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Drivers for competitiveness in agri-food chains: A comparative analysis of 10 EU food product chains

WP4 EUMercoPol

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Introduction

There has been a large increase in vertical integration of agricultural and horticultural supply chains in the EU since the 1990s. To survive in a more and more globalized and competitive market, agro-related enterprises have to form and count on close associations with clients and suppliers. Marked advantages of organising agri-food production in chains or networks of companies are increased efficiency, flexibility and quality. Due to vertical integration, the arena of competition is shifting from the scale of the individual business to the scale of the entire supply chain. Especially in the food sector, business as usual has changed lately. Retailers no longer focus on the four P's (product, price, place and promotion), but are more keen on: traceability, reliable supply and long term relationships (Skytte & Blunch, 2001).

Supply chain management can be defined as the planning and management of all activities involved in sourcing and procurement, conversion, and logistics management (CSCMP, 2005). Importantly, it also includes coordination and collaboration with channel partners such as suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management brings together supply and demand management within and across companies.

The report examines the drivers for competitiveness of EU agri-food chains. We do this based on available research in 10 example chains, which are important to Mercosur countries: wheat, maize, rice, soy, sugar, beef, poultry, milk powder, oranges and apples. As can be observed in table 1, maize, rice, soybean and oranges, are of little importance to European export (excluding intra-EU trade). Oranges produced in Europe are mostly consumed fresh and soybean and rice production is marginal. The maize produced in Europe is often locally processed and used as fodder. Little research has been undertaken on these chains in Europe. This report, therefore, pays more attention to the regulatory and market landscape of maize, rice, soybeans and juice concentrates, than to the internal factors contributing to their competitiveness.

Table 1 Shares of EU and Mercosur in world food exports (FAOstat data, 2005)

Share of world export (2003)	EU 15*	Mercosur**	Greatest exporter	Share of world export
Wheat	11%	5%	USA	21%
Maize	0%	15%	USA	50%
Rice	1%	3%	Thailand	30%
Soybean	0%	47%	USA	48%
Sugar	12%	32%	Brazil	32%
Bovine	5%	21%	USA	17%
Poultry	9%	21%	USA	28%
Milk Dry	19%	5%	New Zealand	26%
Orange Juice	1%	61%	Brazil	61%
Apple	7%	14%	France	13%

*EU 15 countries, exclusive trade within EU 15
**Argentine, Bolivia, Brazil, Chile, Paraguay, Uruguay inclusive trade between these countries

Drivers

Drivers for competitiveness can be researched in various methodological ways. In this paper, an adjusted version of the competitiveness drivers from the WP4 Principles & Conclusions (GEPAI) presentation is used. We analyse agri-food chains by means of the drivers:

1. Market structure
2. Regulation
3. Chain coordination
4. Logistics
5. Quality
6. Added value
7. Costs

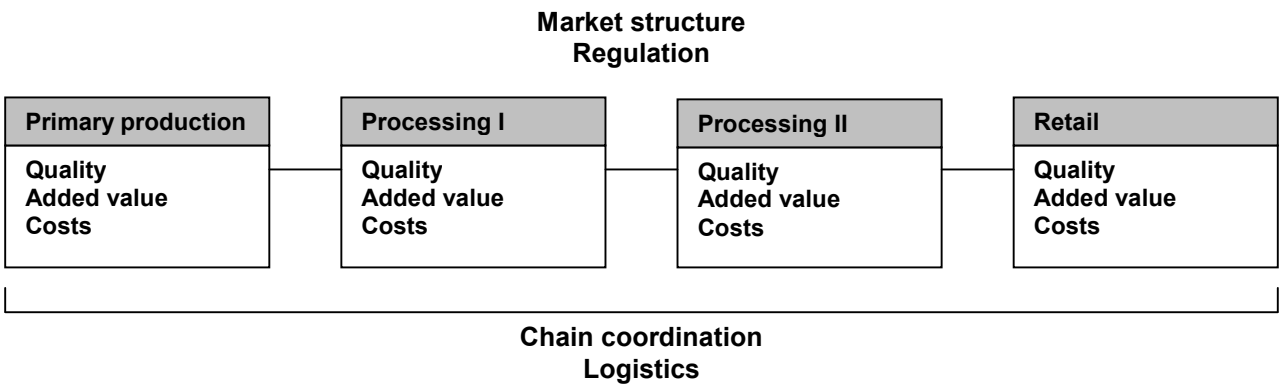
The relationships between the drivers can, in a strongly simplified form, be visualized by figure 1. Hence, it portrays the interlinkages between the drivers. Both regulation and market structure can be seen as the outside forces acting on the supply chain in a rather autonomous mode, though chains often themselves initiate private regulation too (e.g. quality labeling). Compliance with EU and national regulation is crucial for chain competitiveness. Compliance with and the creation of private regulation is increasingly becoming so as well.

Chain coordination and logistics rather function *within* the chain. The latter two drivers are highly interlinked. Logistics in this report moreover focuses on the physical aspects of distribution and coordination, as chain coordination takes care of the formal and informal relations between chain segments (e.g. contracts, trust, information sharing). Both drivers influence the chain competitiveness to a large extent. Chain coordination and logistics determine the chain's efficiency, product quality and safety.

The goal of all coordination and logistic activities is to reduce costs, secure and enhance quality and/or create added value at all stages, thereby increasing the competitiveness of the chain as a whole. Interlinkages between the last three drivers: quality, added value and costs, are multiple. E.g.: Greater quality can lead to added value, whilst specific reductions in costs can be seen as added value.

The competitiveness of a chain as a whole is more than the sum of the individual competitiveness of chain segments. This report, therefore, focuses particularly on indicators that mark increased, chain-wide competitiveness. These quantitative and qualitative indicators are portrayed for all drivers; both in general terms as for specific EU product groups.

Figure 1: Drivers of competitiveness in the supply chain



1. Market structure

Market structure defines the boundary conditions for the supply chain. It presents us the level of fragmentation of separate chain segments in a country, the size of the home market, and the trade balance (e.g. Weindlmaier, 2000). These figures are important to assess the competitiveness of an agri-food chain. E.g. the level of fragmentation is a determinant for chain coordination; the (possibilities for) economies of scale can establish cost efficiencies; and the level of organisation at producer level can outline possibilities for upstream chain coordination. The EU's market structure for the 10 product groups varies widely.

Wheat

France is the biggest producer of wheat in the EU. The share of France in world wheat production is 6%. In comparison, China, which is the biggest wheat producer in the world, has a share of 15%. France is Europe's largest exporter as well and holds a second position with 14% of world export, after the USA (21%). Most of the exports however stay inside the European Union. Italy is the world's largest importer of wheat followed by Brazil and Japan (FAOstat data, 2005).

The European wheat sector is fragmented at producer level (Vorst et al, 2002). This is also true for the sugar, soy and maize sector, because these crops are basically produced in the same rotation on the same farms. Farmers cultivating cereals, oilseeds and protein crops include almost 900,000 holdings, with an average size of 30 ha. Differences in farm size across countries, however, are large. They are below 10 ha (Greece and Italy) and exceed 50 ha in Spain, France, Ireland and the UK. Farm size on average exceeds 40 ESU[1] on more than half of the holdings in the UK, with an average size of almost 180 ha (Houwers et al, 2001).

In many regions, like Scotland, the fragmentation in producers is balanced by a very strong organization of producer groups. Around 85% of farmers are members of a producer organisation (Jack et al, 1998). Grain prices have been falling in Europe the last decades due to EU price politics. Alongside an overcapacity in the processing industry, this has caused a multitude of mergers and take-overs in the grain processing industry. As a result the processing chains of the European grain sector are becoming increasingly concentrated (Poignée, 2005). For grain milling, all countries, except Spain, show a decline in the number of enterprises. On the other hand, hard wheat products and brewing show very large increases in number of enterprises in several European countries, except Denmark (Baker, 2003).

Maize

The EU-25 countries produce 8% percent of the world's maize production, which more or less equals the production of the Mercosur countries. The USA is the world's greatest producer (42%) followed by China (18%) and Brazil (6%). Just like wheat, France is Europe's greatest producer and exporter and holds a 4th position in the world's export ranking (FAOstat data, 2005). Most of the exports, however, stay within the European market. The greatest share of EU-produced maize is used as animal feed.

European maize farmers generally cultivate small areas (2,4 hectares). Nevertheless, the former state owned farms in Czech Republic cultivate on average 50,6 hectares, whilst

[1] ESU: European Size Unit. 1 ESU roughly corresponds to either 1,3 hectares of cereals, 1 dairy cow or 25 ewes.

Cypriote farmers only cultivate 1 hectare (EuroStat data, 2005). The structure of the European maize-processing sector is comparable to that of the wheat and soy sector.

Rice

Though the EU (25) is a big net rice importer, Mediterranean EU countries still produce 2,8 billion tons of rice. A large part of this rice is of the *Japonica* variety (round grained rice). Because European citizens favour the *Indica* varieties, the EU exports its *Japonica* surplus, which accounts for 0,3 billion tons of rice (excluding intra-trade) (Yap, 1997; FAOstat data, 2005). The EU has to import the *Indica* varieties. EU imports count up to 1,1 billion tons of rice per year.

European rice importers operate from Geneva. The Grain and Feed Trade Association (GAFTA) and the London Rice Brokers Association (LBRA) are the two main organizations in the international rice trade that provide contracts and arbitrage. The Federation of European Rice Millers processes 90% of imported rice. It is made up of company members from around Europe as well as the national rice milling associations of: Italy, Spain, Portugal, France and Germany.

Sugar

In 2003, almost 400.000 farmers cultivated sugar beet in Europe. On average they cultivated 5,7 ha. The cultivated area was biggest in the Czech Republic (71 ha) and smallest in Greece (2,3 ha) (EuroStat data, 2005). France is the tenth world sugar producer and Europe's number one. Furthermore, France is Europe's greatest sugar exporter and ranks third on the world list with a share of 6% in exports, after Brazil (32%) and Thailand (13%).

Although, the producer side of the sugar sector is rather fragmented, the European sugar-processing sector is highly concentrated. In most countries sugar processing is done by big (former) national industries. Each European country only has one or two sugar industries (IIED, 2004). This does not always result in the highest efficiency as is shown by the case of Greece (see: 4. Logistics - Ioannou, 2003).

The EU sugar sector displays two strategies for the future. One group of European sugar industries is merging with other food industries, especially those producing sweeteners and bakery products. Other European sugar industries aim at processing raw material from abroad, after the expected lowering of the import quota (Wijnands & Silvis, 2000).

Soybean

In Western Europe, soybean is grown mainly in Italy and France with 0,24% and 0,07% of world production respectively. EU25 ranks on the second place of world soy importers with a share of 31% of world soy imports compared to 35% of number one China. Within Europe, the Netherlands is the biggest importer of soy (FAOstat data, 2005). This is due to the presence of intensive livestock production in the Netherlands, Flanders and Western Germany. This sector consumes a large part of soy cake and soy meal, which is a by-product of soy oil production. Two-thirds of the product of soy crushing forms the soy meal, which is mainly incorporated in fodder.

The crushing industry in Western Europe has an overcapacity, therefore it is expected that the industries will expand further in the years to come. The industry is already concentrated in three major enterprises: Archer Daniels Midland (ADM), Cargill and Cereol. The latter two just bought Europe's number four, VandeMoortele. European margarine demand is

decreasing, and probably further concentration will take place in the margarine industry as well (Wijnands & Silvis, 2000).

The increased competition in the retail sector has increased pressure on prices, pushing down price levels all through the food value chain. Near the bottom of the chain, crushers and refiners are increasingly being caught in a cost price squeeze. The soy-processing industry will have to adjust to the continuous pressure. To some extent, this pressure is driving the geographic realignment of the industry as companies look to manage dispersion and logistics as part of their strategic mix to reduce costs. Vegetable oil companies are, in essence, following two strategies: (i) By selling bulk in order to establish a low-cost leadership position; and/or (ii) By developing strong consumer-focused brands. The latter companies focus on the ability to adjust the processing quickly to changing consumer preferences. This is seen as a viable way to maintain market share and generate added value (Shwedel et al, 2005). The animal feed sector is very competitive and rather fragmented. E.g. the largest animal feed producers in the Netherlands have a market share of 15%.

Beef

The EU-15 produces 7,4 billion tons of beef per year, which cannot by far satisfy domestic consumption. Yearly, a net 31 billion tons of beef is imported, mainly from the USA and Argentina (FAOstat data, 2005).

The average European cattle ranch has only 33 cows and steers. Cyprus has on average the biggest ranches with 170 cows and steers while Lithuanian cattle growers only have 4.3 animals (EuroStat data, 2005). Especially in Western Europe, the big supermarkets heavily dominate the beef sector. In most European countries, but especially in the UK, retailers only sell meat with their own, private label. The big retailers in the UK account for 80% of the beef sales (Fearne, 1998).

Poultry

The EU-15 is a large producer of poultry meat with 8,7 million Megatons a year. The EU-15 mainly uses this for domestic consumption and is a small net exporter with 315.000 Megatons (FAOstat data, 2005).

The average European broiler grower possesses 761 broilers. However, the intracontinental differences are huge. Average UK growers have 55 thousand broilers, while Lithuanian producers on average only own 67. In many countries in the EU, the poultry-processing sector is very concentrated (Yakovleva & Flynn, 2004). The grower sector is fragmented but highly organized, especially in the Netherlands (Westgren, 1994). The environmental regulation in the Netherlands prohibits free growth of broiler farms resulting in more producer power vis-à-vis the feed companies (Westgren, 1994).

Dairy

EU-15 production of milk is 125,6 million Megatons. The EU-15 is a net exporter of dairy products with a net export of 9,6 million Megaton of milk equivalents (FAOstat data, 2005). Germany is Europe's greatest milk producer and the world's 4th producer after USA, Russia and India. Germany is also Europe's largest exporter of dairy products (FAOstat data, 2005).

The average European dairy farmer owns 8,6 milking cows. Italian milk farmers generally own the largest amount of milking cows (104), while Lithuanian farmers on average only have 2,3 cows. The coordination between dairy farmers and processors is very well developed

in Denmark and the Netherlands. This is due to a (historical) strong concentration of the cooperative dairy industries (Wijnands & Silvis, 2003). The European dairy industry does intensive efforts to broaden the horizon. Besides increasing the level of concentration of the sector, companies are looking for possibilities to expand in Eastern Europe, Asia, the United States, Columbia and Argentina (Koole et al, 2005).

Oranges

The EU-15 produces 6,1 million Megatons of oranges, which is by far not enough to satisfy domestic demand. Most oranges used for the beverage industry are therefore imported. The EU is responsible for the import of 70% of the world orange juice concentrates. Brazil is responsible for 80% of the exports (Neves & Neves, 1999).

The world six largest fruit juice companies own 80% percent of the market share. This does not withstand the fact that in Europe, the beverage industry is extremely fragmented and shows low margins and an overcapacity of 30%. There are more than 400 companies in Germany and 600 in the rest of Europe, counting up to a total of more than 1000 companies (larger than 3 million liters/year) (Neves and Neves, 1999). The retail sector, again, is highly concentrated. The biggest six enterprises generally own a market share of more then 60% around Europe (Baker, 2003).

However, this situation is not going to hold for a long time. Multinationals like PepsiCo and Coca-Cola are already increasing their market share. Subsequently, the concentrate exporters try to jump over the European beverage industries by delivering directly to retailers (Neves & Neves, 1999). Retailers almost solely execute the orange juice sales.

Apples

The EU-15 produces 7,8 million Megatons of apples. The EU-15 is a net importer by 452,000 Megatons of apples and 200,000 Megatons of apple juice concentrate (FAOstat data, 2005).

The average European berry and fruit farm only counts 1,3 hectare. On average farm sizes are biggest in Czech Republic (8,7 ha) and smallest on the island of Malta (0,09 ha). EU-25 now counts almost two million berry and fruit producers. The number of fruit and vegetable processing enterprises throughout Europe shows considerable variation over time and place without a significant trend. In the fruit sector, supermarkets sell 70% of the total fruit sales (Baker, 2003).

2. Regulation

Regulation sets the other boundary condition for business within the supply chain. Two types of regulation can be distinguished: public and private. Private regulation mainly evolved from the initiative of the sectors themselves and varies in range and scope; e.g. EUREP-GAP applies to the majority of large EU retailers, whilst the Scottish Quality Beef and Lamb (SQBL) label only works for a relative small area and sector of the EU. Once established labels also work as a top-down enforcement. Public and private regulations are dealt with, here, in the same paragraph.

Public regulation

Farmers, processors and retailers in the EU and companies exporting to the Union are subject to many regulations on: fertilizer use; crop protection; labour conditions; processing; and handling. Compliance with the rules regarding food safety is a necessity for entrance to the single market. Many of these rules are EU directives others are country specific. An example of this is the UK Ministry of Agriculture Codes for Good Agricultural Practices (Hughes & Merton, 1996) and the UK Food Safety Act (Vorst et al, 2002).

Food and feed imported into the European Community has to comply with the relevant requirements of the European Food Laws (CEC, 2005; EU 178/2002). Besides the EU regulations, all member states have their own regulations too, although harmonization processes are continuing. As it is impossible to discuss all EU regulations concerning food, we will only shortly mention regulations on traceability, GMO, contaminants and packaging and processing. For a more complete figure on the regulations regarding the import of foodstuffs, we refer to the 'Guidance document on certain key questions related to import requirements' (CEC, 2005).

EU Directive on Traceability

The General Food Law (EU 178/2002) obliges all parts of the European food chain to register from which supplier they buy food products and to whom they sell it. EU 178/2002 has no extraterritorial effect; this means that imported food should not be traced back further than the importer (EU standing committee on the food chain and animal health, 2002). The European Commission implemented a system for the identification and registration of bovine animals (EU directive 1760/2000) at the production stage and created a beef labelling system specific to the EU. The EU legislation involves that bovine meat has to be labelled to provide information concerning the identification of the animal (or batch), the slaughterhouse and the cutting facility, if any, information on the country of birth of the animal and on all those countries in which the animal has lived. The directive provides regulations for the traceability. E.g. live poultry and hatching eggs must be traceable to their original group and stock.

EU Directive on GMO

For the European soy sector, the GMO regulations of the EU are extremely important. According to regulation EC 1829/2003 food or animal feed containing GMO's must not:(a) have adverse effects on human or animal health, or on the environment; (b) mislead the consumer; and (c) differ from the food which it is intended to replace to such an extent that its normal consumption would be nutritionally disadvantageous for the consumer (EC, 2003). GMO's may not be placed on the marked unless it is authorised by the EU. The European commission will only grant Authorisation when the applicant has demonstrated adequately and sufficiently that it satisfies the conditions above. Additionally, food and animal feed products that contain or are produced from more than 0.9% of GMO, has to be labelled.

Industries, producing food and animal feed that contains or is produced from GMO's, have to make sure that the following information is transmitted in writing to the operator receiving the product (Regulation 1830/2003): (a) an indication of each of the food ingredients which is produced from GMO's; (b) an indication of each of the feed materials or additives which is produced from GMO's; and (c) in the case of products for which no list of ingredients exists, an indication that the product is produced from GMO's.

EU directives on contaminants and diseases

The EU has an extensive set of safety regulations. Regulation (EC) 466/2001 and its amendments set the maximum levels for certain contaminants in foodstuffs. The EU has set the sampling criteria for the tracing of the malicious elements in Directive 2001/22/EC. Maximum Residue Levels (MRL's) are the maximum allowed concentrations of pesticides in food products. The EU set MRL for individual pesticides and commodity combinations. Foods, which are derived from commodities, which comply with the respective MRL's, are assumed to be toxicologically acceptable. When MRL violations are discovered, the products are not admitted to the market (CREM, 1999).

Food, which is decaying or made of mouldy raw material, can be highly toxic. Rotten products may produce (myco)toxins. Aflatoxins, for instance, are a type of mycotoxins produced by moulds, which grow in improperly stored grains and dried fruits like apples and certain other food. Aflatoxins are very dangerous to humans and animals, not only because of their acute toxicity in high doses, but also because of their strong carcinogenic properties. (CREM, 2004; Scholten et al, 2004) The total aflatoxin level may not be higher than 4 µg/kg.

For animal production EU directive 89/397 and subsequent amendments point out that regular inspections at the point of production are highly important. All member states have included this directive in their national legislation. The UK has implemented this directive by the UK Food Safety Act (Fearne, 1998). Belgium introduced an official health standard qualification for poultry. A-qualified producers have the right health-infrastructure and have proven absence of zoonotic agents and zoonoses. Level B indicates that the producer has the needed infrastructure level, while level C indicates that the meat does not meet the rules.

EU legislation on packaging and processing

Other legislation is set up for procedures in the packing and processing phases of the production process:

- General requirements for food labelling are explained in Directive 79/112/EEC;
- The EU has issued a directive for packaging and packaging materials (Directive 94/62/EC), which regulates minimum standards (CREM, 1999);
- Hygiene of Foodstuffs Directive 93/43/EEC concerns the hygiene of foodstuffs and obliges food processors work according to Hazard Analysis and Critical Control Points (HACCP). The directive is obligatory for EU businesses and EU retailers. Hence, HACCP principles are also relevant for food product suppliers outside the EU.
- A traceability regulation for packages is expected to be introduced in 2006 (EU standing committee on the food chain and animal health, 2002).

The FAO and WHO developed a Codex Alimentarius for the safety and hygienic standards of food products. These standards are used as a reference point for both public and private regulation. The Codex Alimentarius contains more than 200 standards in the prescribed format for individual foods or groups of foods. In addition, it includes the General Standard

for the Labelling of Prepackaged Foods, the Codex General Guidelines on Claims and the Codex Guidelines on Nutrition Labelling, all of which are aimed at ensuring honest practices in the sale of food while also providing guidance to consumers in their choice of products (FAO, 2005).

Fruit juice enterprises demand a constant quality of juice concentrate and many chains in the EU formalised their demands according to the Codex Fruit Juice Standards. They organised these specific standards together with the governments of the producing and processing countries (Goodrich and Brown, 2001).

Private Regulation

Private regulation within the supply chain is normally established to ensure safety, guarantee quality or increase added value. Regulations can be set up either by the firms in the retail or processing part of the chain or by a result of co-operation of producers, processors and retailers. Private safety regulations may form important barriers to entry the EU single market, especially now that these norms are becoming increasingly stricter than public regulation. Hence, it is of great importance that any foreign company willing to export to the EU knows the state of the art of the set of regulations set up by European retailers and producers.

Special Labels

There is an enormous amount of labels and certifications in Europe, which all demand some kind of regulation and are directed at increasing added value. The labels mostly indicate that a product must come from a certain area or have a certain quality or a special production method. Examples of labels are (Chazoule & Lambert, 2003):

- *Organic labels;*
- *Label Rouge* (quality);
- *Appellations d'origine contrôlées* (area bound);
- *Appellations d'origine protégées (*area bound);
- *Indications géographiques protégées* (area bound);
- *Spécialité traditionnelle garantie* (traditionally made).

The EU has set special regulation for labelling (EU Food Quality, 2005). For beef a *PDO (Protected Designation of Origin)* can be attributed to foodstuffs, which are produced, processed and prepared in a given geographical area using recognised know-how. In the case of the *PGI (Protected Geographical Indication)* the geographical link to a specific place or region must be in at least one of the stages of production, processing or preparation. A *TSG (Traditional Speciality Guaranteed)* does not refer to the origin but highlights traditional character, either in the composition or means of production.

Labels can be found in most product groups except for those that are mainly consumed as ingredients of other products like soy and maize. Recently labelling activities have started in the fruit juice sector too (Pilkauskas, 2000). The EU has some special regulations, which make it possible to protect names of area-bounded produce: Protected Denomination of Origin or Geographical Indication (Fotopoulos & Krystallis, 2003).

Retail-led regulations

Private safety and quality regulations have become increasingly important in the European food sector. Almost all retailers demand some kind of safety guarantee from their producers.

The most important private regulations in the European food business are without doubt the set of EUREP-GAP regulations.

EUREP-GAP started in 1997 as an initiative of retailers belonging to the Euro-Retailer Produce Working Group (EUREP), a group of European supermarkets. EUREP-GAP is a set of agricultural practices and product quality regulations producer groups have to comply with if they are producing for EUREP supermarkets. For the moment, the EUREP-GAP norms only apply to fruit, potatoes and vegetables. However, regulations for meat and dairy products are just being set up.

The EUREP-GAP regulations on fruit and vegetables contain regulations on: (i) traceability; (ii) registration; (iii) races and planting material; (iv) history and management of the plots; (v) soil and substrate management; (vi) fertilisation; (vii) irrigation; (viii) crop protection; (ix) harvest; (x) post-harvest treatment; (xi) waste management; (xii) health, safety and welfare of employees; (xiii) environmental-aspects; (xiv) complain forms; and (xv) internal audits (EUREP-GAP, 2005). Only specific accreditation certification bodies can provide the EUREP-GAP certification.

Sainsbury's, a member of the EUREP-GAP group and one of UK largest retailers, developed its own quality regulations. Sainsbury's only buys apples, which are produced according to Sainsbury's product management system and Sainsbury policy on integrated crop management systems (Hughes & Merton, 1996). ENFRU, the producer group that sells fruits to Sainsbury restricts the membership to farmers that can produce according with these guidelines. Sainsbury's and other private regulations rather focus on rather than on traceability (Vorst et al, 2002). In other countries, like the Netherlands, producers organised themselves in groups in order to facilitate compliance to the EUREPGAP norms (e.g. the Greenery) (Bondt et al, 2005).

For poultry and beef, the EUREP-GAP regulations include norms on stock and traceability, animal welfare, feed and water, housing, health, waste, handling and labour regulations (EUREPGAP, 2005). For dairy products, milk installations have to fulfil certain conditions. Many EUREP retailers already demand extra quality from their producers. The biggest UK supermarkets, for instance, only sell Farm Assured Beef. Farm Assured implies that there are rules regarding the traceability, feeding, animal health, animal welfare, transport and handling of the animals (Fearne, 1998). The Scottish Quality Beef and Lamb (SQBL) association certifies farms according to quality standards. SQBL is contracted by the Scottish Food Quality Certification Ltd. (SQFC), which is accredited by the United Kingdom Accreditation Service (UKAS) to certify farms according to the EN45011 and EN 45012 European standard.

The British Retail Consortium (BRC) is a technical standard directed at branded products including regulations on quality and safety. BRC is valid for all product groups. Global standard-Food consists of a checklist of Good Manufacturing Practices combined with HACCP norms and some demands from ISO norms directed at quality and environmental certification. The International Food Standard (IFS) is basically the same as BRC but developed by German and French retailers.

Producer and processor-led regulations

Apart from agri-food wide regulation as EUREP-GAP and the area-bound labels specific beyond-compliance regulations have been established to guarantee extra quality and in some

cases increase the added value. Producer groups or processors initiate most of these certifications. Marked examples are:

Wheat

Few retailers demand special quality from their wheat product suppliers. However, some quality labelling in flour and bread does exist. Farmers that are part of a certified scheme have to fulfil more standards. The German EifelAhre mark is given to certified bread and flour from certified farms. The company Agrar-Control does the certification. Farms have to fulfil private standards as well as special, best-farming practices and have to be from a certain region (Poignée, 2003).

Cereal processors like breweries, however, do demand guaranteed quality levels. Many European breweries only buy their barley from certified producers (AKK, 1998; Jack et al, 1998). Therefore, Scottish grain farmers established the Scottish Quality Cereals (SQC) label. The quality scheme of SQL demands all cereals to be traceable, even to parcel level. Furthermore, sowing, dates of fertilizer and pesticides gifts have to be registered accurately (Jack et al, 1998). Many wheat farmers in Western Europe are producing both for food and animal feed industry. Both markets have specific quality regulations like protein content, safety regulations and farming practices (Poignée, 2003). Additionally, the processing industry has to comply with Total Quality Management (TQM) practices and Good Manufacturing Practices (GMP) (Poignée, 2003).

Soybean and Maize

The Dutch margarine, fat and oil agency, in which the soy processing industries are united, set up a Good Manufacturing Practice (GMP) as a spin-off of the 'dioxin scandal' in animal feed. Efforts are undertaken to establish a similar system in other countries, but this is hampered by dysfunctional chain coordination (Wijnands and Silvis, 2000). Since recently, Dutch feed producers only bought raw and processed materials from plants that are approved by the *TrusQ* safety scheme. *TrusQ*, a recent initiative from a number of Dutch animal feed companies, is responsible for approximately 60% of Dutch animal feed production and goes further than GMP.

Rather than being a system that is directed at company level, including input and output control, *TrusQ* is directed at downstream and upstream parts of the chain. Frequent audits are done at the subcontractors and consumers level. Subcontractors are for example *corn* millers, *soy* crushers, breweries, and *sugar* industries. Therefore, a large number of risk analyses have been carried out. The raw material is only bought when all checks have a positive result (Brunnekreef, 2005; Bouwmeester et al. 2005). The introduction of TrusQ was rather expensive for the feed industries because of the costs of the regular checks and the loss of some cheap sources of raw material. The efforts of the feed companies are not directly rewarded by the retail enterprises, as the TrusQ system is stricter than the EUREPGAP norms. However, retailers are increasingly demanding TrusQ certified supplies. E.g., the Dutch leading dairy company Campina recently announced to buy only milk from Dairy farmers using TrusQ certified animal feed (Brunnekreef, 2005).

Dairy

European Dairy cooperatives demand safe produce from their producers as well. Chain Quality Milk is a regulation, which is part of Dutch law. It assures that dairy farmers produce safe milk according to a quality handbook. Integral Chain Management (IKB) is a Dutch quality management system related to the production of meat and eggs. The marketing boards ('Productschappen') coordinate this system for different products (e.g. eggs, chicken, pig).

Quality prescriptions include quality of animal feed, drug use and hygiene. Normally more than 80% of the farmers are member of the marketing boards (Bondt et al, 2005). The Danish co-operation Arla, one of the world largest dairy companies, designed a code of practices called Arlagarden (Karantininis & Nielsen, 2004; Bondt et al, 2005). Arla only buys milk from Arlagarden certified farmers.

Sugar

Just like Arla, the Dutch Sugar Industry (CSM), which processes all Dutch sugar, only buys sugar from certified farmers. The certified agricultural producers are not allowed to: contaminate their field with certain substances; use GMO seeds; and use low-quality slurries or butchery wastes. Furthermore, the (post-) harvest activities have to be in line with the regulations (CSM, 2005).

Oranges and apples

Fruit juice enterprises demand a constant quality of juice concentrate and formalised their demands in the Codex Fruit Juice Standards, which they set up together with the governments of the producing and processing countries (Goodrich and Brown, 2001).

3. Chain Coordination

Coordination ensures that interactions between firms and/or farms along a chain exhibit some reflection of organisation rather than being simply random. There are key actors in the chain who take responsibility for the inter-firm division of labour, and for the capacities of particular participants to upgrade their activities. To be effective, key actors must have the power to coordinate and the capacity to sanction desired behaviour. These sanctions mostly are negative and are directed against at transgressions (the "stick"), but they may also be positive and may reward conformance (the "carrot") (Kaplinsky & Morris, 2005). In general chain coordination can be divided in mechanisms of governance build by the chain participants (contracts) and informal norms (trust). The type of contracts and the level of trust depend on the structure of the chain.

Structure

Basically, three structures prevail in agri-food chains:

- One way of chain coordination is by achieving ownership over all the chain parts. This phenomenon can be observed in the USA where meat processors often own the entire chain until the retail inlet. These enterprises own farms, animal feed industries and transport companies.
- Secondly, a dominant chain segment can coordinate the chain. E.g. the retailer, who performs the role of chain leader.
- The chain can be coordinated more or less equally by the partners in the chain. All chain segments are equal in terms of power relations.

Wheat, soy and sugar

The Dutch barley/malt beer chain is an example of a chain being led by one of the chain parts. Participants in this chain indicate that a chain leader and a chain manager are needed for a successful cooperation. In this specific case the brewer performs the task (AKK, 1998).

History, culture and tradition heavily influence the way chains are organized. In the European sugar chain, for example, a long-standing tradition of cooperation between sugar industry and farmers exist (Wijnands et al, 2000). On the other hand, chain structures are subject to rapid change in time. Nutreco, for instance, the second largest animal feed producer in the Netherlands, once owned hatcheries, butcheries and processing plants. Recently they sold off all vertical chains apart from animal feed. Their focus is back on horizontal expansion in the animal feed sector.

Poultry

In the UK poultry chain, poultry growing farms are often owned by the processing industry. This is the most extreme type of vertical integration. Franchising farms is common in the UK as well (Yakovleva et al, 2004). The farms that are not owned or franchised by the processing industry are at least contracted. In the Netherlands, most poultry farms are still independent. This, however, does not imply that there is no vertical coordination; feeders and grower co-operatives compose the production schedules together (Westgren, 1994).

Contracts

According to Hornibrook & Fearne (2005) chains perform best when contracts between firms recognise the perceived risk at each point along the supply chain and offer incentives to overcome them. The most significant perceived risk of producers is the income variability that results from fluctuating prices of the produce. On the other hand, the retailers main perceived

risk is the occurrence of a food scandal. The UK producer groups recognise this. They adopted quality and safety standards, and restricted their membership to so called 'quality farmers'. Advanced internal systems of control and certification assure that the beef delivered to the retail is not infected with BSE or contaminated by toxins from malicious feed (Fearne, 1998). Although the demand for safety is definitely bigger in the meat than in the cereal sector, Scottish cereal producers also developed strict quality and safety standards. The producer group expels members who do not farm according to the set of best practices (Jack et al, 1998).

Primary producers like incentives in the form of contracts that guarantee price levels. 60% of the contracts between Dutch poultry growers and poultry buyers guarantee a specific price, whilst only 40% is sold at market prices (Westgren, 1994). These numbers can be considered as a sign for the level of organisation in the Dutch poultry chains. In other European countries like Spain, there is a trend towards contracted production instead of open markets as well (Manning and Baines, 2004). Perceived risk however depends on, among others, culture, entrepreneurship and history. In the Netherlands, for instance, large differences exist in the way Catholic and Protestant farmers deal with contracts (Brunnekreef, 2005).

Information sharing between buyers and suppliers is crucial for the successful operation of the supply chain. Small errors in information at the start of the chain can cause large deviations at the chain-end (the so-called Forrester effect) (Harland et al, 2004). Therefore, the information sharing between partners or the directness of the relation in communication of requirements, specifications and regulations are indicators for chain coordination (Garcia et al, 2003).

According to Weindlmaier (2000) and Bijman (2000) an important indicator of chain coordination is chain broad investment in research and development activities, and marketing by producer groups and industries. Besides inter-firm investment, investment on firm level can be an indicator of chain co-ordination as well. This is caused by the fact that farmers, for instance, refrain from buying new milking equipment when contracts with buyers are incomplete. We can state therefore that incomplete contracts between chain partners lead to underinvestment. Therefore, when investment within a chain is high chain coordination is good (Dries & Swinnen, 2004). It is important to equally share risks and benefits within the chain. This can be done by joint innovation and joint investments (Harland et al, 2004).

Beef & Poultry
In the meat sector, close contacts have shifted responsibilities. The Vion Food Group, for example, is one of the Netherlands' largest butcheries and meat processors. Nowadays it is partly responsible for the meat sales in the supermarkets. Vion itself ensures that in every supermarket the right quantity of meat stuffs are delivered on time (Brunnekreef, 2005). In this way transaction costs can be reduced and added value may be increased substantially. ICT is an extremely important tool for this level of coordination. The supplier has to know the most up to date information from the box office (Houwers et al, 2004).

Dairy
In highly integrated chains, firms share employees too (Harland et al, 2004). E.g. sales officers of Campina (a Dutch milk co-operative) work some days of the week at the office of the retailer. However, in the European dairy chain, coordination between producers and processors is still much better than between processors and retailers (Wijnands & Silvis, 2000). Contacts between retail and processing are the key for receiving the messages from the market in order to change supply, on demand.

Orange Juice
Increasing chain coordination in the orange juice chain will according to Neves & Neves (1999) decrease stock requirements, improve financing, make logistics more connected and will smoothen the flow of products, information and additionally result in more creative promotions and fast adaptability to external impacts. Another quantifiable indicator of chain coordination is the number of visits from retail to processors and farmers, and vice versa. In case of the orange juice chain, this could result in a major improvement of the input of the juice concentrate industries, which nowadays have low control over the fruit supply (Neves & Neves, 1999).

Trust

The indicator of trust can be seen as the informal norms that act upon the chain segments. Good relationships and trust between people working in different parts of the chain is a very important driver for successful chain co-ordination (Hornibrook& Fearne, 2005; Schiefer, 2002; Jack et al, 1998). This holds for virtually all chains although Sodana (2004) argues that the power of guns can successfully replace trust in the Italian tomato supply chain.

General checkpoints to evaluate trust in chains are the length of trading relationship. Lengthier relationships generally indicate higher levels of trust. Bidding for orders will be the order of the day in low trust chain relations, whilst in high trust relations bidding will hardly occur and prices will be negotiated in contracts. When there is trust in a chain a supplier will start producing without a written order, when less confidence exists, the supplier will only begin with the process after receiving a written order. As inspection of quality will take place on a regularly basis in a high-trust value chain, little or no inspection will take place on delivery. In a low trust supply-chain a firm within the chain is likely to have many customers and the customer has many sources; the contrary will be true for high trust supply chains.

Information sharing is also part of the concept of transparency. The transparency of a supply chain is the extent to which all the chain's stakeholders have a shared understanding of, and access to, the product-related information that they request. A shared understanding is a precondition for transparency that involves sharing or simultaneous translation of language; meaning and standards at many levels; a shared language; shared interpretation of key concepts; shared standards for product quality; shared reference information models; and shared technological infrastructure (Hofstede, 2002).

Furthermore, the involvement of chain partners in upstream and downstream processes and the degree of co-ordination between operations in the supply chain can be used to measure chain coordination (Garcia et al, 2003). The existence, performance and extent of traceability and ICT systems are an important part of the chain-coordination checklist. If chains are well coordinated feedback and feed-forward will be standard (Hughes & Merton, 1996; Food Chain Centre, 2003a; Garcia et al, 2003). The other way around, tracking and tracing systems in Scottish cereals were capable of increasing trust significantly (Jack et al, 1998).

Another highly interesting feature of high trust relations in a chain is the extensive technology transfer between chain partners. Besides that, the inter-firm communication will be multi-channelled, including technicians, engineers and management. Additionally, in high trust chains the fixing of the price will be transparent, with open books. Furthermore, in high trust chains payments are done more quickly than in low trust chains (Kaplinsky & Morris, 2005).

4. Logistics

In general, logistics involve the movement of physical goods from one place to another (Lummus et al, 2001). The Council of Supply Chain Management Professionals (CSCMP, 2005) defines logistics as "the process of planning, implementing, and controlling the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption". The competitiveness of the organisation of logistics within the chain highly depends on its efficiency and reliability. However, the basic structure of the logistics is, for a large part, determined outside the chain, by the market structure, the transportation, the type of product and the production process (Zuurbier et al, 1996). Hence, they create the margins for performance and efficiency.

Some general indicators for logistics efficiency are the amount of stock needed in the different stages of the supply chain, the time needed from order to delivery, the time from producer to store and the shell life of the product (Food Chain Centre, 2004). Especially in the fresh produce sector, efficient logistics is paramount to an efficient supply chain as retailers and caterers desire frequent deliveries of perishable products (Grunert et al, 2004). The 'internal' characteristics of the product determine the logistics-system needed. These internal attributes include weight, volume, perishability and lifecycle.

McKinnon (1999) describes the following indicators for the performance of transportation in the food supply chain:

- *Vehicle fill* can be measured by: payload weight; pallet numbers and average pallet height. Most freight surveys measure load factors solely with respect to weight. In food sectors, where products are of relatively low density, vehicle loading is much more constrained by volume than by weight.
- *Empty running*. This includes the distance of vehicle-travelled empty. Besides empty running, measurement of the other utilisation of the transport fleet can provide significant insight in the transport efficiencies.
- *Vehicle utilisation*. This can be subdivided in: (i) running on the road; (ii) being loaded or unloaded (iii) preloaded and awaiting departure; (iv) delayed or otherwise inactive (v) undergoing maintenance or repair; and (vi) empty and stationary.

Inefficient logistics may have many root causes. Pack sizes may for example vary and do not always fit neatly into a crate for transportation. Additionally, vehicles are assigned delivery slots at the retailer's warehouse. If they miss that slot, it can be a long wait before they can get unloaded (Food Chain Centre, 2003b).

Subsequently, transportation cost as the percentage of total cost in a chain segment constitutes a measure for the comparative efficiency of chain logistics (Ioannou, 2003). In the case of the sugar industry in Greece a simple Excel calculation was sufficient to save a million on transport costs (Ioannou, 2003). Improved chain coordination and the use of e-commerce systems can improve logistics (Julia-Igual et al, 2003). At the very moment, retailers are busy streamlining their logistics. They do that by, among others, reducing the amount of suppliers to a number of preferred suppliers. This causes consolidation at supplier level (Houwers et al, 2004; Brunnekreef, 2005). Apart from indicators pointing at maximizing the turnover rate, the reliability of supply must be secured at each stage of the chain at all times (Zuurbier et al, 1996). For example in the orange juice chain, it is a major challenge to supply customers with a year-round standard product quality. A large network of orange suppliers from many different regions is needed to be able to mix qualities to the set standard (Grunert et al, 2004).

5. Quality

Quality means comfort, security, safety, individuality and variety (de Vlieger, 2003). Quality improvement in the chain counts up to improved quality for the final consumer. Achieving a set quality standard is more important than achieving the highest attainable quality (Food Chain Centre, 2003a; 2003b).

Fitness for purpose is a key concept in quality thinking. To achieve quality improvement, the produce has to be adjusted to the life-style and the accompanying technology levels of the consumers. The UK consumer, for instance, favours frozen poultry products that can be prepared in the microwave, in contrary to consumers on the continent who like their chicken fresh (Yakovleva and Flynn, 2004). Quality can be described in all chain parts. In spite of this, this paragraph mainly focuses on the quality of the final product. Quality issues within the supply chain including protein or fat content for soy, wheat, corn, milk, and carcass balance for beef and poultry will be dealt with in more detail in the cost or value added sections. Regulations assuring quality or safety are discussed in the Regulation section.

The variability of the end product is another crucial quality indicator. Consumers like broad supplies; nonetheless, they expect their favourite brand of cookies to taste the same, always. Variability in the supply chain can lead to inefficiencies. In butcheries for example machines might halt when carcasses are under- or oversize (Food Chain Centre, 2003a). Variability in supply within the supply chain is not always negative. Wheat, barley, corn and soy are incorporated in such a wide range of end products that a demand exists for almost any quality level (Jack et al, 1998). The same is true for orange juice concentrate (Neves & Neves, 1999a). Factors determining juice concentrate quality are: strength of concentrate (brix), acid, ratio viscosity, and colour and flavour (Grunert et al, 2004).

Another indicator of quality is the level of certification obtained by the firm, e.g. ISO or HACCP. Furthermore, the availability of trained, capable staff in the quality control sections of processing plants is of key importance to quality. Additionally the knowledge on quality production of workers and farmers and the amount of quality requirements in the contracts between producers and sellers are relevant factors influencing the quality of the end product (Garcia et al, 2003).

Many authors consider an advanced and well performing traceability system an important driver for quality improvement in the food chain (Hughes & Merton, 1996; Jack et al, 1998; van Dorp, 2003). This is especially true when a continuous data stream exists that contains information on the product quality and handling, which is passed through in both the upstream and downstream direction (Hughes and Merton, 1996). For example: the farmer that is able to check the quality level of his just slaughtered steer via the internet is a downstream feedback that can improve meat quality (Food Chain Centre, 2003a). Subsequently, the performance of the traceability system can be indicated by the extent of traceability and the time needed for tracing back to the origin.

The extent of traceability can be described by the points were the trace stops. Milk powder and juice concentrate can in general be traced back to the processing plant were the juice concentrate or the powder was made. Due to intensive mixing, these products cannot be traced back to farm level. Poultry can be traced to group level (Viaene & Verbeke, 1998), fodder and parent stock (Manning & Baines, 2004). Due to extensive regulations, beef traceability includes: the place and time of birth, breeding and slaughter, and may include

feed and genealogy (Fearne, 1998; Simpson et al, 1998; van Dorp, 2003). Soy, corn and maize have to be traced one step forward and one step backward during each stage of the supply chain, starting from the importer. In Europe the traceability of other grain products like barley and wheat vary regionally. In Scotland all barley produced for breweries and distilleries can be traced back to field level, which is remarkable. Even the fertiliser and crop protection measures are known. This extensive traceability leads to higher quality (Jack et al, 1998).

Besides the extent of traceability, the time needed to trace for instance a steak back to the cow or vice versa is an important indicator for the performance of the traceability system. In addition, the accessibility to information regarding tracking and tracing is a key to the performance of traceability as a driver for quality. When the information is accessible to all chain partners including consumers and government, the traceability system will be more important as a tool for quality improvement than when the information is only accessible for retail and industry (Simpson et al, 1998). As most of the traceability systems are only designed because of food safety regulations, these safety regulations can be considered a major driver for quality.

6. Added Value

Added value in the food supply chain is the increase in value of a particular foodstuff during its journey through the chain. Additional manufacturing and good marketing usually create added value. Value-added is not always money-making. Value-added is a "gross" figure, including manufacturing costs. Added value can basically be created in two ways:

- By upgrading the quality of the products. In this way added value can be achieved by launching new goods or by making old products better and faster available than competitors. This requires combined action of all links in the supply chain.
- By the improvement of the production process: E.g. increasing the efficiency of the internal processes. For example through increased inventory turns, lower scrap, more frequent, smaller and on-time deliveries (Kaplinsky & Morris, 2005; Food Chain Centre, 2003);

Quality Upgrade

Added value, created by the upgrading of the produce, often comes in waves. At first, the technological innovation improves, or at least differentiates, the product from the rest. Then, combined with the first-mover advantage the innovation yields added value. But, in time the effect disappears (Fearne, 1998). Therefore, the innovation has to be continuous to sustain the added value (Poignée, 2005). Good innovations therefore have to: (i) provide value to the final customer; (ii) be relatively unique in the sense that few competitors possess them; and (iii) be difficult to copy (Aalts & Kivits, 2003; Houwers et al, 2004; Kaplinsky and Merton, 2005). Analyzing the innovativeness of a supply chain is not always easy. In the Danish Dairy sector the level of innovation is measured in number of product changes per year (Baker, 2003). Wolters (2003) measures innovation in agribusiness by counting announcements of new techniques in specialized journals. An innovative food supply chain can be characterized by:

(i) A large fraction of sales from novel foodstuffs;
(ii) An elevated proportion of income derived from labelled goods (Kaplinsky and Merton, 2005).

Novel Foodstuffs

Chain coordination can improve responsiveness to the market and food trends. Food trends which appear to be promising for achieving an added value are: nutritional benefits, functional foods (with vitamins or calcium), natural, low fat, low additives, fibre, country or region of origin (Grunert et al, 2004). Especially the dairy sector is keen on following food trends (Baker, 2003). The same holds for the orange concentrate processing industry.

The orange juice sector is launching new products periodically, like: sport drinks, energy drinks, fruit flavoured milk drinks, biological products, and juice added with vitamins. There is a segment that opts for organic products, creating an opportunity to organize and coordinate ‘organic chains’. New juices and juice-based beverages are targeted at specific groups and activities, like: children, physical exercise, health conscious, adventure, fun and authenticity. New ideas for stimulating consumption at other occasions than breakfast try to replace other beverages. Also the packaging technology is contributing to increasing consumption, through convenient designs, and practical, individual sizes and formats (Neves & Neves, 1999).

Chicken processors are also known for producing added value by differentiation. Although only three chicken races are used in European chicken produce, thousands of differentiated

poultry products are marketed (Manning and Baines, 2004). The product cycle of poultry is relatively short and this contributes to its adaptability and responsiveness.

Quality Labelling
Quality labelling is seen amongst the most popular added value strategies in Europe (AKK 1998, Fotopoulos & Krystallis, 2003; Poignée, 2005). In France, 80% of agricultural produce has some kind of safety, quality or regional based label (see: *Regulations*) (Chazoule & Lambert, 2003). However, these labels alone do not assure higher added value. Labelling of a product only causes comparative advantage when the consumer pays for the added value. Furthermore, the claimed quality on the label has to be unique (Manning & Baines, 2004).

The French 'Label Rouge' guarantees a 100% price bonus for chicken growers. Label Rouge chicken are slow growing, and have a better taste and value (Horne et al, 2003). Quality labelling is not always a success story. The introduction of slow growing chicken in the Netherlands, for instance, failed because of a lack of consumer demands (Houwers et al, 2004). Besides that, the Dutch Apple Growers Organisation and other fresh produce organisations (the Greenery) are trying to establish a premium brand. Their goal is to obtain added value. However, this is a very risky business, as consumer loyalty is not easily achieved (Bijman et al, 2000). Barjolle and Sylvander (2003) performed a research on the success factors of products from a protected area. They concluded that no single success factor exists; there is always a joint effect of two or more factors. Including product specificity and size of the market; favourable public institutions and intensive chain coordination.

Responsiveness to the retail market, by changing the raw material, highly depends on the length of the production cycle. The production cycle of fruit trees and cattle, for example, is rather long, which causes a long delay between making a change (e.g. in feed) and observing the results in the end product. The production cycle of wheat, maize, rice, soy and sugar are intermediate (Yakovleva & Flynn, 2004; Food Chain Centre, 2003a; Poignée, 2005).

Production Process Improvements
Creating added value by product upgrading is not always possible: E.g. 80% of world sugar production is processed in food and drinks. This implies that most sugar is invisible to consumers and that achieving benefits by improved product quality is difficult (IIED, 2004). However, added value can also be achieved by improving processes within the chain or within individual farms or firms. Process efficiency can by increased by research and development efforts, improving supply chain management, investment in E-marketing and by facilitating supply chain learning.

In the barley-malt-beer chain value added can be increased by securing safety and identity of the barley and malt to the brewer (AKK, 1995). In the poultry supply chain more efficient use of wastes is a significant source of added value by lowering costs (Bolck et al, 2003). In chains in which bulk products are processed (wheat, maize, soy and sugar) economies of scale can be effective in realizing added value (Wijnands & Silvis, 2000). For sugar beets, the extraction rate and the amount of sugar that can be obtained per beet is an important determinant of added value in the chain (Harrison & Kennedy, 1999). In the dairy chain, the protein content is the most important. In the beef sector, the carcass balance forms the most important indicator for increased value. In the UK, for example, a high demand for steaks and other high quality products, results in total loss of revenues because the demand for low quality meat is low. Breeding and feeding efforts can help in restoring the carcase balance (Food Chain Centre, 2003a).

7. Costs

Enterprises in a food supply chain may acquire competitive advantage when their input prices are lower than the input prices in other chains. Costs are influenced by the price, quality and dependability of purchased inputs. The costs are determined by the prices of land, labour, machinery and stock. In addition, fertiliser and seed prices are important in arable production chains (wheat, maize, rice, soy and apples) while fodder prices are more important for animal production chains (beef, poultry and dairy). Information systems aimed at improving forecasting can be of great support. Information is of great importance to attain lower costs than the rivals (Harrison & Kennedy, 1999).

For the sugar chain a very important determinant of costs is the length of the processing campaign. Whilst in Europe sugar plants only operate three months a year, Latin American factories work almost year-round. This results in lower machinery costs (per kg of produce) in the latter region (Zimmerman & Zeddies, 2002). The European orange juice chain forms an exception in the sense that the inputs consist of imported juice concentrates. Hardly any European oranges are used for juice production. Prices of concentrates fluctuate strongly, because orange trees are extremely vulnerable to diseases (Neves & Neves, 1999).

Furthermore, as in many areas of Europe agricultural holdings are rather small and sometimes geographically dispersed, transportation cost can sometimes be rather high. However the fragmentation of the primary sector is often compensated by a strong organisation of producers (Garcia et al, 2003). During an extensive chain study, participants of one of UK's beef chains discovered that costs could be lowered by increasing homogeneity of produce, reduce handling and movement, improve the layout of the butcheries (Food Chain Centre, 2003b). UK beef farmers who went to Argentina to visit a ranch concluded that the financial detail with which all management decisions were made improved the margins at farm level significantly (Food Chain Centre, 2003a).

Overview

Table 2: Key indicators per driver

Market Structure		Country trade balance
		Level of concentration of importers
		Level of concentration of the processing industry
		Level of concentration of the retail sector
		Level of organisation of primary producers
		Farm size
Regulation	*A. Public*	EU Traceability
		EU GMO
		EU Packaging
		EU Diseases contamination
		National food laws
	B. Private	Special labels
		Retail led quality regulation
		Processor led
Chain Coordination	*A. Structure*	Full ownership/1 leader/all equal
	B. Contracts	Type
		Perceived risk incorporated
		Level of guarantees
		Joint investment
		Tracking and tracing systems
	C. Trust	Length of relationships
		Level of information sharing (transparency)
Logistics		Time needed from order to delivery
		Amount of stocks
		Shell life of the product
		Time from producer to store
		Transportation
Quality		End product variability
		Level of certification
		Tracking & tracing systems
		Backward
		Forward
Added Value	*A. Quality Upgrade*	Novelty development
		Labelling
	B. Process Upgrade	Use of by-products
		E-marketing and ICT use
		Supply chain learning
Cost		ICT (forecasting & planning systems)
		Access to resources
		Economy of scale
		Geographical dispersion

Table 2 shows the outline of key indicators. Hence, it presents a summary of the report. The indicators of the first two drivers are rather descriptive. In this they mostly do not represent direct indicators for competitiveness, but information of these drivers is very much needed to undertake any supply chain research.

Research on the competitiveness of a supply chain normally focuses on the specific characteristic of that supply chain. E.g. researching the UK beef chain emphasis is on regulation and quality tracking and tracing systems. Therefore, the presented methodology should not be used as a one-size-fits-all solution to supply chain research. Rather it should be used as a tool box out of which instruments can be picked that are adjusted to the specific research needs at hand.

For research on competitiveness of supply chains the most important driver varies per region, product group and specific chain within the product group. For example, meat delivered to first star retailers (e.g. AHOLD) demands different quality than for bulk retailers (e.g. ALDI). Therefore chain research should be tailored to the specific needs of the specific chain under investigation.

Information on specific product groups falls short in describing all aspects of the drivers. The info gap matrix illustrates this (table 3). The table distinguishes three categories. Fully filled boxes indicate that information is present on the specific product group. Grey boxes indicate that general information is available, but product group specific information is lacking. The white boxes signify that no information on the driver and the product chain has been collected

So, if undertaking supply chain research on competitiveness it looks wisest to:

1. Design a research question on the competitiveness of a specific chain;
2. Check the info gap matrix for available information;
3. Use the indicators following from this research and assess the chain's competitiveness.

Table 3: EU Info gap matrix

	1. Market Structure	2. Regulations	3. Chain Co-ordination	4. Logistics	5. Quality	6. Added Value	7. Costs
Sugar							
Wheat							
Maize							
Rice							
Soybean							
Bovine							
Poultry							
Milk							
Apple							
Orange juice							

White: No information
Grey: General information but no specific information
Black: Specific information on product group

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