

ANNEX C9

PITA Project: Policy Influences on Technology for Agriculture:
Chemicals, Biotechnology and Seeds

KWS SAAT AG monograph

Annex C9

TSER Programme
European Commission - DG XII
Project No. PL 97/1280
Contract No. SOE1-CT97-1068

Jos Bijman and Marc-Jeroen Bogaardt

**Agricultural Economics Research Institute (LEI)
The Netherlands**

September 2000

Introduction to the PITA Project

Technological innovation in the agrochemical, biotechnology and seeds industries and in associated public sector research establishments (PSREs) has the potential to deliver more socially and environmentally sustainable farming systems and to improve the quality of life of citizens in Europe. This is particularly true of farms on the most fertile land. However, although policies developed in different areas may all aim to improve the quality of life, in practice, in their influence on company and PSRE strategies, they frequently counteract one another and so attenuate the desired effect.

Market-related factors also influence decision making in industry and PSREs, the most important for this project being the policies of food processors and distributors and also public attitudes and opinion, which often set more demanding standards than those of national governments and the EU.

The PITA project (see Project Structure) is developing an integrated analysis of policies and market-related factors relevant to the agrochemical, biotechnology and seeds sectors. The core of the project is an investigation of the impact of these factors on the strategies and decision making of companies and PSREs and the downstream implications of these decisions on employment, international competitiveness and environmental benefits. The final outcome will be feedback of our conclusions to policy makers and company managers.

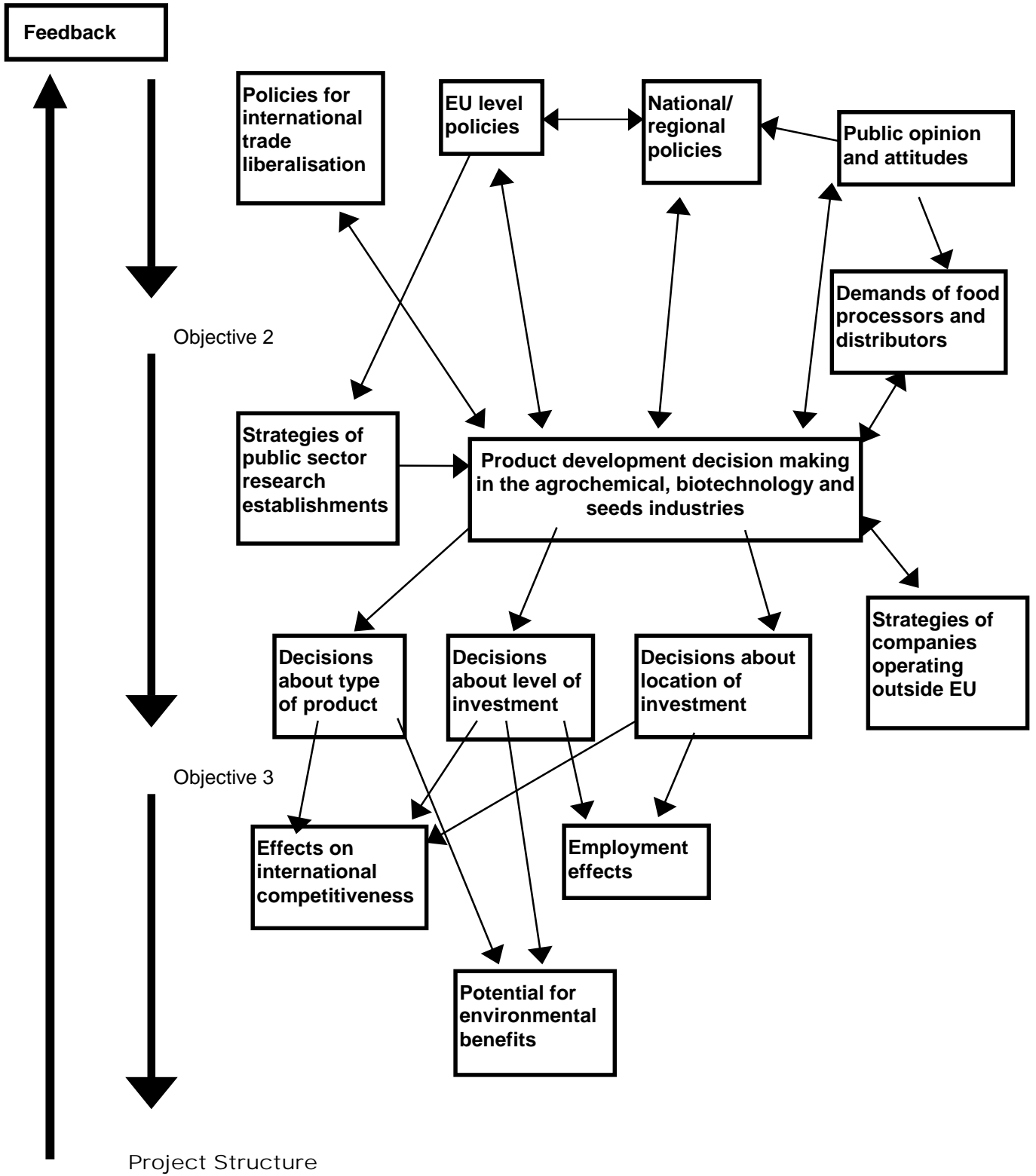
The range of policies and other influences studied includes:

- policies to stimulate innovation in the agrochemical, biotechnology and seeds industries;
- purchasing policies of food processors and distributors;
- policies for international trade liberalisation;
- policies for the regulation of industry and farming (for environmental protection and public health and safety, particularly for pesticides and biotechnology);
- agricultural and farming support policies, particularly for crop production;
- policies to promote environmental sustainability and wildlife biodiversity in arable farming areas;
- public opinion and attitudes.

The overall aim of the project is to contribute to the development of sustainable industrial and farming systems and an improved quality of life by encouraging the development and uptake of 'cleaner' technology for intensive agriculture. Its objectives are:

- to develop an integrated analysis of policies and market-related factors relevant to technological innovation in the agrochemical, biotechnology and seeds sectors, to study their interactions and to develop hypotheses about their impact on strategic decision making in industry and PSREs.
- to study the influence of policies and market-related factors on innovation strategies in the agrochemical, biotechnology and seeds industries and PSREs, and their impact on decisions about product development, levels of investment and location of investment.
- to study the outcomes of the industry decisions investigated under objective 2, in their effects on employment, on international competitiveness and on their potential to deliver environmental benefits.

Objective 1



Contents

1. INTRODUCTION	6
2. KWS SAAT AG	6
2.1 KEY FIGURES	6
2.2 KEY DEVELOPMENTS	7
2.3 BRIEF HISTORY OF KWS	9
3. INNOVATION STRATEGY	10
3.1 INTRODUCTION	10
3.2 CROPS AND TRAITS	10
3.3 BIOTECHNOLOGY	12
3.4 THE GABI PROJECT	13
4. INNOVATION DECISION MAKING STRUCTURE AND PROCESS	14
4.1 GENERAL DECISION MAKING STRUCTURE	14
4.2 INNOVATION DECISION MAKING PROCESS	15
5. INFLUENCE OF PUBLIC POLICIES AND MARKET DEVELOPMENT	16
5.1 INTRODUCTION	16
5.2 SCIENCE, TECHNOLOGY AND INNOVATION POLICIES	17
5.3 ENVIRONMENTAL PROTECTION, PUBLIC HEALTH AND BIODIVERSITY POLICIES	18
5.4 AGRICULTURE AND INTERNATIONAL TRADE POLICIES	18
5.5 MARKET CONDITIONS AND CONSUMER ATTITUDES	19
6. COMPANY DISCOURSE ON ENVIRONMENTAL ISSUES	20
7. CONCLUSIONS	21
7.1 INNOVATION STRATEGY	21
7.2 PUBLIC POLICY IMPACT ON INNOVATION	22
7.3 ENVIRONMENTAL ISSUES	23
SOURCES	24
WRITTEN MATERIAL	24
WEBSITES	24

ANNEX C9

APPENDIX 1.	25
SUBSIDIARIES	25
APPENDIX 2	27
ORGANISATIONAL POSITION OF KWS SUBSIDIARIES	27
APPENDIX 3.	28
GUIDING PRINCIPLES ON THE USE OF GENETIC ENGINEERING IN KWS	28



1. Introduction

This monograph reports on the innovation strategy of KWS Group, which consists of KWS SAAT AG and several of its subsidiaries. KWS is a German based seed company, supplying farmers with seeds for sugar beet, maize, cereals, oilseed rape and several other crops.

This report has been written on the basis of two kinds of sources: (1) material published by the company itself (annual reports, news releases, web site) and material published by others (in research reports, newspapers, trade journals); (2) interviews with several KWS managers. We thank these managers for their collaboration and for the information supplied.

This report contains many quotes, which are presented in italics and with borders. If quotes are taken from written sources, the source is mentioned. If quotes are from KWS managers, the individual source is not named.

This report is structured as follows. Section 2 gives general background information on KWS, particularly its strategy on the main crops in its portfolio. Section 3 describes the innovation strategies of the company. Special attention is given to biotechnology. In section 4 we discuss the KWS organisation of decision making on innovation. Section 5 presents the impact of public policies and market developments as they are felt by KWS. The next section presents the internal discourse on environmental and sustainability issues. Finally, in section 7, some conclusions are drawn on innovation strategies and decision making, on impact of public policies on innovation, and on environment issues in relation to innovation.

2. KWS SAAT AG

2.1 Key figures

KWS SAAT AG¹ is an international operating company developing, producing and marketing of agricultural seeds for temperate climate zones. KWS' core business lies in sugar beet (more than 50 percent of turnover), maize and cereals (Table 1). Other crops include oilseeds (sunflower, oil seed rape, turnip, oil radish, mustard), grasses, potatoes and fodder beet. KWS is a global market leader in sugar beet seed, a market leader for maize in Germany, and a major player in maize and cereal seeds in other European countries.

Table 1 Sales of KWS Group by product group (percentage of turnover)

	1996/1997	1997/1998	1998/1999
Sugar beet	51	52	53
Maize	29	25	24
Cereals	14	16	16
Oil and protein plants	6	6	7

Source: KWS website.

The headquarters of KWS are in Einbeck, in the state of Niedersachsen, Germany. Due to internal growth and some acquisitions, the number of employees increased substantially over the last four years. In 1996, KWS had about 1600 employees; this figure had risen to 2000 in

¹ The abbreviation *KWS* comes from *Kleinwanzlebener Saatucht*. Kleinwanzleben is a town in Germany where the company was founded. In January 1999, the name of the company changed from *KWS Kleinwanzlebener Saatucht AG* into *KWS SAAT AG*.

ANNEX C9

1999. Turnover of the KWS Group was 332 million Euro in 1998/99 (Table 2). KWS fiscal year runs from July 1 to June 30.

KWS Group consists of KWS SAAT AG as the parent company and more than 32 subsidiaries and associated companies (see Appendix 1 and 2). KWS is active in approximately 65 countries world-wide. Main markets are Germany, other Western European countries, the USA, and Eastern Europe (Table 3). In its main markets KWS has breeding and testing sites, multiplication operations, seed preparation plants, farms, and sales agents.

Table 2 Financial figures of KWS Group (in million Euro)

	1994/1995	1995/1996	1996/1997	1997/1998	1998/1999
Sales	229.5	257.9	302.0	338.8	331.5
Net income	8.9	11.8	15.5	18.6	18.4
R&D costs	34	38	45	50	50
Investments	17.3	24.5	31.6	28.8	19.3
Employment	1,503	1,620	1,697	1,893	2,037

Source: KWS, Annual Report 1997/1998, 1998/1999; R&D cost: estimation.

Table 3 Sales of KWS Group by geographical presence (in percentage of turnover)

	1996/1997	1998/1999
Germany	29%	38%
Rest of EU	42%	32%
North America	11%	14%
Eastern Europe	12%	11%
Africa/Asia	6%	5%
Total	100%	100%

Source: www.kws.de

Approximately 53% of the shares of KWS are owned by the families of the founders of the company: Büchting, Giesecke, and Oetker. Südzucker AG, a major German sugar company owns 24.9 %, AgrEvo owns 12% and approximately 10% is owned by small shareholders like employees, farmers, and private investors.

2.2 Key Developments

Sugar Beet

In sugar beet seed, KWS is world market leader. Its main competitors are Advanta and Novartis. These three are the main companies in the world with an independent breeding programme. Western Europe is the key market for the international sugar beet seed business. In Germany, the largest single producer of sugar beet in the EU, KWS is the market leader. KWS sales of sugar beet seed rose by 15 percent from 1996 to 1997, due to the strong performance of KWS products – particularly in pest resistant varieties – in combination with favourable market conditions all over Europe. However, sales remained stable between 1997 and 1998, due to a reduction in cultivation acreage (caused by a slump in world market prices) and increasing competition in some European markets (e.g., France). The economic crisis caused a substantial reduction in sales in important sugar beet markets like Ukraine, Russia and Moldavia. Nevertheless, KWS is maintaining its local presence, as it

considers its involvement in Eastern Europe as a strategic position in the long term. KWS is expanding its sugar beet seed activities in the USA. For this reason, its subsidiary *Betaseed* formed an alliance with American Crystal Sugar Company (ACSC).

Maize

Maize is the second core crop of KWS. The company is the market leader in Germany and fourth largest maize breeder in Europe. It is particularly strong in early maturing varieties, which grow in the northern part of Europe, Germany, Poland, Czech Republic, the Netherlands, Belgium, northern France and the UK. KWS wants to expand in late-maturity varieties, as they are grown in southern France, Hungary, and the USA. The reason for this expansion is that maize is the biggest seed market, with a gross margin between 2.5 and 2 billion Euro (compared to a gross margin of 300 to 400 million Euro for sugar beet).

The biggest potential is in maize on the world wide level. If you see our market shares, it is the best opportunity for KWS to grow in maize. And that is our strategy: to stabilise and also to improve where possible in sugar beet. But the biggest potential is in maize and also in cereals.

The increasing importance of maize in KWS strategy was shown by the establishment of a separate maize subsidiary, *KWS Mais GmbH*, in 1998. All maize sales and production activities of KWS Saat AG were transferred to KWS Mais. Also the oil and field seeds business (oil seed rape, sunflower, oil radish, mustard, grasses and fodder beet) were transferred to KWS Mais. The breeding activities for these crops remain within the parent company (i.e., KWS Saat). Since 1999, KWS has had a separate sales organisation for maize in France: KWS Mais France. For the largest European grain and silage maize market, KWS will develop maize varieties specially adapted to local conditions.

In September 1999, KWS and French maize seed company RAGT Semences signed an agreement for co-operation in the areas of maize, sunflower, oil seed rape, soybeans, grasses and legumes.

The agreement aims to strengthen the European market positions of both companies in the corn business segment, but also in the oil and protein crop product segment, by exploiting complementary expertise in the areas of marketing, sales and production management. The agreement also provides for mutual participation in the respective subsidiaries, initially of 10%, which should be increased to 34% after three years.

(Annual Report 1998/1999).

In North America, maize seed is sold by the 87% subsidiary Great Lakes Hybrids. Alongside the traditional varieties, Great Lakes Hybrid sells genetically engineered varieties: 8% of maize sales and 55% of soy bean sales (in 98/99). In the North American maize market, Great Lakes Hybrid is just a small company, and it could not provide KWS with the critical mass it wanted for its expansion. Therefore, KWS has been looking for a partner in North America.

In January 2000, KWS announced a merger with Limagrain of its maize and soybean activities in North America. In July 2000, the newly formed company – AgReliant Genetics – has one of the five leading maize programmes in North America. North America is the largest commercial market for maize seed, and both Limagrain and KWS wanted to increase their critical mass, which will make further expansion possible. AgReliant Genetics, with total sales of approximately US\$ 80 million, has its headquarters in Westfield, IN, and has its Canadian operations in Chatham, Ontario. Leading varieties of maize, soybeans, and other seeds will continue to be sold under AgriGold, Great Lakes, LG Seeds, and Pride brand names (News Release, 1 July 2000).

KWS maize seed sales decreased by 6.4 percent from 1997 to 1998, due to high world-wide corn reserves and a drop in price as well as in area under cultivation. In Germany, the

downturn in maize sales was even stronger, due to reduced maize acreage and a loss of market share. For oil and feed seeds, the market developments were more promising. Oil seed rape acreage grew, mainly because of the *increasing industrial use of sustainable raw materials* (Annual Report, 1998/1999, p. 15).

Cereals

KWS' cereal operations are combined in the Lochow-Petkus Group. The group consists of Lochow-Petkus, in Bergen, Germany, and its subsidiaries in France (Lochow-Petkus France), UK (Cambridge Plant Breeders Twyford; 74% ownership) and Poland (Lochow-Petkus Polska). The main products are winter wheat, and hybrid rye, barley for malting, winter oats and triticale.

Besides the traditionally strong position in hybrid rye, Lochow-Petkus is expanding its winter wheat activities. Breeding programmes for wheat are located in Germany and in the UK (at CPB Twyford). In March 1999, the expansion of the wheat activities was given a further boost by the acquisition of a 49% stake in the French plant breeder Momont Henette S.A. Lochow-Petkus France will be incorporated into Momont Henette.

Lochow-Petkus is also expanding in Poland. By 1999 acquisition of 85% of the shares of the agricultural business KonRolPasz Sp.Z.O.O., KWS will establish a central organisation for testing, growing and processing all the cereal varieties that are important for the Polish market.

With more than 2 million hectares of wheat and 2.5 million hectares of rye growing acreage, and in view of Poland's anticipated EU membership, the Polish market will become increasingly important to Lochow-Petkus.

(Annual Report 1998/1999, p. 14).

2.3 Brief History of KWS

KWS was founded in the city Klein Wanzleben in Germany in 1864 as a partnership (*offene Handelsgesellschaft*) between the Rabbethge and Giesecke families. The partnership became a joint-stock corporation (*Aktiengesellschaft*) in 1885. The company flourished during the period from 1885 to 1910. By 1900, KWS had become a world leader in the sugar beet seed business, covering a good quarter of world demand for sugar beet seed, including Russia. In the early 1920s the company started breeding seeds for cereals, fodder beet and potatoes. At the end of World War II, the company managed to relocate from Klein Wanzleben in East Germany to Einbeck in West Germany and started building up a sales network world-wide. During the 1950s, KWS added maize and fodder, oil and protein plants to its breeding programme. A number of subsidiaries and affiliates have been established in Europe and abroad since 1961. In 1967 KWS broadened the company's base even further by acquiring some 82% of F. Von Lochow-Petkus GmbH (*Gesellschaft mit beschränkter Haftung*), Germany's largest cereal breeding company. In 1992, Lochow-Petkus, opened a research station in the French Allonnes. Lochow-Petkus is specialised in cereals, especially rye and barley, and has a 20 per cent share of the German market. In 1972 KWS initiated research into cellular biology by opening its own tissue lab, the first of its kind in Germany. In 1984 KWS founded Planta, a company dedicated to applied plant genetics and biotechnology. In 1993 KWS started field trials with genetically modified crops - the first breeder in Germany to take this future-oriented step in plant breeding. After the reunification of Germany in 1990, KWS was able to reacquire its former breeding station at Klein Wanzleben. In 1995 KWS returned to the Ukraine, the largest sugar beet growing area in the world, by acquiring a holding in the company Unisem, of Vinnitsa.

3. Innovation Strategy

Customer orientation, strong product development and continuity remain central to the success of KWS.

(Annual Report 1998/1999, p. 6)

3.1 Introduction

KWS invests about 15% of its turnover in R&D, similar to other large seed companies. The R&D activities include biotechnology and genomics research as well as the more conventional breeding programmes. Of the total R&D investment of 50 million Euro, between 7 and 10 million Euro is spent on biotechnology (in 1998/99). Approximately 400 employees are working in R&D.

The R&D budget is mostly spent on defined projects, but a small amount is unallocated. It is the discretion of the head of R&D to spend these funds on unexpected projects. According to a KWS manager, the head of R&D needs to have some resources available to be able react rapidly to unexpected opportunities.

Because you do not know everything what is going to happen within the next year. The head of R&D can decide, within this specific budget, to allocate some money on a specific project or a new topic. So in the budget there is an amount of money which is not allocated to specific projects.

Plant breeding in general is a decentralised activity, with breeding programmes in the regions where the varieties are marketed. As such, KWS also has a decentralised innovation strategy. For sugar beet breeding, there is a strong co-ordination from the headquarters in Einbeck. In sugar beet breeding more concentration is possible than for other crops, as varieties developed in one part of Europe can be easily adapted to conditions in other parts of Europe. Thus, although KWS has various sugar beet breeding programmes targeted at different regions and different breeding goals (e.g. on Rhizomania and Cercospora resistance), co-ordination and final decision making is located in Einbeck. In contrast, KWS has separate maize breeding programmes in each major production region (Europe and the USA), as maize varieties have to be adjusted to particular climate conditions. For biotechnology research, KWS does follow an explicit centralised approach, with all R&D concentrated in the company's headquarters in Einbeck.

Decision making on R&D takes place at the Breeding and Research Division. This division, within the company, known as the *Institute*, consists of four departments: sugar beet breeding, strategic research (i.e. co-ordination of all breeding activities), breeding stations and laboratories, and Planta, the biotechnology unit. All breeding and research activities outside Einbeck are co-ordinated from the *Institute*. For instance, all sugar beet breeders of KWS are located in Einbeck, except for the breeders in the USA. The latter report directly to the head of sugar beet breeding in Einbeck.

In 1996 KWS opened a new 10 million Euro processing plant for sugar beet seeds at its headquarters in Einbeck, Germany. The new seed processing plant is a major investment as part of KWS' ongoing efforts to improve seed quality. The plant supplements the existing processing facility at this location.

3.2 Crops and Traits

In the company's own words, KWS' goals are to breed plants for a healthy environment and a sustainable agriculture; plants which protect themselves against diseases and parasites;

plants which offer a wide range of uses, also as renewable resources; and plants which make crops more competitive (www.kws.de).

KWS sees the farmer as its main customer:

The focus in plant breeding is on farmers' needs. That means three things: yield, stability of yield, and quality. Yield is clear, that is output per hectare. Stability means that the plant is not eaten up by a fungus or pest one year. Or that it falls down if there is a storm going on. And stability is also that you have a reasonable use of inputs each year, like fertilisers and fungicides. Quality is different in each crop. For example in sugar beet it is the sugar content that can be extracted in the factory.

The most important traits that KWS breeds into its plant varieties are (www.kws.de):

- Yield: sugar, energy, seeds/grains;
- Quality: improved quality for processing, for human and animal consumption, and for use as a renewable resource;
- Resistance: against fungal, viral and bacterial diseases, against damage caused by insects and nematode;
- Agronomic traits: sturdy stems to prevent lodging, monogermic seed and bolting resistance in the case of sugar beet, early maturity;
- Input use efficiency and stress tolerance: efficient uptake of nitrogen and phosphate, drought and cold tolerance.

Within this broad list of desirable traits, there is a long-term shift taking place. While for many decades the focus has been on increasing yield, on saving on-farm labour and on improving quality (like processing of sugar beets), the emphasis has shifted towards developing resistance to diseases and pests and to improving nutrient efficiency. This shift is partly due to public concerns about environmental impact of chemical pesticides.

Since the public concern is against chemistry, resistance breeding has a much higher priority than before.

For KWS' core crops, R&D is targeted at the following major breeding goals :

- | | |
|-------------------|---|
| for sugar beet: | resistance to the <i>Rhizomania</i> virus, resistance to <i>Cercospora</i> fungus, higher sugar yield |
| for maize: | early maturing, resistance to European corn borer, |
| for oilseed rape: | new fatty acid composition, |
| for cereals: | improvement of baking or brewing quality |

3.3 Biotechnology

The primary goal [of biotechnology research] is to accelerate the breeding process by integrating new technology (marker technology) and also to pursue new plant breeding aims (genetic engineering). The completion of the biotechnology research centre [in 1999] was an essential precondition for the efficient integration of the new technologies into breeding.

(Annual Report, 1998/1999, p. 5/6)

KWS consider biotechnology as an important tool for plant breeding. The company wants to have own expertise in those biotechnology activities that are essential for future plant breeding activities. On its web site, the company provides information on its biotechnology research projects, on the field trials with genetic engineered plants it is conducting, and on its guiding principles on the use of genetic engineering (see Appendix. 3). It even boasts that it has unique expertise in biotechnology and genetic engineering, which are essential for developing and breeding genetically modified plants (see: www.kws.de).

KWS' biotechnology activities are concentrated at *Planta Angewandte Pflanzengenetik und Biotechnologie*, that is part of the Breeding and Research Division. Planta was established in 1984, to focus on applied plant genetics and biotechnology research activities. The emphasis of Planta's work is on the development and use of technologies that facilitate the breeding of new varieties through tissue culture techniques and genetic engineering. They include maintenance of breeding lines through tissue culture (*gene bank*), and the production of homozygous lines through double haploid methods. Planta generates the data on molecular markers for identifying genotypes and for effective backcrossing in the breeding programme. Planta employs about 15 scientists and 80 scientific assistants. Together with national and international partners (like universities and public institutes such as Max Planck), Planta also undertakes basic research relevant to the breeding of sugar beet, maize, oilseed rape, cereals and potato. (source: www.kws.de)

The R&D department works for all crop breeding programmes. As a service centre for breeders. As KWS has an internal pricing system, a large part of the work of the R&D department has to be paid out of the budget available for the breeding programmes. In April 1999, a new biotechnology centre was opened at KWS premises in Einbeck. Construction had started in 1997, and investments were 15 million Euro. It is a centre of competence for the entire product portfolio of KWS. An important feature of the centre is that both conventional and biotechnology research methods are concentrated at one location, thus allowing a closer integration of these two fields.

R&D activities at Planta and other research units of KWS focus include:

- Conventional breeding of high-performance crop varieties (sugar beet, corn, cereals, fodder, oil and protein plants, potatoes);
- Development of quantitative genetic methods to improve breeding programmes;
- Marker-assisted selection processes;
- Basic research in the fields of molecular biology and cell biology;
- Improving transformation and regeneration methods;
- Cell and tissue culture, for in vitro reproduction and cultivation;
- Double-haploid production;

ANNEX C9

- R&D in seed production and plant cultivation, like:
 - (i.) Improving seed quality.
 - (ii.) Analysing quality of seed material.
 - (iii.) Seed processing
 - (iv.) Optimisation of crop establishment.

Genetic engineering research at Planta is targeted at the following traits (www.kws.de):

- Resistance or tolerance to fungi, viruses, bacteria, insect pests, nematodes, herbicides and abiotic stress;
- Contents: carbohydrate metabolism, starch, fatty acids, processing quality;
- Others: male sterility system, regulation of development phases, photosynthetic capacity

Since 1993, KWS has been conducting field trials with genetically engineered plants. Table 4 gives a list of the trials that have been conducted over the years, in Germany and other countries.

Table 4 Field trials with genetically modified crop plants

Resistance	
Viral disease - sugar beet	Germany 1993-1998 (Oberviehhausen, Bavaria and Wetze, Lower Saxony), Italy, France and USA
Insect pests – maize	France, USA 1996, 1999
Herbicide maize – sugar beet	France, USA, Great Britain, 1996-1999
Fungal disease – oilseed rape	Germany 1998/99, (Wetze, Lower Saxony)
Plant material contents	
Starch – potato	Germany 1993-1994, 1997-1999, (Oberviehhausen, Bavaria)
Fatty acids – oilseed rape	Germany 1997-1998, (Wetze, Lower Saxony)
Phytochrome B – potato	Germany 1998-1999, (Oberviehhausen, Bavaria)
Noxious nitrogen – potato	Germany 1999, (Oberviehhausen, Bavaria)
Other	
Male sterility – maize	USA, 1996

Source: www.kws.de

3.4 The GABI project

KWS is participating in a German genome analysis project GABI (Genom-Analyse im Biologischen System Pflanze). This joint research project, set up in 1998, contains a network of companies in plant breeding, plant protection and food processing, research institutes, and the Federal Ministry of Education and Research and the Deutsche Forschungsgemeinschaft (DFG). This concerted action aims to develop plants with improved or new characteristics, for farming, for processing and for consumption (see chapter 4 for more information on GABI).

For KWS, the GABI project is particularly interesting for crops like sugar beet, maize, oilseed rape and rye. KWS expects that this basic research project will lead to insights that can be used to improve the company's own research. Significant results are expected above all in the areas of sugar storage in sugar beet, cold tolerance and early ripening in maize and seed development in oilseed rape (Annual Report, 1998/1999, p. 9).

4. Innovation Decision Making Structure and Process

4.1 General decision making structure

The supervisory board of KWS consists of seven members, representing the owners of the company and the employees. The executive board of KWS has three members with the following responsibilities.

Table 5. Executive Board of KWS in 1999

Name of the person	Responsibilities
Dr. Andreas J. Büchting	Chairman, Corporate Affairs, Research
Dr. Christopher Ahrens	Sugar Beet, Marketing, Eastern Europe
Jochen Beyes	Maize, Finance

Source: KWS, Annual Report 1998/1999.

KWS is organised in the three core divisions: sugar beet; maize, oil and field seeds; and cereals. Within each division several subsidiaries are operating. All cereals activities are located in one subsidiary, *Lochow-Petkus*. Sugar beet and maize activities are more dispersed over several subsidiaries, operating in different regions or countries. See Appendix 2 for an organisational chart of KWS.

An important element of KWS' innovation strategy is continuity in the breeding programmes. According to one manager, a main success factor of a plant breeding company is continuity. In the strategic planning process, a long-term perspective (5 to 10 years) is taken. The strategic planning process is an ongoing process. Each year, at the end of March or beginning of April, a meeting of the heads of the divisions together with the executive board is held, to discuss issues of market development and potential earnings in each market. The results of the strategic planning discussion are the frame for the budgeting process.

Decision making on budgeting and strategic planning is a combination of bottom-up and top-down approaches. The top-down approach is the result of the strategic planning process. On the basis of assessments of the situation in main markets, of the competition and of the long-term strategic objectives, the management board formulate the goals in terms of market shares and turnover KWS has to realise, requiring budget allocations for marketing and sales, for R&D, etc. If budget allocations are made, return-on-investment and return-on-sales for different crops and different regions can be established.

In the bottom-up approach, divisions and subsidiaries make a plan for budget needs in R&D, in production, in marketing and sales. The budget plans of the individual subsidiaries are combined at Division level. Every year in June – the fiscal year for KWS runs from July to June – there are budget meetings, involving the management board and the division managers when the board requirements are brought in line with the results of the bottom-up approach. At the end of the day, there is commitment among all participants. According to KWS managers, it is absolutely necessary that everyone is committed to the final agreement.

The main subsidiaries also have their own supervisory board, consisting of members of the division, and sometimes also including one of the members of the executive board. This structure also guarantees commitment all through the organisation.

Until 1993, KWS had a function-oriented organisation. Then it changed towards a decentralised and crop oriented organisation. This structure provides good incentives at the product-market level. However, it has as a disadvantage that there is less integration in

specific markets. Therefore, KWS is looking for tools to improve integration and at the same time maintain the dynamics of a product driven structure.

4.2 Innovation Decision Making Process

The head of the R&D Department is responsible for all research and breeding at KWS Group. Each division (sugar beet; maize and oilseeds) has its own Head of Breeding, who is responsible for the breeding activities performed by the subsidiaries in his division. All the research activities are co-ordinated by the Head of the R&D Department in Einbeck. All the decisions concerning innovation are made at the headquarters in Einbeck.

The breeding programmes are located at the three divisions. The breeders, who are responsible for the execution of the breeding programmes, report to the Research and Breeding Department in Einbeck. The head of this Department is Dr. Günther Strittmatter. Within each division, the main breeders discuss with the sales managers about the targets of the breeding programmes.

The innovation process is organised along the lines of separate projects, whether they are research projects or breeding projects. For each project, annual meetings take place to discuss the progress on the project. The following people take part in these meetings: the project leader, leaders of similar projects (to get a technical perspective), sales people (to get a market perspective), the person responsible for intellectual property rights, and the Head of R&D. In this group also ideas with consequences for the budget are discussed, like the speeding up or the slowing down of a project.

For a number of innovation projects, KWS has two parallel lines: GMO and conventional breeding. Therefore, in the project meetings, the relative status and perspective of both concepts are discussed.

KWS has no formal procedure for turning a new idea into an official project. New ideas can come from breeders and from marketing people. Starting an innovation project involves interaction between these two groups. New research projects come from breeders and/or from the *Institute*. Where breeders may have more ideas about marketing opportunities, the researchers may have ideas about how to incorporate new traits in the breeding process.

KWS has an informal structure of discussing market developments, activities of competitors, technological developments, policy development etc. Once a month, several top managers come together to discuss questions which are important for the whole KWS group. The outcome of these discussions find their way into the formal evaluation of projects.

Biotechnology projects start with the formulation of a project proposal outlining the technical and economic perspectives and the regulatory and patent perspective. Every year the assumptions behind the project are evaluated (using a formal protocol), on the basis of information gathered from various sources, in-company market research and statistics-based market surveys acquired from third parties. Furthermore, KWS monitors public policy developments in order to see what will happen to certain crops, and developments in the relative competitiveness of the crops.

The yearly economic evaluation of biotechnology projects is something rather new. A manager for Biotechnology Control and Business Development was appointed only in 1997.

The main reason for this function is that the biotech projects increased over time to a certain budget, and then it was the impression that we should have a closer look at what was going on with these projects and what is the perspective of the projects.

In evaluating biotechnology projects, KWS uses four parameters: the technical perspective, the patent situation, the regulatory aspects, and the market perspective. The latter means the market potential for a specific resistance and the probability of gaining a certain market share. The evaluation of regulatory aspects is done within the R&D Department. However, this is rather difficult due to many uncertainties in the policy area. According to one manager, the uncertainty about which concept may be accepted and which not, is a major threat to

KWS. This manager mentioned the difficulties Novartis has experienced in introducing a Bt-maize variety in some European countries:

We have had the Bt-case from Novartis. It is containing a certain antibiotic marker that can be used for the selection process of the bacteria. So it has been approved, 2.5 years ago. So we should base our decision making process on the assumption that it is considered to be safe. It has gone through a two years evaluation process by the national authorities in the EU. But just two weeks ago the German government said that she does not rely on the approval, "We are going to ban this." With this example I want to illustrate that even if our regulatory people are one hundred per cent aware of any development and any last minute change within the regulatory bodies of the EU and the Member States, they are not able to make a firm prediction and say that it should cause no problems.

As a result of the uncertainties in the regulation of biotech products KWS has postponed or slowed down certain biotechnology projects. It has made them very cautious in starting up new biotech projects. KWS calls itself conservative in the area of developing biotechnology projects.

It strictly reduces our capacity to generate innovation. It is just a simple question of risk because every step further in the product development increases the costs. The major step is the regulatory process.

KWS works on the assumption that in the short term no changes will take place in the European market concerning the acceptance of transgenic crops. Still, KWS continues to work on biotechnology research, in order to be ready to market biotechnology products once the situation in the market changes. Continuation in biotechnology research is possible because it is only 15% of total R&D spending.

At the moment the way is not open for GMOs in the supermarket. In reaction to that KWS can not go high speed on developing GMO varieties. We are just continuing the projects dealing with GMO varieties and we continue to apply deregulation of seed release, variety release, but of course we can not do it in high speed and with high effort. But it needs to be continued because we still hope that the market will become deregulated. We think that we eventually will be allowed to sell one. And till that moment we need to have the actual seed varieties and not old ones. Therefore we cannot stop the business. Our biotech R&D programs will not be further extended, but they will be continued on a realistic level.

5. Influence of Public Policies and Market Development

5.1 Introduction

A seed company like KWS is faced with restrictions and opportunities caused by government policies at national and international levels. R&D activities (e.g., biotechnology) are encouraged by governmental technology policies (providing subsidies and other incentives), but are also restricted by regulations on the safety for humans, animals and the environment. On the market side, KWS is indirectly affected by the restrictions and opportunities that its clients face. As KWS' main clients are farmers, changes in agricultural policies which influence farmers' decisions also affect KWS innovation strategies.

Besides the influence of government policies on KWS' activities and strategies, several market-related factors also influence KWS' innovation strategy, market developments further down the production and distribution chain for agricultural products that influence farmers'

choices and thus influence KWS market prospects. An example of these market developments are the consumer concern for pesticide use in cultivation of food products. As consumers want food products with fewer or no pesticides used in production, farmers will look for plant varieties that minimise the necessary pesticides. Such a development induces a seed company to develop varieties with even better pest and diseases resistance.

In this chapter we present the impact that (changes in) governmental policies and market-related factors will have on KWS strategy, particularly its innovation strategy. Three areas of government policies are distinguished: science, technology and innovation policies; environmental protection, public health and biodiversity policies; and agricultural and international trade policies. The information presented here comes from KWS publications as well as from the interviews with KWS managers.

5.2 Science, Technology and Innovation Policies

I would like to highlight the decision of the German government to start and to focus on genomics research: GABI. We think it is a very valuable investment from the government side.

KWS is participating in the plant genomics research project GABI (Genom-Analyse im Biologischen System Pflanze), initiated by the German government. The objectives of this programme are strengthening the science base in Germany, guaranteeing that important genetic information does not become private property, and helping German companies to use this information in their own research. The GABI project is organised as a public-private partnership, between the Federal Ministry of Education and Research and a special organisation representing approximately 25 companies in the plant breeding, plant protection and plant processing industries. The public funds available are 4.5 million Euro in 1999, and about 15 million Euro yearly for the years 2000 to 2002.

The programme consists of two areas. One area is focused on fundamental research which is completely funded by the German government. The research is performed by universities and the Max Planck Institutes. These results will be published after 6 months. The second area concerns joint activities between public research institutions and private companies. These activities are more focused on applied research projects in which particular traits of crops will be identified and analysed. Within the GABI programme, a patent and licensing agency will be set up, to protect the intellectual property rights of the research results, and to organise efficient exchange of property rights among all GABI participants and with third parties.

For KWS participating in this project is important for the collaboration with other companies, for access to genetic information and technologies developed within the programme, and for intangible public support for its biotechnology research. The knowledge KWS acquires out of the GABI project can be used both in classical breeding and in biotechnology breeding. KWS has been actively involved in setting up the GABI programme. Currently, KWS is involved in two ways. First, the company is participating in a consortium with several other private companies. The head of the Department R&D is chairman of the board of this consortium. Second, KWS is a partner in several joint projects between industry and research institutes. The focus of these projects is on innovations rather than basic research.

On the issue of patent protection for biotechnology findings, KWS experiences some impact of the strengthening of intellectual property rights

We have not been very familiar with the patent as a concept because plant breeding was and is based on plant breeders' rights and variety protection. It is not the question of variety protection or patents. We will have both these concepts in the plant breeding industry. I think that in the patent situation the impact is more on the R&D strategy: for what concepts do we go and which should be try to avoid.

5.3 Environmental Protection, Public Health and Biodiversity Policies

EU Directive 90/220, which according to KWS is the basis for all the regulatory issues it is facing in the field of biotechnology, is currently being reformed. Uncertainty in the regulatory process can lead to standstill and delays in biotechnology projects. For KWS it means more carefully looking at most promising projects and eventually freezing others.

On the national regulatory field, KWS considers Germany as one of the most reliable places within the EU, because the procedures on the national level have been or are more or less reliable. Still, different ministries play different roles. The activities of the Ministry of Education and Research is assessed positively by KWS managers, particularly for the GABI project. The activities of the Ministries of Environment and of Health are looked at with more scepticism, because it is not always clear whether decisions are taken because of real concerns for environmental safety and public health or induced by political considerations. KWS stresses that it is important to have a clear and transparent system of regulations so that the company can make its long-term decisions.

According to KWS, positive food safety side effects of genetically modified crops are not always sufficiently considered by decision makers in regulating these crops. For instance, the issue of myco-toxins in cereals should receive more attention. An interesting side effect of Bt-maize is that it reduces the incidence of fungal infections.

As to the reform of the EU regulation on deliberate release of genetically modified organisms (90/220), KWS has issued a News Release, stating that it is interested in actively supporting the activities of the European Parliament and Commission to work out clear regulations for the marketing of genetically modified plants.

For the company, it is, however, of vital importance that scientifically sound and well defined criteria are established to put the company into a safe legal position.

(KWS News Release, 11 February 1999)

KWS SAAT AG's Chairman of the Board, Dr. Andreas J. Büchting, stressed the need to design clear rules and regulations, also in order to convince consumers that appropriate measures are taken to make sure that negative consequences can be avoided when cultivating genetically modified plants on a large scale:

"(..) the consumer will only build up a lasting confidence in the fascinating chances offered by genetic engineering, if we are ready to take consumer concerns seriously."

(KWS News Release, 11 February 1999)

5.4 Agriculture and International Trade Policies

For sugar production in the EU, there is a strict market regulation. By having a fixed production quota for internal production together with high levies for sugar imports, the internal price for sugar is kept high. Actually, the EU sugar price is twice as high as the world market price. If the EU production is more than internal consumption, export subsidies are given. These subsidies are paid by producers through a levy on all sugar beet production. Under 1995 WTO agreement (i.e., the outcome of the Uruguay Round of trade negotiations), the use of export subsidies has to be reduced. The amount of subsidised exports have to be reduced by 21% in the period 1995-2000, and the budget for subsidies has to be reduced by 36% in the same period.

Due to very low world market prices for sugar, exports are only possible with substantial subsidies. As WTO requirements prohibit the use of more export subsidies, either the EU sugar quota has to be reduced, or guaranteed prices have to go down. In April 2000, the EU Commission has announced a reduction in the EU sugar quota (Agrarisch Dagblad, 26/4/00).

KWS managers are well aware of these adjustment in the European sugar market, and the obligations to reduce subsidised exports.

Reduction of the sugar quota means a reduction of the market for sugar beet seeds, and thus stronger competition among seed companies. In addition, the sugar beet cultivation area in Europe is shrinking due to continuous yield increases. KWS is trying to compensate these unfavourable market developments for sugar beet seed in the EU with expansion outside the EU.

International trade policy also affects other KWS markets. As part of the 1992 Blair House Agreement between the EU and the USA (which was incorporated in the 1995 WTO agreement), acreage subsidies for oilseed crops have been reduced. Particularly in the UK, it has led to a substantial reduction of oilseed rape area. As a result, the Lochow-Petkus subsidiary in the UK, CPB Twyford, had significantly reduced rape seed sales in 1999 (Annual Report, 1998/1999, p. 10).

The prolongation of the EU dairy policy, with its production quota, to at least the year 2008, guarantees a stable market for silage maize in the EU. And the rise of silage maize acreage premiums, which pushes down the production costs per feed unit for bull feed and dairy farming, also benefits silage maize growing (Annual Report, 1998/1999, p. 10).

The future accession of Poland to the EU has been a reason for KWS to expand its activities in this country.

5.5 Market Conditions and Consumer Attitudes

KWS' innovation decisions are influenced by two types of market conditions: first, agricultural seeds and second for food products. As farmers are the primary clients, their purchasing decisions have a direct influence on KWS' innovation decisions. Indirectly, the attitude of the general public also influences KWS activities and choices. For example, the focus in crop breeding on increasing resistance against pests and diseases is mainly driven by the (expected) consumer demand for food products that require fewer pesticides during cultivation and storage.

The rather negative attitude of the general public towards biotechnology is seen as unfortunate by KWS. Biotechnology has at least three advantages. It will generate the jobs of the future, improve food availability and provide better quality products. An example of the latter is the issue of myco-toxins in cereals. Even though consumers may not be aware of the risks of myco-toxins in cereals, KWS is considering an R&D project that will focus on this problem. KWS believes that this project in the end will contribute to consumer benefit.

In relation to consumer attitudes, for instance towards biotechnology, KWS is fully aware of the importance of knowing consumer preferences, as consumers are the customers of KWS' customers. However, KWS managers stress the long term perspective that is needed in decision making on plant breeding. The time frame for innovation is 10 to 15 years. This presents the dilemma of how to react to changes in public opinion. Every time it changes, for instance with regard to biotechnology, the company has to make an assessment whether this is a long term fundamental change or just a short term fashion.

Besides the biotechnology issue, most consumers have no strong opinion on the quality of field crops. For most of the consumers sugar is just sugar. Thus, if KWS focuses on quality traits in sugar beet breeding it focussing on process quality. By improving the sugar content that can be extracted in the factory, the competitiveness of sugar beet industry can be strengthened.

6. Company Discourse on Environmental Issues

According to the chairman of the Executive Board of KWS, demands from policy makers and from society for environmentally friendly products is an essential input for all innovation activities (News Release, 19/1/00). Several statements about environmental issues can be found on the KWS Internet site:

To breed plants for a healthy environment and a sustainable agriculture.

The current aim of modern agriculture is to be sustainable. Sustainable agriculture includes the use of new plant varieties that are in harmony with natural ecosystems, less reliant on chemicals harmful to the environment and humans, and produce crops of a high quality.

The use of host-plant resistance for diseases and pests, an approach to overcome yield losses and minimise the use of harmful chemicals, is high on the research agenda of plant breeding. Likewise, the development of new varieties that have industrial uses is a new initiative. Some agricultural crops offer alternatives to the use of petrochemical products. When decomposed or burnt such plants only add so much carbon dioxide to the atmosphere as they absorbed during growth. The use of plants and plant materials offer a renewable and environmentally friendly resource to industry and provide an alternative source of income to farmers and the processing sector.

In a September 4, 1997 News Release, KWS informed about its field trials on genetically engineered oilseed rape, emphasising oilseed rape as a supplier of environmentally friendly raw material:

The aim of this work is to improve the composition of the fatty acids contained in rapeseed oil to make it suitable as a renewable resource for industry. New grades of rapeseed oil will offer environmentally friendly, resource-saving alternatives to petroleum chemistry.

A large part of KWS research is targeted at enhancing crop resistance against pests and diseases.

With regard to biotechnology, I would say that about 80 percent of our budget goes into projects on resistance. So, the main focus is on substituting agro-chemical input.

On organic farming, KWS managers stated that it is an interesting area, but it is not the main area of work. However, in order to obtain more knowledge of organic farming in general and about using own varieties in organic farming systems, KWS would like to rent a farm for working in an ecological way.

We want to get our own experience in this field of farming because we would like to advise our customers – the farmers – about our own experiences if you compare classic and ecological farming. (...) Up till today, we do not work on specific projects for ecological farming, because the market segment is too small.

KWS already offers organic seed, multiplied in France. So far, the amount is very small (only 500 units of sugar beet seed), but KWS expects that organic farming will become more important in the future. Also in maize, KWS offers small quantities of organically produced seed.

For its genetic engineering work, KWS has adopted a policy of transparency and openness. It also plays a pro-active role in facilitating a wide acceptance of biotechnology and genetic

engineering. For instance, KWS will open its new biotechnology research centre as part of the Hanover 2000 EXPO. Conventional and molecular methods of plant breeding will be illustrated in a variety of ways, and the aims of breeding explained. Controversial topics will also be addressed. (Annual Report, 1998/1999).

Respect for and protection of the environment is one of the guiding principles for KWS' work on genetic engineering.

Regardless of our legal obligations, we recognise a responsibility to nature, farmers and consumers when undertaking the use of technologies that could have a negative environmental impact or impinge on the ethical values held by society.

(source: www.kws.de)

7. Conclusions

7.1 Innovation Strategy

KWS SAAT AG is a German plant breeding company supplying farmers world wide with seeds for sugar beets, maize, cereals, oil and field crops. It also has a minority stake in a seed potato breeding company: Ragis-Saka. The cereals activities are located at the Lochow-Petkus, a 81% ownership subsidiary of KWS.

KWS' activities are organised along crop lines. There is a division for sugar beet, one for maize and one for cereals. Sugar beet is by far the most important crop for KWS, generating more than 50 percent of turnover. The market for sugar beet seed in the European Union is gradually decreasing, due to increasing productivity of new varieties and to decreasing acreage. Therefore, KWS is seeking expansion in Central and Eastern Europe and in North America.

The second main crop for KWS is maize. Maize accounts for the largest share of the world seed market, and the USA is the largest single market for commercial maize seed. The company sees its largest growth options in maize. KWS is expanding in France, the largest maize production country in Europe, and in the USA. Expansion in France and other European countries is in collaboration with RAGT. This collaboration covers sales and production of maize and oilseeds. The North American joint venture with Limagrain goes a step further, it also covers breeding of new varieties. The new varieties coming out of this integrated programme can also be used in parts of the European market.

The main clients of KWS are farmers and sugar beet processors. Breeding goals are a reflection of the demands of the clients. At KWS, breeding and research are aimed at three goals: increasing the yield of crops, improving the stability of the yield, and improving the quality of the agricultural product. The first two aspects are more focused on the needs of farmers. The latter is more focused on the demands of the sugar and other processing industries.

In the eyes of KWS managers, a key success factor for a plant breeding company is continuity. Breeding a new crop variety takes between 10 and 15 years between the first crossing and the commercialisation of a new variety. This implies that innovation choices have to be carefully made and that once chosen, directions and targets will not easily be recalled. KWS decision making on innovation, with many people involved at several levels in the company and at repetitive stages of project progress, is explained by the need to carefully weigh all technological and market developments. For all major R&D projects yearly meetings take place to discuss progress among the representatives from plant breeding, legal affairs, marketing and sales, and regulatory affairs. As part of these meetings, GMO projects and conventional breeding projects that aim at the same traits, are compared. The long term perspective needed in setting plant breeding goals also explains the complaints by

KWS managers about the unpredictability of the EU approval process for genetically modified plants.

KWS considers biotechnology and genetic engineering as very important tools for plant breeding. Marker technology is already used in the breeding and selection processes. KWS also has the competences to develop genetically modified varieties. Although only 15% of R&D is spend on typical biotechnology research, the company sees a further integration of conventional and molecular breeding techniques.

R&D activities are dispersed within the company, although with strong co-ordination from the headquarters in Einbeck. Biotechnology research and other research that is not crop-specific is centralised in Einbeck. An indication of the importance of R&D and innovation at KWS is that the responsibility for these activities lies with the chairman of the board.

Centralisation of R&D decision making may be reinforced as public acceptance of GM-crops remains low and as R&D costs rise. The former implies that decisions on GM-crops have to be taken with respect to all markets at the same time. The latter means that more attention should be given to avoiding duplications and that results should be implemented as rapidly and broadly as possible.

On biotechnology and genetic engineering, KWS follows a policy of transparency, explaining what it is doing and why. It also has made public its guidelines for working on genetic engineering projects. These guidelines show that KWS acknowledges the difficulties in public acceptance of GM crops and are an answer to demands from both direct customers (i.e. farmers) and others to know KWS' policy on the use of genetic engineering in crop breeding.

Given the importance of continuity and long-term market forecastings innovation decisions are not easily recalled. Innovation decision making in a seed company like KWS is strongly bounded by long-term trajectories. This implies that short-term changes in consumer attitude, for instance regarding genetically modified crops, are not given much weight in innovation decision making. As KWS expects biotechnology to bring major benefits to its customers, it continues innovation along the biotechnology path, although currently with a low profile and stable budget.

7.2 Public Policy Impact on Innovation

On the market side of innovation, public policies are very important for KWS' innovation strategy. Agricultural activities in Europe continue to be strongly influenced by the Common Agricultural Policy, but also by environmental policies and international trade policies. Therefore, any company supplying seeds to farmers in Europe, is indirectly affected by policy decisions. The EU sugar policy has provided high protection for sugar beet farmers, and therefore a stable market for sugar beet seed companies. With the expected changes in the sugar policy, due to WTO agreements cutting subsidised exports, market growth for sugar beet seed suppliers has become much more difficult. In reaction to this trend, KWS is expanding in other crops – particularly in maize – and in other regions of the world – particularly in North America. The expected accession of Central-European countries to the EU is reason for KWS to expand its activities in those countries.

In setting priorities for breeding targets, the focus has shifted from yield to resistance and processing quality. The increasing importance of producing in an environmentally friendly way requires new crop varieties with enhanced pest and disease resistance. Government policies to protect the environment put constraints on pesticide use by farmers, and thereby induce farmers to shift to crop varieties with enhanced pest resistance.

On the research side of innovation, KWS is faced with public policies regulating biotechnology in the EU and Germany. The paradox of government policy subsidising and promoting biotechnology R&D on the one hand and restraining the introduction of genetically engineered crop varieties on the other hand is difficult to comprehend by any seed company seeking to apply the latest advances in biological sciences. KWS is enthusiastic about the German genomics research programme *GABI*, but it is discontented with the uncertainties in regulatory policies. At the European level, the slow reform of Directive 90/220 has a negative

influence on KWS innovation, as it leads to delays in investments in biotechnology R&D. KWS managers emphasise the need for a clear, reliable, precise, and consistent regulatory system at European and national level. Even if no framework yet exists, as regulation usually follows rather than precedes new ideas, a transparent system of what can be expected is needed.

7.3 Environmental Issues

KWS stresses that it works towards a healthy environment and a sustainable agriculture. By sustainable agriculture, the company means a profitable agriculture, because without profitability there is no future for agriculture and thus no future for seed companies supplying farmers. KWS states that it is dedicated to a healthy environment because it develops varieties of crops – like oilseed rape – that can be used as renewable resources.

By enhancing pest and disease resistance in KWS' crops, it supports the trend to lower the use of chemical pesticides. For instance, 80% of its biotechnology research is targeted at improving pest and disease resistance. Genetically modified plants that have a better resistance, need less chemical plant protection products.

KWS' activities in organic farming so far are limited, as the company does not see a large market for organic varieties. Still, it does supply a limited amount of organically produced sugar beet seed. Also, the company is seeking to obtain knowledge on organic cultivation methods of sugar beet and other crops. KWS wants to be ready if the market for organic crops grows rapidly, but until that time it is keeping a low profile on organic farming.

Sources

Written material

AGROW (1999), *KWS's plans for GM sugar beet*, January 15th 1999, no. 320, p. 21.

Agrarisch Dagblad (1998), *KWS en RAGT schuiven zaaizaadactiviteiten ineen*, Doetinchem, December 10th, 1998.

Agrarisch Dagblad (2000), *KWS en Limagrain voegen hun Amerikaanse maisbedrijven samen*, Doetinchem, January 22, 2000.

Cultivar, Seed and Agchem Business, *Agriculture in the Netherlands, The Keys to Success*, special issue, May 1996.

Prophyta, January 1999.

KWS Kleinwanzlebener Saatucht AG, *Annual Report 1997/1998 – Abridged Version*.

KWS SAAT AG, *Annual Report 1998/1999 – Abridged Version*.

KWS News Releases:

- 4 September 1997

- 11 February 1999

- 19 January 2000

- 1 July 2000

Websites

www.kws.de

Interviews

Dr. D. (Dorothea) Borchardt, Coordinator Breeding Research, KWS SAAT AG, Einbeck, Germany (March 14, 2000).

Dr. H. (Henning) von der Ohe, Head of Corporate Development, Controlling and Communication, KWS SAAT AG, Einbeck, Germany, (March 14, 2000).

Dr. Y. (Yelto) Zimmer, Biotech-Controlling and Business Development, KWS SAAT AG, Einbeck, Germany (March 14, 2000).

Appendix 1.

Subsidiaries

European subsidiaries

Name of the company	Ownership (%)	Location
Agrar Consulting GmbH Einbeck	100	Einbeck, Germany
Interagrarkooperation GmbH ¹⁾	100	Liebertwolkwitz/Leipzig, Germany
Intersaat GmbH	100	Einbeck, Germany
KWS Mais GmbH	100	Einbeck, Germany
Lochow-Petkus GmbH	81	Bergen, Germany
MOD Management, Organisation und Datenverarbeitung Consulting GmbH	60	Hannover, Germany
Peragis Saatzucht- und Handels GmbH	100	Einbeck, Germany
Planta Angewandte Pflanzengenetik und Biotechnologie GmbH	100	Einbeck, Germany
Ragis Kartoffelzucht- und Handels GmbH	100	Einbeck, Germany
Saka-Ragis Pflanzenzucht Gbr ²⁾	34	Hamburg, Germany
Semena AG	100	Basel, Switzerland
KWS Austria Saatzucht GmbH	100	Tulln, Austria
KWS Semena S.R.O.	100	Zahorska, Slovakia
KWS Semences S.A.R.L.	100	Grandfresnoy, France
KWS France S.A.R.L. ³⁾	100	Grandfresnoy, France
Razes Hybrides S.A.R.L. ³⁾	51	Alzonne, France
Societe des Mais Europeenes S.A.R.L. ³⁾	100	Sarreguemines, France
KWS Italia S.P.A.	100	Bologna, Italy
Pan Tohum Islah Ve Üretme A.S.	51	Ankara, Turkey
KWS Benelux b.v.	100	Amsterdam, The Netherlands
KWS Polska Sp.Z.O.O.	100	Poznan, Poland
Lochow-Petkus France S.A.R.L. ⁴⁾	100	Allonnes, France
Cambridge Plant Breeders Twyford Ltd. ⁴⁾	74	Thriplow, United Kingdom
Lochow-Petkus Polska Sp.Z.O.O. ⁴⁾	100	Strzelin, Poland
Semillas Seleccionadas de Remolacha S.A.	33	Vitoria, Spain
Betamag Vetomag Kft.	25	Nagyecenk, Hungary

Source: KWS, Annual Report 1998/1999.

ANNEX C9

1. Subsidiary of Agrar Consulting GmbH Einbeck;
2. Subsidiary of Ragis GmbH
3. Subsidiary of KWS Semences S.A.R.L.;
4. Subsidiary of Lochow-Petkus GmbH.

Non-European subsidiaries

Name of the company	Ownership	Location
KWS Seeds Inc. ¹⁾	100	Shakopee, MN, USA
<i>Betaseed Inc</i>	100	Shakopee, MN, USA
<i>Ach Seeds Inc</i>	100	Eden Prairie, MN, USA
<i>Great Lakes Hybrids Inc.</i>	84	Ovid, MN, USA
KWS Chile Ltda.	100	Santiago de Chile, Chile
KWS Argentina S.A.	90	Balcarce, Argentina

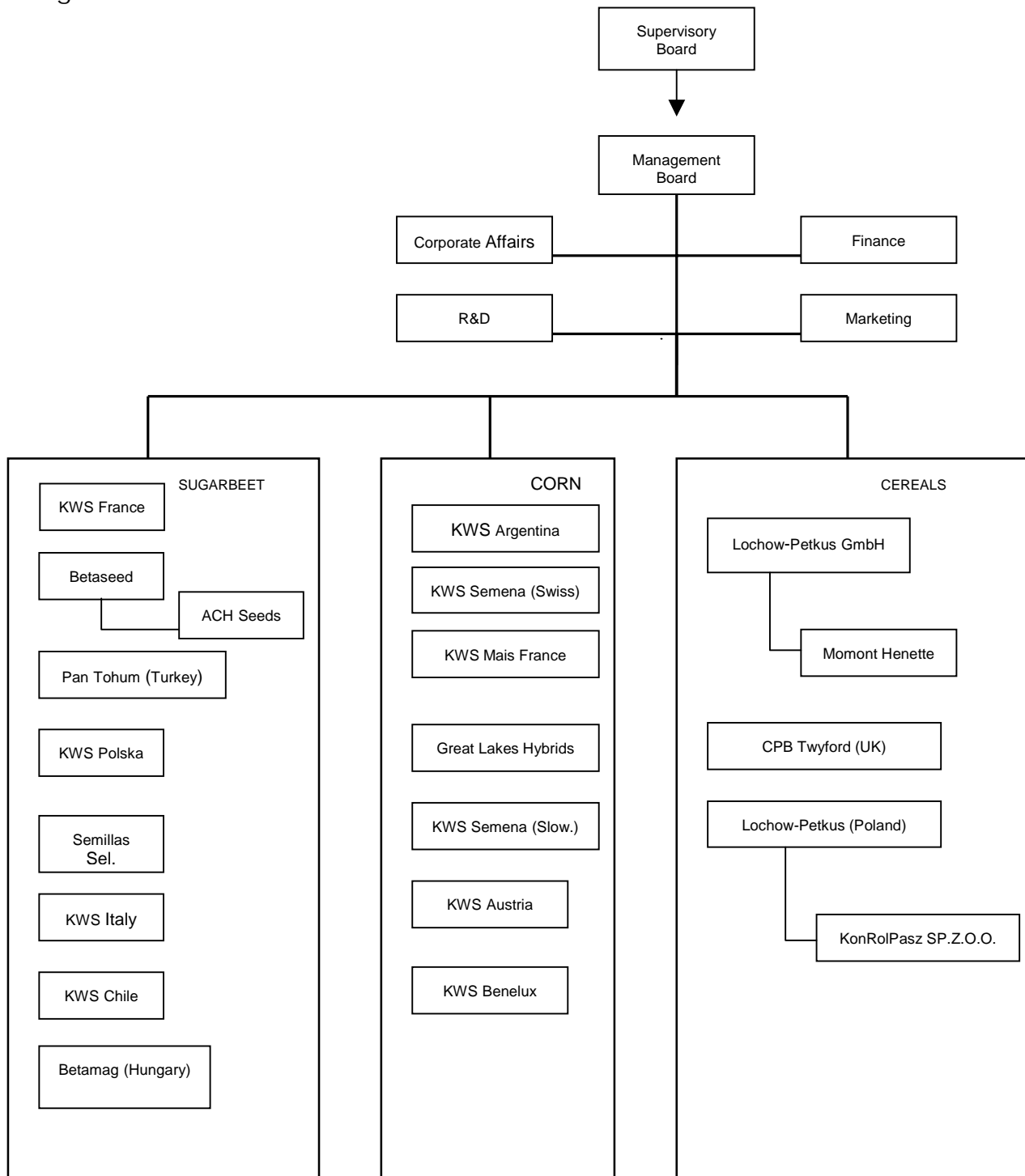
Source: KWS, Annual Report 1998/1999

1. Subsidiary of Intersaat GmbH and KWS AG.



Appendix 2

Organisational Position of KWS Subsidiaries



Appendix 3.

Guiding Principles on the Use of Genetic Engineering in KWS

KWS's main guiding principles are:

- an **evaluation** of uses and risks for every individual case
- respect for and protection of the **environment**
- to test all possible **alternatives**
- **openness** with information

The main goal of KWS is the breeding of plant varieties that promote sustainable and profitable agriculture.

To achieve this objective KWS would like to use the best possible technologies from the entire range available, from conventional or classical breeding techniques to modern genetic engineering. The methods finally used are judged according to their ability to deliver products that are safe, environmentally friendly, inexpensive and quick.

Genetic engineering is just another tool in the array available to plant breeding, one that allows the development of special traits or characteristics in plants.

Classical plant breeding deals with the entire genome of the plant while genetic engineering is specific to individual genes (characteristics) such as disease resistance or substances like vitamin A. In the production of automobiles, the serial model is analogous to conventional plant breeding while the special equipment (airbags, antiskid system, etc.) are akin to what genetic engineering provides.

The potential of genetic engineering is often exaggerated, but neither should it be underestimated.

In 1998 genetically engineered crops were cultivated world - wide on an area twice the size of entire acreage under crops in Germany (some 20 million ha). This can be seen as a measure of the success genetic engineering has had in finding favour with farmers. KWS believes that transgenic crops have much to offer and in the foreseeable future, there will be products with tangible benefits to farmers and consumers in Europe.

KWS has adopted a policy of transparency and plays a pro-active role in facilitating a wider acceptance of biotechnology and genetic engineering in Europe.

KWS takes the concerns of farmers, consumers and civil societal groups seriously. Regardless of its legal obligations, KWS recognises that it owes a responsibility to society when undertaking the use of technologies that could have a negative environmental impact and/or influence on the ethical values held by society. KWS brings its considerable experience with transgenic crops and those of others to the open debate.

Extreme positions are not constructive for dialogue and should be a thing of the past.

Today there are more than 25,000 field trials being undertaken world-wide, over 20 million ha under genetically engineered crops, and thousands of tons of vitamins and enzymes used in processed foods being produced by genetically engineered micro-organisms. In Germany alone the work of more than 2,000 laboratories includes genetic engineering, and field trials in more than 100 sites were conducted in 1998. Genetic engineering is almost a part of everyday life with the time for extreme positions long over.

Each new technology must be examined for its consequences and impacts, regardless of whether negative or positive.

Extensive studies have shown that genetic engineering is not a "risky technology". Genetically engineered plants carry neither more nor less risks than conventionally bred

ANNEX C9

ones. The transfer of pollen is not a risk special to genetically engineered plants. The question is one of whether the introduced gene has any negative implications when transferred. The possibility of transferring "foreign" genes to the genome of related plants through the use of genetic engineering is one that is recognised and taken into account in the existing legal provisions. At KWS, a risk assessment is carried out on a case-by-case basis for every gene sought to be introduced by genetic engineering. A panel of external experts oversees.