e.g. reducing application of plant protection inputs, fertilizer etc.) or/and b) reducing prices for inputs (e.g. look for new supplier, use substitute products, lobby to reduce taxes on inputs). Therefore, the analysis of both cost components are of a high importance for the interpretation of results.

In this investigation major cost items like labor and fertilizers were disaggregated into price and quantity components leading to important findings. Further detailed analysis of other cost items (e.g. fuel costs, plant protection costs, machinery costs) would also yield valuable results.

Analysis of legislative framework conditions relevant to competitiveness

A remarkable result of the analysis is that Germany has a) the highest production costs not only per hectare but also per ton of crop and b) the highest yields among rapeseed and soybean producers. One of the reasons for the cost disadvantage of German farms is to find in legislative framework conditions. Several investigations show that legislative framework conditions in Germany may considerably influence costs of production (for details see ISERMEYER et al, 2000; DEBLITZ et al, 2000). Analysis of the influence of legislative framework conditions on production costs should help to estimate its dimension and provide policy makers with information on the potential impact of reforms.

However, the analysis of this issue is influenced by a number of factors. The interrelation between legislative framework conditions and production costs was only accounted for to a limited extent in the context of this study.

Inclusion of transport and processing costs

The international competitiveness of oil crops is dependent not only on the farm level production costs, but also on additional costs to offer the commodity on a common market. Most of the previous studies have focused only on the farm level competitiveness.

In the frame of this investigation inland marketing and transportation costs to the export destination were estimated to give an overview on the dimension of their importance in total landed costs at the export destination. The results show that they contribute a considerable share of the total landed costs. However, as the focus of the study was a detailed collection and analysis of framework conditions, production systems and production costs the estimation of inland marketing and transportation costs was limited to selected countries.

It will be very reasonable to account for delivery costs with a more detailed analysis in future studies.

12 Summary

Oil crops are produced in different regions of the world under various production systems. The largest part of them is processed into vegetable oil and protein meal. In the last two decades trade in seed, meal and oil has more than doubled and competition between producing regions in the world oilseed sector is growing. Therefore, it is to expect that further liberalization of world markets, growing globalization and reduction of subsidies in the agricultural sector will further emphasize the importance of competitiveness in agriculture.

In the context of these developments the competitive production of oil crops is gaining in importance. The main objective of this dissertation is the farm level analysis of production systems and production costs of oil crop production and the generation of first conclusions with regard to international competitiveness.

For the purpose of the analysis major oil crop producing countries of the world are selected for the comparison: Argentina, Brazil, Canada, China, Germany, Indonesia, Malaysia and the United States. Within these countries the major oil crop producing regions are identified and production systems and production costs are studied on the basis of the so-called typical farms.

Data collection and analysis is done according to harmonized methods that allow a comparison of results internationally between selected regions.

Competitiveness in commodity markets reflects the influence of many different factors. Relative resource endowments and agro-climate conditions, macro-economic and sector-specific policies, infrastructure, supporting institutions and a number of other factors determine the relative efficiency of producing different goods and, consequently, a country's comparative advantage in international trade. These factors are analyzed for selected countries and a short summary of major findings are given below:

Natural framework conditions, production systems and expansion potential

Natural conditions show great differences between production regions in selected countries. Two major factors influence crop yields: a) current production systems that at a large depend on natural conditions of the region (climate and soil productivity) and b) biological productivity of crops (extreme yield differences exist between oil palm and annual oilseeds).

Under very favorable natural conditions in **Indonesia** and **Malaysia** and very high biological productivity of palm trees producers harvest about 15 to 23 ton **FFB** per ha (equivalent of 3.4 to 5.1 tons of palm oil per ha) per year. Optimal temperature, rainfall and sunshine well distributed throughout the year allow producers to harvest FFBs all year round.

Oil palms are cultivated in monoculture and harvested fruits are processed locally. Smallholders (in Indonesia) usually allocate their whole plots to palm trees and sell their produce (FFBs) to wholesaler or directly to a nearby mill. In both countries, plantations use good quality planting material, apply optimal amounts of fertilizer combined with thorough plant protection measures that secure very stable and high yields of FFBs.

In **Canada** the low yields of 1.4 to 1.7 ton of rapeseed per ha (equivalent of 0.5 to 0.6 ton oil per ha) are due to less favorable natural conditions and extensive production systems. Water deficits and a very short vegetation period set crop production at risk in many regions of Canada. Summer crops are dominantly grown to avoid winter frost risk. In recent years, diversification of crop production took place to reduce production risk. The farms plant about thee to five crops, wheat is the major crop in the rotation with rapeseed contributing about one fifth to one third of the total area. Specialty crops are expanding with high pace due to technical advances.

Extensive soil cultivation and seeding techniques gain in importance to solve soil erosion and soil water-holding capacity problems. In Brown Soil Zone summer fallow is used to improve water-holding capacity of the soil and to distort the development cycle of diseases. Rapeseed is usually planted after summer fallow as it has higher water requirements than wheat or specialty crops. Summer rapeseed grown under extensive production system in Canada cannot realize the high yield potential of winter crop grown in Germany or China.

Relative favorable and stable climate and intensive production systems allow **German** producers to achieve the highest yields of 4 ton per ha (equivalent of 1.5 ton oil per ha) among annual oilseeds. The farms grow about five to six crops where grains (wheat, barley and rye) dominate and are rotated with broadleaf crops (rapeseed and sugar beets). In Mecklenburg rapeseed tend to have a considerably higher share of the planted area compared to the Magdeburg Börde where it proved to be a good alternative to grains.

Climate conditions and soils at the selected regions of **soybean** producing countries (**Argentina, Brazil, China, USA**) are favorable for soybean production resulting in relative high yields in the range of 2.0 to 3.3 ton per ha (equivalent of 0.4 to 0.6 ton oil per ha). Soybean is in most of the locations dominantly rotated with corn in a two-year rotation. Only at marginal or expansion areas other crops like grains or sunflower appear in the rotation. Soybean and corn are complementing each other in agronomical sense and only limited shift in the crop rotation is observed under changing market prices.

Favorable climate conditions in some areas in **Argentina**, **Brazil** and **China** allow farmers to practice double cropping (plant and harvest two crops a year).

In **South America** extensive soil cultivation systems gain importance such as "No Till" or "Direct Seeding". These practices aim to reduce soil erosion, increase water-holding capacity of soil and shorten time between harvest and planting under double cropping.

The highest expansion potential in terms of area and production lie in **Brazil**, **Argentina**, **Indonesia** and **Malaysia**. In **Brazil** vast areas of cerrado bear great potential for expansion. In **Argentina** permanent pasture can be diverted from extensive livestock production to crop production, if rising international commodity prices will give an incentive for expansion.

In Indonesia and to lesser extent in Malaysia extensive areas of less developed regions are still available for **expansion** of the **palm oil industry**. Improvements in infrastructure and clear land use rights between companies and local population are needed to foster expansion of the palm oil industry in both countries.

Canada, **Germany** and the **United States** have limited expansion potential in terms of wasteland. However, expansion potential maybe realized through the use of set aside land and through shifts between crops.

China has the lowest expansion potential for crop production, as agricultural land is very scarce. Existing problems such as soil and water erosion, loss to other uses (expansion of cities and industry) lead to rapid losses of productive land. Additionally, grains and oilseeds are considered to be capital-intensive crops, whereas small sized farms and high density of population will favor expansion of labor-intensive crops such as fruits and vegetables.

An additional potential to increase production lies in increasing the productivity of the production systems. New production techniques, new varieties with higher productivity, resistant to disease, drought or low temperatures could assist to overcome limiting factors of production, increase productivity and allow expansion of production in marginal areas.

Agricultural policy and GMO issues

The United States and EU have the highest government support for agricultural production among the analyzed countries. In the **United States** a number of measures such as Production Flexibility Payments (PFC), Marketing Assistance Loans (MLA), various insurance programs and Agricultural Appropriation Acts support U.S. farmers. However, most of programs are decoupled from production of specific crop and are classified according to WTO rules as not trade distorting.

In recent years, with low crop prices the MLA program has led to high direct subsidies for farmers, which are calculated as a difference between market price and the loan rate set by the government on the basis of high historical prices. Ratio between soybean and corn loan rates have given U.S. farmers an incentive to plant soybeans instead of corn under the conditions of low market prices.

In the **EU** exist a number of different policies that support agricultural production through the common agricultural policy (CAP). In recent years there were a number of reforms to CAP. The most important for oilseed was the Blair House Agreement (in 1992), and for agriculture production overall the MacSharry reform (in 1992) and the most recent Agenda 2000 (in 1999). The latter two reforms were a major shift from market price support towards direct payments. Farmers received permanent compensatory payments linked to land use for arable crops to compensate for price reductions. Additionally, farmers are to set aside a part of the arable land (minimum 10%) in order to be eligible for the compensation payments.

Before Agenda 2000, compensatory payments for oilseeds and grains were different and for analyzed regions oilseed payments were considerably higher than grain payments. Thus, in addition to agronomical advantage rapeseed production was supported by subsidies as well. Moreover, farmers have an option to plant rapeseed for non-food purposes on set aside land, which is used to produce bio diesel. In recent years with promotion and government support of bio diesel in Germany the non-food rapeseed production has increased considerably.

China had a number of policies that intervened in agricultural production and especially in grain production. Trade in grains, oilseeds, meals and vegetable oils was under strict control of the government. However, in recent years the involvements of government as well as production subsidies have ceased significantly. Oilseed production was liberalized even earlier of grains. This trend is supported by the recent entry of China into the WTO in December 2001.

In **Canada** support policies are limited to crop insurance, stabilization of farmers' incomes (Canadian Safety Net), various credit programs, diesel and land property tax rebates. The effect of these programs is related to the farm in whole and does not affect rapeseed production directly.

Argentina, **Brazil**, **Malaysia** and **Indonesia** have the least government support for the investigated crops. However, in all countries government policies support expansion of agricultural production and exports. These policies directly or indirectly influence oil crop production as well.

In **Malaysia** and **Indonesia the** governments play a substantial role in production, processing and marketing of palm oil and by-products, by regulation, licensing and supporting research.

In recent years, issues on Genetically Modified Organisms (GMO) have gained in importance leading to trade distortions and debates on the international level between countries supporting and rejecting GMO crops. In the context of this debate legal framework conditions in each country and the acceptance of GMO has become very actual issue.

Genetically modified crops are used widely and legally in **Argentina**, **Canada** and the **United States**. In **Brazil** use of GMO seed is prohibited, however many farmers grow GMO soybeans illegally. No GMO oilseeds are planted in **China** so far. A respective legislation is currently drafted, which is not in favor of GMO crops. Soybean and soybean product imports from the United States and Argentina were hurt considerably due to newly introduced import rules in China.

In **Southeast Asia** hybrid oil palms are used as planting material on most of the commercial plantations. However, with time it is to expect that **cloned oil palms** will gain in importance due to their superior characteristics compared to hybrids in terms of yield and quality.

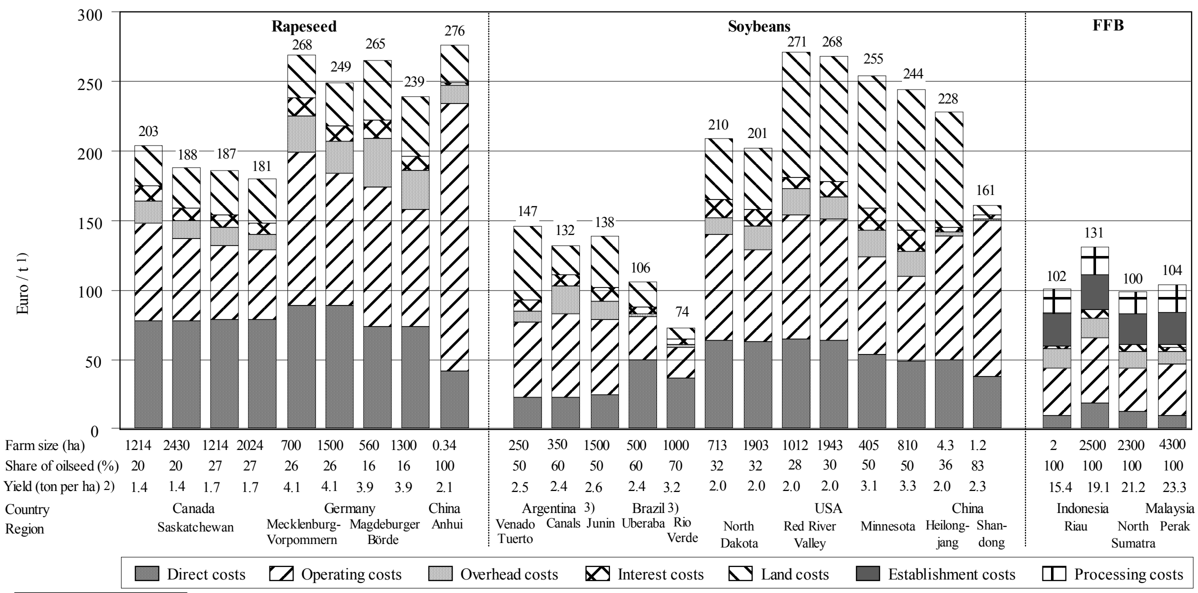
Production costs and profitability of oil crops

The above-described factors influence the competitive position of each country. The combined impact of these factors on the competitiveness of selected countries on the world market is reflected in production costs at farm level.

Economic results for all farms are converted from national to a common currency (Euro) with an average exchange rate for the reference year. Additionally, in order to reflect the differences between crops results expressed per yield unit are adjusted with a rapeseed equivalent (RE). RE accounts for differences in oil and meal content and their value in the analyzed crops. Rapeseed serves as a reference and adjustment factors for soybean and FFB are at respectively 0.996 and 2.806. The calculated RE are used to adjust all economic results for international comparison.

A comparison of farm-level **production costs** between crops and countries shows that farm-level production costs per hectare vary considerably between countries from 237 Euro (Rio Verde, **Brazil**) to 1,073 Euro (Mecklenburg-Vorpommern, **Germany**). It reflects considerable differences in the intensity of production systems and yields at the analyzed locations and says little about their competitiveness. When yields are accounted and costs are expressed per yield with respective crop adjustment the difference range is reduced considerably between locations and vary between 74 Euro (Rio Verde, Brazil) to 276 Euro (Anhui, China) (Figure 12.1). Farms in Argentina, Brazil, Indonesia and Malaysia come out to be **low cost producers**, where especially Southeast Asian producers benefit considerably from the high biological productivity of oil palms. German, the U.S. and Chinese farmers turn out to be **high cost producers**, tightly followed by Canada.

Figure 12.1: Oil crops: Total production costs, 2000, Euro per ton RE



1) Costs are displayed as rapeseed equivalents. Costs of soybeans and fresh fruit bunches (palm oil) are multiplied by 0.996 and 2.806 respectively. For rapeseed the factor is 1.0;
2) Yield: ton per hectare of raw output;
3) Reference year 1999.
Exchange rate: 2000 : 1 Euro = 1.96 DM; 0.92 US-$; 1.37 CAN-$; 7.66 RMB; 3.51 RM; 7,756 Rp
1999 : 1 Euro = 1.06 ARG-$; 1.92 R-$.
Source: Own calculations.

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In **Argentina** and **Brazil** relative good climate and soils support high yields under relative extensive production system. Fertilizer and plant protection is used to a very limited extent keeping direct costs low especially in Argentina. Extensive production techniques such as *Direct seeding* or *No till* reduce the amount of field operations and machinery needed on the farm resulting in relative low operating costs. These techniques combined with GMO varieties improve efficiency of weed management. Double cropping at most of locations considerably reduces fixed costs for machinery, land and buildings. In both countries overhead costs are relatively low due to limited use of storage and buildings and taxes especially in Brazil. Moderate profits, very limited government support and available land for expansion lead to relative low land costs especially in Brazil.

In **Indonesia** and **Malaysia** under very favorable climate and on good soils high biological yield potential of palm trees is well realized under relative intensive production systems. High yields overcompensate considerably the relatively high production costs occurring per hectare. Direct costs are kept very low and about 90% is contributed by fertilizer. Some of the direct costs such as planting material, fertilizer and plant protection occur during the first three years of the preproductive phase and are allocated into establishment costs and depreciated over the whole productive phase. Some substantial operating costs related to land clearing and preparing, field planting and seedling care are allocated to the establishment cost group as well. Therefore, on-going costs related to palm trees care and harvesting are kept relative low. Labor costs of hired workers on plantations contribute a considerable share (over 65%) of the operating costs due to limited possibilities to mechanize the field activities and harvesting. Plantations have to bear relative high overhead costs related to establishment of whole infrastructure (e.g. roads, irrigation, offices, storage, security, etc.) and additional overhead costs related to social infrastructure for workers that usually settle within plantation (houses, shop, kindergarten, church etc.). However, when these considerable expenses are expressed per ha and further per ton of yield unit they turn out to be quite moderate.

In **Germany** under relative good climate and soil conditions high yields are realized under intensive production systems. However, high yields cannot compensate high production costs per ha resulting in the highest production costs per yield unit. Relative high application of fertilizer and plant protection and high input prices result in the highest direct costs. Intensive soil cultivation and weed management combined with high labor prices lead to very high operating costs. Disaggregating labor costs into price and quantity components show that Germany, Canada and the United States face the highest labor cost per hour which are result from a) relative high wages existing outside of agriculture, b) regulations for minimum wage and benefits for employees and c) additional costs related to social contributions. Substantial farm facilities for crop storage, machinery, very high taxes and fees result in the highest overhead costs. Limited available land for expansion and very high subsidies result in very high land costs.

In the **United States** under fairly good climate and on good soil conditions high to moderate yields are realized. Direct costs are kept low due to limited fertilizer input, reflecting the soybeans specificity being a legume crop that can fix nitrogen from the environment itself. Moderate application of herbicides combined with mechanical weed management is used at the selected locations. Seed costs are the highest among analyzed countries. This is a result of high seeding rate and the use of certified seed that is especially expensive in case of GMO varieties. Conventional soil cultivation with intensive weed management contributes to high machinery related costs. These costs combined with relative high labor costs (hired labor and family work) result in very high operating costs. Overhead costs are high and are result of numerous farm facilities for harvest storage, machinery, and drainage at some locations, taxes and fees. Land costs are the highest among the analyzed countries due to relative high demand among farmers, from other sectors, and high subsidies.

In **China** moderate yields of soybeans and rapeseed are harvested in labor-intensive production systems. Production cost disadvantages of Chinese producers are mainly attributed to very high family labor cost. Direct costs at the selected locations are kept low due to use of own seed and very limited application of plant protection chemicals. Fertilizers are applied intensively at relative high price. Operating costs consist mainly of opportunity costs for family labor that is intensively used for crop production. This is the major cost disadvantage for Chinese farmers. Despite relative low wages in the country a high labor input is required for rapeseed or soybean production at the farms resulting in relatively high opportunity cost. The problem of correct estimation of these costs is imminent and the major issue remains what are the alternatives for farmers. With a fast growing economy and opening market opportunities farmers have options to leave agriculture for other sectors of the economy or to switch to labor intensive crops such as fruits and vegetables, thus their opportunity costs are expected to grow in the future. Overhead costs in China are kept low due to a very limited use of farm facilities and low taxes and fees. Land markets do not exist so far in China, thus it was difficult to estimate an economic cost of land at the analyzed farm. Fees collected from farms for land use were associated with land cost for the purpose of analysis and were relative low compared to other countries. Additional cost reduction of overheads and land costs is realized through double cropping in the central part.

In **Canada** extensive production systems and difficult climate conditions lead to very low yields. High direct costs attribute the major cost disadvantage of Canadian farmers. Direct costs were high due to relative intensive use of fertilizers and plant protection. Relative high seeding rate and use of certified seed (due to high share of GMO) have contributed to the high direct costs as well. Practice of extensive soil cultivation, seeding and weed management with relative few field activities resulted in low costs related to machinery. Most of work was done by family labor with very limited use of hired workers and under the extensive production systems labor costs were kept low. Moderate use of farm facilities for storage and machinery and moderate taxes and fees resulted in relative low overhead costs.

Sensitivity analysis was done to study the influence of fluctuating exchange rates and alternative rapeseed equivalent on the results. For the purpose of analysis the change between the reference year 2000 and 2002 is studied given that production costs remain constant (no change in price and quantity components). During this period currencies for all countries (except Indonesia) depreciated against the Euro leading to an improvement of cost competitiveness in terms of Euro. The discrepancy of results is high especially for Argentina and Brazil where financial crisis resulted in high inflation in both countries. Thus, it is to expect that high inflation resulted in an increase of input prices and possible change of input use. In this example it becomes evident importance of keeping data updated especially for countries with limited data sources and instable economies.

Alternative rapeseed equivalents (RE) were calculated based on average prices for a longer time period from 1990 through to 1999. Long-term fluctuation of prices considerably change the level of RE compared to the reference year 2000. Using alternative REs for adjustment of economic result will increase soybeans production costs by 9% whereas FFBs production costs will decrease by 10%.

A comparison of **profitability** between crops and countries shows:

- **Market prices** vary considerably between countries and crops where export oriented countries have lower prices compared to importing;
- The lowest price is for soybeans in Brazil, followed by Argentina and the United States. Prices vary considerably between years.
- Producers in Southeast Asia, South America, Germany, China (soybeans) and North Dakota, USA generate **positive entrepreneur's profit** (total revenues minus total costs) under current market condition including subsidies;
- The **highest profit margins per ton** displays the farm in China (Shandong), large estates in Indonesia and Malaysia, and farms in Mecklenburg-Vorpommern, Germany;
- Profitable margins of **German** farms are solely based on the **high subsidy levels**. Without subsidies none of the farms are able to generate profits;
- The **United States** is the second country with a **high** level of **government support**, whereas it is only about half of the German level. Even with high subsidies US soybean producers are not able to generate profits with soybean production, an exception is North Dakota;

After analysis of farm level production costs one should note that they only form part of the international competitiveness. Commodities have to be transported from the producer to the export destination. **Inland marketing** and **transportation cost** and **international freight costs** contribute a considerable share to the landed costs of a commodity at the common market. These costs depend on various factors such as distance of farms to the port, infrastructure, government policies etc. High delivery costs reduce diffusion of market signal to the producers and may make a country uncompetitive at the common export market. These costs are estimated for soybeans from Argentina, Brazil and the United States and palm oil from Indonesia and Malaysia to the common market of the EU.

- The estimation of these costs shows that the highest costs of delivery from farm gate to port of destination is for **soybeans** exported from Brazil and Argentina. The major cost disadvantage for Brazil is due to relative **high inland costs**, where soybeans have to be moved for very long distances from the major producing regions to the port of embarkation.

- Delivery costs for soybeans from the United States and palm oil from Indonesia and Malaysia are only half of the South American figures. Low inland costs due to very intensive and efficient infrastructure compared to South America gives the United States a considerable cost advantage. Relative good infrastructure in Southeast Asia allows producers to keep delivery costs low. Another reason is that a high value product (palm oil) is exported. When converted to rapeseed equivalent it results in relative low delivery costs.
- Delivery costs of soybeans from Brazil and Argentina contribute about one third to one half of the total landed cost at the EU port compared to the United States with less than one fifth. Recognizing that difference South American producers have started intensively to invest in infrastructure and government supports these developments with respective policies. According to different sources inland transportation and marketing costs were reduced considerable in recent years and are expected to be further decreasing in the future.

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Appendix

Part 1

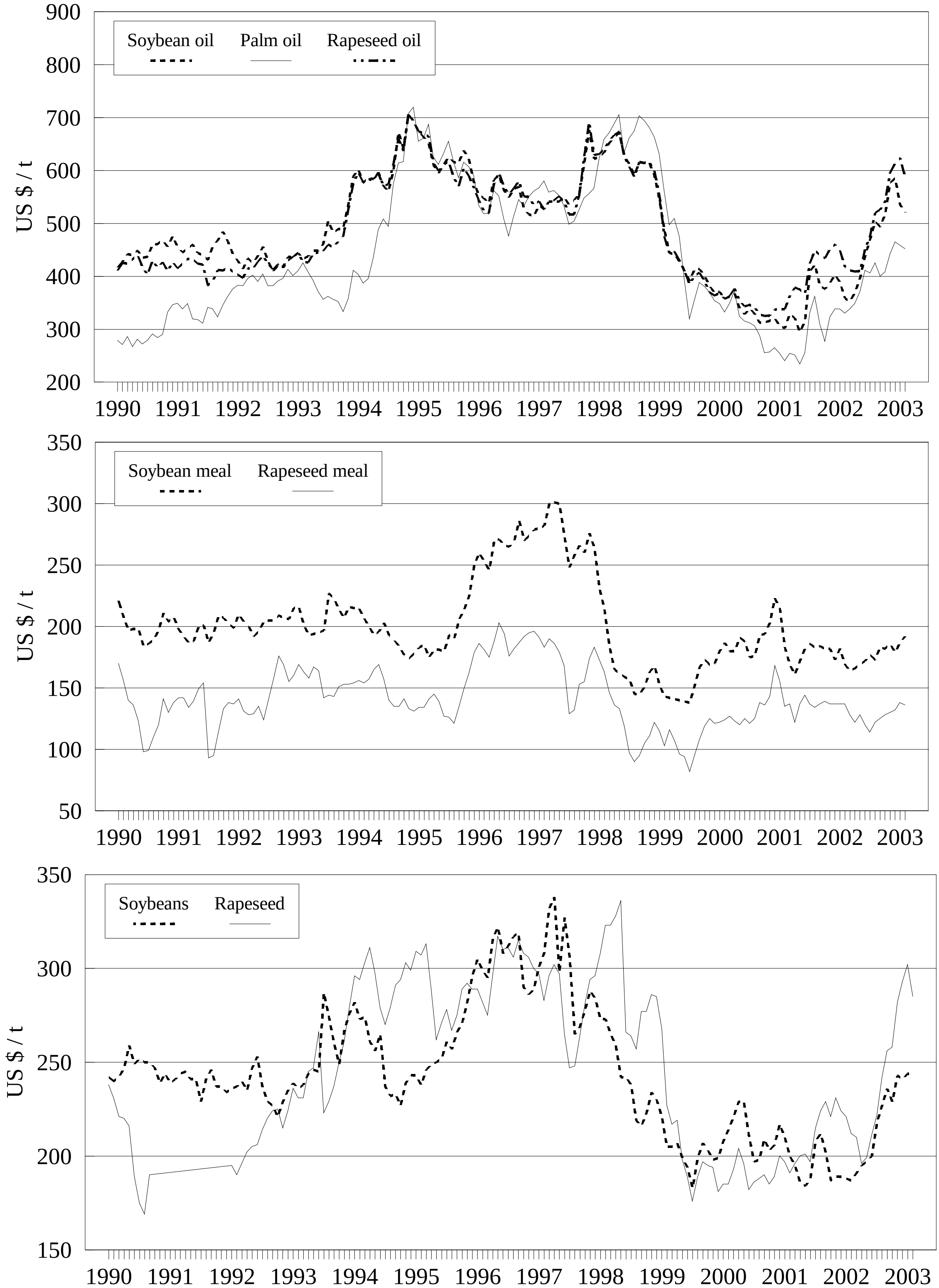
Introduction, Oilseed sector, Methods

Table A1.1: Exports of selected oilseeds and processed products, million tons, 1981 to 2001

Product and Region	Average 1981-85	1986-90	1991-95	1996-00	Years 1998	1999	2000	2001 1)
	million tons							
Meals								
Soybeans meal								
World	18.0	21.9	25.9	33.5	36.1	36.4	35.1	40.1
Argentina	1.6	4.3	6.5	10.8	11.6	13.1	12.9	14.4
Brazil	8.2	8.4	9.4	10.5	10.8	10.9	9.5	11.3
USA	5.6	5.6	5.6	6.8	8.0	6.6	6.3	7.1
Rapeseed meal								
World	0.6	1.6	2.5	2.8	2.6	2.3	2.9	2.3
Canada	0.2	0.4	0.9	1.2	1.5	1.2	1.2	1.0
India	0.1	0.3	0.8	0.6	0.7	0.1	0.1	0.2
Vegetable oils								
Soybeans oil								
World	3.0	3.1	4.1	6.8	7.9	7.6	6.9	8.0
Argentina	0.3	0.8	1.4	2.4	2.5	3.0	3.0	3.4
Brazil	1.0	0.7	1.0	1.3	1.4	1.6	1.1	1.7
USA	0.8	0.7	0.8	0.9	1.5	0.9	0.6	0.7
EU 2) 3)	0.8	0.7	0.5	0.9	1.1	1.1	1.1	1.1
Rapeseed oil								
World	0.6	1.4	1.6	1.9	2.2	1.8	1.9	1.2
EU	0.4	0.9	0.9	0.7	0.9	0.7	0.5	0.2
Canada	0.2	0.2	0.4	0.7	0.7	0.7	0.8	0.7
USA	-	-	0.0	0.1	0.2	0.1	0.1	0.1
Palm oil								
World	4.2	6.9	9.5	12.8	11.2	14.2	15.2	17.6
Malaysia	2.9	4.9	6.3	8.2	7.7	9.2	9.3	10.7
Indonesia	0.4	0.9	1.7	2.9	2.0	3.3	4.1	4.9
Oilseeds								
Soybeans								
World	26.7	26.7	29.5	39.4	36.9	39.9	46.9	55.6
USA	21.3	18.4	19.7	24.8	20.7	24.1	27.2	28.9
Brazil	1.6	3.1	3.7	8.3	9.3	8.9	11.5	15.7
Argentina	2.3	1.9	3.1	2.5	2.9	3.1	4.1	7.2
Rapeseed								
World	1.6	2.6	3.5	6.0	6.0	8.5	7.6	7.1
Canada	1.4	1.9	2.7	3.4	3.9	3.8	3.9	4.0
Australia	0.0	0.0	0.1	0.9	0.7	1.6	1.6	1.4
EU	0.1	0.1	0.2	0.8	0.7	1.7	0.8	0.3

1) Estimation.
2) From 1991 including new federal states (Germany); from 1995 EU-15.
3) Exclduning intra-european trade.
Source: Oil World 2020, Oil World Annual 2002. Park_2002-10-16

Figure A1.1: Prices for oil crops and processed products (US-$ per t, cif Northsea harbours)



Source: Oilworld Monthly January 1990 to February 2003, own illustration. Park_2003-08-28

Part 2

Canada

Table A2.1: Yields of canola and major crops in Canada, dt per ton, 1980 to 2000

Year	Wheat[4)]	Canola	Barley	Peas
1980	17.21	11.94	24.31	
1981	19.96	13.19	25.06	
1982	21.34	12.54	27.12	
1983	19.34	11.21	23.56	
1984	16.10	11.11	22.56	
1985	17.66	12.57	26.08	
1986	21.94	14.12	30.17	
1987	19.22	14.23	27.87	
1988	12.18	11.35	24.64	
1989	17.92	11.00	24.93	
1990	22.71	12.91	29.68	
1991	22.48	13.45	25.68	19.80
1992	20.76	11.97	29.11	19.40
1993	20.97	13.24	28.45	20.70
1994	20.84	12.48	27.00	21.00
1995	21.99	12.04	28.00	18.30
1996	23.86	14.30	29.71	22.50
1997	20.99	13.03	26.95	20.60
1998	22.15	13.95	27.43	21.60
1999	25.69	15.71	29.93	26.90
2000 [1)]	22.94	14.36	27.79	23.70
Ø 1980 to 2000	20.39	12.89	26.95	21.45
Max.[2)]	25.69	15.71	30.17	26.90
Min.[3)]	12.18	11.00	22.56	18.30

1) Estimation; 2) Maximum yield in observed period; Park_2003-07-15
3) Minimum yield in observed period;4) Wheat total.
Source: CANSIM (Canadian Socio Economic Information Management System).

Table A2.2: Canola production system of selected farms in Saskatchewan, Brown Soil - Part 1 -

	Canola Conventional	Brown Soil Canola Roundup Ready	Canola Liberty Link
System			
Share (%)	50	33	17
Seasonality	Spring crop	Spring crop	Spring crop
Crop rotation	Fallow-Canola-Wheat-Legume-Wheat	Fallow-Canola-Wheat-Legume-Wheat	Fallow-Canola-Wheat-Legume-Wheat
Soil cultivation	Minimum Till	Minimum Till - Zero Till	Minimum Till - Zero Till
Harvest			
Amount/Year	1	1	1
Month	Aug-Oct	Aug-Oct	Aug-Oct
Yield (t per ha)	1.3	1.36	1.46
Oil content (%)	41.5	41.5	41.5
Protein content (%)	19.0	19	19
Soil preparation and seeding			
Soil preparation			
Month	Oct or Apr	Oct	Oct
Amount of operations	1	0.25	0.25
Activity / Machinery	harrow	harrow	harrow
	application of herbicide	spread straw of preceding crop	spread straw of preceding crop
Seeding / Planting			
Month	Apr-May	Apr-May	Apr-May
kg/ha	6.7 Brassica napus (Argentine)	5.6 Brassica napus (Argentine)	5.6 Brassica napus (Argentine)
seed / m²	160	130	130
Amount of operations	1	1	1
Activity / Machine	Airseeder	Airseeder	Airseeder
Fertilization			
N-fertilization			
Amount of applications	combined with P-/S-fertilization during seeding	combined with P-/S-fertilization during seeding	combined with P-/S-fertilization during seeding
Type of fertilizer	Urea	Urea	Urea
Nutrient values (%)	46N / 0P / 0K	46N / 0P / 0K	46N / 0P / 0K
Application (date, kg/ha)	22 (during seeding)	22 (during seeding)	22 (during seeding)
Formula	Granule	Granule	Granule
Machine	Airseeder	Airseeder	Airseeder
S-fertilization			
Amount of applications	combined with N-/P-fertilization	combined with N-/P-fertilization	combined with N-/P-fertilization
Type of fertilizer	Sulfate ammonium	Sulfate ammonium	Sulfate ammonium
Nutrient values (%)	20N / 0P / 0K / 24S	20N / 0P / 0K / 24S	20N / 0P / 0K / 24S
Total nutrients (kg per ha)	10	10	10
Application (date, kg/ha)	10 (during seeding)	10 (during seeding)	10 (during seeding)
Formula	Granule	Granule	Granule
Machine	Airseeder	Airseeder	Airseeder
P-fertilization			
Amount of applications	combined with N-/S-fertilization	combined with N-/S-fertilization	combined with N-/S-fertilization
Type of fertilizer	Mono-ammonium phosphate	Mono-ammonium phosphate	Mono-ammonium phosphate
Nutrient values (%)	11N / 52P / 0K	11N / 52P / 0K	11N / 52P / 0K
Total nutrients (kg per ha)	17	17	17
Application (date, kg/ha)	17 (during seeding)	17 (during seeding)	17 (during seeding)
Formula	Granule	Granule	Granule
Machine	Airseeder	Airseeder	Airseeder
K-fertilization			
Amount of applications	none	none	none

Table A2.2: Canola production system of selected farms in Saskatchewan, Brown Soil - Part 2 -

	Brown Soil Canola Conventional	 Canola Roundup Ready	 Canola Liberty Link
Plant protection			
Grass herbicides			
Amount of applications	2.5	3	3
Trade name	Edge Granule + Roundup Original + Poast Ultra	Roundup Original + Roundup Transorb	Roundup Original + Liberty + Fusion[1)]
Active ingredients	Ethafluralin + Glyphosat + Setoxydim	Glyphosate	Glyphosate + Glufosinate + Fenoxaprop / Fluazifop
1. Application (l/ha, time)	17.0 kg Edge (fall/spring)	1.24 l Roundup Original (before seeding)	0.74 l Roundup Original (before seeding)
2. Application (l/ha, time)	1.24 l Roundup (before seeding)	..24 l Roundup Transorb (after emergence	1.35 l Liberty (after emergence)
3. Application (l/ha, time)	0.32l Poast Ultra (after emergence)	..24 l Roundup Transorb (after emergence	0.47/0.8 l Fusion (after emergence)
Machinery	Granule sprayer / Sprayer	Sprayer	Sprayer
Broadleaf herbicides			
Amount of applications	combined with grass herbicides	combined with grass herbicides	combined with grass herbicides
Fungicides			
Amount of applications	none	none	none
Trade name	–	–	–
Active ingredients	–	–	–
1. Application (l/ha, time)	–	–	–
Machinery		–	–
Growth regulators			
Amount of applications	none	none	none
Insecticides			
Amount of applications	none	none	none
Trade name	–	–	–
Active ingredients	–	–	–
1. Application (l/ha, time)	–	–	–
Insects	–	–	–
Machinery	–	–	–
Harvest and postharvest activities			
Harvest			
Activities	2	2	2
Month	Aug - Oct	Aug - Oct	Aug - Oct
Machine	Swather Combine	Swather Combine	Swather Combine
Transport			
Activities	2	2	2
Machine	Transportation with truck to farmgate Transportation with truck to trader	Transportation with truck to farmgate Transportation with truck to trader	Transportation with truck to farmgate Transportation with truck to trader
Drying			
Share of harvest for drying (%)	0	0	0
Water content before drying (%)	10	10	10
Allowed water content (%) [2)]	8.5	8.5	8.5
Time of drying	airing in store	airing in store	airing in store
Technology	airation fans	airation fans	airation fans
Fuel	–	–	–
Storage / Marketing			
Type of storage	storage in bins	storage in bins	storage in bins
Share of stored crop (%)	100	100	100
Length of storage (days)	variable	variable	variable
Delivery point	Swift Current	Swift Current	Swift Current
Distance	ca. 60 km	ca. 60 km	ca. 60 km

1) Fusion contain two active ingredients.
2) Standard moisture content that do not lead to discount and premium.
Source: Own data collection.

Park_2003-07-15

Table A2.3: Canola production system of selected farms in Saskatchewan, Black Soil - Part 1 -

	Canola Conventional	Black Soil Canola Roundup Ready	Canola Liberty Link
System			
Share (%)	25	50	25
Seasonality	Spring crop	Spring crop	Spring crop
Crop rotation	Wheat-Canola-Barley / Wheat-Flax / Oats-Peas various combinations, canola only after grain	Wheat-Canola-Barley / Wheat-Flax / Oats-Peas various combinations, canola only after grain	Wheat-Canola-Barley / Wheat-Flax / Oats-Peas various combinations, canola only after grain
Soil cultivation	Minimum Till	Minimum Till - Zero Till	Minimum Till - Zero Till
Harvest			
Amount/Year	1	1	1
Month	Aug - Oct	Aug - Oct	Aug - Oct
Yield (t per ha)	1.59	1.67	1.79
Oil content (%)	42	42	42
Protein content (%)	20	20	20
Soil preparation and seeding			
Soil preparation			
Month	Oct or Apr	Oct	Oct
Amount of operations	1	0.5	0.5
Activity / Machinery	harrow application of herbicide	harrow spread straw of preceding crop	harrow spread straw of preceding crop
Seeding / Planting			
Month	May	May	May
kg/ha	6.7 Brassica napus (Argentine)	5.6 Brassica napus (Argentine)	5.6 Brassica napus (Argentine)
seed / m²	160	130	130
Amount of operations	1	1	1
Activity / Machine	Airseeder	Airseeder	Airseeder
Fertilization			
N-fertilization			
Amount of applications	combined with P-/S-fertilization during seeding	combined with P-/S-fertilization during seeding	combined with P-/S-fertilization during seeding
Type of fertilizer	NH_3	NH_3	NH_3
Nutrient values (%)	82N / 0P / 0K	82N / 0P / 0K	82N / 0P / 0K
Application (date, kg/ha)	84 (during seeding)	84 (during seeding)	84 (during seeding)
Formula	gasous	gasous	gasous
Machine	Airseeder + NH_3-Tank	Airseeder + NH_3-Tank	Airseeder + NH_3-Tank
S-fertilization			
Amount of applications	combined with N-/P-fertilization	combined with N-/P-fertilization	combined with N-/P-fertilization
Type of fertilizer	Sulfate ammonium	Sulfate ammonium	Sulfate ammonium
Nutrient values (%)	20N / 0P / 0K / 24S	20N / 0P / 0K / 24S	20N / 0P / 0K / 24S
Total nutrients (kg per ha)	10	10	10
1. Application (date, kg/ha)	15 (during seeding)	15 (during seeding)	15 (during seeding)
Formula	Granule	Granule	Granule
Machine	Airseeder	Airseeder	Airseeder
P-fertilization			
Amount of applications	combined with N-/S-fertilization	combined with N-/S-fertilization	combined with N-/S-fertilization
Type of fertilizer	Mono-ammonium phosphate	Mono-ammonium phosphate	Mono-ammonium phosphate
Nutrient values (%)	11N / 52P / 0K	11N / 52P / 0K	11N / 52P / 0K
Total nutrients (kg per ha)	25	25	25
1. Application (date, kg/ha)	25 (during seeding)	25 (during seeding)	25 (during seeding)
Formula	Granule	Granule	Granule
Machine	Airseeder	Airseeder	Airseeder
K-fertilization			
Amount of applications	none	none	none

Table A2.3: Canola production system of selected farms in Saskatchewan, Black Soil - Part 2 -

	Canola Conventional	Black Soil Canola Roundup Ready	Canola Liberty Link
Plant protection			
Grass herbicides			
Amount of applications	2.75	3	3
Trade name	Edge Granule + Roundup Original + Mustergold	Roundup Original + Roundup Transorb	Roundup Original + Liberty + Fusion[1)]
Active ingredients	Ethafluralin + Glyphosate + Ethamet-sulfuron-methyl / Quizalofop-ethyl	Glyphosate	Glyphosate + Glufosinate + Fenoxaprop / Fluazifop
1. Application (l/ha, time)	20.0 kg Edge (fall/spring)	1.24 l Roundup Original (before seeding)	1.24 l Roundup Original (before seeding)
2. Application (l/ha, time)	0.74 l Round up (before seeding)	1.24 l Roundup Transorb (after emergence)	1.35 l Liberty (after emergence)
3. Application (l/ha, time)	2.5 l Mustergold (after emergence)	1.24 l Roundup Transorb (after emergence)	0.47/0.8 l Fusion (after emergence)
Machinery	Sprayer	Sprayer	Sprayer
Broadleaf herbicides			
Amount of applications	combined with grass herbicides	combined with grass herbicides	combined with grass herbicides
Fungicides			
Amount of applications	ca. 5-10% of area	ca. 5-10% of area	ca. 5-10% of area
Trade name	Ronilan EG/Benlate	Ronilan EG/Benlate	Ronilan EG/Benlate
Active ingredients	Vinclozolin/Benomyl	Vinclozolin/Benomyl	Vinclozolin/Benomyl
1. Application (l/ha, time)	0.86 l Ronilan EG/Benlate (by flowering)	0.86 l Ronilan EG/Benlate (by flowering)	0.86 l Ronilan EG/Benlate (by flowering)
Disease	Sclerotinia	Sclerotinia	Sclerotinia
Machinery	Airplane	Airplane	Airplane
Growth regulators			
Amount of applications	none	none	none
Insecticides			
Amount of applications	seldom, only in case of intensive problem	seldom, only in case of intensive problem	seldom, only in case of intensive problem
Trade name	Dylox	Dylox	Dylox
Active ingredients	Trichlorfon	Trichlorfon	Trichlorfon
1. Application (l/ha, time)	2.7 l Dylox	2.7 l Dylox	2.7 l Dylox
Insects		Beet webworm, Diamond-back moth, Tarnished plant bugs	
Machinery	Airplane	Airplane	Airplane
Harvest and postharvest activities			
Harvest			
Activities	2	2	2
Month	Aug - Oct	Aug - Oct	Aug - Oct
Machine	Swather Combine	Swather Combine	Swather Combine
Transport			
Activities	2	2	2
Machine	Transportation with truck to farmgate Transportation with truck to trader	Transportation with truck to farmgate Transportation with truck to trader	Transportation with truck to farmgate Transportation with truck to trader
Drying			
Share of harvest for drying (%)	0	0	0
Water content before drying (%)	ca. 12-14	ca. 12-14	ca. 12-14
Allowed water content (%) [2)]	8.5	8.5	8.5
Time of drying	Drying and airation in store	Drying and airation in store	Drying and airation in store
Technology	Dryer + blower	Dryer + blower	Dryer + blower
Fuel	Propane	Propane	Propane
Storage / Marketing			
Type of storage	storage in bins	storage in bins	storage in bins
Share of stored crop (%)	75	75	75
Length of storage (days)	variable	variable	variable
Delivery point	Wynyard	Wynyard	Wynyard
Distance	ca. 60 km	ca. 60 km	ca. 60 km

1) Fusion contain two active ingredients.
2) Standard moisture content that do not lead to discount and premium.
Source: Own data collection.

Park_2003-07-15

Table A2.4: Yields of selected crops at the selected locations of Black and Brown Soil Zones of Saskatchewan, dt per ton, 1980 to 1999

	Canola	Spring wheat	Barley	Lentils	Peas
			Black (Wynyard)		
1999	14.60	22.99	30.88	12.91	23.99
Ø 1980 to 1999	11.60	18.63	24.73	10.83	18.70
Max.[1)]	18.49	28.25	40.88	17.54	36.54
Min.[2)]	4.48	6.05	8.61	2.44	3.34
Variation coefficient	0.24	0.20	0.22	0.32	0.26
			Brown (Swift Current)		
1999	13.98	22.08	26.36	14.49	25.40
Ø 1980 to 1999	10.47	17.49	20.80	11.69	16.69
Max.	25.22	26.90	35.50	20.01	32.55
Min.	1.68	2.02	2.69	4.64	4.00
Variation coefficient	0.37	0.29	0.31	0.26	0.40

1) Maximum yield in observed period; 2) Minimum yield in observed period. Park_2003-07-15

Source: Saskatchewan Agriculture and Food (1999), own calculations.

Table A2.5: Agricultural budget of the federal and province governments, 1996/97 to 1999/00

	Provincial expenditures				Federal expenditures			
	1996-97	1997-98	1998-99	1999-00 [1)]	1996-97	1997-98	1998-99	1999-00 [1)]
	(can$ 1,000)							
Operating expenditures	575,232	481,524	497,524	483,660	764,095	769,514	802,797	792,865
Capital expenditures	18,377	28,912	31,052	20,378	50,967	50,314	47,951	48,036
Program expenditures	1,148,039	1,045,343	1,193,750	1,407,793	2,389,707	1,686,959	1,346,991	1,804,180
Income support (NISA [2)])	361,918	348,959	448,730	545,567	525,530	541,409	327,089	1,048,034
Ad hoc and Cost Reduction	36,015	43,410	26,238	25,807	19,900	5,416	38,213	11,894
Crop insurance	282,046	220,068	229,350	228,910	186,215	384,073	226,880	223,123
Financing Assistance	137,502	101,013	107,148	116,136	37,786	98,873	55,617	75,615
Storage and freight	199	2,167	10,421	10,484	909,996	101,548	72,857	67,678
Research	188,101	205,667	228,137	273,538	32,693	32,196	38,140	36,718
Food inspection	17,155	6,971	11,678	18,457	5,061	8,566	10,365	5,171
Food aid	0	0	0	0	275,551	235,919	253,212	237,098
Marketing and trade	25,901	22,549	25,350	37,948	281,042	204,814	258,427	35,094
Rural and regional development	68,854	63,200	64,553	57,287	80,361	63,793	55,884	54,315
Environment	30,348	31,339	42,146	93,659	35,572	10,352	10,308	9,439
Tax expenditures	446,630	464,080	300,824	314,719	0	0	0	0
Gross expenditures	2,188,278	2,019,858	2,023,150	2,226,551	3,204,769	2,506,787	2,197,739	2,645,081
Recoveries	-93,319	-96,053	-70,740	-77,578	-103,957	-58,295	-35,817	-40,000
Total net expenditures	2,094,959	1,923,805	1,952,410	2,148,973	3,100,811	2,448,492	2,161,921	2,605,081

1) Estimation. 2) NISA = Net Income Stabilization Account. Park_2003-07-15
Source: Agriculture and Agri-Food Canada, Policy Branch.

Table A2.6: Insured area under major crops by coverage level, 1998

Crop	Coverage rate 50 % Area ha	50 % share in %	60 % Area ha	60 % share in %	70 % Area ha	70 % share in %	80 % Area ha	80 % share in %	Total insured area ha
Spring wheat	282,497	12	172,783	8	1,411,487	62	401,256	18	2,268,023
Durum wheat	222,724	13	135,451	8	1,142,566	65	248,459	14	1,749,199
Barley	217,131	26	85,975	10	427,879	51	110,428	13	841,412
Oats	92,650	32	24,297	9	134,413	47	34,394	12	285,753
Flax	88,919	22	34,942	9	225,791	56	51,583	13	401,235
Canola	306,102	17	134,223	8	1,005,221	57	326,071	18	1,771,617
Peas	114,202	24	56,243	12	253,487	54	47,293	10	471,225
Lentils	79,403	33	40,228	17	98,711	42	19,408	8	237,750
Average	175,453	23	85,518	10	587,444	54	154,862	13	1,003,277

Sourc: Saskatchewan Crop Insurance Corporation, Agri-Food Canada. Park_2003-07-15

Table A2.7: Export grade determinants of canola

Trade grade	Rough material (%) 1)	Damaged seed (%) 2) green, germinated, moldy seeds	throug heat damaged seed	Total damaged seed		
No. 1 Canola	2.5	2,0	0.1	3,0		
No. 2 Canola	2.5	6,0	0.5	10.0		
No. 3 Canola	2.5	20.0	2.0	20.0		
		Foreign material (%) Ergot	Insect Excreta	Sclerotia	Stones	Conspicuous 3) admixture	nconspicuous 4 admixture

		Foreign material (%)					
		Ergot	Insect Excreta	Sclerotia	Stones	Conspicuous 3) admixture	nconspicuous 4 admixture
No. 1 Canola	2.5	0.05	0.1	0.1	0.1	1.0	5.0
No. 2 Canola	2.5	0.05	0.2	0.1	0.1	1.5	5.0
No. 3 Canola	2.5	0.05	0.3	0.2	0.1	2.0	5.0

1) Wild oats, seed pods, knuckles based on gross weight of sample = net dockage. Park_2003-07-15
2) based on net weight of the sample after dockage deduction.
3) seed that easily distinguished from canola e.g. flax, yellow mustard, other seed.
4) seed that are not readily distinguishalbe from canola e.g. wild mustard, domestic oriental mustard and others.
Shipments that do not meet teh standards for commercial cleanliness are referred to as *not commercially clean* .
Such shipments are allowed only with the persmission of the Canadian Grain Council.
Source: Canadian Grain Commission, Official Grain Grading Guide, 5 May 2003.

Table A2.8: Quality of canola, 1999

	Oil content 1) %			Protein content 2) %			Chlorophyll content mg/kg			Glucosinolate 1) µmol/g			Free fatty acids %
	Ø	Min.	Max.	Ø	Min.	Max.	Ø	Min.	Max.	Ø	Min.	Max.	
No. 1 Canada Canola													
Manitoba	42.3	36.1	46.2	21.7	18.2	25.7	15	3	25	11	7	22	0.30
Saskatchewan	43.9	37.0	49.3	19.9	16.1	26.3	15	1	25	9	4	22	0.20
Alberta	43.1	38.1	48.7	20.9	16.7	26.2	13	0	25	10	4	29	0.23
Western Canada	**43.3**	**36.1**	**49.3**	**20.6**	**16.1**	**26.3**	**15**	**0**	**25**	**10**	**4**	**29**	**0.23**
No. 2 Canada Canola													
Manitoba	41.3	37.2	45.0	22.5	18.9	25.3	32	18	45	12	8	17	0.31
Saskatchewan	43.0	36.2	47.0	20.8	16.6	24.7	33	22	45	11	7	21	0.18
Alberta	43.5	39.3	48.5	20.7	17.0	25.8	32	16	45	11	7	21	0.21
Western Canada	**42.9**	**36.2**	**48.5**	**21.0**	**16.6**	**25.8**	**33**	**16**	**45**	**11**	**7**	**21**	**0.20**
No. 3 Canada Canola													
Manitoba	42.1	40.4	46.1	21.7	18.3	24.2	57	46	96	11	8	13	0.29
Saskatchewan	42.8	38.2	45.6	20.8	18.5	25.7	56	39	98	11	7	18	0.25
Alberta	42.8	39.4	45.1	21.2	18.8	24.6	56	44	94	12	8	17	0.44
Western Canada	**42.7**	**38.2**	**46.1**	**21.1**	**18.3**	**25.7**	**56**	**39**	**98**	**11**	**7**	**18**	**0.32**

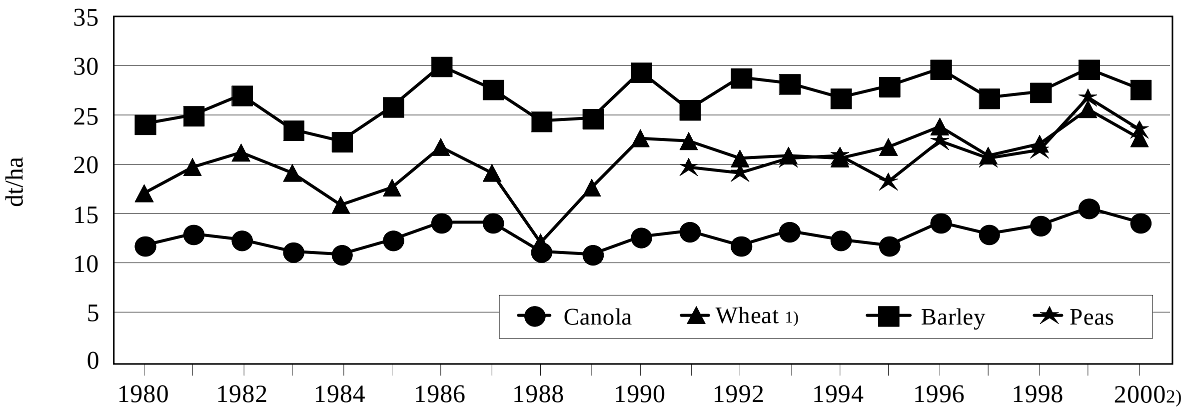
1) 8,5% moisture content. Park_2003-07-15
2) N x 6,25; 8,5% moisture.
Source: Canadian Grain Commission (1999).

Table A2.9: Quality of No.1 canola for export purposes, 1999

Quality characteristic		October 1999 Exports		1998 - 99 Exports	
		Thunder Bay	Vancouver	Thunder Bay	Vancouver
Oil content [1]	%	41.5	42.7	41.1	41.8
Protein content [2]	%	21.2	20.7	22.2	21.6
Chlorophyll content	mg/kg in seed	16.0	23.0	20.0	17.0
Glucosinolate	µmol/g	12.0	11.0	12.0	12.0
Eruca acids	% in Oil	0.2	0.2	0.3	0.3

1) at 8.5% moisture content; Park_2003-07-15
2) N x 6.25; 8.5% moisture content.
Source: Canadian Grain Commission (1999).

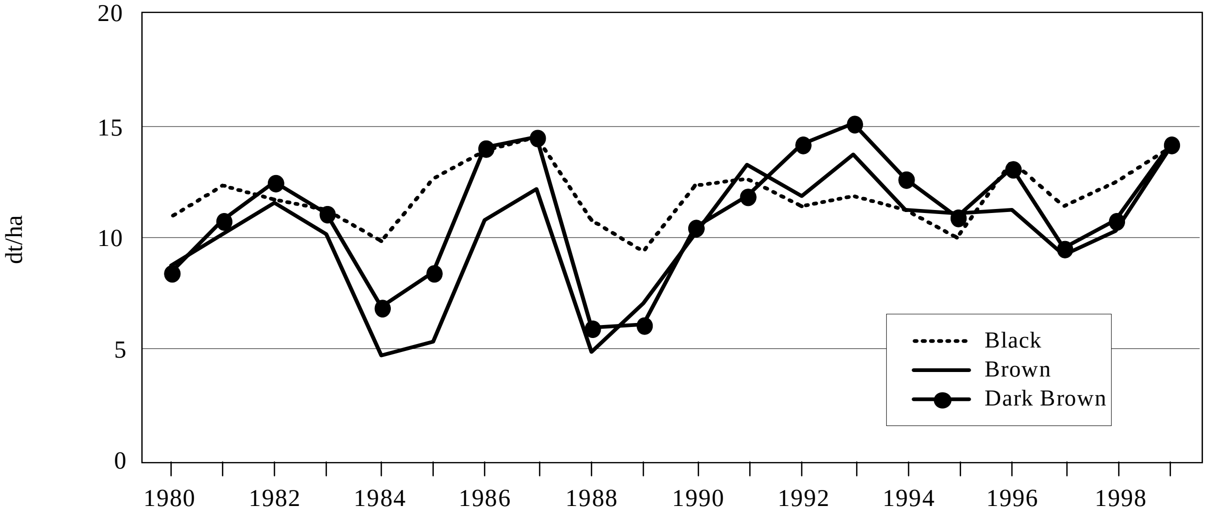
Figure A2.1: Yields of canola and major crops in Canada, 1980 to 2000



	Canola	Wheat	Barley	Peas
1999	15.71	25.69	29.93	26.90
Ø 1980/91 to 2000	12.89	20.39	26.95	21.45
Max.3)	15.71	25.69	30.17	26.90
Min.4)	11.00	12.18	22.56	18.30

1) Total wheat. 2) Estimated. 3) Maximum yield in observed period. Park_2003-07-04
4) Minimumr yield in observed period.
Source: Saskatchewan Agriculture and Food. Statistical Handbook (1998). own calculations.

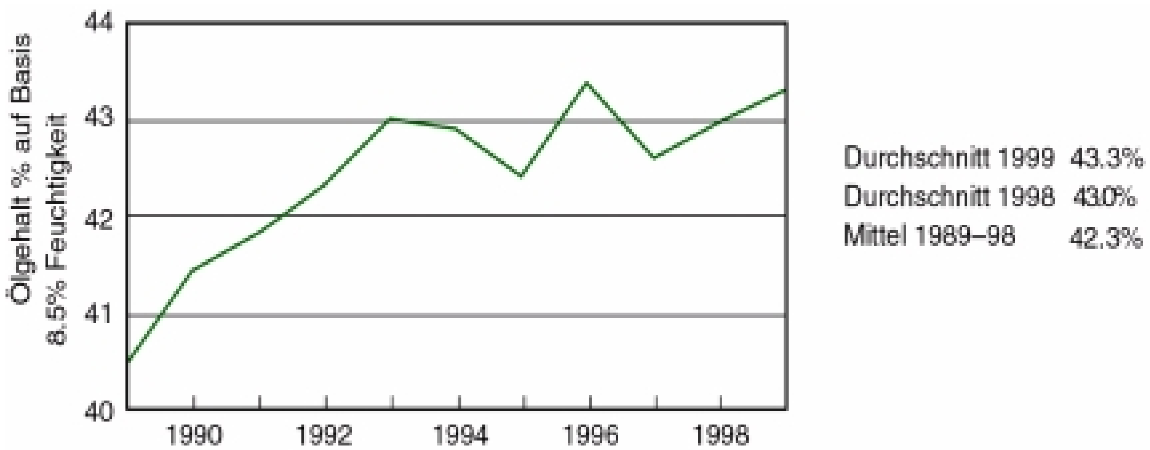
Figure A2.2: Canola yields of Saskatchewan soil zones, 1980 to 1999



	Black	Brown	Dark Brown
1999	14.09	14.00	14.26
Ø 1980 to 2000	11.88	10.09	11.08
Max.[2)]	14.47	14.00	15.05
Min.[3)]	9.35	4.71	6.00
Variation coefficient	0.12	0.27	025

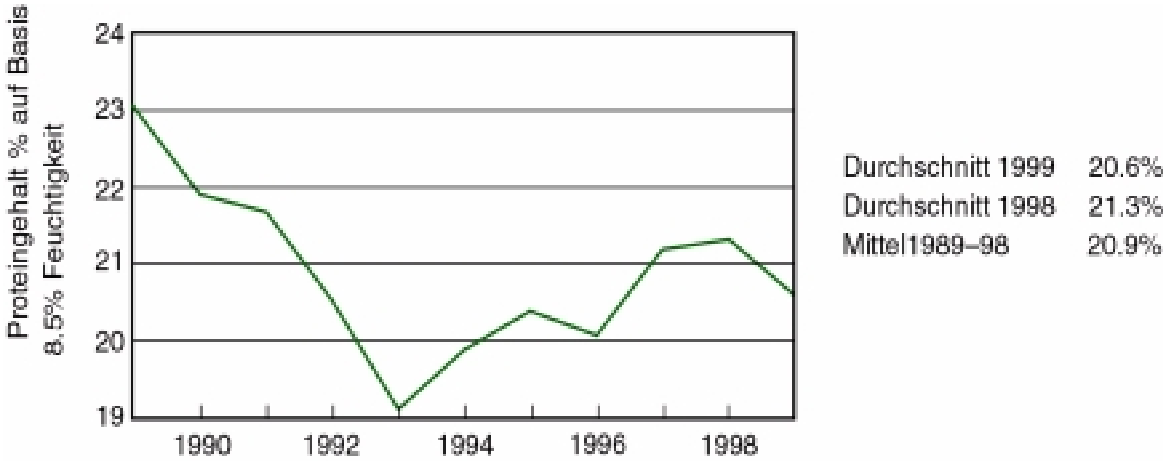
Source: CANSIM (Canadian Socio Economic Information Management System), own calculations. Park_2003-07-04

Figure A2.3: Historical oil content of No.1 Canola in Canada, 1989 to 1999



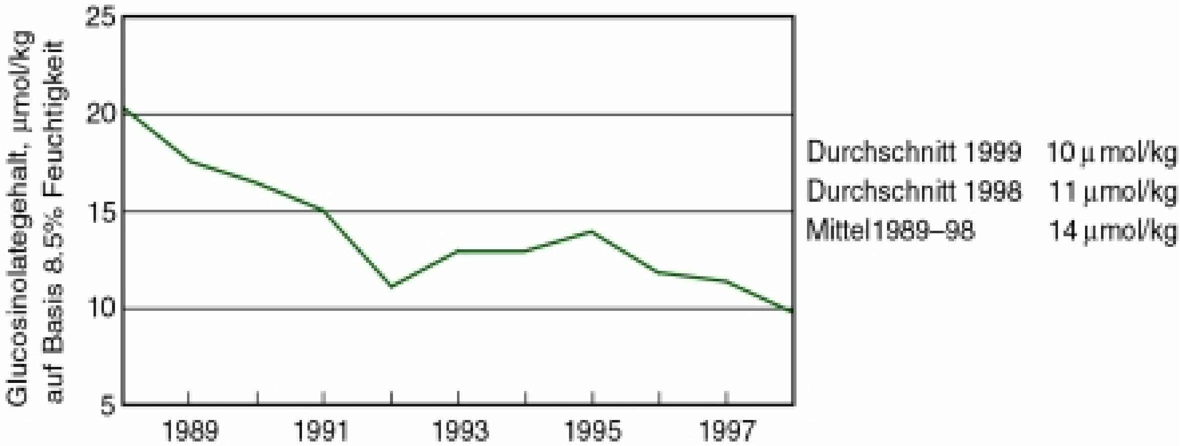
Source: Canadian Grain Commission (1999). Park_2003-07-17

Figure A2.4: Historical protein content of No.1 Canola in Canada, 1989 to 1999



Source: Canadian Grain Commission (1999). Park_2003-07-17

Figure A2.5: Historical glucosinolates content of No.1 Canola in Canada, 1989 to 1999

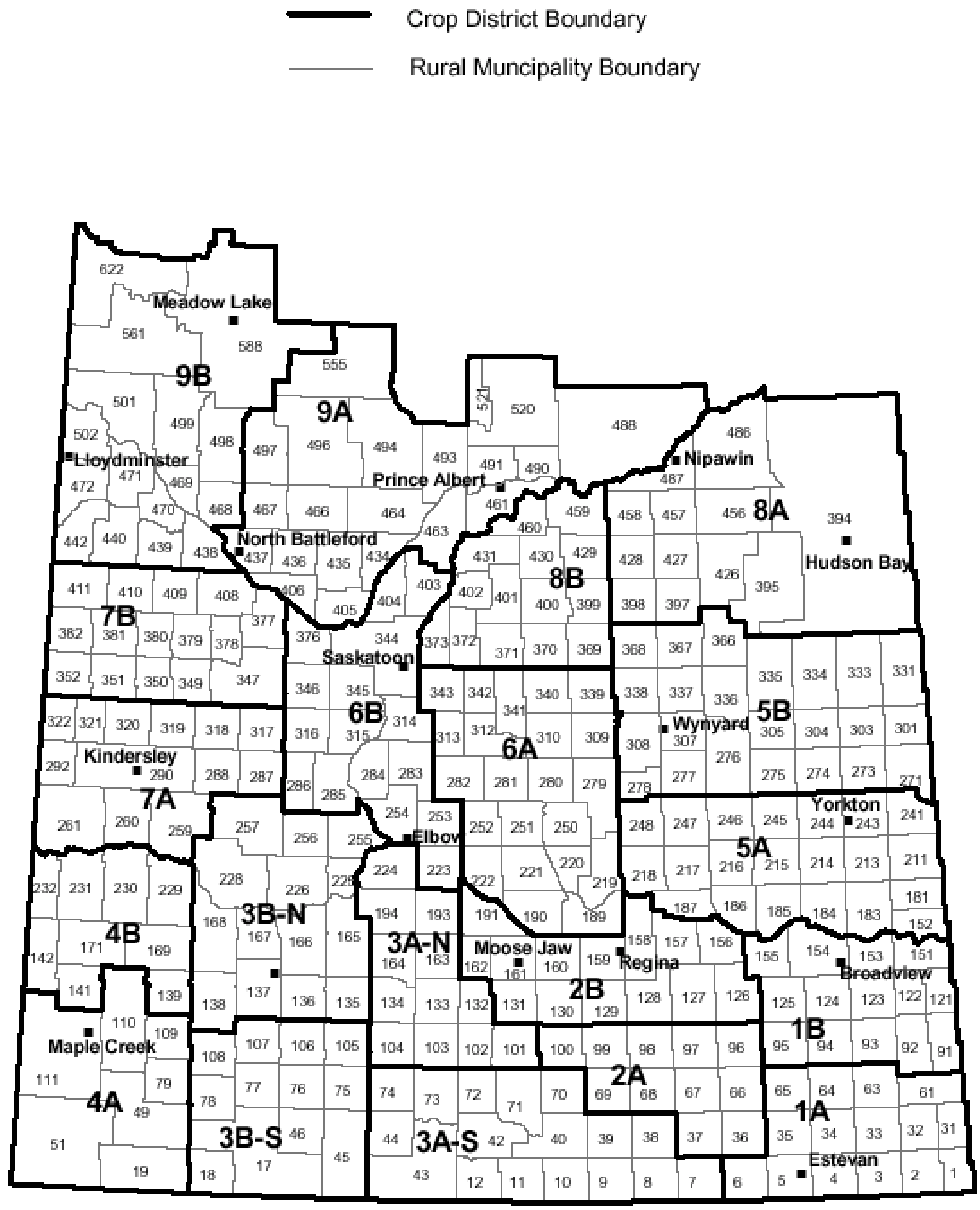


Source: Canadian Grain Commission (1999). Park_2003-07-17

Map A2.1: Canada

Park_2003-07-14

Map A2.2: Saskatchewan Crop Districts and Rural Municipalities



Source: Saskatchewan Agriculture and Food, 1996

Part 3

United States

Table A3.1: Area under major crops in the United States, 1,000 ha, 1980 to 2000

Years	Wheat	Soybeans	Corn	Sunflower
1980	32,694	28,300	34,012	1,582
1981	35,715	27,334	34,034	1,564
1982	34,898	28,686	33,127	1,949
1983	30,926	25,811	24,365	1,259
1984	32,057	27,420	32,585	1,519
1985	30,569	25,554	33,751	1,236
1986	29,137	24,446	30,992	820
1987	26,641	23,545	26,791	730
1988	26,519	23,812	27,405	825
1989	31,006	24,614	29,268	745
1990	31,178	23,389	30,015	771
1991	28,280	23,950	30,739	1,111
1992	29,227	23,950	32,097	885
1993	29,206	24,316	29,639	1,116
1994	28,470	24,937	31,939	1,444
1995	27,936	25,291	28,927	1,408
1996	30,395	25,979	32,064	1,026
1997	28,495	28,331	32,188	1,169
1998	26,637	29,148	32,442	1,444
1999	25,420	29,858	31,336	1,438
2000 [1)]	25,474	30,150	32,205	1,160
% Δ 1995 - 2000	**-8.8%**	**19.2%**	**11.3%**	**-17.6%**

1) Estimated. Park_2003-07-15

Source: USDA-NASS, On-Line Database (2000); own calculations.

Table A3.2: Area under major crops in the North Dakota, 1,000 ha, 1980 to 2000

	Planted area (1,000 ha)			
Years	Wheat [1)]	Sunflower	Soybeans	HRS [2)]
1980	4,749	971	85	2,307
1981	4,786	1,072	101	2,853
1982	4,259	1,376	172	2,732
1983	2,983	961	219	2,023
1984	3,569	1,153	304	2,185
1985	3,784	886	202	2,319
1986	3,893	591	192	2,590
1987	3,764	567	210	2,469
1988	3,743	607	304	1,902
1989	4,371	534	259	2,934
1990	4,593	554	202	3,116
1991	4,047	692	257	2,772
1992	4,715	496	283	3,683
1993	4,755	534	243	3,582
1994	4,690	643	259	3,582
1995	4,569	587	267	3,318
1996	5,132	478	344	3,845
1997	4,705	595	465	3,399
1998	3,954	805	607	2,671
1999	3,808	688	546	2,266
2000 [3)]	4,213	522	850	
% △ 1995 to 1999/2000	**-7.8**	**-11.0**	**218.0**	**-31.7**

1) Wheat: HRS + Winter wheat; 2) Hard Red Spring Wheat; 3) Estimated. Park_2003-07-15
Source: USDA-NASS, On-Line Database (2000); own calculations.

Table A3.3: Area under major crops in the Northern Plains, 1,000 ha, 1980 to 2000

Years	Soybeans	Corn	Wheat	Sunflower
1980	401	1,692	6,388	1,184
1981	417	1,740	6,429	1,255
1982	504	1,736	5,838	1,629
1983	623	1,283	4,229	1,143
1984	870	1,769	5,186	1,396
1985	720	1,813	5,471	1,097
1986	739	1,692	5,538	745
1987	777	1,546	5,245	688
1988	1,845	2,104	9,348	793
1989	1,797	2,287	10,979	692
1990	2,772	5,484	12,278	706
1991	2,968	5,941	11,137	937
1992	2,995	6,050	12,297	726
1993	2,853	5,718	12,149	887
1994	3,286	6,261	11,884	1,159
1995	3,403	5,524	11,341	1,133
1996	3,501	6,374	12,588	887
1997	4,229	6,568	11,754	1,032
1998	4,573	6,746	10,439	1,287
1999	5,099	6,544	9,921	1,214
2000 [2)]	5,666	6,961	10,186	1,002
% Δ 1995 - 2000	**66.5%**	**26.0%**	**-10.2%**	**-11.6%**

1) Northern Plains: Kansas, Nebraska, North Dakota, South Dakota. Park_2003-07-15
2) Estimated.
Source: USDA-NASS, On-Line Database (2000); own calculations.

Table A3.4: Soybeans production system at the selected farms in South Central North Dakota - Part 1 -

	South Central North Dakota	
	Soybeans Conventional	**Soybeans Roundup Ready**
System		
Share (%)	75	25
Seasonality	Spring crop	Spring crop
Crop rotation	Soybeans-Wheat-Barley	Soybeans-Wheat-Barley
	Soybeans dominantly in three year rotation	Soybeans dominantly in three year rotation
Soil cultivation	Conventional	Conventional
Harvest		
Amount/Year	1	1
Month	End Sep - mid Oct	End Sep - mid Oct
Yield (t per ha)	2.0	2.0
Protein content (%)	44.0	44.0
Oil content (%)	18.0	18.0
Soil preparation and seeding		
Soil preparation		
Month	Sep+Oct+Apr	Sep+Oct+Apr
Amount of operations	2.5	2.5
Activity / Machinery	harrow cultivator	harrow cultivator
Seeding / Planting		
Month	May to mid June	May to mid June
kg/ha	60-70	60-70
seed / m²	35	35
Inoculation (%)	25%	25%
Amount of operations	1	1
Activity / Machine	75 % Airseeder; 25 % planter	Airseeder
Fertilization		
N-fertilization		
Amount of applications	_	_
Type of fertilizer	_	_
Nutrient values (%)	_	_
Application (date, kg/ha)	_	_
Formula	_	_
Machine	_	_
S-fertilization		
Amount of applications	_	_
P-fertilization		
Amount of applications	1	1
Type of fertilizer	Mono-ammonium phosphate	Mono-ammonium phosphate
Nutrient values (%)	11N / 52P / 0K	11N / 52P / 0K
Total nutrients (kg per ha)	28	28
Application (date, kg/ha)	28 (during seeding)	28 (during seeding)
Formula	Granule	Granule
Machine	Airseeder / Planter	Airseeder
K-fertilization		
Amount of applications	_	_
Liming		
Amount of applications	_	_

Table A3.4: Soybeans production system at the selected farms in South Central North Dakota - Part 2 -

	South Central North Dakota	
	Soybeans Conventional	**Soybeans Roundup Ready**
Plant protection		
Grass herbicides		
Amount of applications	2.25	1.25
Trade name	Pursuit, Roundup Ultra	Roundup Ultra + Sulfate ammonium
Active ingredients	Imazethapyr, Glyphosate	Glyphosate
1. Application (l/ha, time)	0.25 x 2.3 l Roundup Ultra before seeding	0.25 x 2.3 l Roundup Ultra
2. Application (l/ha, time)	0.21 l Pursuit (after emergence)	2.3 l Roundup Ultra
3. Application (l/ha, time)	0.21 l Pursuit (after emergence)	_
Machinery	Self-propelled sprayer	Self-propelled sprayer
Broadleaf herbicides		
Amount of applications	combined with grass herbicides	combined with grass herbicides
Fungicides		
Amount of applications	_	_
Growth regulators		
Amount of applications	_	_
Insecticides		
Amount of applications	_	_
Trade name	_	_
Active ingredients	_	_
1. Application (l/ha, time)	_	_
Insects	_	_
Machinery	_	_
Harvest and postharvest activities		
Harvest		
Activities	1	1
Month	End Sep - mid Oct	End Sep - mid Oct
Machine	Combine	Combine
Transport		
Activities	2	2
Machine	Transportation with truck to farmgate Transportation with truck to trader	Transportation with truck to farmgate Transportation with truck to trader
Drying		
Share of harvest for drying (%)	0	0
Water content before drying (%)	14	14
Allowed water content (%) [2)]	13	13
Time of drying	airing in store	airing in store
Technology	airation fans	airation fans
Fuel	_	_
Storage / Marketing		
Type of storage	storage in bins	storage in bins
Share of stored crop (%)	100	100
Length of storage (days)	variable	variable
Delivery point	Enderlin / Fargo	Enderlin / Fargo
Distance	ca. 50-80 km	ca. 50-80 km

1) Standard moisture content that do not lead to discount and premium. Park_2003-07-15
Source: own data collection.

Table A3.5: Soybeans production system at the selected farms in Red River Valley - Part 1 -

	Red River Valley	
	Soybeans Conventional	**Soybeans Roundup Ready**
System		
Share (%)	70	30
Seasonality	Spring crop	Spring crop
Crop rotation	Soybeans-Wheat-Sugarbeets; Soybeans-Wheat-Soybeans Soybeans dominantly in three year rotation	Soybeans-Wheat-Sugarbeets; Soybeans-Wheat-Soybeans Soybeans dominantly in three year rotation
Soil cultivation	Conventional	Conventional
Harvest		
Amount/Year	1	1
Month	End Sep - End Oct	End Sep - End Oct
Yield (t per ha)	2.0	2.0
Protein content (%)	45.0	45.0
Oil content (%)	18.0	18.0
Soil preparation and seeding		
Soil preparation		
Month	Sep + Oct + Apr	Sep + Oct + Apr
Amount of operations	3	3
Activity / Machinery	harrow cultivator / land leveler	harrow cultivator / land leveler
Seeding / Planting		
Month	May	May
kg/ha	60-70	60-70
seed / m²	35	35
Inoculation (%)	_	_
Amount of operations	1	1
Activity / Machine	Airseeder	Airseeder
Fertilization		
N-fertilization		
Amount of applications	_	_
S-fertilization		
Amount of applications	_	_
P-fertilization		
Amount of applications	1	1
Type of fertilizer	Mono-ammonium phosphate	Mono-ammonium phosphate
Nutrient values (%)	11N / 52P / 0K	11N / 52P / 0K
Total nutrients (kg per ha)	39	39
Application (date, kg/ha)	39 (before seeding or in fall)	39 (before seeding or in fall)
Formula	Granule	Granule
Machinery	Airseeder	Airseeder
K-fertilization		
Amount of applications	_	_
Liming		
Amount of applications	_	_

Table A3.5: Soybeans production system at the selected farms in Red River Valley - Part 2 -

	Red River Valley	
	Soybeans Conventional	**Soybeans Roundup Ready**
Plant protection		
Grass herbicides		
Amount of applications	1.25	1.25
Trade name	Reptor, Roundup Ultra	Roundup Ultra + Sulfate ammonium
Active ingredients	Imazamox, Glyphosate	Glyphosate
1. Application (l/ha, time)	0.25 x 2.3 l Roundup Ultra (before seeding)	0.25 x 2.3 l Roundup Ultra (before seeding)
2. Application (l/ha, time)	0.3 l Reptor	2.3 l Roundup Ultra (after emegence)
3. Application (l/ha, time)	_	_
Machinery	Sprayer	Sprayer
Broadleaf herbicides		
Amount of applications	combined with grass herbicides	combined with grass herbicides
Fungicides		
Amount of applications	_	_
Growth regulators		
Amount of applications	_	_
Insecticides		
Amount of applications	_	_
Harvest and postharvest activities		
Harvest		
Activities	1	1
Month	End Sep - End Oct	End Sep - End Oct
Machine	Combine (50 % custom)	Combine (50 % custom)
Transport		
Activities	2	2
Machine	Transportation with truck to farmgate	LKW Transport zum Hof
	Transportation with truck to trader	LKW Transport zum Handel
Drying		
Share of harvest for drying (%)	0	0
Water content before drying (%)	14	14
Allowed water content (%) 2)	13	13
Time of drying	airing in store	airing in store
Technology	airation fans	airation fans
Fuel	_	_
Storage / Marketing		
Type of storage	storage in bins	storage in bins
Share of stored crop (%)	100	100
Length of storage (days)	variable	variable
Delivery point	Fargo / Dawson	Fargo / Dawson
Distance	ca. 50-70km	ca. 50-70 km

1) Standard moisture content that do not lead to discount and premium. Park_2003-07-15
Source: own data collection.

Table A3.6: Soybeans production system at the selected farms in South Central Minnesota - Part 1 -

	South Central Minnesota	
	Soybeans Conventional	**Soybeans Roundup Ready**
System		
Share (%)	40	60
Seasonality	Spring crop	Spring crop
Crop rotation	Soybeans-Corn	Soybeans-Corn
Soil cultivation	Conventional / Plow	Conventional / Plow
Harvest		
Amount/Year	1	1
Month	End Sep - End Oct	End Sep - End Oct
Yield (t per ha)	3.4	3.2
Protein content (%)	48.0	48.0
Oil content (%)	18.0	18.0
Soil preparation and seeding		
Soil preparation		
Month	Oct+April	Oct+April
Amount of operations	2.25	2.25
Activity / Machinery	Plow Cultivator	Plow Cultivator
Seeding / Planting		
Month	May	May
kg/ha	70-80	70-80
seed / m²	40	40
Inoculation (%)	_	_
Amount of operations	1	1
Activity / Machine	Planter	Planter
Fertilization		
N-fertilization		
Amount of applications	_	_
S-fertilization		
Amount of applications	_	_
P-fertilization		
Amount of applications	applied in preceding corn	applied in preceding corn
Type of fertilizer	Diammonium phosphate	Diammonium phosphate
Nutrient values (%)	18N / 46P / 0K	18N / 46P / 0K
Total nutrients (kg per ha)	19	19
Application (date, kg/ha)	applied in preceding corn	applied in preceding corn
Formula	Granule	Granule
Machinery	applied in preceding corn	applied in preceding corn
K-fertilization		
Amount of applications	applied in preceding corn	applied in preceding corn
Type of fertilizer	KCl	KCl
Nutrient values (%)	0N / 0P / 60K	0N / 0P / 60K
Total nutrients (kg per ha)	17	17
Application (date, kg/ha)	applied in preceding corn	applied in preceding corn
Formula	Granule	Granule
Machinery	applied in preceding corn	applied in preceding corn
Liming		
Amount of applications	on 10 % of area	on 10 % of area
Type of fertilizer	Dolomit	Dolomit
t/ha	5-7t	5-7t
Machinery	custom	custom

Table A3.6: Soybeans production system at the selected farms in South Central Minnesota - Part 2 -

	South Central Minnesota	
	Soybeans Conventional	**Soybeans Roundup Ready**
Plant protection		
Grass herbicides		
Amount of applications	2	1
Trade name	Command + Pursuit DG	Roundup Ultra + Sulfate ammonium
Active ingredients	Clomazone + Imazethapyr	Glyphosate
1. Application (l/ha, time)	2.3 l Command (before seeding)	2.3 l Roundup Ultra (after emergence)
2. Application (l/ha, time)	50 g Pursuit DG Nachauflauf	
3. Application (l/ha, time)	–	–
Machinery	Sprayer	Sprayer
Broadleaf herbicides		
Amount of applications	combined with grass herbicides	combined with grass herbicides
Fungicides		
Amount of applications	–	–
Growth regulators		
Amount of applications	–	–
Insecticides		
Amount of applications	–	–
Hacker		
Month	June - July	June - July
Amount of field activities	1.5	0.5
Machinery	Hacker	Hacker
Harvest and postharvest activities		
Harvest		
Activities	1	1
Month	End Sep - End Oct	End Sep - End Oct
Machine	Combine (50 % custom)	Combine
Transport		
Activities	2	2
Machine	Transportation with truck to farmgate Transportation with truck to trader	Transportation with truck to farmgate Transportation with truck to trader
Drying		
Share of harvest for drying (%)	0	0
Water content before drying (%)	14	14
Allowed water content (%) 2)	13	13
Time of drying	airing in store	airing in store
Technology	airation fans	airation fans
Fuel	–	–
Storage / Marketing		
Type of storage	storage in bins	storage in bins
Share of stored crop (%)	100	100
Length of storage (days)	variable	variable
Delivery point	Mancato	Mancato
Distance	ca. 40 km	ca. 40 km

1) Standard moisture content that do not lead to discount and premium. Park_2003-07-16
Source: own data collection.

Table A3.7: Share of Round Up-resistant soybeans in the total soybean area by the U.S. states, 2000

State	share of Roundup resistant varieties %
Arkansas	43
Illinois	44
Indiana	63
Iowa	59
Kansas	66
Michigan	50
Minnesota	46
Missouri	48
Nebraska	72
North Dakota	22
Ohio	48
South Dakota	68
Wisconsin	51
Sonstige	54
USA	54

Source: USDA-NASS (2000). Park_2003-07-16

Table A3.8: Agricultural budget of the USDA for years 1999 to 2001, million US-$

Agency / Program	Program level				Outlays			
	1999	2000 Current Estimate	2001 Budget	Change 2000 /2001	1999	2000 Current Estimate	2001 Budget	Change 2000 /2001
Farm Service Agency (FSA):								
Farm loan and grant programs	3,941	5,842	4,562	-1,280	225	985	217	-768
Conservation Reserve Programm (CRP)	1,462	1,610	1,742	132	1,514	1,631	1,742	111
Conservation and Other Programs	30	50		-50	58	82	51	-31
Commodity programs	24,767	33,330	24,725	-8,605	16,923	24,615	15,258	-9,357
Salaries and expenses	1,009	1,062	1,095	33	978	996	1,090	94
Total (FSA)	**31,209**	**41,894**	**32,124**	**-9,770**	**19,698**	**28,309**	**18,358**	**-9,951**
Risk Management Agency (RMA):								
Administrative and operating expenses	64	64	68	4	54	64	67	3
Crop insurance fund	1,913	2,104	2,169	65	1,677	1,936	2,529	593
Total (RMA)	**1,977**	**2,168**	**2,237**	**69**	**1,731**	**2,000**	**2,596**	**596**
Foreign Agricultural Service (FAS):								
Export credit guarantees	3,045	3,787	3,792	5	148	45	317	272
Market Development Programs	118	120	120		142	162	126	-36
Export subsidies programs	146	698	544	-154	128	711	569	-142
Food aid (P.L.480)	2,337	1,435	1,135	-300	1,668	2,212	1,294	-918
Salaries and expenses	178	169	172	3	122	129	137	8
Total (FAS)	**5,824**	**6,209**	**5,763**	**-446**	**2,208**	**3,259**	**2,443**	**-816**
Rural development	**10,414**	**11,706**	**12,984**	**1,278**	**2,474**	**2,287**	**2,344**	**57**
Food, nutrition, and consumer services	**33,847**	**34,472**	**36,507**	**2,035**	**33,047**	**34,064**	**36,076**	**2,012**
Food safety	**713**	**751**	**771**	**20**	**604**	**653**	**158**	**-495**
Natural resources and environment:								
Natural resources conservation service	**1,197**	**1,213**	**2,202**	**989**	**1,246**	**1,402**	**2,050**	**648**
Forest service	**3,491**	**3,486**	**3,853**	**367**	**3,425**	**3,357**	**3,617**	**260**
Marketing and regulatory programs	**962**	**955**	**991**	**36**	**818**	**848**	**833**	**-15**
Research, education and economics:								
Agricultural research service	870	906	956	50	847	912	969	57
Cooperative state research, education and ext. Serv.	928	1,074	1,096	22	880	957	1,002	45
Economic Research Service (ERS)	63	65	55	-10	58	56	56	
National Agricultural Statistics Service (NASS)	104	99	101	2	105	100	101	1
Total (Research, education and economics)	**1,965**	**2,144**	**2,208**	**64**	**1,890**	**2,025**	**2,128**	**103**
Other activities	**411**	**421**	**574**	**153**	**358**	**441**	**563**	**122**
Total USDA	**92,010**	**105,419**	**100,214**	**-5,205**	**62,834**	**71,096**	**64,953**	**-6,143**

Budget year is from october previous year to september displaye year. Park_2003-07-16

Source: USDA (2000).

Table A3.9: National loan rates and Production Contract Payments of selected crops in the USA

	Loan Rate	Flexibility Contract Payments	Contracted area	Contract payment yields
Wheat	**$/bu**	**$/bu**	**million acres[1)]**	**bu/acre[2)]**
1995/96	2.58	-	-	-
1996/97	2.58	0.874	76.7	34.70
1997/98	2.58	0.631	76.7	34.70
1998/99	2.58	0.663	78.9	34.50
1999/2000	2.58	0.637	79.0	34.50
Corn	**$/bu**	**$/bu**	**million acres**	**bu/acre**
1995/96	1.89	-	-	-
1996/97	1.89	0.251	80.7	102.90
1997/98	1.89	0.486	80.9	102.80
1998/99	1.89	0.377	82.0	102.60
1999/2000	1.89	0.363	81.9	102.60
Sunflower	**$/cwt**	**$/cwt**	**million acres**	**cwt/acre[3)]**
1995/96	8.70	-	-	-
1996/97	8.91	-	-	-
1997/98	9.30	-	-	-
1998/99	9.30	-	-	-
1999/2000	9.30	-	-	-
Soybeans	**$/bu**	**$/bu**	**million acres**	**bu/acre**
1995/96	4.92	-	-	-
1996/97	4.97	-	-	-
1997/98	5.26	-	-	-
1998/99	5.26	-	-	-
1999/2000	5.26	-	-	-

1) 1 acre = 0.4047 hektare. Park_2003-07-16
2) 1 Bushel (bu) wheat, soybeans = 27.2155 kg; 1 Bushel corn= 25.401 kg.
3) 1 cwt = 45.36 kg
Source: USDA-ERS; Agricultural Outlook (August 2000).

Table A3.10: National paid Loan Deficiency Payments, Marketing Loans and realized Marketing Loan Gains, 1999 (at 24.01.2001)

		Loan Deficiency Payments			Loan activities				
Crop	**Yield unit**	**Total amount (1000)**	**Total payment (1000) US$**	**Average payment US-$ per yield unit**	**Loan (1000)**	**Payback (1000) US$**	**Market Gain Amount (1000)**	**Market Gain (1000) US$**	**Market Gain US$ per yield unit**
Soybeans	bu[1)]	2,319,079	2,107,130	0.91	284,235	274,012	272,024	218,640	0.80
Corn	bu	7,269,233	1,993,014	0.27	1,377,807	1,383,003	1,266,416	412,338	0.33
Wheat	bu	1,911,093	889,843	0.47	141,302	122,847	115,133	47,564	0.41
Sunflower for oil	cwt[2)]	30,828	109,391	3.55	1,988	1,794	1,784	6,543	3.67
Sunflower, other	cwt	3,750	10,231	2.73	404	365	67	207	3.09
Barley	bu	204,466	37,170	0.18	13,007	12,011	8,615	1,235	0.14
Canola	cwt	13,033	34,254	2.63	206	176	166	510	3.07
Other			1,033,337					1,104,200	
Total payment			**6,214,369**					**1,791,237**	

1)1 bu (= 1 Bushel) soybeans, wheat = 27.22 kg, 1 bu corn = 25.40 kg, 1 bu barley = 21.77 kg
2)1 cwt (= 1 Hundredweight) = 45.36 kg
Source: Price Support Division of USDA-FSA (2001). Park_2003-07-16

Table A3.11: AMS-estimation for soybeans and sunflower of the harvest 1999

		Soybeans	Sunflower
Value of production	**millions US-$**	**12,451**	**353.5**
LDPs	millions US-$	2,107	119.6
LDPs per yield unit	US-$/bu,cwt	0.91	3.46
Loan Gains	millions US-$	218.45	6.75
Loan Gains per yield unit	US-$/bu,cwt	0.80	3.51
Loan-Payback	*millions US-$*	*54.96*	*0.98*
Commodity Loan - Interest subsidies	millions US-$	33.49	0.58
Estimated AMS [1)]	**millions US-$**	**2,304.10**	**125.98**
De Minimis 5 % [2)]	**millions US-$**	**622.56**	**17.67**

1) AMS = (LDPs + Loan Gains + Interest subsidies) - Loan Payback. Park_2003-07-16
2) 5 % of value of production.
Source: FSA, NASS: LDP and Price Support Cumulative Activity as of January 02, 2001; own calculations.

Table A3.12: US crop insurance: subsidy levels and administration fees

Coverage Level	Share of premium subsidy [1]		Share of premium subsidy of	Management fee	
	before 2001	2001	GRP/GRIP [2]	before 2001	2001
CAT [3]	100 %	100 %	100 %	US-$60	US-$100
50/100	55 %	67 %	-	US-$20	US-$30
55/100	46 %	64 %	-	US-$20	US-$30
60/100	38 %	64 %	-	US-$20	US-$30
65/100	42 %	59 %	-	US-$20	US-$30
70/100	32 %	59 %	64 %	US-$20	US-$30
75/100	24 %	55 %	64 %	US-$20	US-$30
80/100 [4]	17 %	48 %	59 %	US-$20	US-$30
85/100 [4]	13 %	38 %	59 %	US-$20	US-$30
90/100 [4]	-	-	55 %	US-$20	US-$30

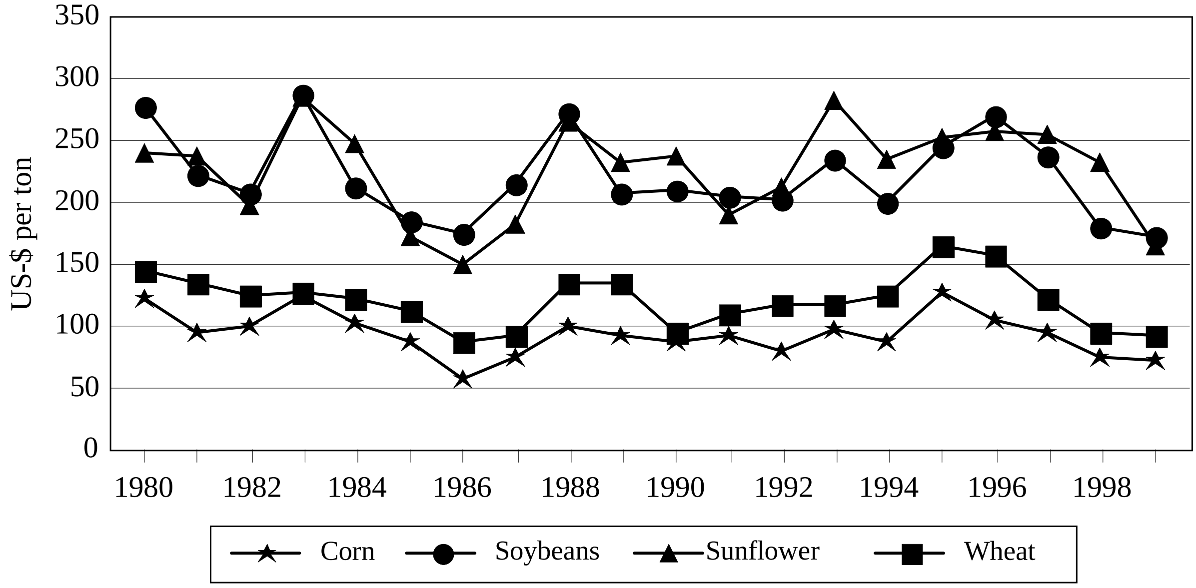
1) valid for insurance programs except GRP and GRIP. Park_2003-07-16
2) GRP = Group Risk Plan; GRIP = Group Risk Income Protection.
3) CAT = Catatstrophic Coverage Level. 4) limited to some reginos.
Source: USDA-RMA (2001).

Table A3.13: U.S. soybean grade determinants

Grade	Minimum test weight bu (lbs) [1]	Maximum limits of damaged kernels (%) [2]		Foreign material (%)	Splits (%)	Soybeans of other colors (%)
		Heat	Total			
U.S. No. 1	56	0.2	2.0	1.0	10.0	1.0
U.S. No. 2	54	0.5	3.0	2.0	20.0	2.0
U.S. No. 3	52	1.0	5.0	3.0	30.0	5.0
U.S. No. 4	49	3.0	8.0	5.0	40.0	10.0

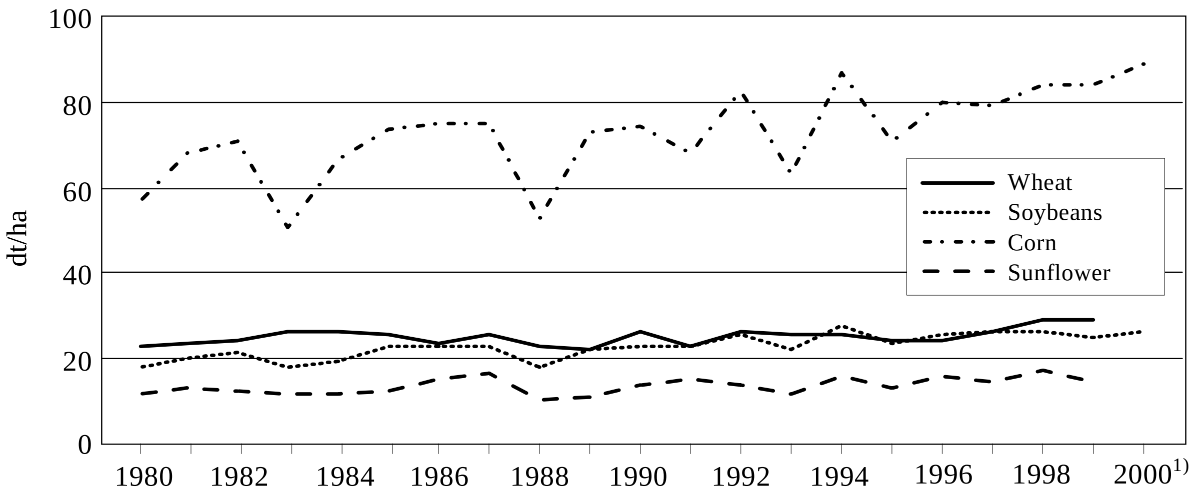
1) lbs = Pounds, 1 lb = 0.4536 kg; bu = Winchester Bushel = 2150.42 cubic inches, 1 inch = 2.54 cm Park_2003-07-16
2) as a share of net weight sample (cleaned).
U.S. Sample grade is soybeans that:
a) Do not meet the requirements for the grades U.S. Nos. 1,2,3,4 or
b) contain 4 or more stones which have an aggregate weight in excess of 0.1 percent of the sample weight, 1 or more pieces of glass, 3 or more crotalaria seed, 2 or more castor beans, 4 or more particles of an unknown foreign substances or a commonly recognized harmful or toxic foreign substances, 10 or more rodent pellets, bird droppings, or an equivalent quantity of other animal filth in a 1,000 grams of soybeans; or
c) Contain 11 or more animal filth, castor beans, crotalaria seeds, glass, stones, or unkown foreign substance(s) in any combination; or
d) Have a musty, sour, or commercially objectionable foreign oder (except garlic oder) or
e) Are heating or otherwise of distinctly low quality.
Source: USDA/Grain Inspection, Packers and Stockyards Administration (1999).

Figure A3.1: Nominal prices (US-$ per ton) for soybeans, corn, wheat and sunflower in the USA, 1980 to 1999



Source: NASS/USDA, On-line Database, 2000. Park_2003-07-18

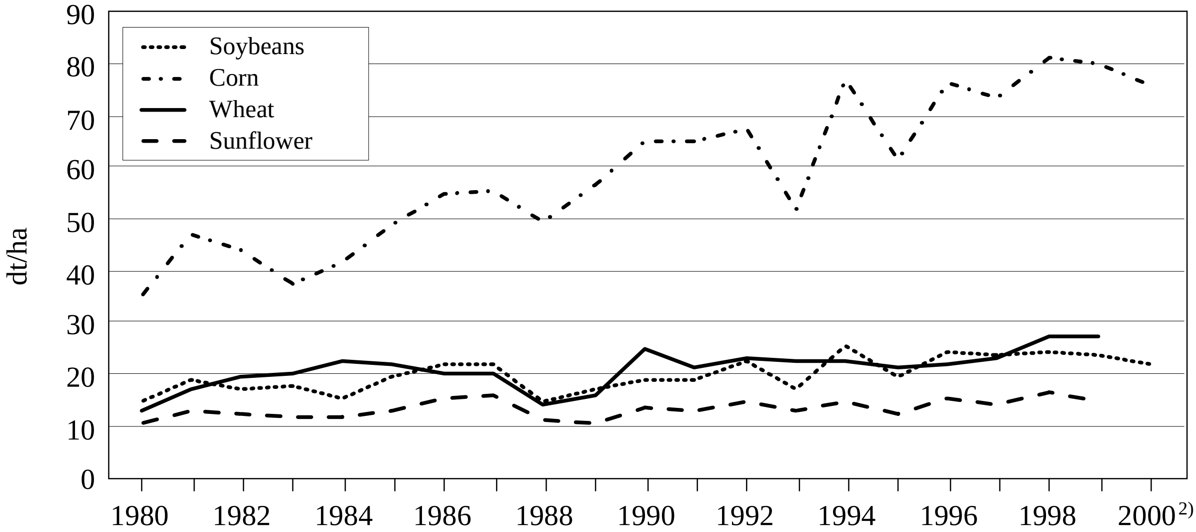
Figure A3.2: Yields of major crops in the USA, dt per ha, 1980 to 2000



	Wheat	Soybeans	Corn	Sunflower
1999	28,70	24,53	83,98	14,03
Ø 1980 to 1999/00	25,02	22,71	72,75	13,48
Min.[2)]	21,98	17,61	50,90	10,37
Max.[3)]	29,04	27,83	89,00	16,79

1) Estimation.2) Minimum yield in observed period. Park_2003-07-18
3) Maximum yield in observed period.
Source: USDA-NASS On-Line Database (http://www.usda.gov/nass).

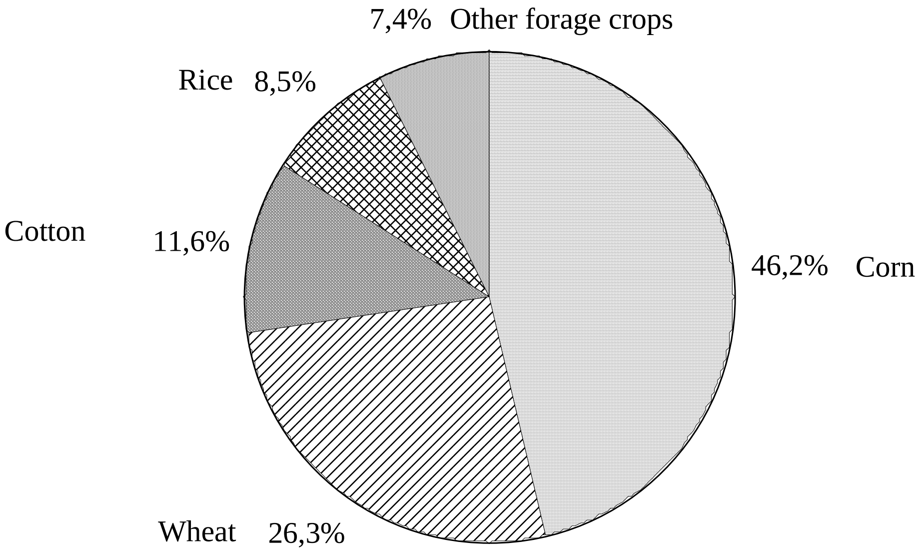
Figure A3.3: Yields of major crops in the Northern Plains, dt per ha, 1980 to 2000



	Soybeans	Corn	Wheat	Sunflower
1999	23,79	80,02	27,37	14,68
Ø 1980 to 1999/2000	20,02	59,43	20,98	13,23
Max. 3)	25,39	81,59	27,51	16,31
Min. 4)	14,57	34,83	12,74	10,54

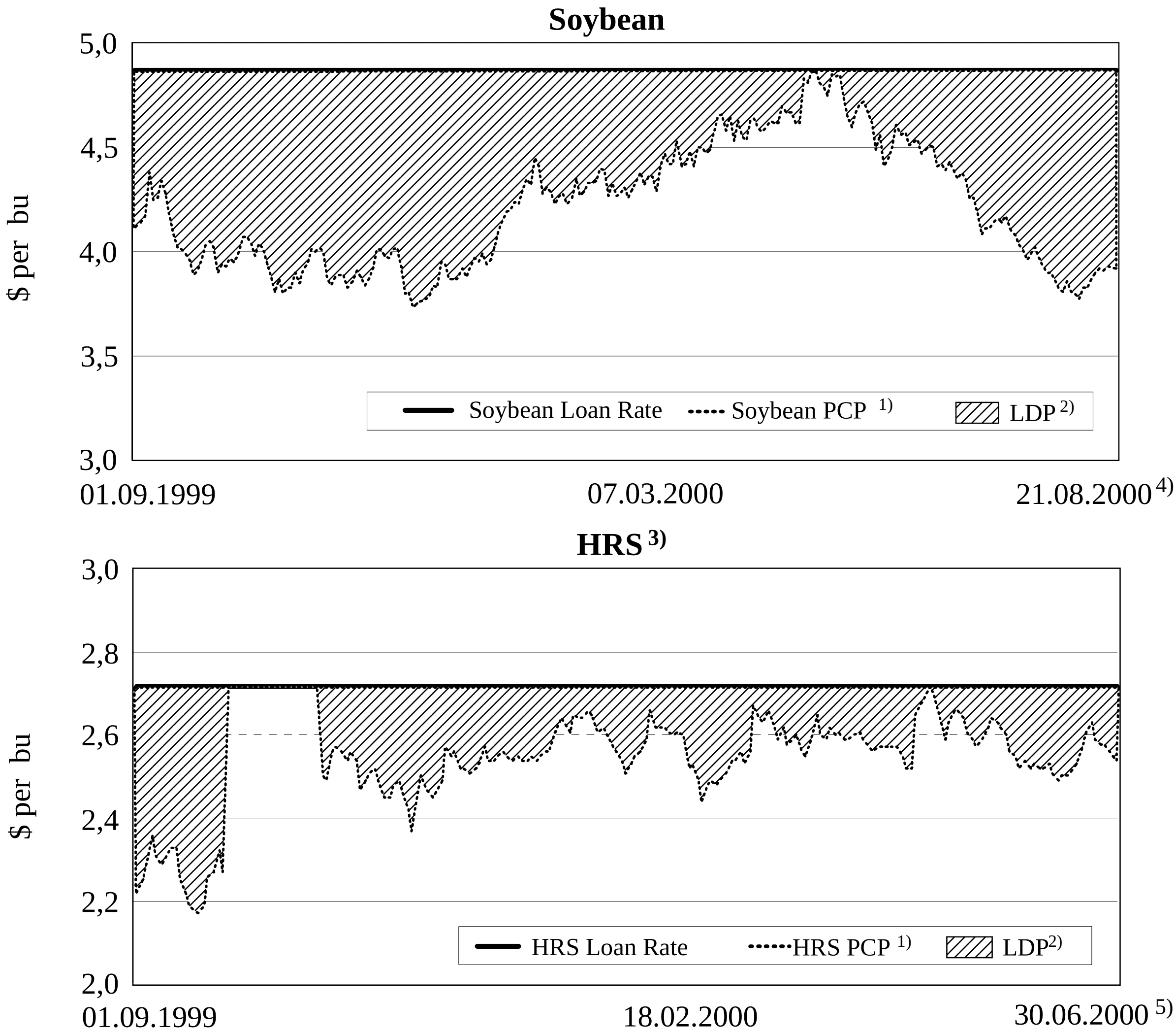
1) Northern Plains: Kansas, Nebraska, North Dakota und South Dakota. Park_2003-07-18
2) Estimation. 3) Maximum yield in obserbed period.
4) Minimum yield in obserbed period
Source: NASS-USDA On-Line Database (2000); own calculations.

Figure A3.4: Share of contract crops in the Production Flexibility Contract Payments, %



Source: ERS, USDA (2000). Park_2003-07-18

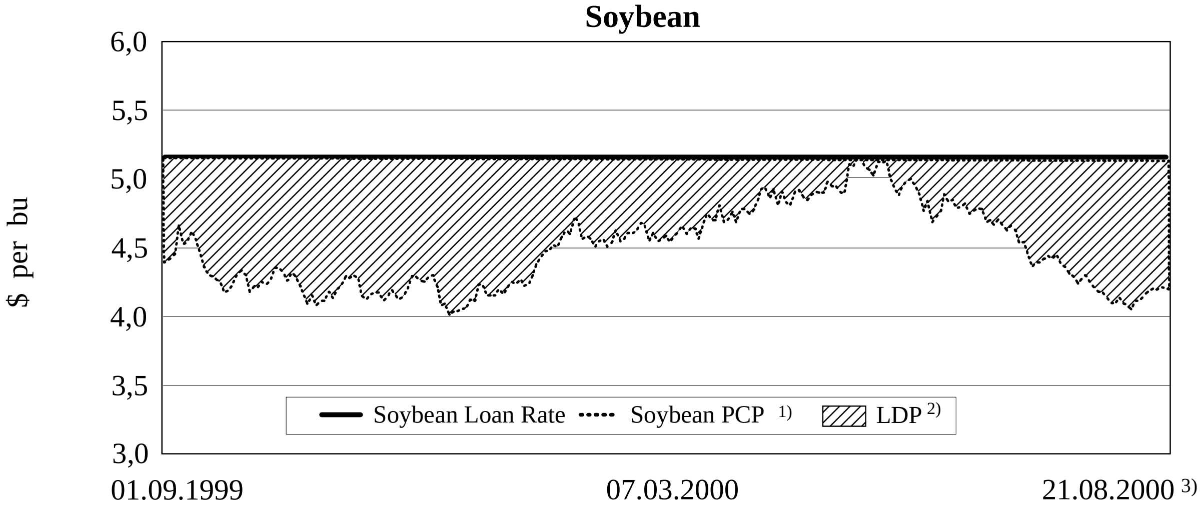
Figure A3.5: Loan rates, PCPs and LDPs for soybeans and HRS for markting year 1999/00 in South Central North Dakota

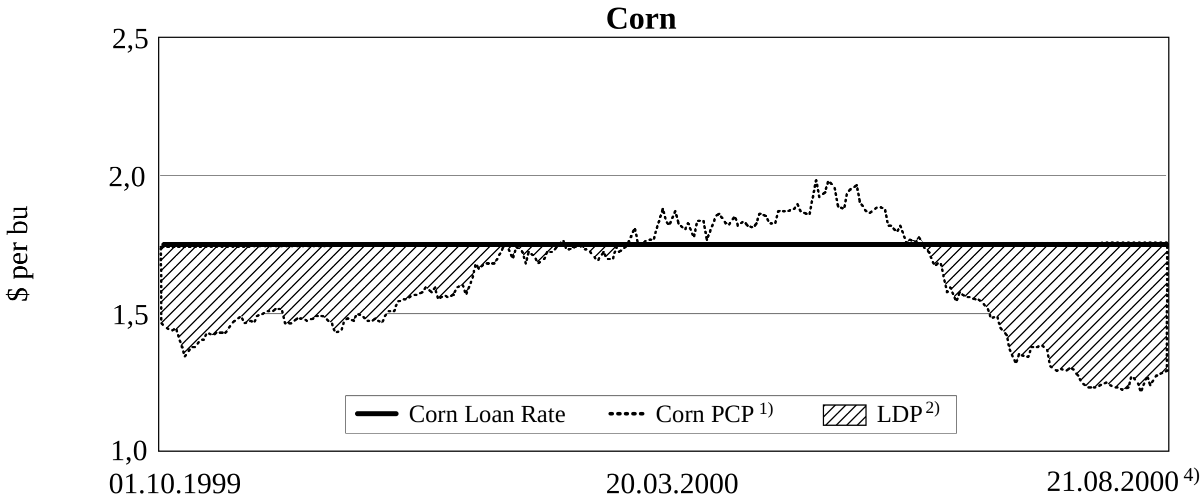


	Ø Marketing year 1999 / 2000	Min.	Max.
Soybean Loan Rate	4,87	-	-
Soybean PCP	4,21	3,73	4,87
Soybean LDP	0,66	0,00	1,14
HRS Loan Rate	2,72	-	-
HRS PCP	2,53	2,13	2,72
HRS LDP	0,21	0,00	0,59

1) PCP = Posted County Price. 2) LDP = Loan Rate - PCP. Park_2003-07-18
3) HRS = Hard Red Spring Wheat. 4) Marketing year: September to August.
5) Marketing year: July to June.
Source: CARD, Iowa State University; own calculations

Figure A3.6: Loan rates, PCPs and LDPs for soybeans and corn for markting year 1999/00 in South Central Minnesota

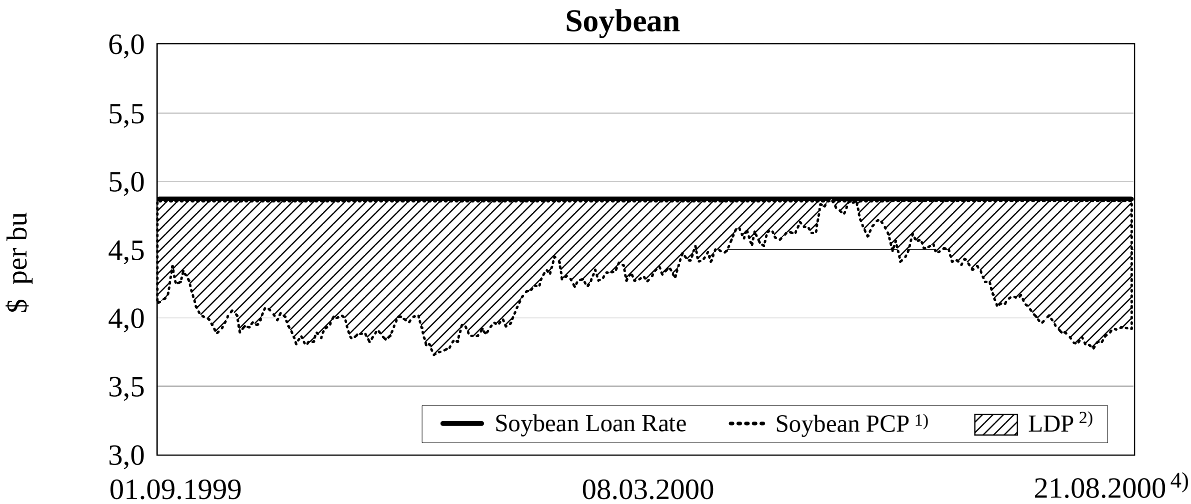


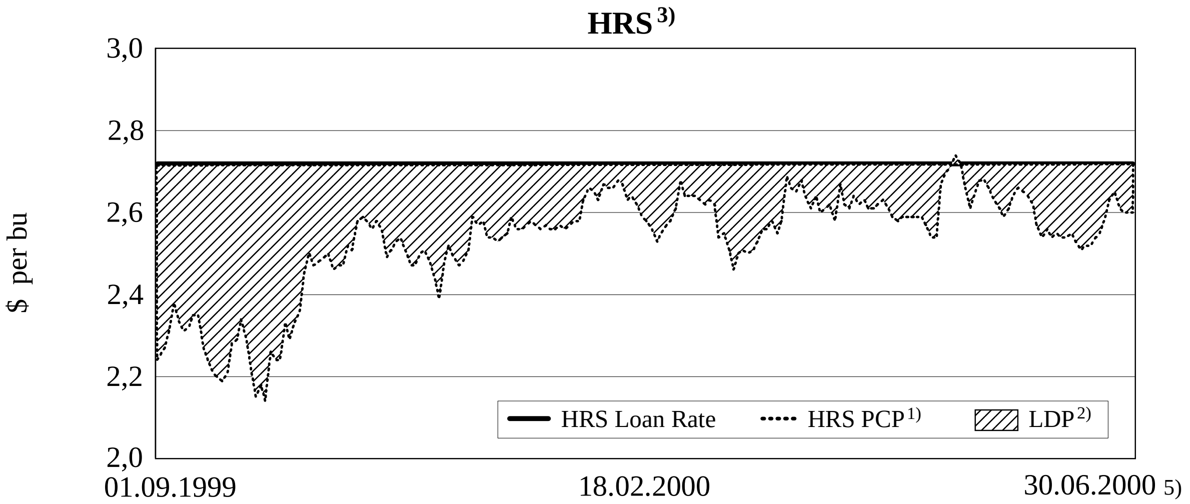


	Ø Marketing year 1999 / 2000	Min.	Max.
Soybean Loan Rate	5,15	-	-
Soybean PCP	4,51	4,01	5,15
Soybean LDP	0,64	0,00	1,14
Corn Loan Rate	1,75	-	-
Corn PCP	1,60	1,21	1,98
Corn LDP	0,15	0,00	0,54

1) PCP = Posted County Price. 2) LDP = Loan Rate - PCP. 3) Marketing year: September to August. Park_2003-07-18
4) Marketing year: October to September.
Source: CARD, Iowa State University; own calculations.

Figure A3.7: Loan rates, PCPs and LDPs for soybeans and HRS for markting year 1999/00 in Red River Valley

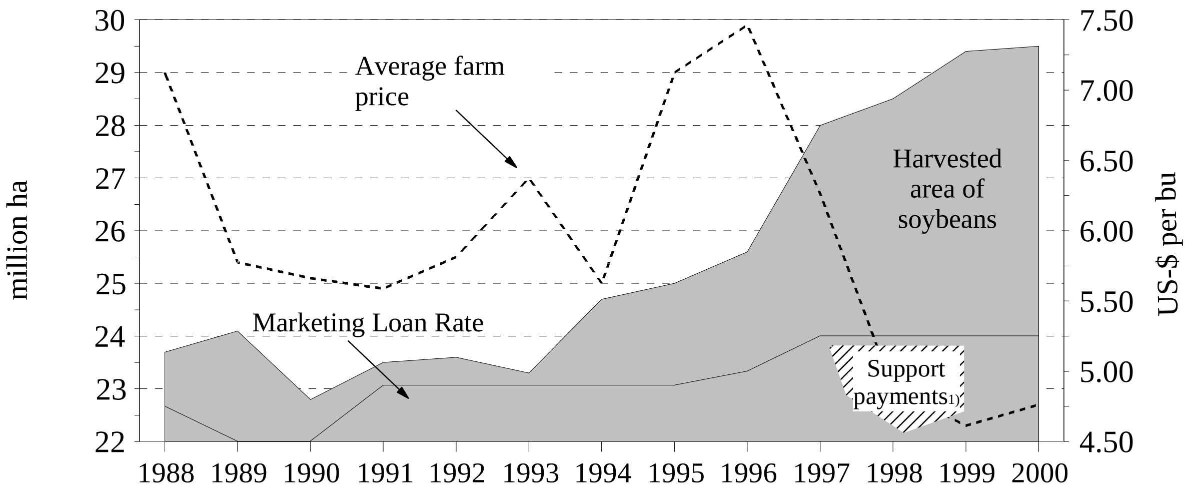




	Ø Marketing year 1999 / 2000	Min.	Max.
Soybean Loan Rate	4,92	-	-
Soybean PCP	4,25	3,78	4,92
Soybean LDP	0,67	0,00	1,14
HRS Loan Rate	2,72	-	-
HRS PCP	2,51	2,14	2,74
HRS LDP	0,21	0,02	0,58

1) PCP = Posted County Price. 2) LDP = Loan Rate - PCP. Park_2003-07-18
3) HRS = Hard Red Spring Wheat. 4) Marketing year: September to August.
5) Marketing year: July to June.
Quelle: CARD, Iowa State University; eigene Berechnungen.

Figure A3.8: Harvested area, prices and marketing loan rates for soybeans in the USA, 1988 to 2000



1) Loan Dificiency Payments und Marketing Loan Gains for soybeans.
Source: USDA, Agriculture and Agri-Food Canada, 2000.

Park_2003-07-18

Map A3.1: Agricultural production regions of the USA

Appalachian	
Kentucky	Virginia
North Carolina	West Virginia
Tennessee	

Mountain	
Arizona	Nevada
Colorado	New Mexico
Idaho	Utah
Montana	Wyoming

Northern Plains	
Kansas	North Dakota
Nebraska	South Dakota

Corn Belt	
Illinois	Missouri
Indiana	Ohio
Iowa	

Northeast	
Connecticut	New Jersey
Delaware	New York
Maine	Pennsylvania
Maryland	Rhode Island
Massachusetts	Vermont
New Hampshire	

Pacific	
California	Washington
Oregon	

Delta States	
Arkansas	Louisiana
Mississippi	

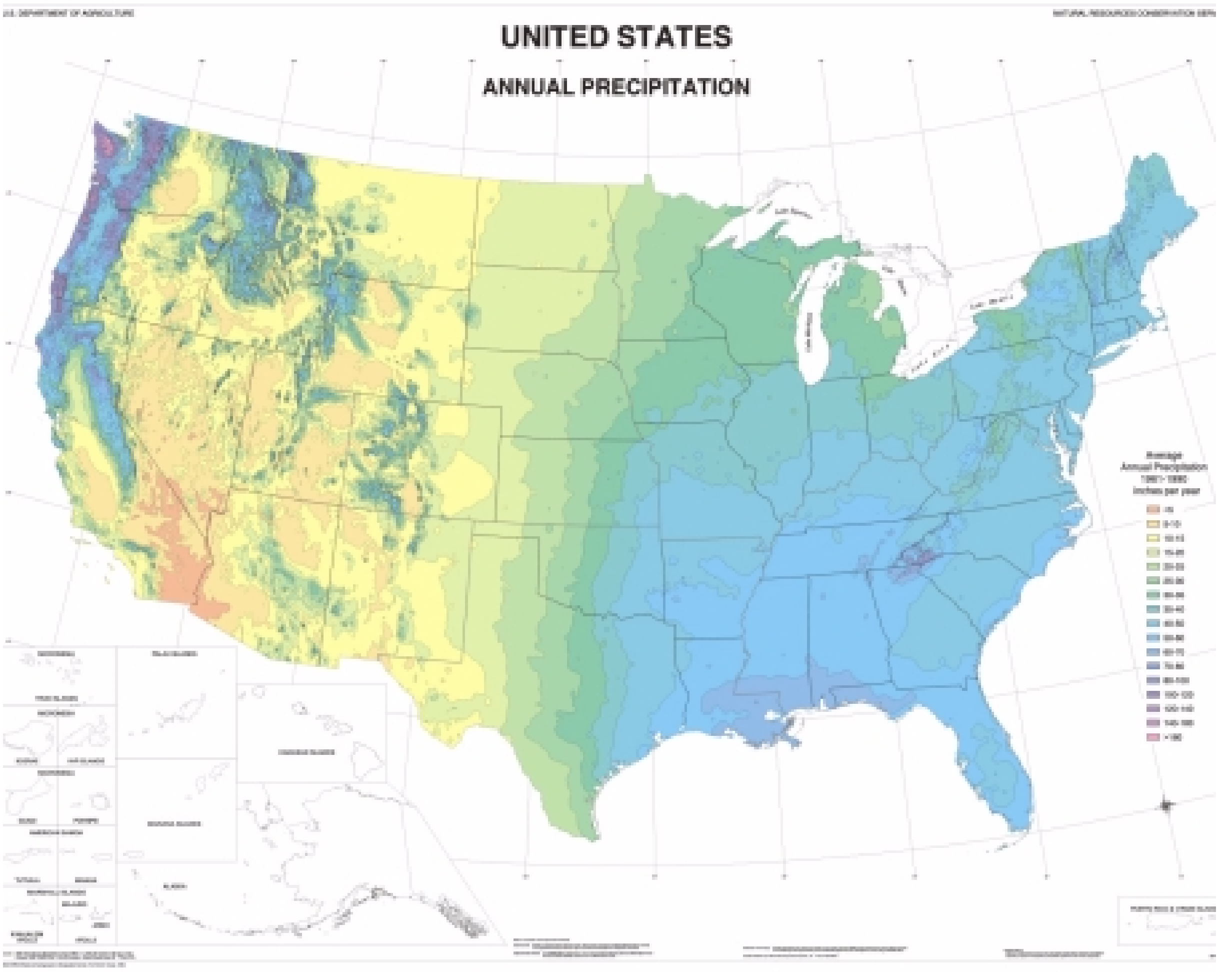
Southeast	
Alabama	Georgia
Florida	South Carolina

Lake States	
Michigan	Wisconsin
Minnesota	

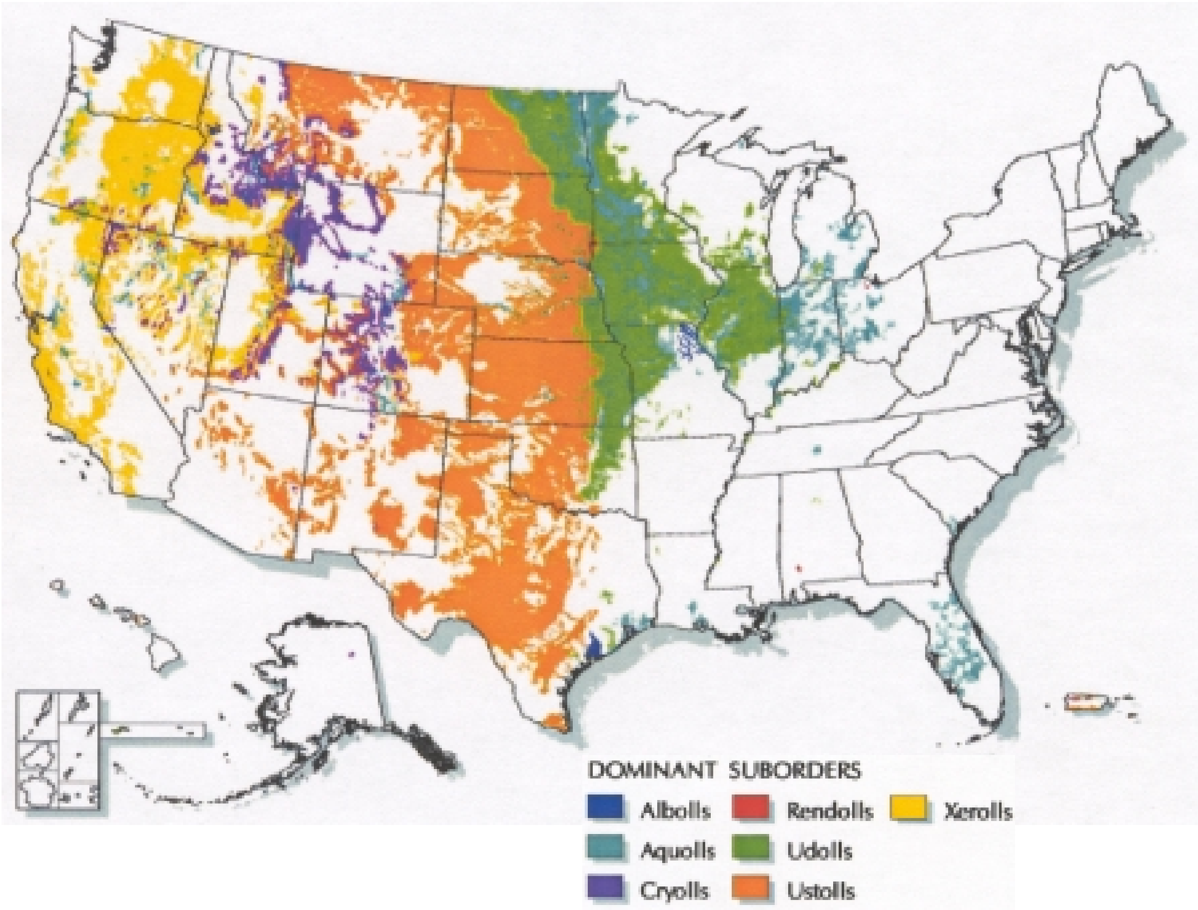
Southern Plains	
Oklahoma	
Texas	

Source: NASS, USDA.

Map A3.2: Average annual rainfall in the USA, 1961 to 1999

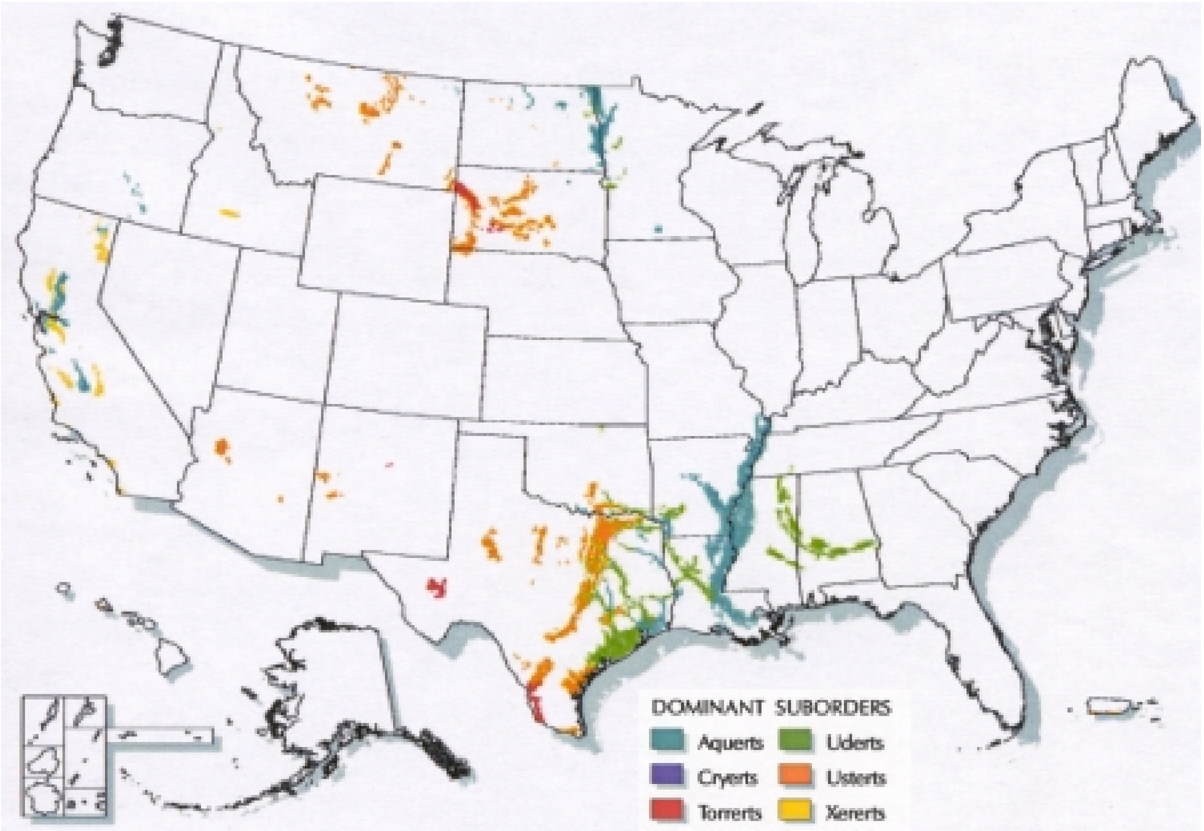


Map A3.3: Mollisols in the USA



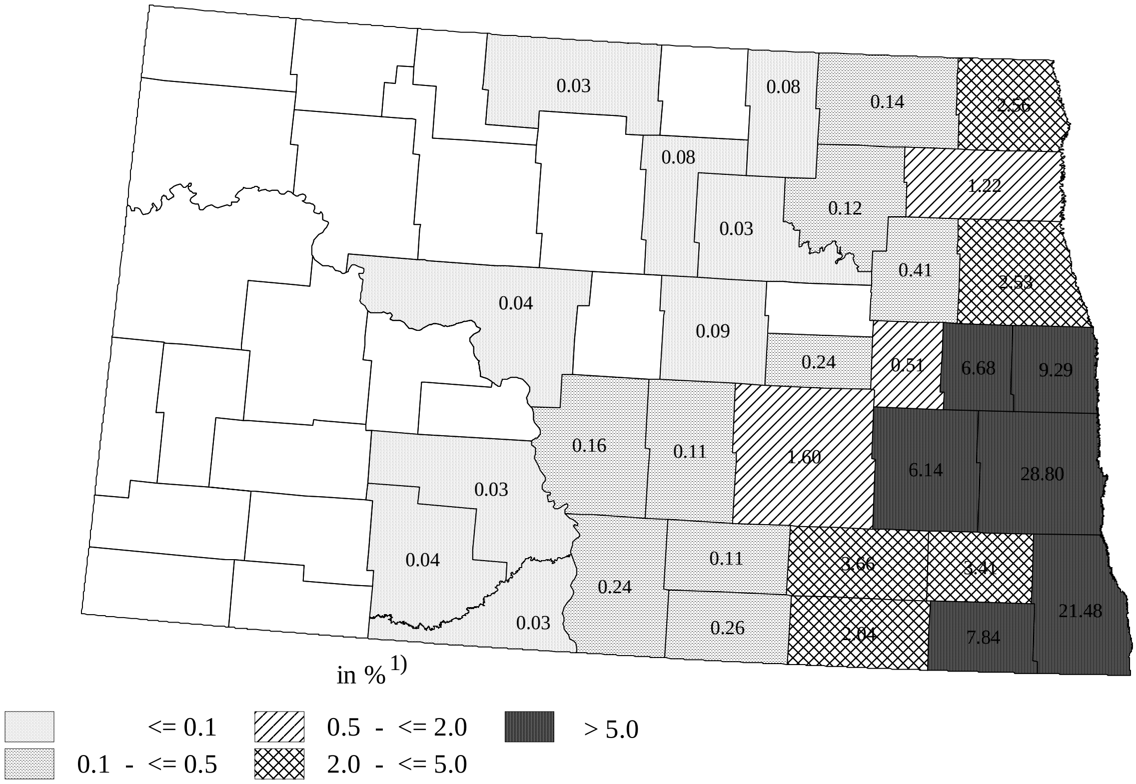
Source: Natural Resources Conservation Service (NRCS), USDA.

Map A3.4: Vertisols in the USA



Source: Natural Resources Conservation Service (NRCS), USDA.

Map A3.5: Regional distribution of soybean production in North Dakota, 1999



1) As a share of the state soybean production.
Source: USDA-NASS On Line Database (http://www.usda.gov/nass).

Park_2003-07-14

Part 4

Germany

Table A4.1: Rapeseed production system at the selected farms in Germany - Part 1 -

	Central Mecklenburg-Vorpommern Winter rapeseed	Magedeburger Börde Winter rapeseed
System		
Share (%)	100	100
Seasonality	Winter crop	Winterfrucht
Crop rotation	Rapesee-Wheat-Barley Rapeseed dominantly in three year rotation	Rapeseed-Wheat-Wheat / Rye-(Barley) Rapeseed dominantly in three year rotation
Soil cultivation	Conventional with Plow	Conventional with Plow
Harvest		
Amount/Year	1	1
Months	End July - begin August	End July - begin August
Yield (t per ha)	4.0	3.9
Oil content (%)	42.0	42.0
Protein content (%)	21.0	21.0
Soil preparation and seeding		
Soil preparation		
Month	July - August	July - August
Amount of operations	4	4
Activity / Machinery	harrow, cultivator, plower, fine cultivator	cultivator (1 to 2 times) plower, roller (after planting)
Seeding / Planting		
Month	begin August	mid August
kg/ha	2.5 - 3.5	2.5 - 3.5
seed / m²	50 - 60	55 - 65
Inoculation (%)	Oftanol (110 g/kg Thiram + 400 g/kg Isofenphos)	Oftanol (110 g/kg Thiram + 400 g/kg Isofenphos)
Amount of operations	1	2
Activity / Machine	planter	planter
Fertilization		
N-fertilization		
Amount of applications	3	3
Type of fertilizer	Urea, SSA	AHL, SSA
Nutrient values (%)	46%N, 21%N + 24%S	28%N, 21%N + 24%S
Total nutrients (kg per ha)	250	200
1. Fall application (date, kg/ha)	Sep - Oct	_
2. Application (date, kg/ha)	Feb	Feb
3. Application (date, kg/ha)	Apr	Mar
4. Application (date, kg/ha)		Apr
S-fertilization		
Amount of applications	1 (SSA with N-fertilization in Apr)	1 (SSA with N-fertilization in Apr)
P-fertilization		
Amount of applications	1	1
Type of fertilizer	Mono-ammonium phosphate	Mono-ammonium phosphate
Nutrient values (%)	11N / 52P / 0K	11N / 52P / 0K
Total nutrients (kg per ha)	70	55
Application (date, kg/ha)	Aug	Aug
Formula	Granule	Granule
Machinery	Spreader	Spreader
K-fertilization		
Amount of applications	1	1
Type of fertilizer	P+Mg fertilizer	P+Mg fertilizer
Nutrient values (%)	40% K2O + 6%MgO + 4%S	40% K2O + 6%MgO + 4%S
Total nutrients (kg per ha)	70	120
Application (date, kg/ha)	Aug (before furrow)	Aug (before furrow)
Formula	Granule	Granule
Fertilization		
Liming		
Amount of applications	1	1
Type of fertilizer	Dolomite	Carbonation Lime
Nutrient values (%)	48% CaO + 4% MgO	27% CaO
Total nutrients (kg per ha)	500	200
Application (date, kg/ha)	Aug (before furrow)	Aug (before furrow)
Formula	Powder	Powder
Machinery	Spreader	Spreader

Table A4.1: Rapeseed production system at the selected farms in Germany - Part 2 -

	Central Mecklenburg-Vorpommern Winter rapeseed	Magedeburger Börde Winter rapeseed
Plant protection and weed management		
Grass herbicides		
Amount of applications	1	2
Trade name	Agil / Fusilade / Galant Super / Targa Super	Agil / Fusilade / Galant Super / Targa Super
Active ingredients	Propaquizafop (100g/l) / Fluazifop (125 g/l) / Haloxyfop (108 g/l) / Quizalofop (46.3 g/l)	Propaquizafop (100g/l) / Fluazifop (125 g/l) / Haloxyfop (108 g/l) / Quizalofop (46.3 g/l)
Application (l/ha, time)	0.4 - 0.8 l/ha + oil 1 l/ha Sep	0.4 - 0.8 l/ha + oil 1 l/ha Sep
Machinery	Sprayer	Sprayer
Broadleaf herbicides		
Amount of applications	1	2
Trade name	Butisan Top	Butisan Top
Active ingredients	Metazachlor (375 g/l) + Quinmerac (125 g/l)	Metazachlor (375 g/l) + Quinmerac (125 g/l)
Application (l/ha, time)	1.5 - 2 l/ha Aug - Sep	1.5 - 2 l/ha Aug - Sep
Machinery	Sprayer	Sprayer
Fungicides and growth regulators		
Amount of applications	3	3
Trade name	Folicur / Caramba / CCC 720	Folicur / Caramba
Active ingredients	Tebuconazol (250 g/l) / Metconazol (60g/l) / Chlormequat Chlorid (720 g/l)	Tebuconazol (250 g/l) / Metconazol (60g/l)
1. Application (l/ha, time)	0.5 l/ha Sep - Oct	0.5 l/ha Sep - Oct
2. Application (l/ha, time)	0.4 l/ha + 1.75 l/ha CCC720 Mar - Apr	0.4 l/ha März - Apr
3. Application (l/ha, time)	0.5 l/ha Apr - May (Sclerotinia, Verticillium)	0.5 l/ha Apr - May (Sclerotinia, Verticillium)
Machinery	Sprayer	Sprayer
Insecticides		
Amount of applications	2 - 3 (combinded with fungicide application)	3 - 3 (combinded with fungicide application)
Trade name	Fastac SC	Fastac SC
Active ingredients	Alpha-Cypermethrin (100 g/l)	Alpha-Cypermethrin (100 g/l)
1. Application (l/ha, time)	0.1 l/ha Sep - Oct (rape flea)	0.1 l/ha Sep - Oct (rape flea)
2. Application (l/ha, time)	0.1 l/ha Mar - Apr (rape stem and cabbage weed weevil)	0.1 l/ha Mar - Apr (rape stem and cabbage weed weevil)
3. Application (l/ha, time)	0.1 l/ha Apr - May (cabbage weed weevil and blossom rape beetle)	0.1 l/ha Apr - May (cabbage weed weevil and blossom rape beetle)
Machinery	Sprayer	Sprayer
Harvest and postharvest activities		
Harvest		
Activities	1	1
Month	End July - begin August	End Sep - mid Oct
Machinery	Combine	Combine
Transport		
Activities	2	2
Machinery	Transportation with truck to farmgate Transportation with truck to trader	Transportation with truck to farmgate Transportation with truck to trader
Drying		
Share of harvest for drying (%)	50	10
Water content before drying (%)	15	12
Allowed water content (%) 2)	9	9
Technology	Continuous dryer	Heat blower, airing in store
Fuel	Fuel oil	Gas
Storage / Marketing		
Type of storage	Storage in bins	Flat storage
Share of stored crop (%)	100	100
Length of storage (days)	variable	short up to wheat harvest
Delivery point	Regional wholesaler/Harbor Rostock	Regional wholesaler/Harbor (Mittellandkanal)
Distance	ca. 50 - 80 km	ca. 50 - 80 km

1) Standard moisture content that do not lead to discount and premium. Park_2003-07-15
Source: own data collection.
L:/BAL/1-SR-Büro/Parkhomenko/Tabellen/dissertation/Tabellen/Anhang/Teil 2/A-Deutschland.xls

Table A4.2: Compensation payments for oilseeds by federal states

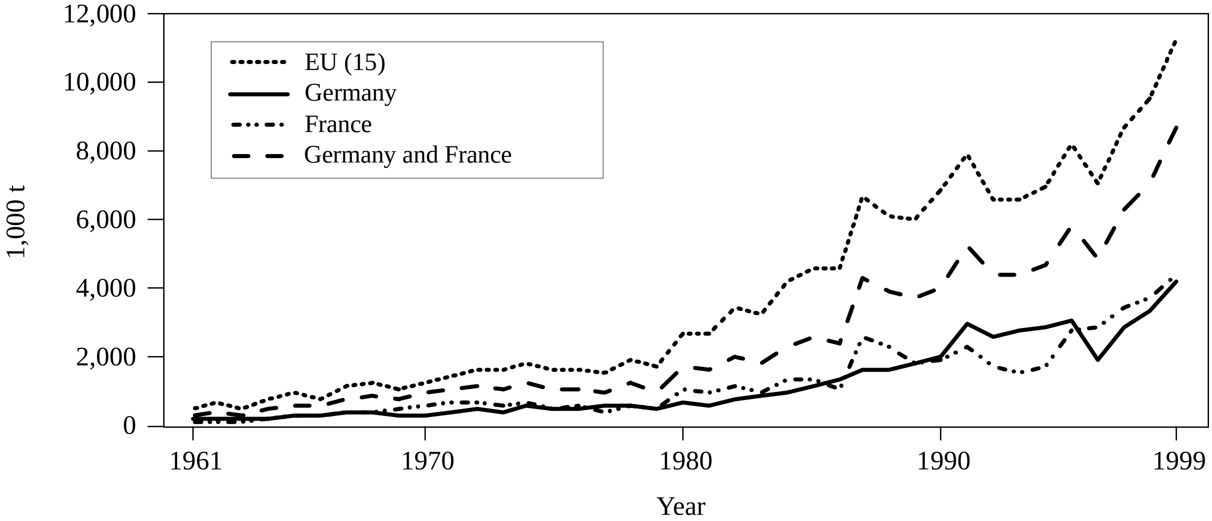
State and production region	Oilseed yield dt/ha	Payment for harvest 1999	Payment for harvest 2000	Payment for harvest 2001	Grain yield dt/ha	Payment for harvest 2002
			Euro/ha			Euro/ha[2)]
Baden-Württemberg	29.7	546	473	419	51.4	324
Bayern	31.8	584	507	449	55.3	348
Berlin	26.8	492	427	378	45.2	285
Brandenburg						
Region 1	34.4	632	548	485	54.5	344
Region 2	26.8	492	427	378	45.2	285
Bremen	31.3	575	499	442	53.4	336
Hamburg	30.7	564	489	433	60.1	379
Hessen	31.0	570	494	438	55.0	347
Mecklenburg-Vorp.	34.4	632	548	485	54.5	344
Niedersachsen						
Region 1	30.6	562	488	432	55.2	348
Region 2	30.6	562	488	432	59.8	377
Region 3	30.6	562	488	432	56.1	353
Region 4	30.6	562	488	432	51.2	323
Region 5	30.6	562	488	432	49.3	310
Region 6	30.6	562	488	432	54.2	342
Region 7	30.6	562	488	432	51.1	322
Region 8	30.6	562	488	432	49.4	311
Region 9	30.6	562	488	432	52.4	330
Region 10	34.4	632	548	485	53.7	338
Nordrhein-Westfalen	31.1	571	496	439	58.1	366
Rheinland-Pfalz	28.5	524	454	402	47.8	301
Saarland	27.0	496	431	381	43.8	276
Sachsen	29.6	544	472	418	62.3	393
Sachsen-Anhalt	26.7	490	425	377	61.4	387
Schleswig-Holstein	33.8	621	539	477	68.1	429
Thüringen	28.7	527	458	405	61.3	386

1) Payments are rounded. Park_2003-07-16

2) Payments are uniform for grains, oilseeds and set aside. Exempt are the states with separate corn areas (BW and BY) where payments are based on grain yield without corn.

Source: BMELF: Agenda 2000, Pflanzlicher Bereich, Agrarumweltmaßnahmen; Uhlmann: Ölsaatenmarkt (2000/2001).

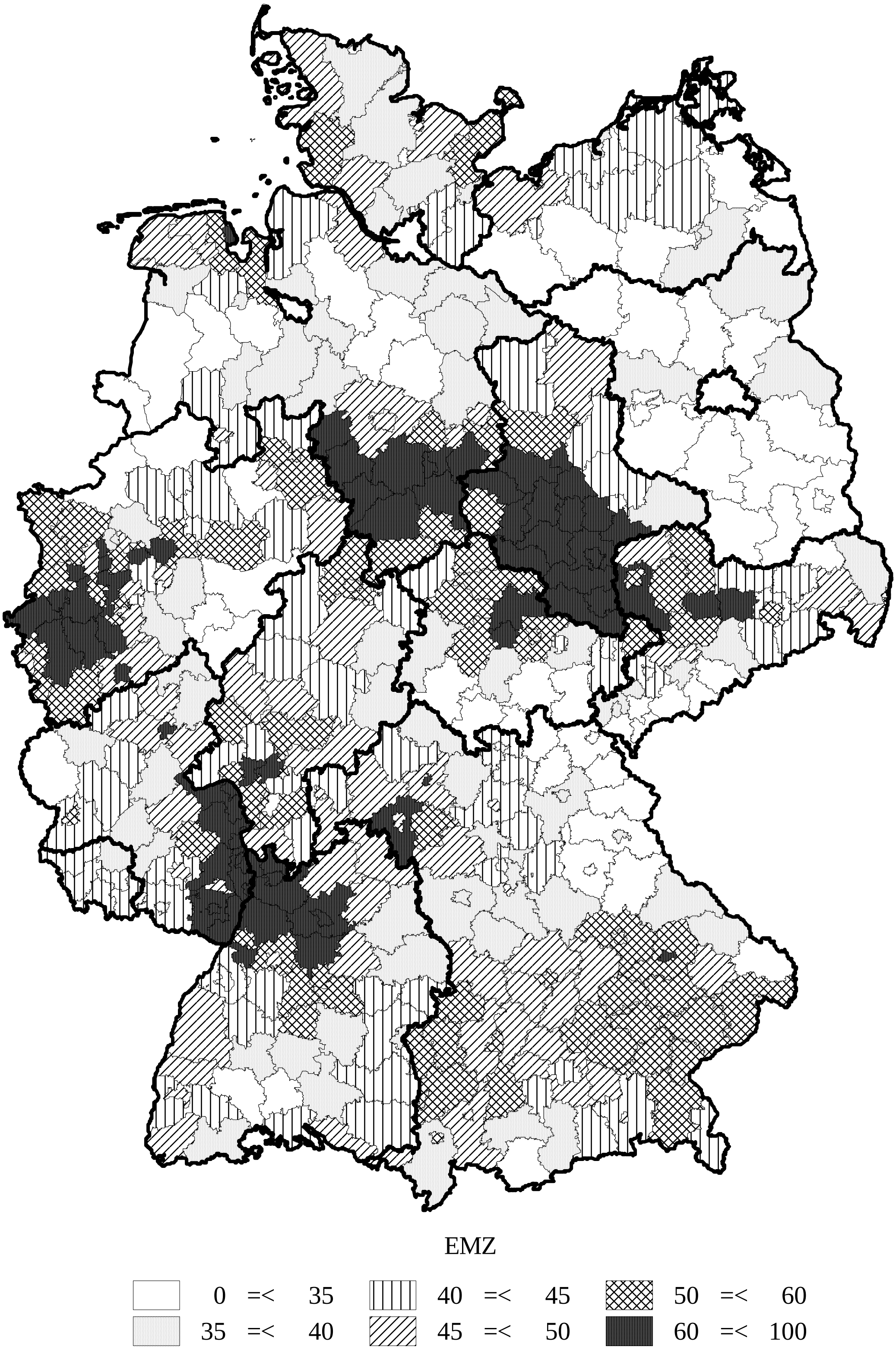
Figure A4.1: Rapeseed production in the EU, 1961 to 1999



Source: Eurostat On-Line Database (2000).

Park_2003-07-18

Map A4.1: Soil quality (EMZ) in Germany



Source: Institute of Farm Economics and Rural Studies, Doll (1999).

Park_2003-09-05

Part 5

Argentina

Table A5.1: Soybean production system at the selected farms in Argentina - Part 1 -

	Soybean as main crop (1a) **Conventional**	**Soybean as main crop (1a)** **Direct seeding**	**Soybean as second crop (2a)** **Direct seeding**
System			
Seasonality	Spring crop	Spring crop	Spring crop
Crop rotation	Soybean1 - (Wheat - Soybean2) - Corn	Soybean1 - (Wheat - Soybean2) - Corn	Soybean1 - (Wheat - Soybean2) - Corn
Soil cultivation	Conventional	Direct seeding	Direct seeding
Harvest			
Amount/Year	1	1	1
Months	Apr-May	Apr-May	May-June
Yield (t per ha)	3.2	3.2	2
Soil preparation and seeding			
Soil preparation			
Month	Nov-Dec	none	none
Amount of operations	3		
Activity / Machinery	harrow, seedbed preparation		
Seeding / Planting			
Month	Nov-Dec	Nov-Dec	Dec-Jan
kg/ha	80 (Group IV)	90 (Group IV) Roundup-resistant	90 (Group IV) Roundup-resistant
seed / m²	25-30	28-33	28-33
Amount of operations	1	1	1
Activity / Machine	Planter	Planter	Planter
Fertilization			
N-fertilization			
Amount of applications	combined with P-fertilization	combined with P-fertilization	combined with P-fertilization
Düngemittelart	Diammonium phosphate	Diammonium phosphate	Diammonium phosphate
S-fertilization			
Amount of applications	none	none	none
P-fertilization			
Amount of applications	1	1	1
Type of fertilizer	Superphosphate	Superphosphate	Superphosphate
Nutrient values (%)	0N / 46P / 0K	0N / 46P / 0K	0N / 46P / 0K
Total nutrients (kg per ha)	40	40	40
Application (date, kg/ha)	40 (during seeding)	40 (during seeding)	40 (during seeding)
Formula	Granule	Granule	Granule
Machinery	Planter	Planter	Planter
K-fertilization			
Amount of applications	none	none	none
Plant protection			
Grass herbicides			
Amount of applications	2	3	2
Trade name	Pivot H + Agil	Atrazin + Roundup Roundup + Roundup Max	Roundup + Roundup Max
Active ingredients	Propaquizafop, Imazethapyr	Atrazin, Glifosate A, Glifosate B	Atrazin, Glifosate A, Glifosate B
1. Application (l/ha, time)	0.8 l Pivot H (before emergence)	2 l Atrazin + 2 l Roundup (before emerg.)	3 l Roundup (before emergence)
2. Application (l/ha, time)	0.35 l Agil (after emergence)	3 l Roundup (before emergence)	1.5 l Roundup Max (after emergence)
3. Application (l/ha, time)		1.5 l Roundup Max (after emergence)	
Machinery	Sprayer	Sprayer	Sprayer

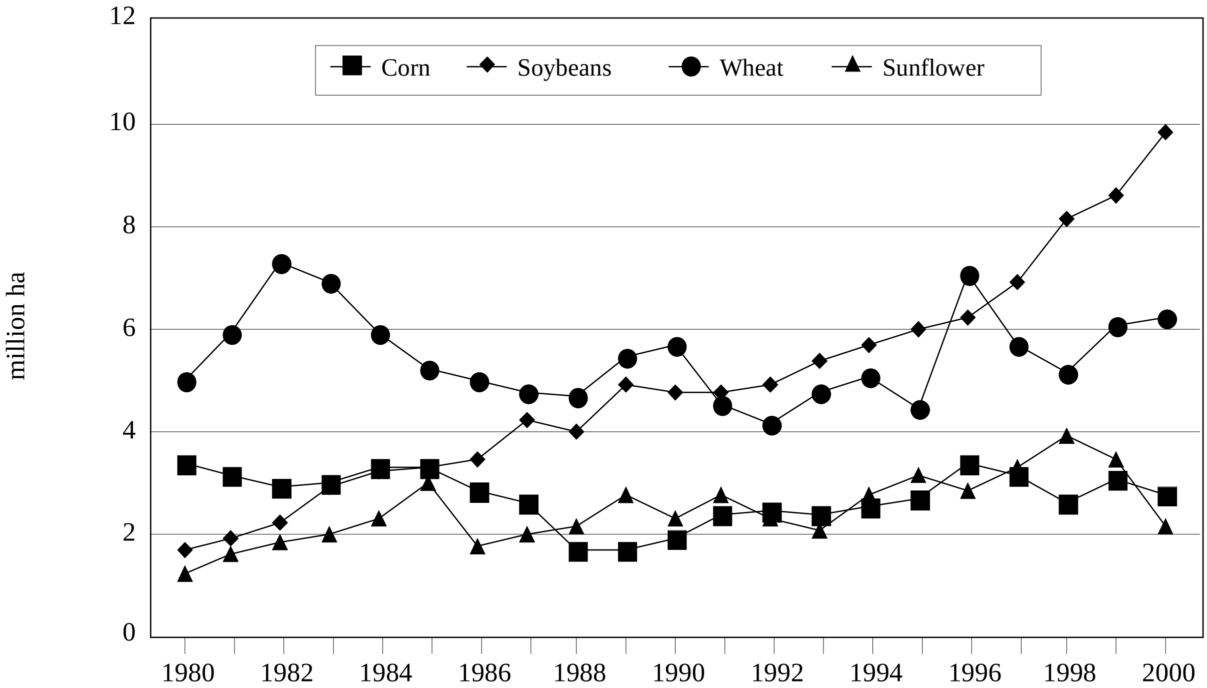
Table A5.1: Soybean production system at the selected farms in Argentina - Part 2 -

	Soybean as main crop (1a) **Conventional**	**Soybean as main crop (1a)** **Direct seeding**	**Soybean as second crop (2a)** **Direct seeding**
Plant protection			
Broadleaf herbicides			
Amount of applications	combined with grass herbicides	combined with grass herbicides	combined with grass herbicides
Fungicides			
Amount of applications	none	none	none
Growth regulators			
Amount of applications	none	none	none
Insecticides			
Insects	Bugs *(Nezara viridula, Edessa meditabunda)* Stem borer *(Epinotia apor)* Caterpillers *(Raschiplusia nu, Anticarsia gemmatalis, Pseudaletia adultera)*	Bugs *(Nezara viridula, Edessa meditabunda)* Stem borer *(Epinotia apor)* Caterpillers *(Raschiplusia nu, Anticarsia gemmatalis, Pseudaletia adultera)*	Bugs *(Nezara viridula, Edessa meditabunda)* Stem borer *(Epinotia apor)* Caterpillers *(Raschiplusia nu, Anticarsia gemmatalis, Pseudaletia adultera)*
Amount of applications	1	1	1
Trade name	Decis Best or Lorsban 48 E oder Lorsban Plus	Lorsban Plus or Endosulfan + Cypermethrin	Lorsban Plus or Endosulfan + Cypermethrin
Active ingredients	Chlorpyrifos + Deltamethrin Chlorpyrifos Chlorpyrifos + Deltamethrin	Chlorpyrifos + Deltamethrin Endosulfane Cypermethrin	Chlorpyrifos + Deltamethrin Endosulfane Cypermethrin
1. Application (l/ha, time)	0.5 l Decis or 1.0 l Lorsban 48 E or 0.7 l Lorsban Plus	0.6 l Lorsban Plus or 0.3 l Endosulfan + 0.1 l Cypermethrin	0.6 l Lorsban Plus or 0.3 l Endosulfan + 0.1 l Cypermethrin
2. Application (l/ha, time)			
Machinery	Sprayer	Sprayer	Sprayer
Harvest and postharvest activities			
Harvest			
Activities	1	1	1
Machines	Combine (custom)	Combine (custom)	Combine (custom)
Transport			
Activities	1	1	1
Machines	Truck (15 t) or hanger	Truck (15 t) or hanger	Truck (15 t) or hanger
Drying			
Share of harvest for drying (%)	100	100	100
Water content before drying (%)	15	15	15
Allowed water content (%) 2)	13	13	13
Time of drying	directly after harvest	directly after harvest	directly after harvest
Technology	In co-operation	In co-operation	In co-operation
Fuel	Fuel oil / Propane	Fuel oil / Propane	Fuel oil / Propane
Storage / Marketing			
Type of storage	Co-operative / Wholesaler 1)	Co-operative / Wholesaler 1)	Co-operative / Wholesaler 1)
Share of stored crop (%)	0 1)	0 1)	0 1)
Length of storage (days)	none 1)	none 1)	none 1)
Delivery point	Harbor Rosario / Buenos Aires	Harbor Rosario / Buenos Aires	Harbor Rosario / Buenos Aires

1) Usually farms do not own storage facilities.
2) Standard moisture content that do not lead to discount and premium.

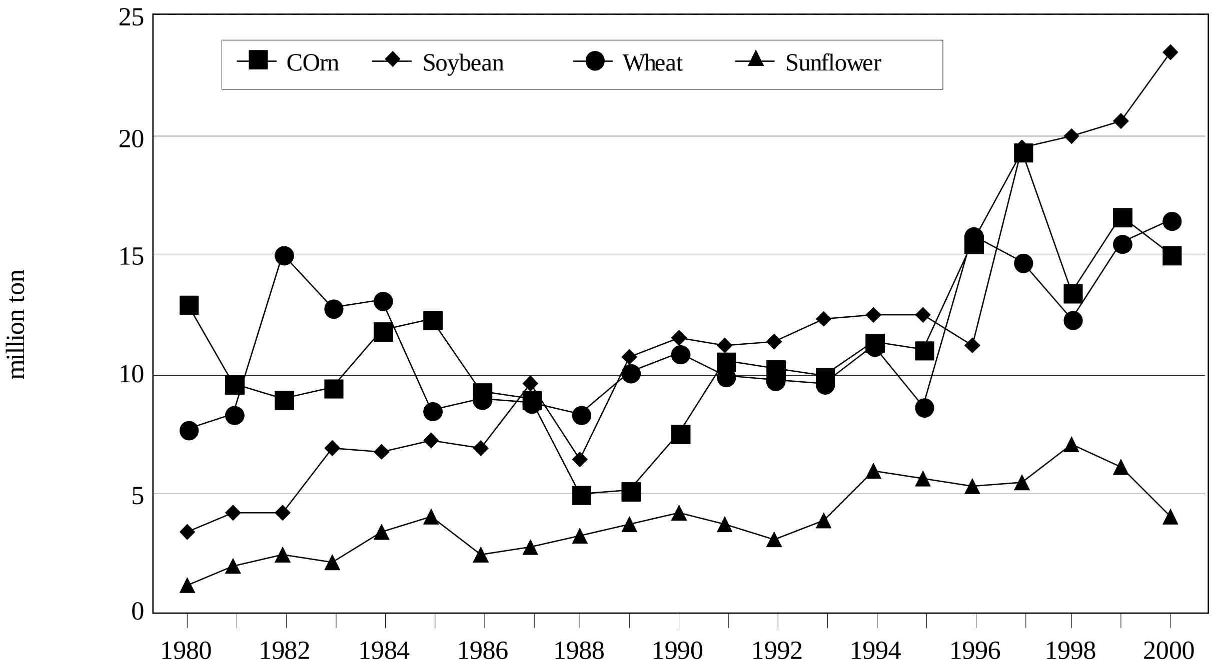
Park_2003-07-16

Figure A5.1: Area under soybeans and major crops in Argentina, 1980 to 2000



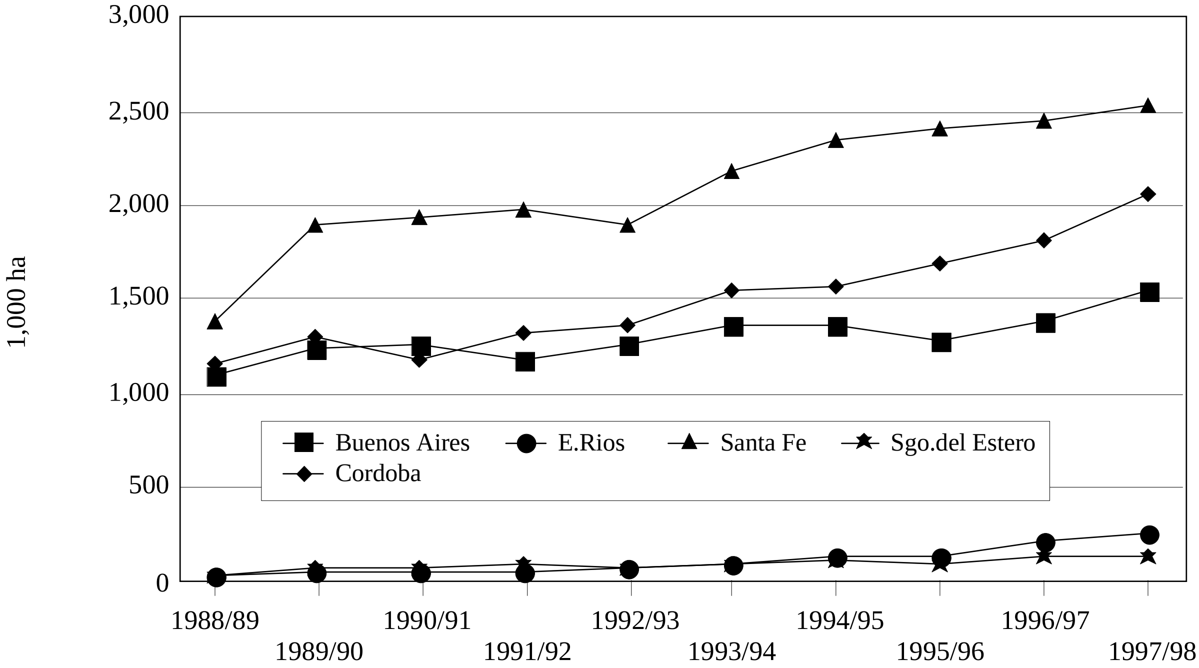
Source: PS&D, ERS (2001). Park_2003-07-18

Figure A5.2: Production of soybeans and major crops in Argentina, 1980 to 2000



Source: PS&D, ERS (2001). Park_2003-07-18

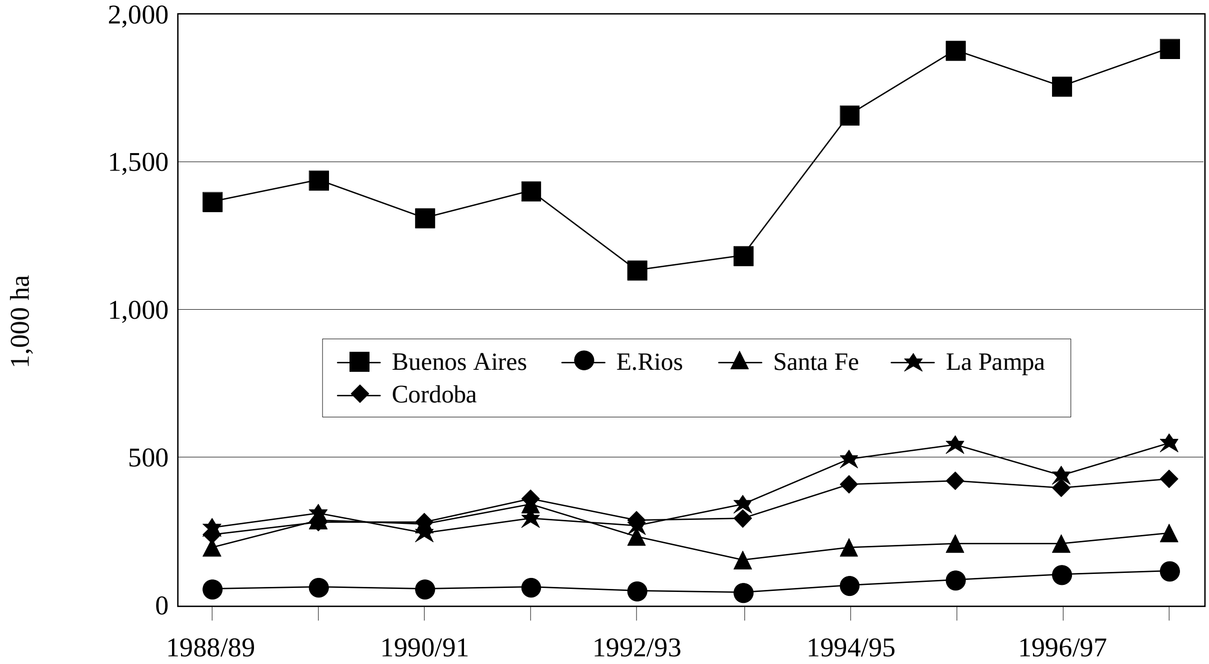
Figure A5.3: Soybean area by provinces, 1988/89 to 1997/98



Source: CIARA, www.CIARA.COM (2001).

Park_2003-07-18

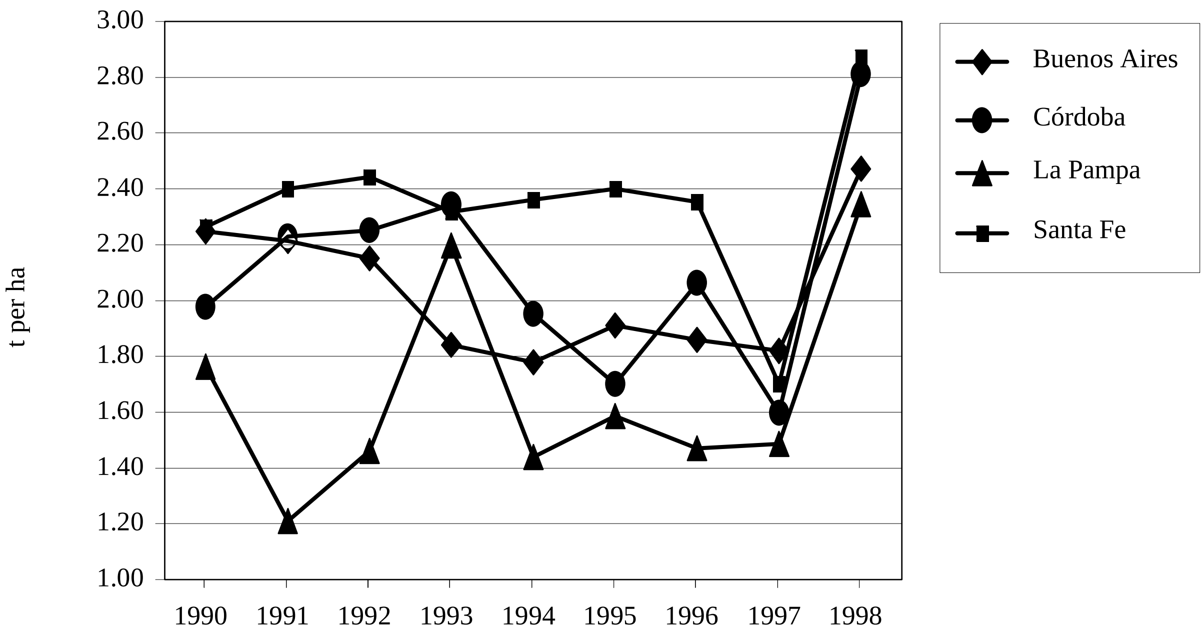
Figure A5.4: Sunflower area by provinces, 1988/89 to 1997/98



Source: CIARA, www.CIARA.COM.AR (2001).

Park_2003-07-18

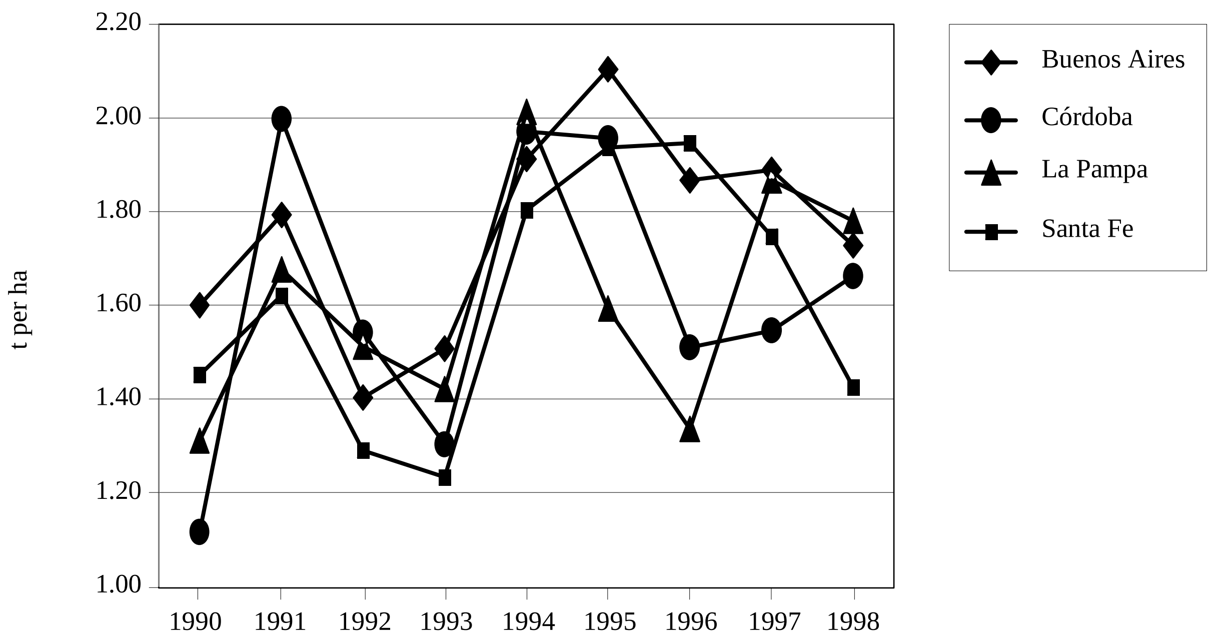
Figure A5.5: Soybean yields in the major producing provinces, 1990 to 1998



Source: SAGPyA.

Park_2003-07-18

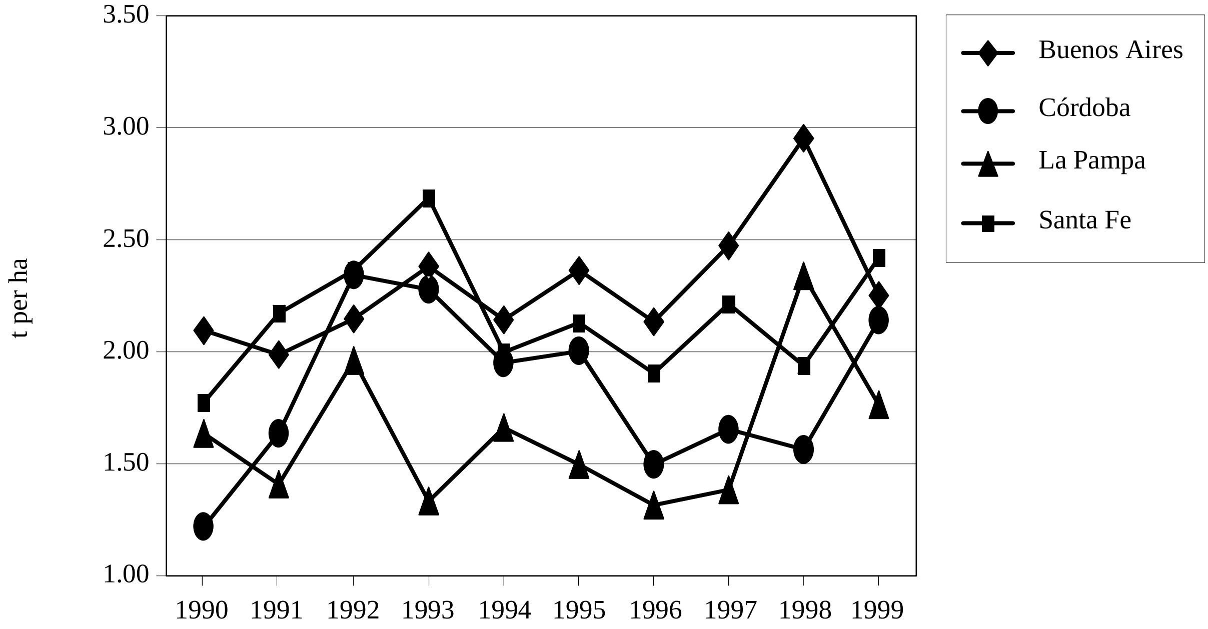
Figure A5.6: Sunflower yields in the major producing provinces, 1990 to 1998



Source: SAGPyA.

Park_2003-07-18

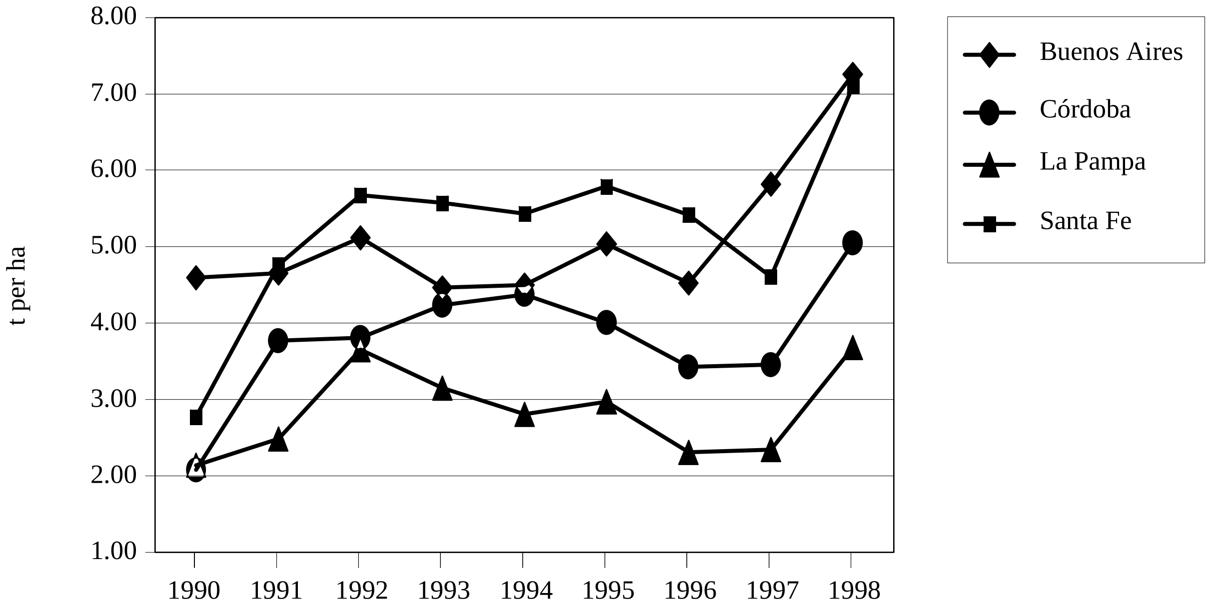
Figure A5.7: Wheat yields in the major producing provinces, 1990 to 1998



Source: SAGPyA.

Park_2003-07-18

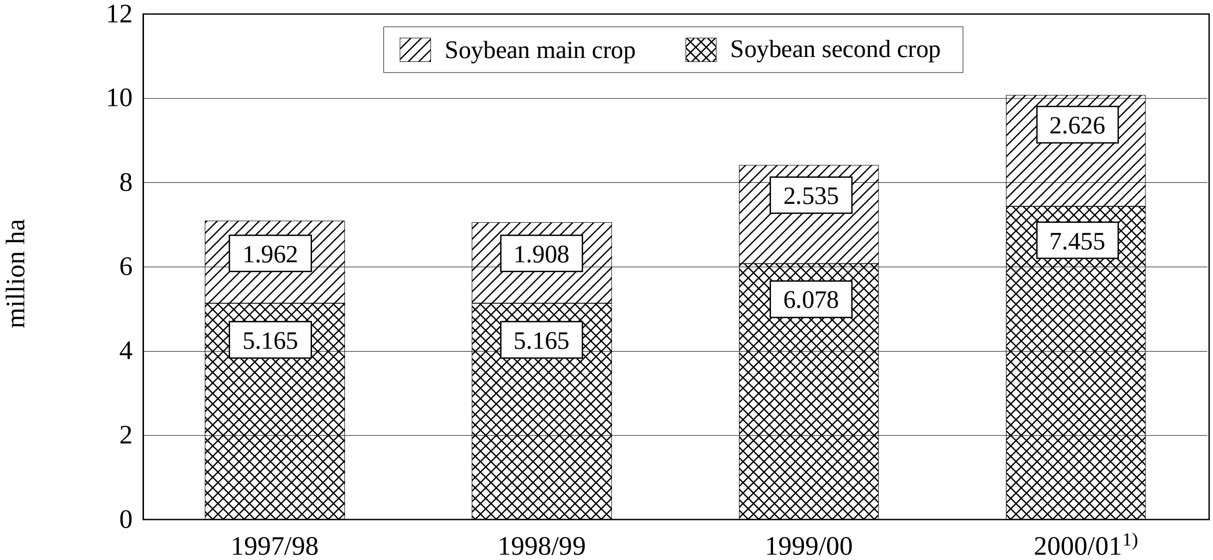
Figure A5.8: Corn yields in the major producing provinces, 1990 to 1998



Source: SAGPyA.

Park_2003-07-18

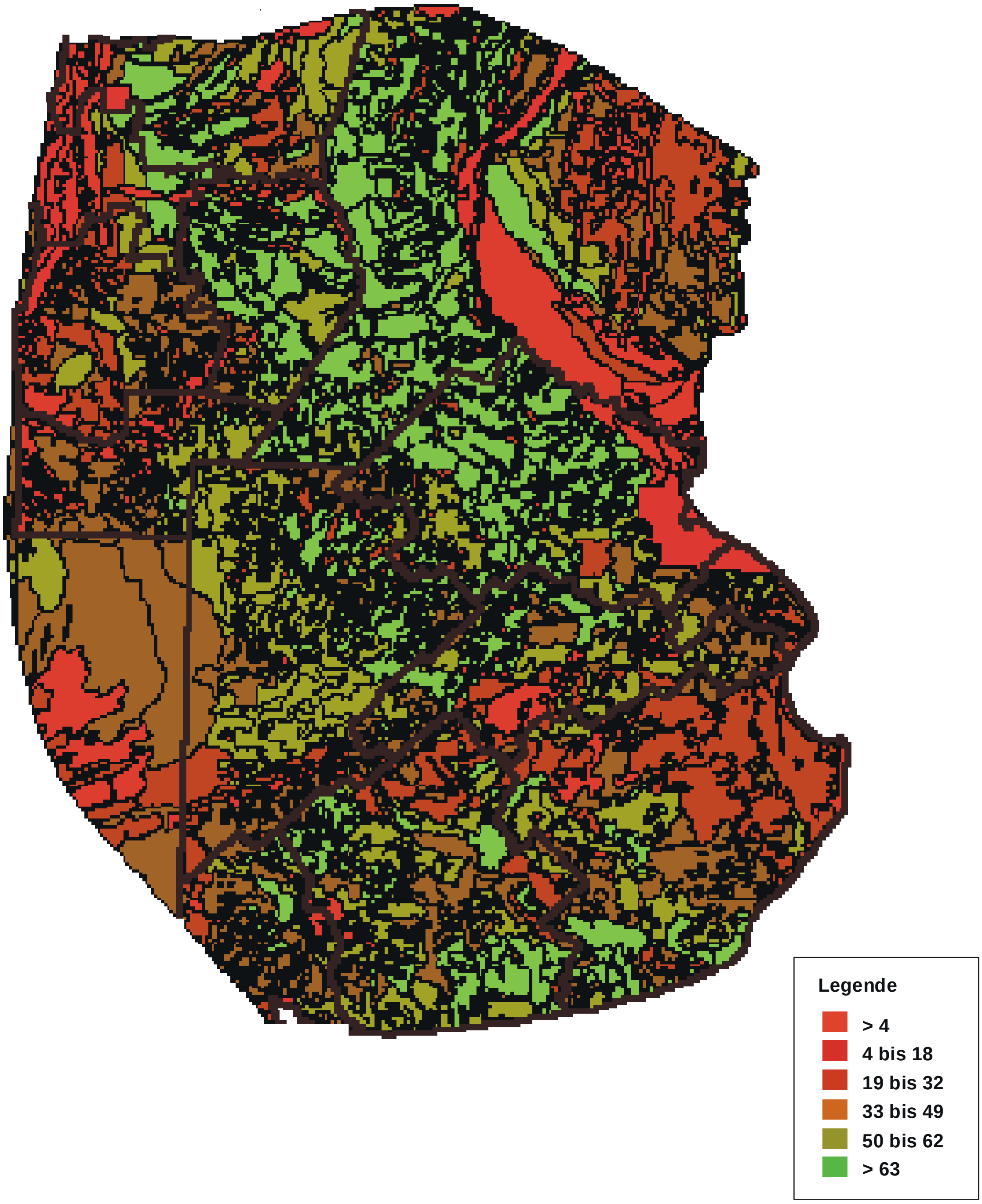
Figure A5.9: Area under first and second soybean crop



1) Estimation.
Source: USDA, Foreign Agricultural Service (2001).

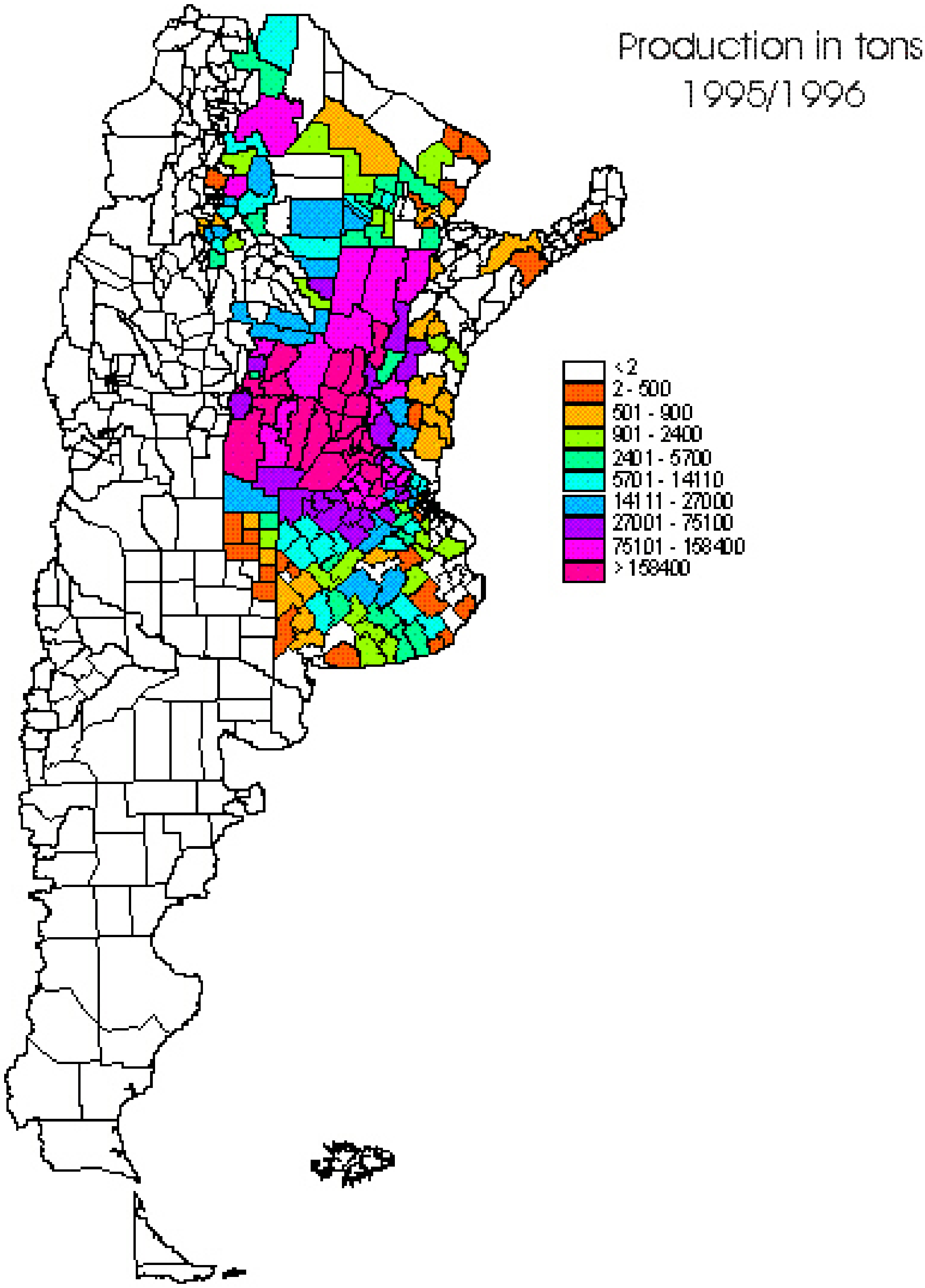
Park_2003-07-18

Map A5.1: Soil quality in Pampa Humeda (0 to 100)



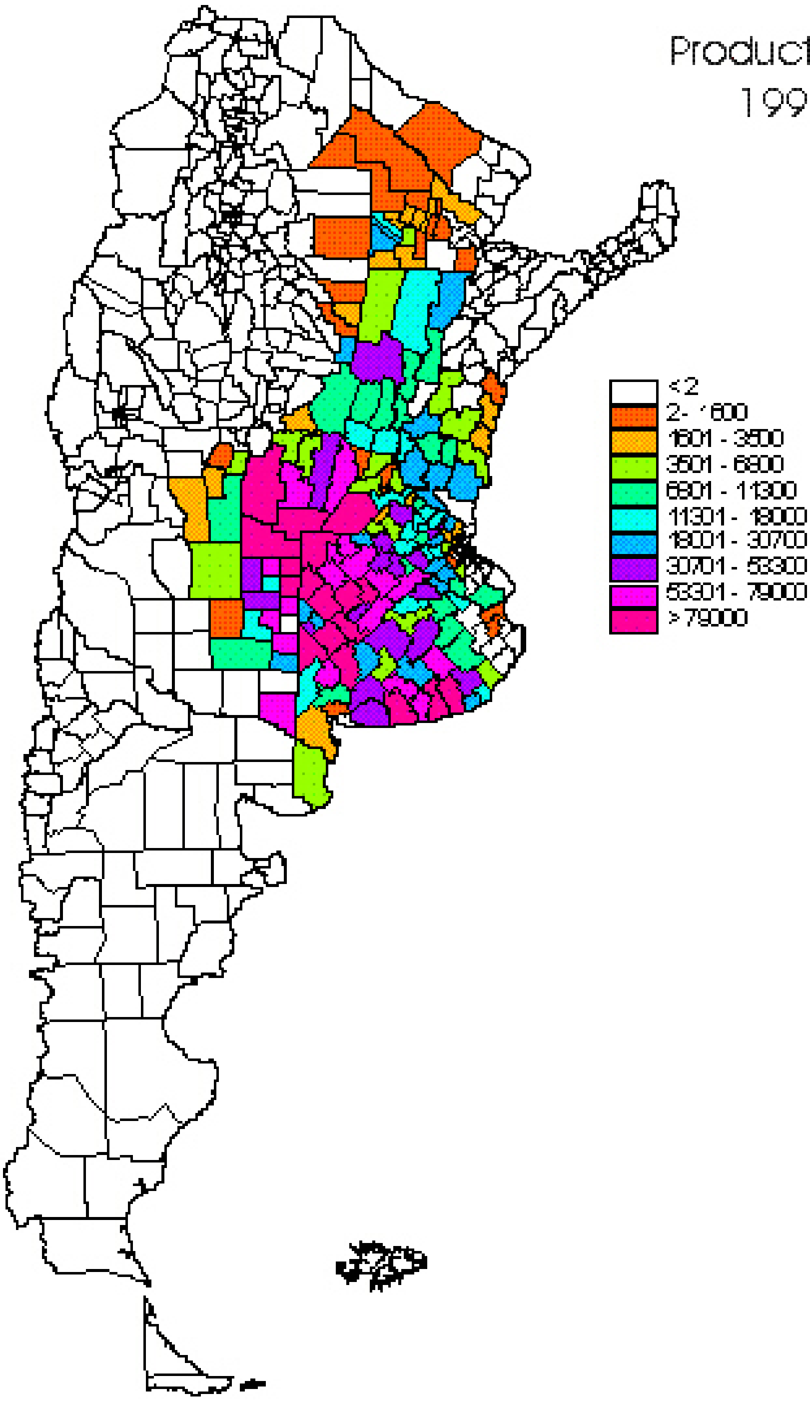
Source: SAGPyA

Map A5.2: Soybeans regional distribution of production in Argentina, 1995/96



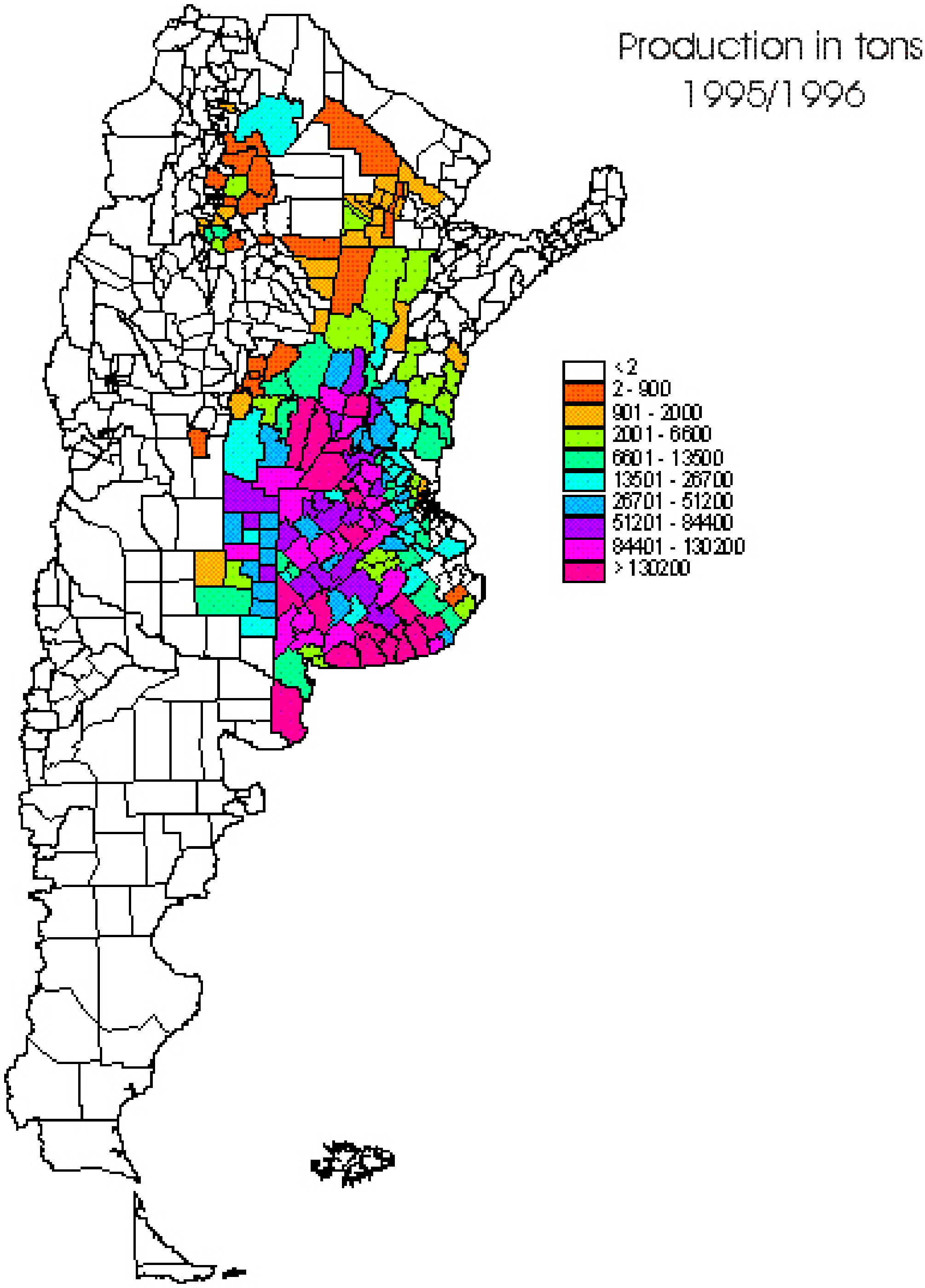
Source: SAGPyA, realised by SIIAP using data of Information and Systems Department.

Map A5.3: Sunflower regional distribution of production in Argentina, 1995/96



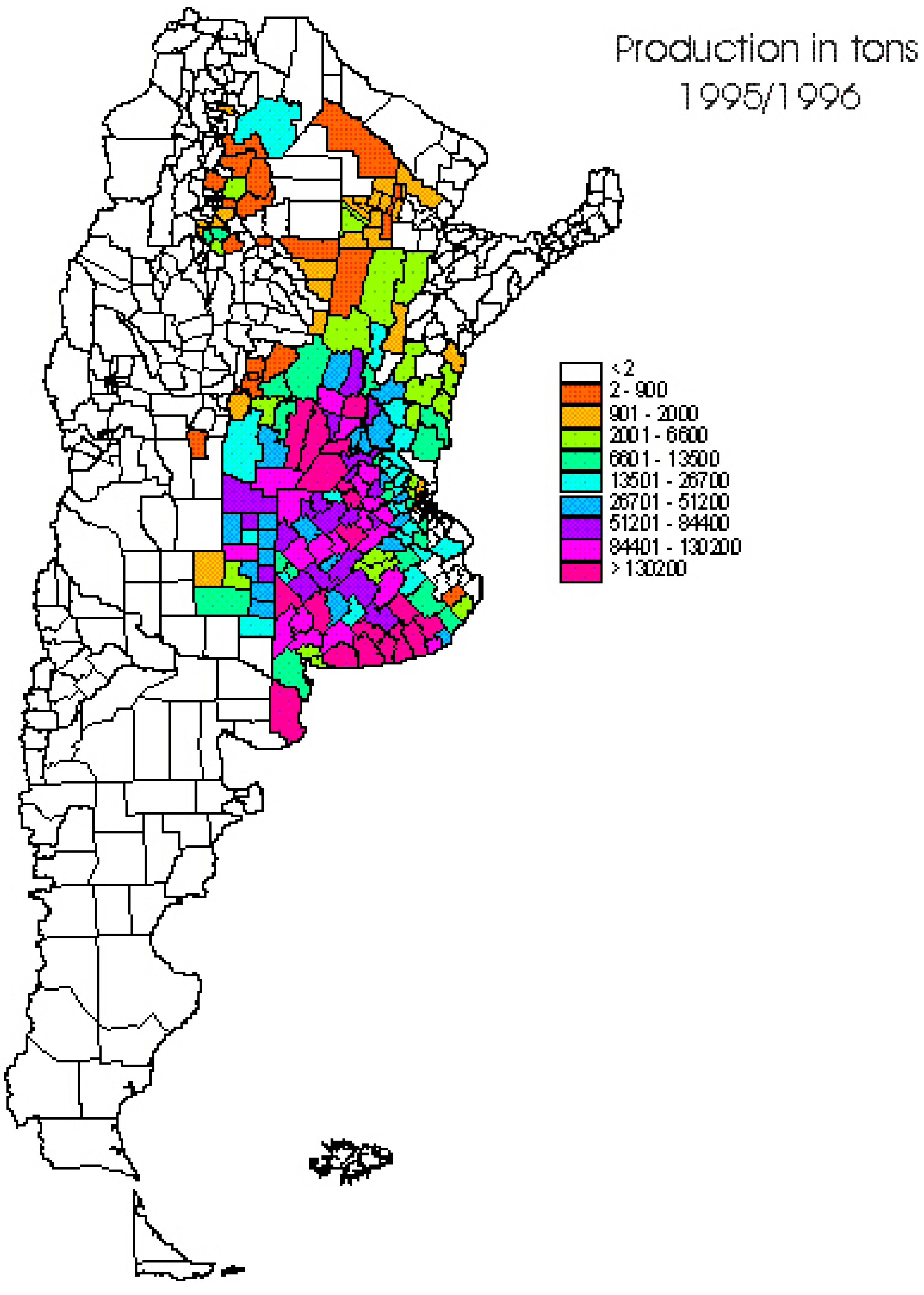
Source: SAGPyA, realised by SIIAP using data of Information and Systems Department.

Map A5.4: Wheat regional distribution of production in Argentina, 1995/96



Source: SAGPyA, realised by SIIAP using data of Information and Systems Department.

Map A5.5: Corn regional distribution of production in Argentina, 1995/96



Source: SAGPyA, realised by SIIAP using data of Information and Systems Department.

Part 6
Brazil

Table A6.1: Soybean production system at the selected farms in Brazil - Part 1 -

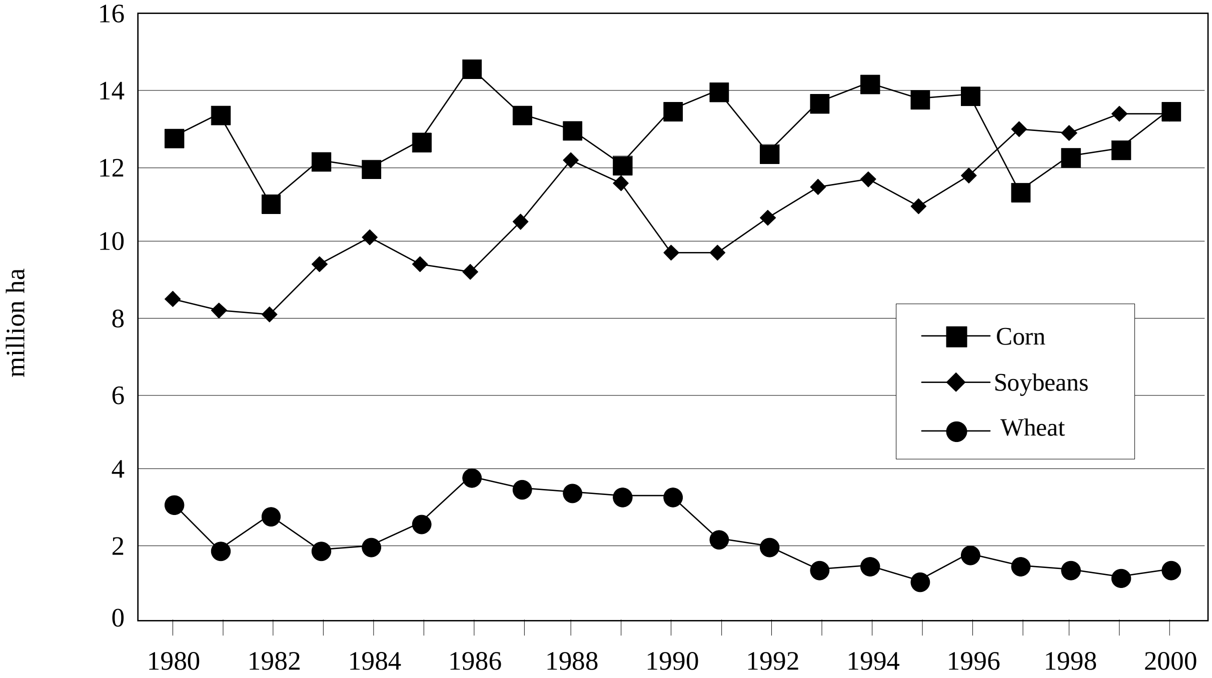
	Uberaba **Soybeans**	**Rio Verde** **Soybeans**
System		
Seasonality	Spring crop	Spring crop
Crop rotation	Soybean - Corn (+ cover crop the same year)	Soybean - Corn (+ Safrinha the same year)
Soil cultivation	No Till	No Till
Harvest		
Amount/Year	1	1
Months	March	Feb or Apr
Yield (t per ha)	2.4	3.2
Soil preparation and seeding		
Soil preparation		
Month	Oct/Nov	Oct/Nov
Amount of operations	2	2
Activity / Machinery	harrow + cultivator	harrow + cultivator
Seeding / Planting		
Month	Nov	Nov
Amount of operations	1	1
Activity / Machine	seedbed preparation with planting	seedbed preparation with planting
Fertilization		
N-fertilization		
Amount of applications	none	none
P-fertilization		
Amount of applications	1	1
Type of fertilizer	MND with N - P - K and Zn	MND with N - P - K and Zn
Nutrient values (%)	0N / 20P / 20K + Zn	0N / 20P / 18K + Zn
Total nutrients (kg per ha)	70	70
Application (date, kg/ha)	Nov, 70 during seeding	Nov, 70 during seeding
Machinery	Direct seeding machine	Direct seeding machine
K-fertilization		
Amount of applications	1	1
Type of fertilizer	MND with N - P - K with Zn (combined with P)	MND with N - P - K with Zn (combined with P)
Nutrient values (%)	0N / 20P / 20K + Zn	0N / 20P / 20K + Zn
Total nutrients (kg per ha)	70	63
Application (date, kg/ha)	Nov, 70 during seeding	Nov, 63 during seeding
Machinery	Direct seeding machine	Direct seeding machine
Plant protection		
Grass herbicides		
Amount of applications	2-3	2-3
Trade name	Roundup + DMA 806 BR Gramoxone / Verdict + Mineralöl	Roundup + DMA 806 BR Gramoxone / Verdict + Mineralöl
Active ingredients	Glyphosate + 2.4 D / Paraquat / Haloxyfop-Methyl	Glyphosate + 2.4 D / Paraquat / Haloxyfop-Methyl
1. Application (l/ha, time)	Sep 2.5 Roundup + 1.0 2.4 D	Sep 3.0 Roundup + 1.0 2.4 D
2. Application (l/ha, time)	Oct 1.5 l Gramoxane	Oct 1.5 l Gramoxane
3. Application (l/ha, time)	Nov (30 days after seeding) 0.4 Verdict + 0.5 % Mineral oil	Nov (30 days after seeding) 0.4 Verdict + 0.5 % Mineral oil
Machines	Sprayer	Sprayer

Table A6.1: Soybean production system at the selected farms in Brazil - Part 2 -

	Uberaba **Soybean**	**Rio Verde** **Soybean**
Plant protection		
Broadleaf herbicides		
Amount of applications	2	2
Trade name	Cobra + Classic / Roundup (dead spray of soybean leaves before harvest)	Cobra + Classic / Gramoxone or Gramocil (dead spray of soybean leaves before harvest)
Active ingredients	Lactofen + Chlorimuron Ethyl / Glyphosate	Lactofen + Chlorimuron Ethyl / Paraquat oder Paraquat + Diuron
1. Application (l/ha, time)	Nov (30 days after seeding) 0.4 Cobra + 40 g Classic	Nov (30 days after seeding) 0.4 Cobra + 40 g Classic
2. Application (l/ha, time)	Feb 1.0 Roundup	Feb 1.0 Gramoxone or 1,0 Gramocil
Machines	Sprayer	Sprayer
Fungicides		
Amount of applications	2	2
Trade name	Vitavax-Thiram 200 SC + (Cobalt + Mylebdenium) / Derosal 500 SC	Vitavax-Thiram 200 SC oder Vetran + (Co + Mo) / Benlate 500 or Derosal 500 SC
Active ingredients	Carboxin; Thiram + (Co + Mo) / Carbendazim	Carboxin; Thiram or Thiram + (Cobalt + Molybdenium) / Benomyl or Carbendazim
1. Application (l/ha, time)	Sep 60 g/ha Vitavax-Thiram + (Co + My)	Sep 60 g/ha Vitavax-Thiram or 40 g/ha Vetran + 0,4 (CO + Mo)
2. Application (l/ha, time)	Oct 0.5 Derosal	Oct 0.4 kg/ha Benlate or 0.5 Derosal
Machines	Sprayer	Sprayer
Inoculation		
Amount of applications	1	1
Trade name		
Active ingredients	Rhizobium	Rhizobium
1. Application (l/ha, time)	0.8	0.8
Machines	Mixer	Mixer
Insecticides		
Amount of applications	2-3	2-3
Trade name	Tamaron / Thiodan CE / Sulfluramide	Thiodan CE (Prophylaxe) / Dimilin + Decis 25 CE (if needed) / Sulfluramide
Active ingredients	Methamidophos / Endosulfan / Sulfluramide	Endossulfan / Diflubenzulon + Deltamethine / Sulfluramide
1. Application (l/ha, time)	Okt 0.5 l TaMäron	Okt 0.5 Thiodan
2. Application (l/ha, time)	0.5 l Thiudan	80 g Dimilin + 0.2 Decis 25 CE
Machines	Sprayer	Sprayer
Harvest and postharvest activities		
Harvest		
Activities	1	1
Machines	Combine (custom)	Combine (custom)
Transport		
Activities	1	1
Machines	Truck (15 t Lkw) or hanger	Truck (15 t Lkw) or hanger
Drying		
Share of harvest for drying (%)	50	100
Water content before drying (%)	14	18
Allowed water content (%) 2)	13	13
Time of drying	-	directly after harvest
Technology	-	Co-operative storage
Fuel	-	Fuel oil / Propane
Storage / Marketing		
Type of storage	Co-operative	Co-operative
Share of stored crop (%)	100	100
Length of storage (days)	variable	variable
Delivery point	variable	variable

1) Standard moisture content that do not lead to discount and premium. Park_2003-07-16
Source: own data collection.

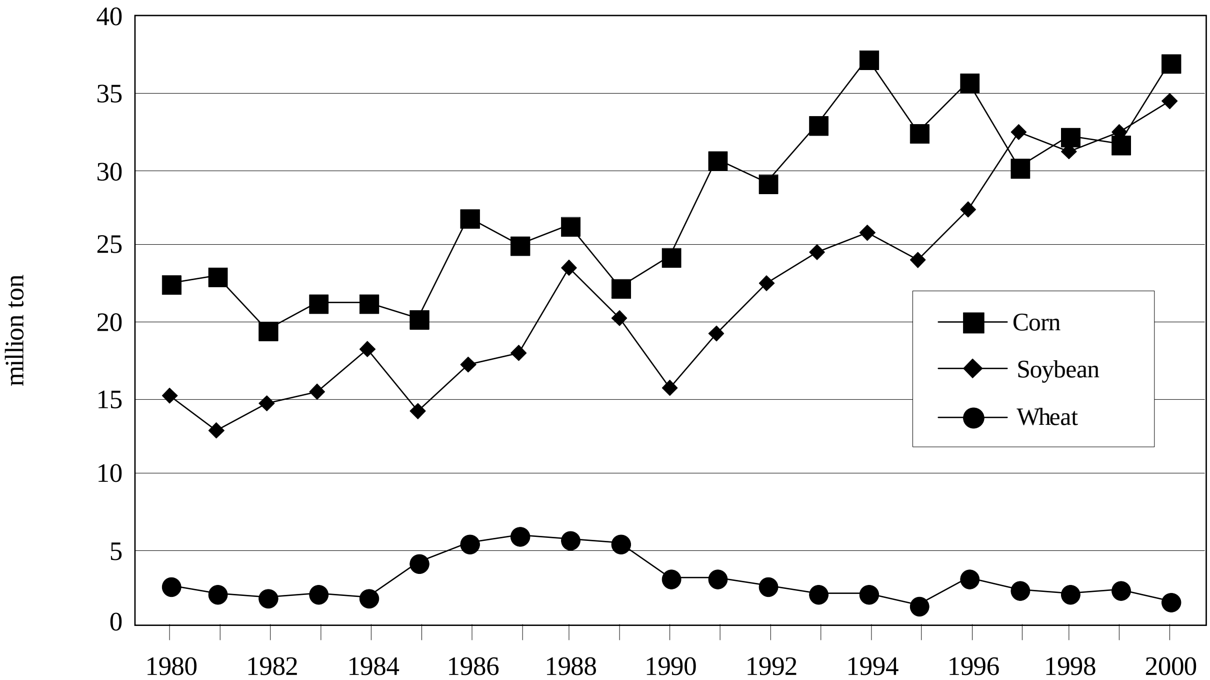
Figure A6.1: Area under soybeans and major crops in Brazil, 1980 to 2000



Source: PS&D, ERS (2001).

Park_2003-07-18

Figure A6.2: Production of soybeans and major crops in Brazil, 1980 to 2000



Source: PS&D, ERS (2001).

Park_2003-07-18

Part 7

China

Table A7.1: Oilseeds production, 1980 to 2000

Year	Oilseeds	Soybeans	Rapeseed	Peanuts	Sunflower
			million tons		
1980	19,4	7,9	2,4	3,6	0,9
1981	23,6	9,3	4,1	3,8	1,3
1982	26,0	9,0	5,7	3,9	1,3
1983	27,2	9,8	4,3	4,0	1,3
1984	31,1	9,7	4,2	4,8	1,7
1985	31,6	10,5	5,6	6,7	1,7
1986	30,9	11,6	5,9	5,9	1,5
1987	33,4	12,2	6,6	6,2	1,2
1988	30,4	11,6	5,0	5,5	1,2
1989	28,5	10,2	5,4	5,4	1,1
1990	33,3	11,0	7,0	6,4	1,3
1991	34,5	9,7	7,4	6,3	1,4
1992	33,0	10,3	7,7	6,0	1,5
1993	38,6	15,3	6,9	8,4	1,3
1994	42,2	16,0	7,5	9,7	1,4
1995	43,3	13,5	9,8	10,2	1,3
1996	41,4	13,2	9,2	10,1	1,3
1997	43,4	14,7	9,6	9,6	1,2
1998	44,4	15,2	8,3	11,9	1,5
1999	45,3	14,3	10,1	12,6	1,8
2000	46,7	15,4	11,0	13,0	1,1
Δ1980 to 2000 (%)	140	94	361	261	21
1980: % of total		41	12,3	19	4,7
2000: % of total		33	24	28	2,4

Source: USDA - PS&D (2001), own calculations. Park_2002-01-28

Table A7.2: "Grain bag" policy objectives and results for 1995, 1996, 1997 and 1998

Objective	Results for 1995	1996	1997	1998
1. Increase grain area [1]	94 area of 109.5 mil. ha. rose to 110.1	95 area of 110.1 mil ha. rose to 112.5	96 area of 112.5 mil ha. rose to 112.9	97 area of 112.9 mil. ha. rose to 113.8
2. Increase supply of inputs	8.1 per cent increase over 94	Increase of 6.6 per cent	Increase of 4 per cent	Est. small increase
3. Raise yields	Rose from 4.06 mt/ha to 4.25	Incr. from 4.25 mt/ha to 4.48	Droughts reduced to 4.37 mt/ha	Initial estimate of 4.40 mt/ha
4. Increase grain production	Rose 4.9% from 467 mt (94)	Rose to 505 mmt, up 8.1%	Output of 494 mmt, down 2.2%	Initial estimate of 495
5. Guarantee grain stocks	Rose 25 million tonnes	Rose 52 million tonnes	n.a.	n.a.
On-farm stocks	Yearend stocks up 21 % over beginning stock	Yearend stocks up 33 % over beginning stock	Yearend stocks up 20 % over beginning stock	n.a.
6. Enforce grain transfers	Partial [2]	Partial	Partial	Partial
7. Stabilise grain supplies for urban residents	Yes	Yes	Yes	Yes
8. Stabilise grain prices	Partial	Partial	Partial	Partial
9. Raise government share over commercial grain sales	n.a.	Probably [3]	Probably	Probably
10. Government control over grain imports and exports	Yes	Yes	Yes	Yes
11. Raise level of grain self sufficiency	Rose from 96.3 % in 1994 to 96.7 %	Self sufficiency of 99%	Grain exports of 7.4 mmt.; imports of 4.1 mmt	Probably self sufficient

1. Total grain includes rice, wheat, corn, sorghum, millet, other miscellaneous grain, tubers (potatoes), and soybeans.
2. Some provinces erected formal and informal barriers to grain transfers.
3. Protection price mechanism came into play in 1996, 1997, and probably 1998 for various grain crops, which means that the government was required to purchase more grain than usual. Also the 1998 grain reform theoretically would place more food grains under government control.

Source: Crook (1998), China National Statistical Bureau - Agricultural Yearbook (2000). Park_2002-01-28

Table A7.3: Import taxes and duties on oilseeds and processed products, 2000

Description	China´s Oilseeds and Oilseed Products Tariffs as of January 1, 2000		
	In Quota Duty (%)	Out of Quota MFN (%)	VAT * (%)
Yellow soybean	3	114	13
Black soybean	3	114	13
Green soybean	3	114	13
Other soybean	3	114	13
Rapeseed, other	12	40	13
Panut kernels, in airtight containers		30	17
Rosted peanuts		30	17
Peanut butter		30	17
Other processed peanuts		30	17
Other cottonseed		15	13
Other sunflower seeds		15	13
Crude soy oil	13	122	13
Other soy oil	13	122	13
Crude rapeseed oil	20	100	13
Othter rapeseed oil	20	100	13
Crude peanut oil	10	75	13
Other peanut oil	10	75	13
Crude cottonseed oil		35	13
Other cottonseed oil		35	13
Crude sunflower seed oil	40	91	13
Other sunflower seed oil	40	91	13
Crude coconut oil		20	17
Other coconut oil		20	17
Palm oil, crude	9	30	13
Palm oil, refined	10	30	13
Soy oil cake		5	0
Soy meal		5	13
Legume sweepings		5	NA
Soyflour	9	40	17
Rapeseed meal		5	0
Peanut meal		5	0
Cottonseed meal		5	0
Sunflower seed meal		5	0
Fish meal		3	0

* Oilseeds for planting are duty free

Source: GAIN Report (Page 25), USDA-FAS (2001) Park_2002-04-09

Table A7.4: Production systems of soybeans and rapeseed at the selected farms in Heilongjiang, Shandong and Anhui provinces - Part 1 -

Region	**South Central Heilongjiang**	**North Central Shandong**	**Central Anhui**
Crop	**Soybeans**	**Soybeans**	**Winter rapeseed**
System			
Share (%)	36	83	100
Seasonality	Summer crop	Summer crop	Winter crop
Crop rotation	Soybeans - Corn (2 years)	Soybeans - Winter Wheat (1 year)	Winter Rapeseed - Rice (1 year)
Soil cultivation	some mechan.	some mechan.	manual with buffalo
Harvest			
Amount/Year	1	1	1
Month	Sept	Sept	April
Yield t / ha	1,95	2,25	2,11
Oil content %	-	-	-
Protein content %	-	-	-
Soil preparation and seeding			
Soil preparation			
Month	Oct + May	-	Sept
Amount of operations	1	-	1
Activity / Machine	custom plow cultivation	-	plow + buffalo harrow + buffalo
Seeding / Planting			
Month	May	June	Sept-Oct [1)]
kg/ha	60	67,5	3,3
seed / m²	-	-	-
Amount of operations	1	1	2 [1)]
Activity / Machine	one row planter	custom	manual
Fertilization			
N-Fertilization			
Amount of applications	1 (combined with P and K)	none	2 (1st combined with P and K)
Type of fertilizer	NPK		Urea + NPK
Nutrient values (%)	10N / 15P / 10K		46N + 10N / 15P / 10K
Application (kg/ha, month)	17,5 (May)		112 (Nov+Feb)
Formula	granule		granule
Machine	manual		manual
S-Fertilization	none	none	none
P-Fertilization			
Amount of applications	with N fert.	none	with N
Type of fertilizer	NPK		NPK
Nutrient values (%)	10N / 15P / 10K		10N / 15P / 10K
Application (date, kg/ha)	26,2		44
Formula	granule		granule
Machine	manual		manual
K-Fertilization			
Amount of applications	with N fert.	none	with N
Type of fertilizer	NPK		NPK
Nutrient values (%)	10N / 15P / 10K		10N / 15P / 10K
Application (date, kg/ha)	17,5		29
Formula	granule		granule
Machine	manual		manual

Table A7.4: Production systems of soybeans and rapeseed at the selected farms in Heilongjiang, Shandong and Anhui provinces - Part 2 -

	South Central Heilongjiang **Soybeans**	North Central Shandong **Soybeans**	Central Anhui **Winter rapeseed**
Plant protection			
	due to lack of experts during visit to the farms, it is difficult to interpret the chemicals applied on the farms.		
Herbicides	yes	yes	yes
Fungicides	no	no	no
Insecticides	yes	yes	yes
Growth regulators	no	no	no
Hartvest and postharvest activities			
Harvest			
Activities	2	3	2
Month	Sept-Oct	June	April
Machine	manual collection of the plants, mech. threshing of the seed	manual collection of the plants, drying plants, manual threshing of the seed	manual collection of the plants, manual threshing of the seed
Transport			
Activities	2	2	2
Machine	transport to yard with tractor, transport to market with tractor	transport to yard with tractor, transport to market with tractor	transport to yard with buffalo, transport to market with buffalo
Drying			
Share of harvest for drying (%)	0	100 2)	0
Water content before drying (%)	-	-	-
Allowed water content (%)	-	-	-
Time of drying	-	immediately after collecting plant under	-
Technology	-	sunshine, directly on the field	-
Fuel	-	-	-
Storage / Marketing			
Type of storage	on yard in bags	on yard in bags	on yard in bags
Share of stored crop	100	100	100
Length of storage, days	variable	variable	short
Delivery point	market	market	market
Distance	about 6 km	about 5 km	about 4 km

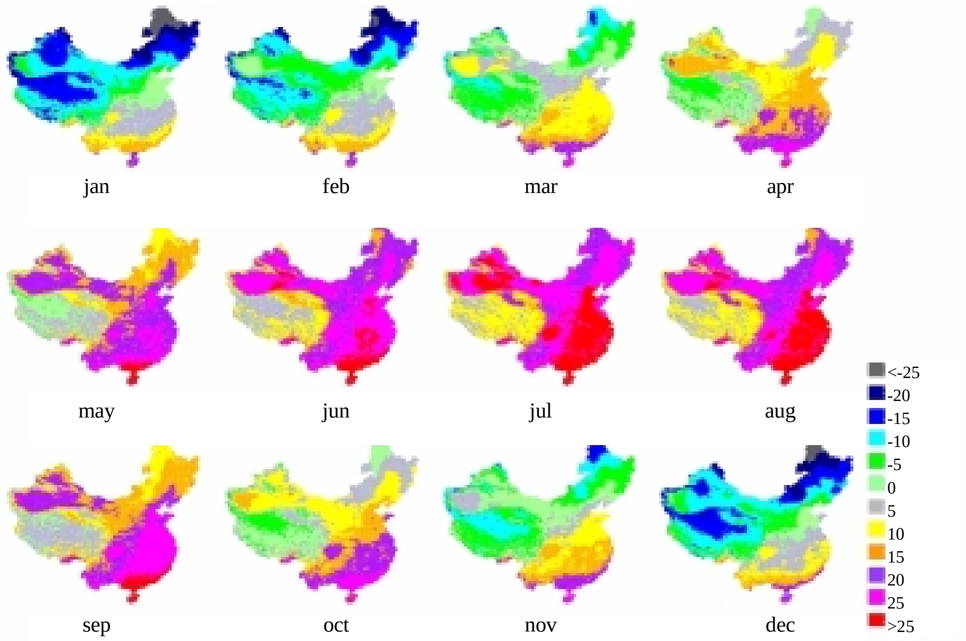
1) Seeds are planted to the "nursery" then transplated to the field in order to give enough time for rice ripening and harvest.
2) Whole plants are dried before threshing.

Source: IFCN data collection Park_2002-04-09

Figure A7.1: Major rivers

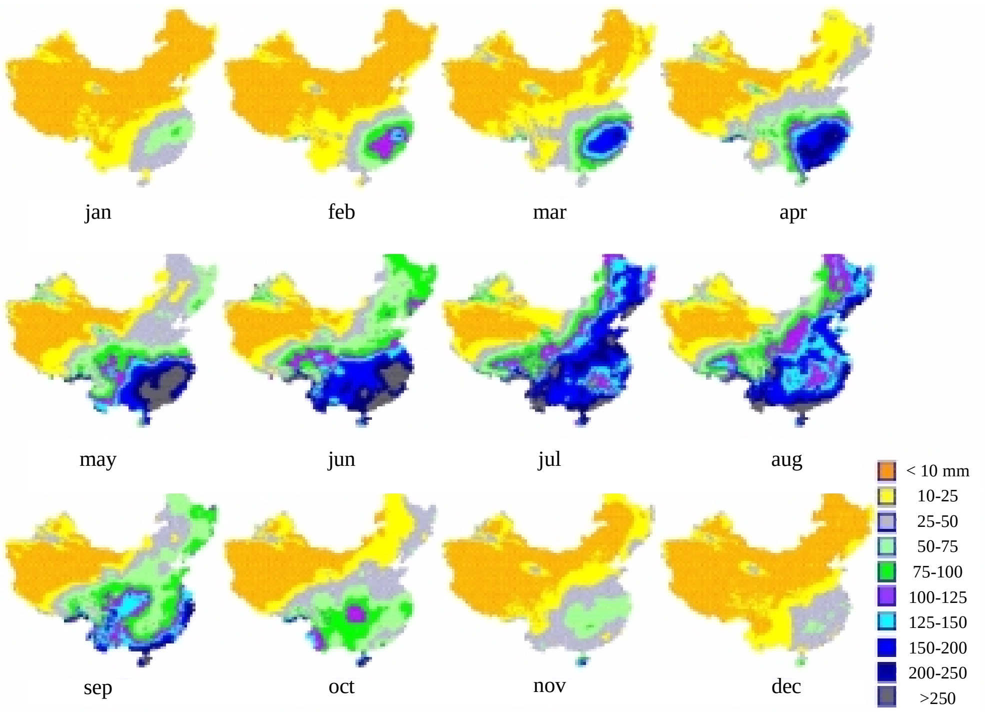
Source: IIASA (1999 b). Park_2002-03-19

Figure A7.2: Average monthly temperature, degree Celsius



Source: IIASA (1999 a). Park_2002-03-19

Figure A7.3: Monthly rainfall, mm

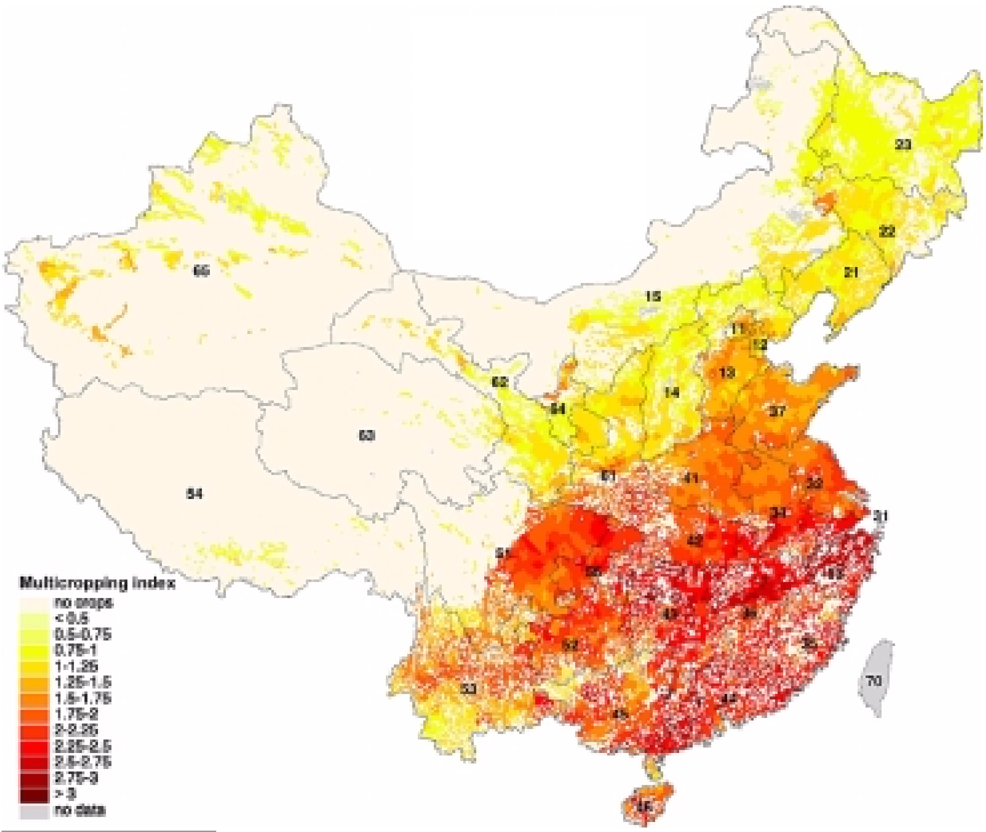


Source: IIASA (1999 a). Park_2002-03-19

Figure A7.4: Level terraced rice fields

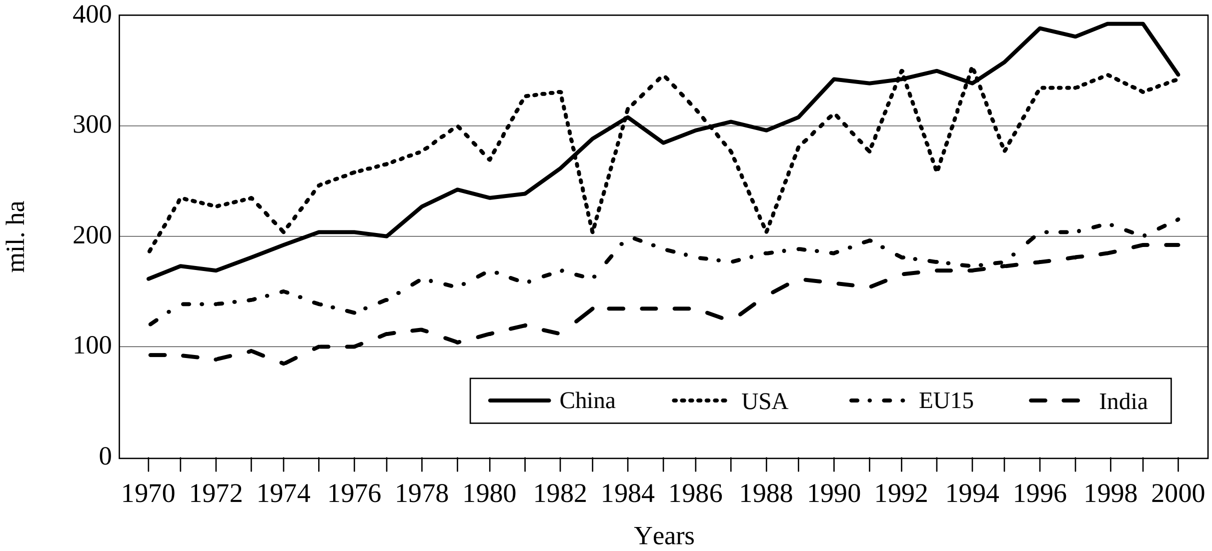
Source: Pini Vollach (2001). Park_2002-03-19

Figure A7.5: Multiple Cropping Index



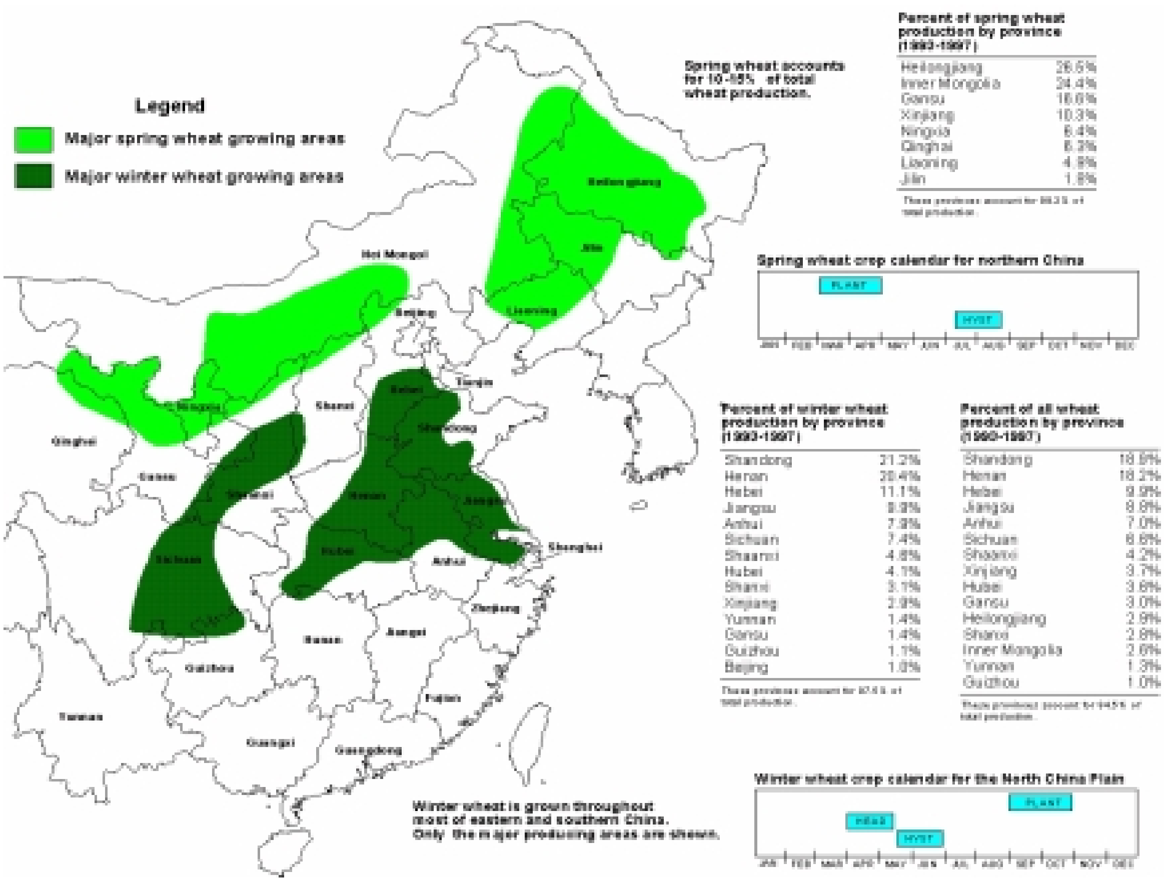
Source: IIASA (1999 b). Park_2002-03-19

Figure A7.6: Major world grain producers, 1980 to 2000



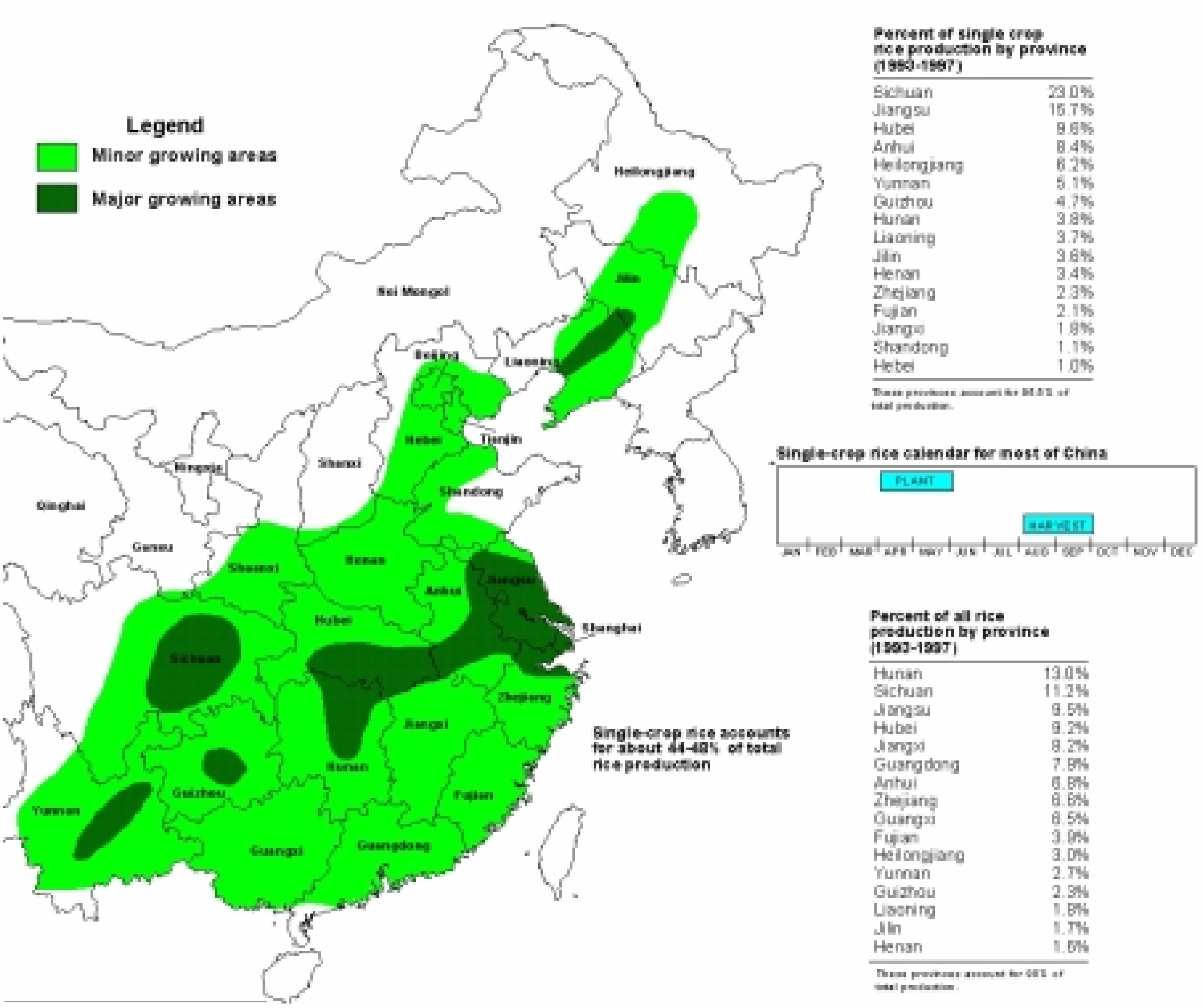
Source: USDA - PS&D (2001). Park_2002-01-14

Figure A7.7: Wheat production regions



Source: USDA - JAWF (2001). Park_2002-03-19

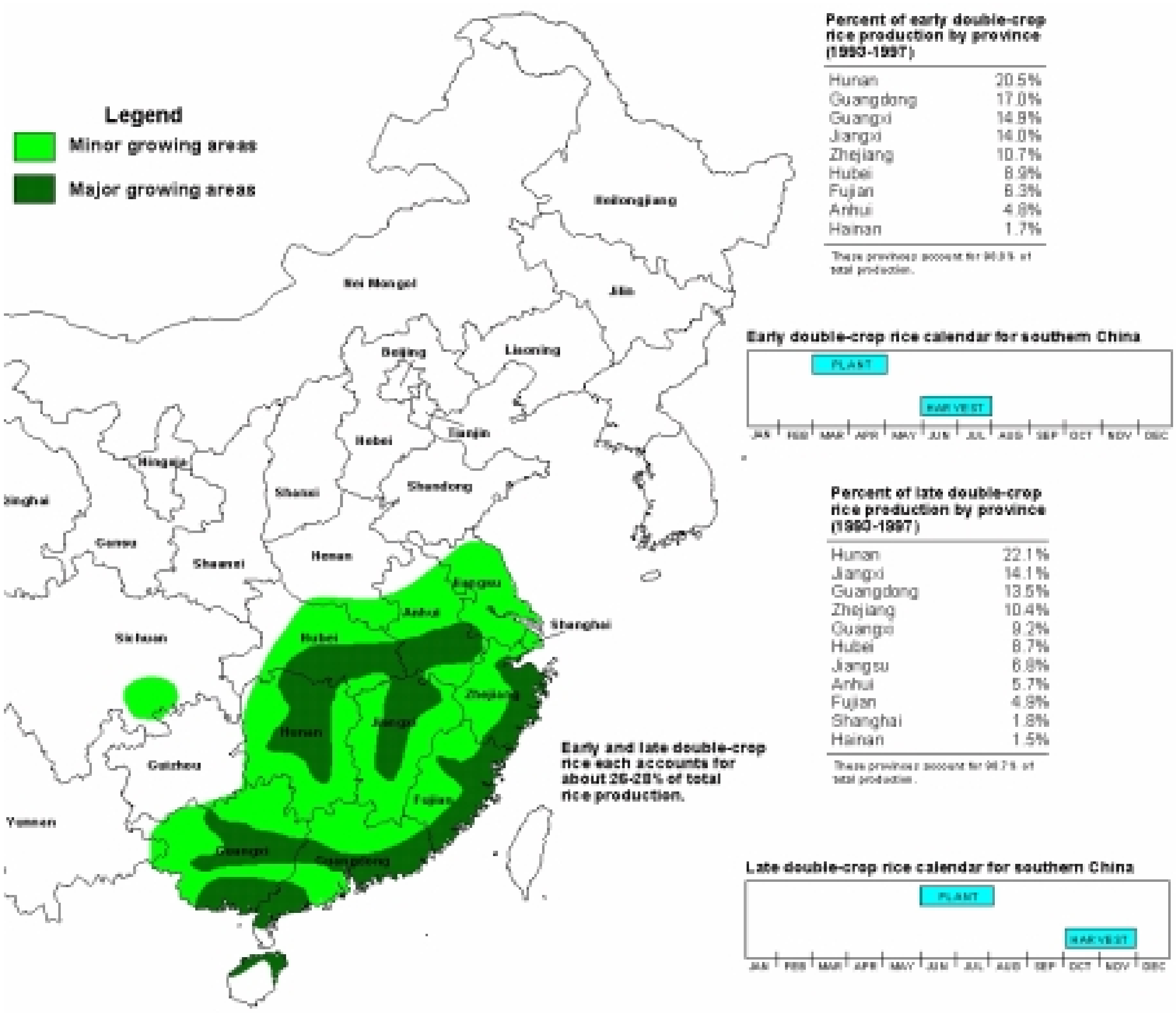
Figure A7.8: Single-crop rice production regions



Source: USDA - JAWF (2001).

Park_2002-03-19

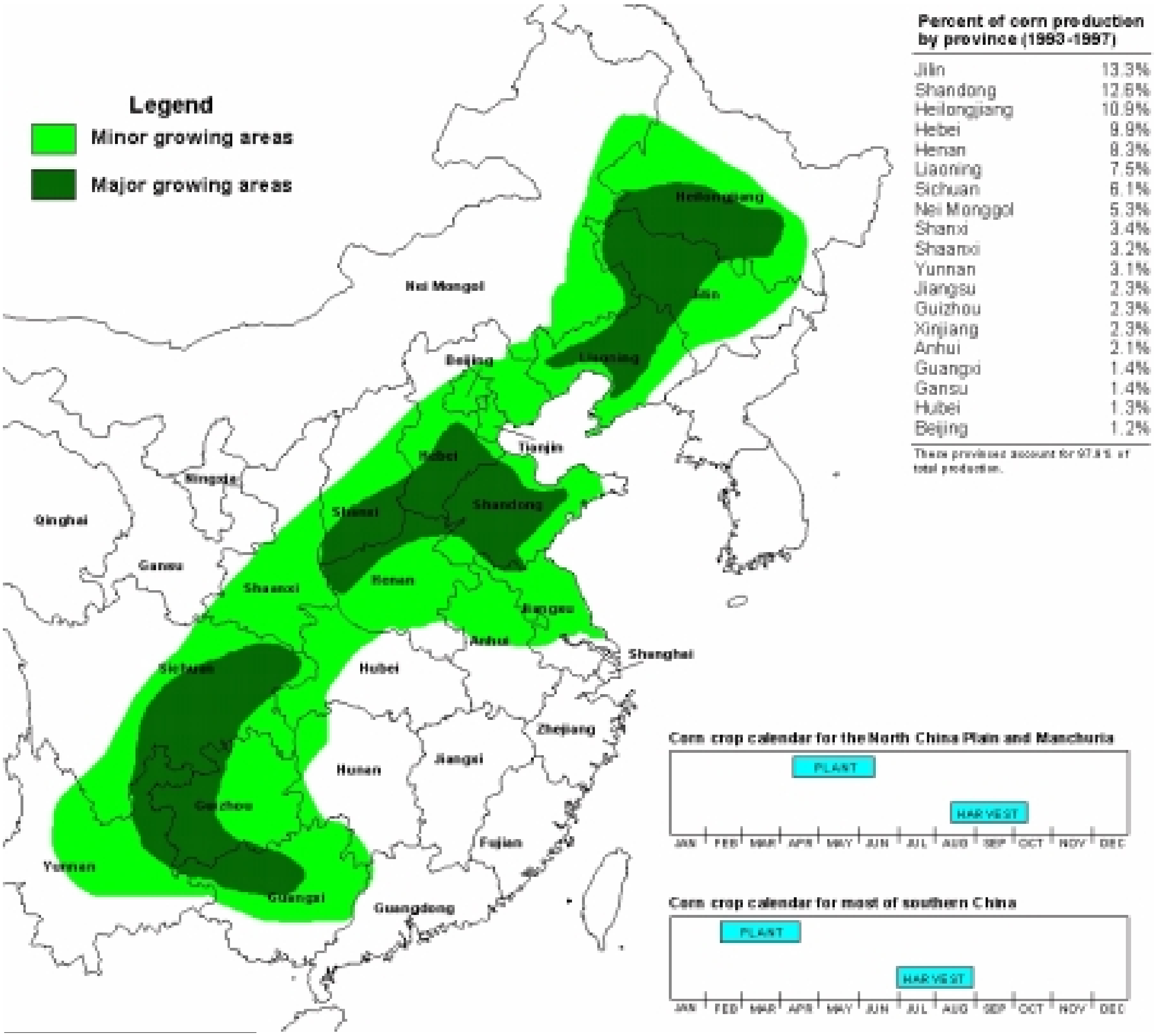
Figure A7.9: Double-crop rice production regions



Source: USDA - JAWF (2001).

Park_2002-03-19

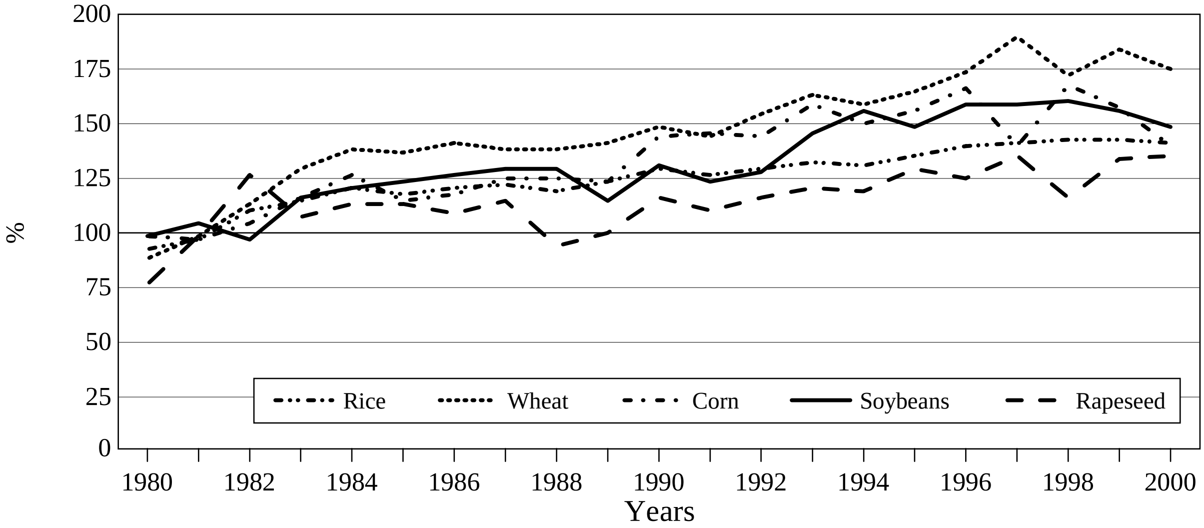
Figure A7.10: Corn production regions



Source: USDA - JAWF (2001).

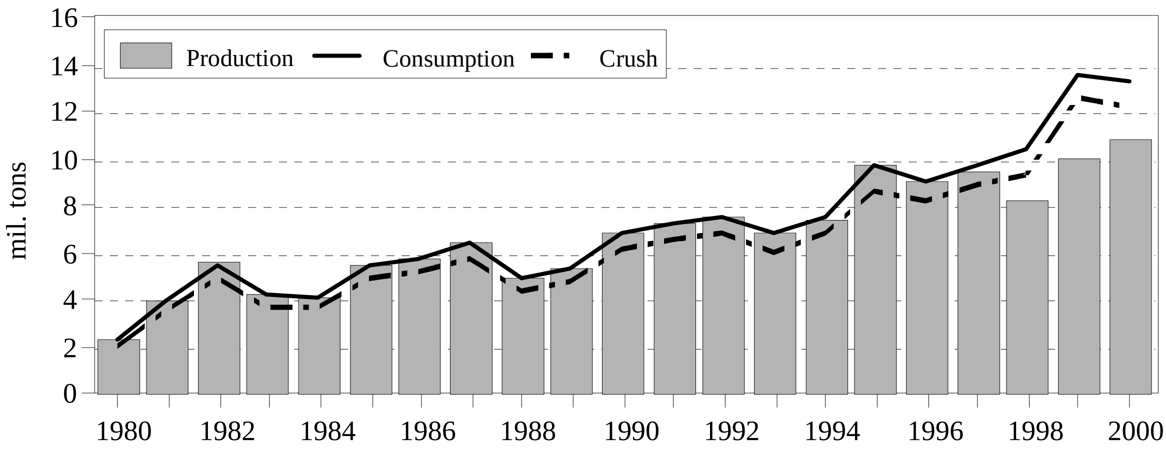
Park_2002-03-19

Figure A7.11: Developement of yields for major crops, 1980 – 2000 (∅ 1980 to 1982 = 100 %)



Source: USDA - PS&D (2001). Park_2002-03-19

Figure A7.12: Rapeseed production, consumption and crush, 1980 to 2000



Source: USDA-PS&D (2001).

Park_2002-03-19

Part 8

Indonesia and Malaysia

Table A8.1: Distribution of monthly rainfall for selected stations in Indonesia (mm)

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Medan	185	60	116	139	163	143	136	181	202	268	176	170	1939
Tandjung Karan	271	274	238	173	126	103	86	84	81	120	110	217	1883
Pontianak	277	208	242	278	282	222	164	204	228	365	388	322	3180
Balikpapan	198	173	228	205	228	190	178	160	138	130	165	203	2196
Rembang	257	195	188	123	100	74	32	21	30	61	122	205	1408
Polewali	155	158	208	246	230	158	114	79	89	190	215	198	2040
Ujung Pandang	719	531	425	166	92	68	34	10	13	40	174	590	2862
Jayapura	318	297	284	230	202	155	169	166	136	161	188	217	2523

Sources: Oldeman & Frère (1982), Surre & Ziller (1963). Park_2003-07-08

Table A8.2: Area and production of oil palm by province and by producer group, 2001*

Province	Smallholders		State estates		Private estates		Total	
	Area 1000 ha	Production 1000 tons	Area 1000 ha	Production 1000 tons	Area 1000 ha	Production 1000 tons	Area 1000 ha	Production 1000 tons
D. I. Aceh	53.7	70.5	42.1	91.9	117.6	276.8	213.4	439.2
Sumatera Utara	105.9	319.2	271.1	1,173.8	259.3	985.8	636.2	2,478.8
Sumatera Barat	58.2	116.0	3.8	21.4	114.1	245.7	176.1	383.0
Riau	235.6	440.8	67.1	298.9	374.9	643.8	677.5	1,383.4
Jambi	156.4	195.6	13.3	40.7	115.0	106.6	284.7	342.9
Sumatera Selatan	178.2	165.6	28.2	111.2	161.6	217.2	368.0	493.4
Bengkulu	26.0	44.9	4.3	5.7	47.7	55.0	78.0	105.6
Lanpung	45.2	37.1	13.2	54.8	46.1	23.7	104.6	115.7
Dki Jakarta	-	-	-	-			-	-
Jawa Barat	6.3	17.7	11.1	12.8	4.0	1.4	21.4	31.9
Jawa Tengah	-	-	-	-			-	-
D. I. Yogyakarta	-	-	-	-			-	-
Jawa Timur	-	-	-	-			-	-
Bali	-	-	-	-			-	-
Nusa Tenggara Barat	-	-	-	-			-	-
Nusa Tenggara Timur	-	-	-	-			-	-
Timor Timur	-	-	-	-			-	-
Kalimantan Barat	149.7	185.1	44.5	133.8	217.5	104.2	411.6	423.0
Kalimantan Tengah	40.3	10.1	-	-	124.7	30.8	165.0	40.9
Kalimantan Selatan	-	-	-	-	141.4	52.0	141.4	52.0
Kalimantan Timur	35.0	43.3	14.3	18.0	105.7	19.2	155.0	80.5
Sulawesi Utara	-	-	-	-	-	-	-	-
Sulawesi Tangah	9.1	7.0	4.3		29.2	14.6	42.7	21.6
Sulawesi Selatan	28.7	41.1	10.3	14.6	35.0	38.4	74.0	94.1
Sulawesi Tenggara	-	-	-	-	-	-	-	-
Maluku	-	-	-	-	-	-	-	-
Irian Jaya	16.0	36.0	6.2	27.7	12.6		34.9	63.7
Total	**1,144**	**1,730**	**534**	**2,005**	**1,906**	**2,815**	**3,584**	**6,550**

Source: Directorate General of Estates (2001). Park_2002-08-27

Table A8.3: Export taxes for palm oil and products

Description	Export Tax (%)	
	Old [1]	New [2]
Oil Palm and Palm Kernel	3	3
Crude Palm Oil (CPO)	3	3
Refined Bleached Deodorized Palm Oil (RBD PO)	1	1
Crude Olein (CRD Olein)	1	1
Refined Bleached Deodorized Palm Olein (RBD Olein)	1	1
RBD Olein - in branded package	0	0
Crude Palm Stearin	0	0
Refined Bleached Deodorized Palm Stearin (RBD Stearin)	0	0
Crude Palm Kernel Oil (CPKO)	0	0
Refined Bleached Deodorized Palm Kernel Oil (RBD PKO)	0	0
Crude Coconut Oil (CCO)	0	0
Refined Bleached Deodorized Coconut Oil (RBD CCO)	0	0

Note: 1 Effective March 1, 2001. Park_2003-02-10
2 Effective March 1, 2002.
Source: Gain Report Side 30, Foreign Agricultural Service (USDA).

Table A8.4: Export check prices (HPE) of palm oil and products

Description	Check Prices	
	Old [1]	New [2]
Oil Palm and Palm Nuts	35	35
Crude Palm Oil (CPO)	160	160
Refined Bleached Deodorized Palm Oil (RBD PO)	175	175
Crude Olein (CRD Olein)	165	165
Refined Bleached Deodorized Palm Olein (RBD Olein)	190	190

Note: The Export Check Prices (based prices) are the prices stipulated monthly by the Ministry of Industry and Trade; These have specific validity dates and are reveiwed monthly. Park_2003-02-10
1 Effective from March 13 to April 12, 2002.
2 Effective from April 13 to May 12, 2002.
Source: Gain Report Side 30, Foreign Agricultural Service (USDA).

Table A8.5: Distribution of monthly rainfall for selected stations in Malaysia (mm)

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Alor Setar	46	62	111	197	239	183	206	215	298	303	221	85	2166
Kota Bharu	185	71	91	91	115	134	151	168	189	307	700	550	2752
Kuala Trengganu	185	107	112	99	106	111	105	145	183	272	672	536	2633
Ipoh	166	139	188	250	221	144	152	153	193	298	285	233	2422
Kuala Lumpur	173	145	225	295	198	133	125	146	185	269	265	234	2393
Muar	125	120	171	227	203	234	233	230	220	232	230	161	2386
Mukah	670	425	305	162	153	174	157	192	254	273	308	482	3555
Kota Kinabalu	128	65	72	112	209	321	273	256	318	341	289	212	2596

Source: Oldeman & Frére (1982)

Table A8.6: Average oil yield for oil palm estates by states, tons per hectare, 2000

State	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
							tons per ha						
Johore	0.27	0.26	0.26	0.26	0.27	0.29	0.30	0.31	0.35	0.36	0.36	0.26	3.55
Kedah	0.18	0.20	0.21	0.21	0.25	0.30	0.37	0.38	0.39	0.34	0.33	0.26	3.42
Kelantan	0.18	0.16	0.15	0.17	0.16	0.14	0.16	0.19	0.22	0.26	0.24	0.19	2.22
Malacca	0.30	0.28	0.29	0.32	0.34	0.34	0.36	0.42	0.41	0.45	0.48	0.35	4.34
N. Sembilan	0.28	0.28	0.28	0.28	0.27	0.26	0.25	0.29	0.34	0.35	0.37	0.28	3.53
Pahang	0.24	0.22	0.23	0.24	0.23	0.21	0.21	0.25	0.31	0.35	0.34	0.27	3.10
Penang	0.24	0.26	0.26	0.25	0.27	0.28	0.30	0.31	0.32	0.28	0.29	0.23	3.29
Perak	0.26	0.25	0.27	0.32	0.32	0.34	0.40	0.41	0.43	0.39	0.39	0.27	4.05
Selangor	0.25	0.26	0.27	0.29	0.31	0.31	0.34	0.36	0.39	0.34	0.36	0.28	3.76
Terengganu	0.19	0.20	0.18	0.19	0.18	0.17	0.20	0.24	0.27	0.32	0.28	0.21	2.63
West Malaysia	0.25	0.24	0.24	0.26	0.26	0.26	0.27	0.30	0.34	0.35	0.35	0.26	3.38
Sabah	0.30	0.25	0.24	0.25	0.28	0.27	0.25	0.30	0.41	0.47	0.47	0.42	3.91
Sarawak	0.20	0.16	0.19	0.20	0.19	0.17	0.18	0.26	0.30	0.29	0.28	0.22	2.64
Sabah+Sarawak	0.28	0.23	0.23	0.24	0.26	0.25	0.23	0.29	0.39	0.43	0.43	0.38	3.64
Malaysia	0.26	0.24	0.24	0.25	0.26	0.25	0.26	0.30	0.35	0.38	0.37	0.30	3.46

Source: MPOB (2001). Park_2002-02-25

Table A8.7: Area under oil palm by state and production scheme, hectares, 2000

State	Estates	Smallholders	FELDA	FELCRA	RISDA	State Schemes	Total
				hectares			
Johore	339,338	125,460	124,335	23,823	4,207	17,553	634,716
Kedah	45,105	10,046	261	1,479	484		57,375
Kelantan	19,685	1,129	34,619	6,413	448	9,771	72,065
Malacca	34,886	4,230	1,444	2,589	710		43,859
N. Sembilan	78,706	11,022	24,761	7,199	1,655		123,343
Pahang	181,419	16,683	235,986	30,519	10,262	39,841	514,710
Penang	7,198	6,869		542	56		14,665
Perak	184,369	53,090	21,849	32,740	2,709	8,776	303,533
Selangor	91,018	33,408	916	5,241	272	4,612	135,467
Terengganu	56,044	4,042	30,907	23,858	16,208	14,708	145,767
West Malaysia	1,037,768	265,979	475,078	134,403	37,011	95,261	2,045,500
Sabah	754,798	48,032	114,920	4,682		78,345	1,000,777
Sarawak	231,720	6,807	8,192	15,272		68,396	330,387
Sabah+Sarawak	986,518	54,839	123,112	19,954		146,741	1,331,164
Malaysia	2,024,286	320,818	598,190	154,357	37,011	242,002	3,376,664

Source: MPOB (2001). Park_2002-02-25

Table A8.8: Suitable and available area for palm oil in West Malaysia

State	Suitable	Available areas				
	Areas	Forest	Swamps	Scrub	Grassland	Total
			hectares			
Pahang	2 124 768	935 769	299 883	66 824	11 469	1 313 945
Johore	1 669 263	396 802	149 267	35 488	7 893	589 450
Perak	928 560	99 135	139 663	27 598	12 109	278 505
Terengganu	661 614	247 357	78 530	54 418	4 103	384 408
Selangor	606 912	49 381	178 146	6 447	2 840	236 814
N. Sembilan	433 037	49 895	7 806	10 658	8 068	76 427
Kelantan	338 893	107 641	257	21 161	413	129 472
Malacca	160 917	8 446	7 991	321	189	16 947
Penang	78 928	661	4 481	595	162	5 899
W. Persekutuan	-	-	-	7	-	7
Total	7 237 965	1 901 335	874 526	225 855	48 718	3 031 874

Note: 1. Available areas are both suitable and available for oil palm.
2. Figures are rounded up to the nearest hectare.

Source: PORIM (1993). Park_2002-02-25

Table A8.9: Production systems of oil palm at the selected estates in Perak (Malaysia), Riau and North Sumatra provinces (Indonesia) - Part 1 -

	Malaysia Southern Perak private estate Oil palm	Indonesia Western Riau ind. smallholder Oil palm	Central Riau state estate Oil palm	North Sumatra private estate Oil palm
System				
Share %	100	100	100	100
Seasonality	Perennial crop	Perennial crop	Perennial crop	Perennial crop
Crop rotation	Oil palm monoculture	Oil palm monoculture	Oil palm monoculture	Oil palm monoculture
Soil cultivation	conventional	manual	conventional	conventional
Harvest				
Amount / yr	every 10th day	every 14th day	every 10th day	every 10th day
Month	year around	year around	year around	year around
Yield t / ha				
FFB	23,3	15,4	19,1	21,2
CPO	5,1	3,4	4,2	4,9
PK	1,4	0,6	0,8	0,9
Fertilization				
N-Fertilization				
Amount of applications	2	2	2	2
Type of fertilizer	Ammonium nitrate	ZA (Ammonium Sulphate)	ZA (Ammonium Sulphate)	ZA (Ammonium Sulphate)
Nutrient values (%)	34,5N	21N	21N	21N
Application (date, kg/ha)	114 (during dry period)	37 (during dry period)	67 (during dry period)	56 (during dry period)
Formula	granule	granule	granule	granule
Machine	manual	manual	manual	manual
P-Fertilization				
Amount of applications	2	2	2	2
Type of fertilizer	Rock Phosphate	Triple Superphosphate	Rock Phosphate	Rock Phosphate
Nutrient values (%)	29P	44P	32P	32P
Application (date, kg/ha)	19 (in dry period)	14 (in dry period)	27 (in dry period)	39 (in dry period)
Formula	granule	granule	granule	granule
Machine	manual	manual	manual	manual
K-Fertilization				
Amount of applications	2	2	2	2
Type of fertilizer	Muriate of Potash (KCl) + Bash	Potassium Chloride (KCl)	Potassium Chloride (KCl)	Potassium Chloride (KCl)
Nutrient values (%)	60K + 30K	60K	60K	60K
Application (date, kg/ha)	207 (during dry period)	94 (during dry period)	192 (during dry period)	173 (during dry period)
Formula	granule	granule	granule	granule
Machine	manual	manual	manual	manual
Boron-Fertilization				
Amount of applications	2	none	1	1
Type of fertilizer	Bash		Dolomite	Dolomite
Nutrient values (%)	30Mg		13Mg + 22CaO	13Mg + 22CaO
Application (date, kg/ha)	19 (during dry period)		17 (during dry period)	11 (during dry period)
Formula	granule		granule	granule
Machine	manual		manual	manual

Table A8.9: Production systems of oil palm at the selected estates in Perak (Malaysia), Riau and North Sumatra provinces (Indonesia) - Part 2 -

	Malaysia Southern Perak private estate Oil palm	Western Riau ind. smallholder Oil palm	Indonesia Central Riau state estate Oil palm	North Sumatra private estate Oil palm
Weeding and plant protection				
Circle weeding	manual + selectively chemical	manual	manual + selectively chemical	manual + selectively chemical
Amount of operations	every 3rd month	every 3rd month	every 3rd month	every 3rd month
Brand name	Round up / Paraquat / Gramoxone		Round up / Paraquat / Gramoxone	Round up / Paraquat / Gramoxone
Active ingredient	Glyphosate / Paraquate		Glyphosate / Paraquate	Glyphosate / Paraquate
Danger	grasses	grasses	grasses	grasses
Art of application	manual with sparyer manual weeding with sickle / hoe	manual weeding with sickle / hoe	manual with sparyer manual weeding with sickle / hoe	manual with sparyer manual weeding with sickle / hoe
Inter-row weeding	manual + selectively	manual	manual + selectively	manual + selectively
Amount of operations	every 3rd month	every 3rd month	every 3rd month	every 3rd month
Brand name	Round up / Paraquat / Gramoxone		Round up / Paraquat / Gramoxone	Round up / Paraquat / Gramoxone
Active ingredient	Glyphosate / Paraquate		Glyphosate / Paraquate	Glyphosate / Paraquate
Danger	grasses	grasses	grasses	grasses
Art of application	manual with sparyer manual weeding with sickle / hoe	manual weeding with sickle / hoe	manual with sparyer manual weeding with sickle / hoe	manual with sparyer manual weeding with sickle / hoe
Pest and disease cotrol (census)	manual	manual	manual	manual
Amount of operations	weekly	weekly	weekly	weekly
Pesticides/Insecticides	selectively	rarely	selectively	selectively
Danger	rats, snakes, ants, other	rats, snakes, ants, other	rats, snakes, ants, other	rats, snakes, ants, other
Fungicides	rarely	rarely	rarely	rarely
Harvest and post-harvest activities				
Harvest				
Amount of operations	year around	year around	year around	year around
Month	year around	year around	year around	year around
Art of harvesting	manual	manual	manual	manual
Transport				
Art of transport	trailer with tractor or truck to mill	sold at the farmgate/field to a wholesaler	trailer with tractor or custom to mill	trailer with tractor or truck to mill
Processing				
Share of harvest for process (%)	100	-	100	100
Storage before processing (hrs.)	up to 24	up to 12 (field/yard)	up to 24	up to 24
Technology	modern mill	-	modern mill	modern mill
Processing capacity (t FFB/hr)	30	-	15	15
Estimated total input FFB (t/yr)	100.200	30.8	47.800	48.800
Estimated total output CPO (t/yr)	22.000	6.8	10.500	11.200
Storage / Marketing				
Type of storage	storage tanks	-	storage tanks	storage tanks
Share of stored CPO (%)	100	-	100	100
Length of storage (days)	variable	-	variable	variable
Delivery point	Port Klang	-	Port Dumai	Port Belawan
Distance	about 120 km	-	about 120 km	about 50 km

Source: own data collection Park_2002-02-25

Part 9

International comparison

Table A9.1: Oilseeds: Total production costs, Euro per ha - Part 1 -

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Crop	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans
Key name	CA-1214BR	CA-2430BR	CA-1215BL	CA-2020BL	DE-700MV	DE-1500MV	DE-560MB	DE-1300MB	CN-1ANH	AR-250ASF	AR-350CO	AR-1500BA	BR-500UB	BR-1000RV
Farm size (ha)	1,214	2,430	1,214	2,024	700	1,500	560	1,300	0.3	250	350	1,500	500	1,000
Share of oilseed (%)	20	20	27	27	26	26	16	16	100	50	60	50	60	70
Yield (ton per ha):	1.4	1.4	1.7	1.7	4.0	4.0	3.9	3.9	2.1	2.5	2.4	2.6	2.4	3.2
Country	Canada	Canada	Canada	Canada	Germany	Germany	Germany	Germany	China	Argentina	Argentina	Argentina	Brazil	Brazil
Region	Saskatchewan	Saskatchewan	Saskatchewan	Saskatchewan	Mecklenburg-Vorpommern	Mecklenburg-Vorpommern	Magdeburger Börde	Magdeburger Börde	Anhui	Venado Tuerto	Canals	Junin	Uberaba	Rio Verde
Market price	227.6	227.6	286.1	286.1	812.2	812.2	737.8	737.8	494.9	421.1	338.2	437.9	292.5	362.7
Government Payment 1 Per Crop	-	-	-	-	558.2	555.7	432.3	432.3	-	-	-	-	-	-
Government Payment 2 Per Crop	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Direct Gov. Payments per farm	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Market price plus subsidies	**227.6**	**227.6**	**292.2**	**286.1**	**1,370.4**	**1,367.9**	**1,170.1**	**1,170.1**	**494.9**	**421.1**	**338.2**	**437.9**	**292.5**	**362.7**
Seed	22.2	22.2	23.6	23.6	40.5	40.5	47.1	47.0	13.7	28.2	26.8	25.4	16.0	20.4
Fertilizer	18.2	18.2	40.8	40.8	154.7	154.7	90.3	90.3	52.6	-	-	-	50.0	52.8
Herbicides	51.9	51.9	50.6	50.6	61.4	61.4	61.4	61.4	17.2	12.5	12.1	25.2	43.4	36.8
Fungicides and insecticides	-	-	5.5	5.5	93.6	93.6	85.4	85.4	4.3	7.4	8.4	3.5	8.9	6.5
Other costs	12.5	12.5	12.9	12.9	5.4	5.9	5.1	5.1	-	10.5	8.5	10.9	1.2	1.9
Direct Cost	**104.8**	**104.8**	**133.4**	**133.4**	**355.5**	**355.9**	**289.2**	**289.2**	**87.9**	**58.6**	**55.7**	**65.0**	**119.5**	**118.4**
Maintenance Machinery	15.3	15.3	12.2	11.7	58.2	54.8	53.0	42.2	-	14.1	10.8	7.2	9.7	7.9
Fuel and lube	13.7	12.7	14.7	12.6	47.5	43.0	40.5	29.5	-	13.0	11.3	15.4	15.5	12.6
Depreciation Machinery	33.7	28.9	32.7	32.3	114.5	107.9	112.5	91.4	9.7	10.8	5.9	4.4	19.1	15.8
Custom Work	-	-	3.2	3.2	2.3	2.2	-	-	-	73.6	83.4	76.6	7.1	10.0
Equip. Liability Insurance	1.7	0.9	1.6	0.8	0.7	0.4	0.9	0.5	-	-	-	-	-	-
Wages	3.6	5.3	4.9	7.7	122.1	121.8	88.5	104.5	-	-	16.1	26.5	11.8	19.6
Unpaid Labour	26.1	17.3	19.9	15.4	93.7	51.6	95.4	60.3	396.1	22.9	17.1	10.9	10.5	4.5
Operating Cost	**94.2**	**80.3**	**89.1**	**83.6**	**438.9**	**381.8**	**390.7**	**328.4**	**405.8**	**134.4**	**144.6**	**141.0**	**73.6**	**70.4**
Land improvement	-	-	0.1	0.1	7.6	7.3	1.0	1.0	-	-	-	-	-	-
Maintenance Buildings	0.6	0.3	0.4	0.3	2.1	1.6	6.8	5.5	-	7.9	2.3	2.8	0.3	1.2
Depreciation Buildings	4.2	3.6	4.7	4.1	17.0	13.9	18.4	15.2	-	2.4	1.9	0.7	0.9	0.8
Farm insurance	2.2	2.1	1.8	2.1	7.2	6.9	9.1	7.8	-	-	2.3	-	0.8	0.5
Farm taxes and duties	7.0	6.8	7.2	7.1	24.2	24.1	28.7	27.6	-	5.9	18.0	16.9	0.5	0.0
Member Fees	0.4	-	0.7	-	-	-	12.0	9.0	-	-	-	-	-	-
Invalidity insurance	-	-	-	-	14.2	14.1	23.7	23.4	-	1.5	5.7	0.8	0.2	0.0
Energy, Water,	1.5	1.2	1.7	1.1	3.7	3.7	2.0	1.6	27.7	0.6	2.3	3.8	1.0	0.3
Other Overheads	5.4	3.5	4.7	3.9	26.1	18.9	34.0	19.1	-	2.8	14.8	7.7	2.3	4.6
Overhead Cost	**21.4**	**17.5**	**21.3**	**18.6**	**102.1**	**90.4**	**135.6**	**110.3**	**27.7**	**21.1**	**47.2**	**32.8**	**6.0**	**7.5**
Paid Interest	4.0	4.9	3.3	4.5	28.7	19.2	27.9	20.5	0.0	7.7	12.6	17.2	6.6	12.9
Unpaid Interest	10.7	7.6	12.3	9.7	23.0	23.9	23.3	17.6	4.9	12.7	7.7	7.7	4.5	1.0
Interest Cost	**14.7**	**12.5**	**15.6**	**14.2**	**51.7**	**43.1**	**51.2**	**38.1**	**4.9**	**20.4**	**20.3**	**24.9**	**11.1**	**13.9**
Paid rent for land	15.6	23.4	27.1	36.3	105.9	105.1	134.4	134.4	56.8	48.4	22.8	34.3	26.8	13.6
Unpaid Rent for land	23.4	15.6	27.1	17.9	18.7	18.5	33.6	33.6	-	85.4	27.0	61.7	17.6	13.6
Land Cost	**39.0**	**39.0**	**54.2**	**54.2**	**124.6**	**123.7**	**168.0**	**168.0**	**56.8**	**133.8**	**49.8**	**96.0**	**44.4**	**27.2**
Total Cost 1	**274**	**254**	**314**	**304**	**1,073**	**995**	**1,035**	**934**	**583**	**368**	**318**	**360**	**255**	**237**
Establishment costs														
Processing costs														
Total Cost 2	**274**	**254**	**314**	**304**	**1,073**	**995**	**1,035**	**934**	**583**	**368**	**318**	**360**	**255**	**237**

Table A9.1: Oilseeds: Total production costs, Euro per ha - Part 2 -

	17	18	19	20	21	22	15	16	23	24	25	26		
Crop	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans	FFB	FFB	FFB	FFB	Min	Max
Key name	US-710ND	US-1900ND	US-1010RRV	US-1940RRV	US-400MN	US-810MN	CN-4HEI	CN-1SHA	ID-2RI	ID-2500RI	ID-2300NS	MY-4300PE		
Farm size (ha)	713	1.903	1.012	1.943	405	810	4,3	1,2	2,0	2.500	2.300	4.300		
Share of oilseed (%)	32	32	28	30	50	50	36	83	100	100	100	100		
Yield (ton per ha):	2,0	2,0	2,0	2,0	3,1	3,3	2,0	2,3	15,4	19,1	21,2	23,3		
Country	USA	USA	USA	USA	USA	USA	China	China	Indonesia	Indonesia	Indonesia	Malaysia		
Region	North Dakota	North Dakota	Red River Valley	Red River Valley	Minnesota	Minnesota	Heilongjang	Shandong	Riau	Riau	North Sumatra	Perak		
Market price	364,2	364,2	325,9	317,4	529,8	590,6	488,9	646,4	983,4	1.239,0	1.441,8	1.654,1	**227,6**	**1.654,1**
Government Payment 1 Per Crop	60,4	60,4	76,2	76,2	123,1	123,1	-	-	-	-	-	-	-	**558,2**
Government Payment 2 Per Crop	63,3	63,3	85,1	85,1	126,8	135,1	-	-	-	-	-	-	-	**135,1**
Direct Gov. Payments per farm	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Market price plus subsidies	**487,8**	**487,8**	**487,2**	**478,7**	**779,6**	**848,7**	**488,9**	**646,4**	**983,4**	**1.239,0**	**1.441,8**	**1.654,1**	**227,6**	**1.654,1**
Seed	43,1	42,7	40,2	40,2	66,6	66,6	31,3	19,4	-	-	-	-	-	**66,6**
Fertilizer	18,7	18,0	20,1	20,1	23,7	23,0	54,8	48,8	55,3	117,1	93,7	76,7	-	**154,7**
Herbicides	47,5	45,5	52,7	49,4	42,6	38,3	8,1	17,6	-	11,1	8,3	5,6	-	**61,4**
Fungicides and insecticides	-	-	-	-	-	-	3,9	1,0	-	-	-	-	-	**93,6**
Other costs	20,8	20,8	19,8	19,8	34,7	35,0	-	-	-	-	-	-	-	**35,0**
Direct Cost	**130,1**	**126,9**	**132,8**	**129,5**	**167,6**	**162,9**	**98,2**	**86,8**	**55,3**	**128,1**	**102,0**	**82,3**	**55,3**	**355,9**
Maintenance Machinery	29,2	18,4	33,2	23,6	42,7	39,2	2,1	-	-	7,0	7,1	16,4	-	**58,2**
Fuel and lube	20,8	17,2	21,2	20,2	26,5	21,2	5,3	4,0	-	5,0	15,2	19,0	-	**47,5**
Depreciation Machinery	41,9	41,6	35,2	31,2	69,1	53,0	11,1	11,0	6,6	16,9	29,0	21,9	**4,4**	**114,5**
Custom Work	6,9	6,9	-	24,0	8,1	5,7	41,8	11,8	-	56,5	-	-	-	**83,4**
Equip. Liability Insurance	0,5	0,3	0,7	0,5	3,9	2,3	-	-	-	31,0	23,6	-	-	**31,0**
Wages	8,8	19,6	53,8	52,5	1,4	28,9	-	-	-	204,1	162,3	246,1	-	**246,1**
Unpaid Labour	46,5	30,0	35,8	24,3	66,0	50,7	113,4	226,8	178,2	-	-	-	-	**396,1**
Operating Cost	**154,6**	**134,0**	**180,0**	**176,4**	**217,7**	**201,0**	**173,7**	**253,6**	**184,8**	**320,4**	**237,1**	**303,4**	**70,4**	**438,9**
Land improvement	-	-	-	-	1,3	1,3	-	-	-	36,2	18,4	10,4	-	**36,2**
Maintenance Buildings	1,5	0,9	1,6	1,3	4,3	3,2	-	-	-	12,5	9,5	10,8	-	**12,5**
Depreciation Buildings	7,6	5,6	6,2	4,7	12,9	18,6	-	1,3	-	0,4	1,9	0,6	-	**18,6**
Farm insurance	4,6	3,9	7,4	5,3	8,0	6,7	-	-	-	0,6	1,0	1,7	-	**9,1**
Farm taxes and duties	3,5	15,3	16,2	13,1	9,9	13,3	6,1	-	-	14,5	22,0	-	-	**28,7**
Member Fees	-	-	-	-	2,7	-	-	-	77,4	18,7	26,4	-	-	**77,4**
Invalidity insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	**23,7**
Energy, Water,	1,8	0,9	1,3	0,8	5,5	2,8	-	-	-	8,8	6,9	21,3	-	**27,7**
Other Overheads	6,3	7,3	5,8	7,2	14,2	12,6	-	-	-	1,4	1,2	31,6	-	**34,0**
Overhead Cost	**25,3**	**34,0**	**38,5**	**32,4**	**58,9**	**58,5**	**6,1**	**1,3**	**77,4**	**93,0**	**87,3**	**76,3**	**1,3**	**135,6**
Paid Interest	10,4	9,3	6,3	12,7	41,6	35,4	0,0	0,0	0,5	6,8	2,7	1,7	**0,0**	**41,6**
Unpaid Interest	16,4	14,4	10,5	10,4	8,7	12,4	5,6	6,0	9,2	33,9	35,4	23,6	**1,0**	**35,4**
Interest Cost	**26,9**	**23,8**	**16,8**	**23,1**	**50,3**	**47,8**	**5,6**	**6,0**	**9,8**	**40,7**	**38,1**	**25,3**	**4,9**	**51,7**
Paid rent for land	68,7	57,8	123,5	130,2	220,4	250,5	162,1	15,4	-	-	-	16,3	-	**250,5**
Unpaid rent for land	20,2	31,1	58,1	51,5	73,5	83,5	-	-	-	-	-	-	-	**85,4**
Land Cost	**88,9**	**88,9**	**181,7**	**181,7**	**293,9**	**333,9**	**162,1**	**15,4**	**-**	**-**	**-**	**16,3**	**-**	**333,9**
Total Cost 1	**426**	**408**	**550**	**543**	**788**	**804**	**446**	**363**	**327**	**582**	**464**	**504**	**237**	**1.073**
Establishment costs									133	171	164	194	133	194
Processing costs									99	139	124	166	99	166
Total Cost 2	**426**	**408**	**550**	**543**	**788**	**804**	**446**	**363**	**560**	**893**	**752**	**863**	**237**	**1.073**

Source: Own data collection and calculations (2002).

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Table A9.2: Oilseeds: Total production costs, Euro per ton RE - Part 1 -

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Crop	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Rapeseed	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans
Key name	CA-1214BR	CA-2430BR	CA-1215BL	CA-2020BL	DE-700MV	DE-1500MV	DE-560MB	DE-1300MB	CN-1ANH	AR-250ASF	AR-350CO	AR-1500BA	BR-500UB	BR-1000RV
Farm size (ha)	1,214	2,430	1,214	2,024	700	1,500	560	1,300	0.34	250	350	1,500	500	1,000
Share of oilseed (%)	20	20	27	27	26	26	16	16	100	50	60	50	60	70
Yield (ton per ha):	1.4	1.4	1.7	1.7	4.0	4.0	3.9	3.9	2.1	2.5	2.4	2.6	2.4	3.2
Country	Canada	Canada	Canada	Canada	Germany	Germany	Germany	Germany	China	Argentina	Argentina	Argentina	Brazil	Brazil
Region	Saskatchewan	Saskatchewan	Saskatchewan	Saskatchewan	Mecklenburg-Vorpommern	Mecklenburg-Vorpommern	Magdeburger Börde	Magdeburger Börde	Anhui	Venado Tuerto	Canals	Junin	Uberaba	Rio Verde
Market price	168.6	168.6	170.3	170.3	203.1	203.1	189.2	189.2	234.5	167.8	140.4	167.8	121.4	112.9
Government Payment 1	-	-	-	-	139.5	138.9	110.8	110.8	-	-	-	-	-	-
Government Payment 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Direct Gov. Payments per farm	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Market price plus Subsidies	**168.6**	**168.6**	**170.3**	**170.3**	**342.6**	**342.0**	**300.0**	**300.0**	**234.5**	**167.8**	**140.4**	**167.8**	**121.4**	**112.9**
Seed	16.5	16.5	14.1	14.1	10.1	10.1	12.1	12.1	6.5	11.2	11.1	9.7	6.6	6.4
Fertiliser	13.5	13.5	24.3	24.3	38.7	38.7	23.2	23.2	24.9	-	-	-	20.7	16.4
Herbicides	38.4	38.4	30.1	30.1	15.3	15.3	15.7	15.7	8.1	5.0	5.0	9.6	18.0	11.4
Fungicides and insecticides	-	-	3.3	3.3	23.4	23.4	21.9	21.9	2.0	2.9	3.5	1.3	3.7	2.0
Other	9.2	9.2	7.7	7.7	1.3	1.5	1.3	1.3	-	4.2	3.5	4.2	0.5	0.6
Direct Cost	**77.6**	**77.6**	**79.4**	**79.4**	**88.9**	**89.0**	**74.2**	**74.2**	**41.6**	**23.4**	**23.1**	**24.9**	**49.6**	**36.9**
Maintenance machinery	11.3	11.3	7.3	6.9	14.6	13.7	13.6	10.8	-	5.6	4.5	2.7	4.0	2.5
Fuel and lube	10.2	9.4	8.7	7.5	11.9	10.7	10.4	7.6	-	5.2	4.7	5.9	6.4	3.9
Depreciation machinery	25.0	21.4	19.5	19.2	28.6	27.0	28.8	23.4	4.6	4.3	2.4	1.7	7.9	4.9
Custom work	-	-	1.9	1.9	0.6	0.6	-	-	-	29.3	34.6	29.3	3.0	3.1
Other	1.3	0.7	0.9	0.5	0.2	0.1	0.2	0.1	-	-	-	-	-	-
Wage	2.7	3.9	2.9	4.6	30.5	30.5	22.7	26.8	-	-	6.7	10.1	4.9	6.1
Unpaid labour	19.3	12.8	11.9	9.2	23.4	12.9	24.5	15.5	187.7	9.1	7.1	4.2	4.4	1.4
Operating Cost	**69.8**	**59.5**	**53.1**	**49.8**	**109.7**	**95.4**	**100.2**	**84.2**	**192.3**	**53.6**	**60.0**	**54.0**	**30.6**	**21.9**
Land improvement	-	-	0.1	0.0	1.9	1.8	0.3	0.3	-	-	-	-	-	-
Maintenance buildings	0.5	0.2	0.3	0.2	0.5	0.4	1.8	1.4	-	3.2	1.0	1.1	0.1	0.4
Depreciation buildings	3.1	2.6	2.8	2.5	4.2	3.5	4.7	3.9	-	1.0	0.8	0.3	0.4	0.2
Farm insurance	1.6	1.6	1.1	1.2	1.8	1.7	2.3	2.0	-	-	0.9	-	0.3	0.2
Farm taxes and duties	5.2	5.0	4.3	4.2	6.1	6.0	7.3	7.1	-	2.4	7.5	6.5	0.2	0.0
Member Fees	0.3	-	0.4	-	-	-	3.1	2.3	-	-	-	-	-	-
Invalidity insurance	-	-	-	-	3.6	3.5	6.1	6.0	-	0.6	2.4	0.3	0.1	0.0
Energy, Water,	1.1	0.9	1.0	0.7	0.9	0.9	0.5	0.4	13.1	0.2	0.9	1.5	0.4	0.1
Other Overheads	4.0	2.6	2.8	2.3	6.5	4.7	8.7	4.9	-	1.1	6.1	3.0	1.0	1.4
Overhead Cost	**15.8**	**13.0**	**12.7**	**11.1**	**25.5**	**22.6**	**34.8**	**28.3**	**13.1**	**8.4**	**19.6**	**12.6**	**2.5**	**2.3**
Paid interest	3.0	3.6	2.0	2.7	7.2	4.8	7.2	5.3	0.0	3.1	5.2	6.6	2.7	4.0
Unpaid interest	7.9	5.6	7.3	5.8	5.8	6.0	6.0	4.5	2.3	5.0	3.2	2.9	1.9	0.3
Interest Cost	**10.9**	**9.3**	**9.3**	**8.5**	**12.9**	**10.8**	**13.1**	**9.8**	**2.3**	**8.1**	**8.4**	**9.5**	**4.6**	**4.3**
Paid rent for land	11.6	17.3	16.1	21.6	26.5	26.3	34.5	34.5	26.9	19.3	9.5	13.1	11.1	4.2
Unpaid rent for land	17.3	11.6	16.1	10.6	4.7	4.6	8.6	8.6	-	34.0	11.2	23.6	7.3	4.2
Land Cost	**28.9**	**28.9**	**32.2**	**32.2**	**31.2**	**30.9**	**43.1**	**43.1**	**26.9**	**53.3**	**20.7**	**36.8**	**18.4**	**8.5**
Total Cost 1	**203**	**188**	**187**	**181**	**268**	**249**	**265**	**239**	**276**	**147**	**132**	**138**	**106**	**74**
Establishment costs														
Processing costs														
Total Cost 2	**203**	**188**	**187**	**181**	**268**	**249**	**265**	**239**	**276**	**147**	**132**	**138**	**106**	**74**

Table A9.2: Oilseeds: Total production costs, Euro per ton RE - Part 2 -

	15	16	17	18	19	20	21	22	23	24	25	26		
Crop	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans	Soybeans	Palm oil	Palm oil	Palm oil	Palm oil	Min	Max
Key name	US-710ND	US-1900ND	US-1010RRV	US-1940RRV	US-400MN	US-810MN	CN-4HEI	CN-1SHA	ID-2RI	ID-2500RI	ID-2300NS	MY-4300PE		
Farm size (ha)	713	1,903	1,012	1,943	405	810	4.3	1.2	2.0	2,500	2,300	4,300		
Share of oilseed (%)	32	32	28	30	50	50	36	83	100	100	100	100		
Yield (ton per ha):	2.0	2.0	2.0	2.0	3.1	3.3	2.0	2.3	15.4	19.1	21.2	23.3		
Country	USA	USA	USA	USA	USA	USA	China	China	Indonesia	Indonesia	Indonesia	Malaysia		
Region	North Dakota	North Dakota	Red River Valley	Red River Valley	Minnesota	Minnesota	Heilongjang	Shandong	Riau	Riau	North Sumatra	Perak		
Market price	179.6	179.6	160.7	156.5	171.4	179.4	249.8	286.2	177.5	177.5	179.3	189.5	112.9	286.2
Government Payment 1	29.8	29.8	37.6	37.6	39.8	37.4	-	-	-	-	-	-	-	139.5
Government Payment 2	31.2	31.2	42.0	42.0	41.0	41.0	-	-	-	-	-	-	-	42.0
Direct Gov. Payments per farm	61.0	61.0	79.6	79.6	80.8	78.4	-	-	-	-	-	-	-	80.8
Market price plus Subsidies	**240.6**	**240.6**	**240.3**	**236.1**	**252.2**	**257.8**	**249.8**	**286.2**	**177.5**	**177.5**	**179.3**	**189.5**	**112.9**	**342.6**
Seed	21.3	21.1	19.8	19.8	21.5	20.2	16.0	8.6	-	-	-	-	-	21.5
Fertiliser	9.2	8.9	9.9	9.9	7.7	7.0	28.0	21.6	10.1	17.2	12.4	9.2	-	38.7
Herbicides	23.4	22.4	26.0	24.3	13.8	11.6	4.1	7.8	-	1.6	1.1	0.7	-	38.4
Fungicides and insecticides	-	-	-	-	-	-	2.0	0.4	-	-	-	-	-	23.4
Other	10.2	10.2	9.7	9.7	11.2	10.6	-	-	-	-	-	-	-	11.2
Direct Cost	**64.2**	**62.6**	**65.5**	**63.9**	**54.2**	**49.5**	**50.2**	**38.4**	**10.1**	**18.8**	**13.5**	**9.9**	**9.9**	**89.0**
Maintenance machinery	14.4	9.1	16.4	11.7	13.8	11.9	1.1	-	-	1.0	0.9	2.0	-	16.4
Fuel and lube	10.3	8.5	10.5	10.0	8.6	6.5	2.7	1.8	-	0.7	2.0	2.3	-	11.9
Depreciation machinery	20.7	20.5	17.4	15.4	22.3	16.1	5.7	4.9	1.2	2.5	3.8	2.6	1.2	28.8
Custom work	3.4	3.4	-	11.9	2.6	1.7	21.3	5.2	-	8.3	-	-	-	34.6
Other	0.2	0.1	0.4	0.2	1.3	0.7	-	-	-	4.6	3.1	-	-	4.6
Wage	4.3	9.7	26.6	25.9	0.4	8.8	-	-	-	30.0	21.5	29.6	-	30.5
Unpaid labour	22.9	14.8	17.7	12.0	21.3	15.4	57.9	100.4	32.5	-	-	-	-	187.7
Operating Cost	**76.3**	**66.1**	**88.8**	**87.0**	**70.4**	**61.1**	**88.8**	**112.3**	**33.7**	**47.1**	**31.4**	**36.5**	**21.9**	**192.3**
Land improvement	-	-	-	-	0.4	0.4	-	-	-	5.3	2.4	1.3	-	5.3
Maintenance buildings	0.7	0.5	0.8	0.6	1.4	1.0	-	-	-	1.8	1.3	1.3	-	3.2
Depreciation buildings	3.8	2.8	3.1	2.3	4.2	5.6	-	0.6	-	0.1	0.3	0.1	-	5.6
Farm insurance	2.2	1.9	3.6	2.6	2.6	2.0	-	-	-	0.1	0.1	0.2	-	3.6
Farm taxes and duties	1.7	7.6	8.0	6.4	3.2	4.0	3.1	-	-	2.1	2.9	-	-	8.0
Member Fees	-	-	-	-	0.9	-	-	-	14.1	2.7	3.5	-	-	14.1
Invalidity insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	6.1
Energy, Water,	0.9	0.5	0.6	0.4	1.8	0.9	-	-	-	1.3	0.9	2.6	-	13.1
Other Overheads	3.1	3.6	2.9	3.5	4.6	3.8	-	-	-	0.2	0.2	3.8	-	8.7
Overhead Cost	**12.5**	**16.8**	**19.0**	**16.0**	**19.1**	**17.8**	**3.1**	**0.6**	**14.1**	**13.7**	**11.6**	**9.2**	**0.6**	**34.8**
Paid interest	5.1	4.6	3.1	6.2	13.4	10.8	0.0	0.0	0.1	1.0	0.4	0.2	0.0	13.4
Unpaid interest	8.1	7.1	5.2	5.1	2.8	3.8	2.9	2.7	1.7	5.0	4.7	2.8	0.3	8.1
Interest Cost	**13.3**	**11.7**	**8.3**	**11.4**	**16.3**	**14.5**	**2.9**	**2.7**	**1.8**	**6.0**	**5.0**	**3.0**	**1.8**	**16.3**
Paid rent for land	33.9	28.5	60.9	64.2	71.3	76.1	82.8	6.8	-	-	-	2.0	-	82.8
Unpaid rent for land	10.0	15.3	28.7	25.4	23.8	25.4	-	-	-	-	-	-	-	34.0
Land Cost	**43.8**	**43.8**	**89.6**	**89.6**	**95.1**	**101.4**	**82.8**	**6.8**	**-**	**-**	**-**	**2.0**	**-**	**101.4**
Total Cost 1	**210**	**201**	**271**	**268**	**255**	**244**	**228**	**161**	**60**	**86**	**61**	**61**	**60**	**276**
Establishment costs									24	25	22	23	22	25
Processing costs									18	20	16	20	16	20
Total Cost 2	**210**	**201**	**271**	**268**	**255**	**244**	**228**	**161**	**102**	**131**	**100**	**104**	**74**	**276**

Source: Own data collection and calculations (2002).

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