European Food Security; Calamities to the Supply of Soy

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Introduction

Global developments such as the increasing world population, changing diets and the growing demand for energy crops, have raised awareness about the global availability of food. On top of that, the recent food crisis (in 2007-2008), where food prices in developing countries peaked, caused social unrest in both the developing and developed world. Climate change and economic and political factors might influence food prices and availability now and in the future (Bindraban et al., 2008). Furthermore, globalization might lead to more regional specialization and the concentration of production areas can increase the vulnerability to risks (Nowicki et al., 2006). These developments lead to the fact that food security has become an issue of growing concern. In this context this paper analysis the European food system (EU-27), food security in Europe and the robustness to possible calamities. The supply of soy bean and soy bean meal is identified as a possible 'vulnerability' to the European food system. A collapse of soy imports and the possible effects on the European food system is therefore investigated. The paper presents the main findings of the report "Resilience of the European food system to calamities", which is written for the Steering Committee Technology Assessment of the Dutch Ministry of Agriculture, Nature and Food Quality and elaborates on the possible policy implications. It explains the main concepts and findings and can be read without previous knowledge of the full working paper, since it is meant to be self explanatory.

The paper proceeds as follows; the first section describes the current European food system and its food security. The second section continues by further focussing on global trends and calamities that might be a threat to food security. Section three introduces the soy bean case and section 4 and 5 further describes the coping and response mechanisms to a calamity in soy bean imports. Section 6 concludes.

1. European food security

In this section, Europe's food system is examined by looking at consumption, production and trade numbers. Recent studies show that the current degree of self-sufficiency in the EU-27 is high and is likely to remain high in the near future (FAPRI, 2007 and EC, 2007a). For the basic food items 95% to 100% of European consumption is produced on its own territory (EC, 2007a). Focussing on Extra-EU trade, net trade volumes are below 10% for most basic commodities (see table 1).

Table 1 provides information about the basic food products and illustrates the net trade expressed in a percentage of consumption. The relatively low numbers in the last column show that Europe today is largely self-sufficient in all basic food items, but two major exceptions, soy bean and vegetable oils, can be distinguished. Soy bean consumption is almost fully imported and vegetable oils are imported for about 37% (in 2005) of total consumption. Bindraban et al. (2008) further describe the buffer capacity of the European food system: "The current consumption patterns allow for a relative buffer in the sense that about 60% of the EU cereal consumption is destined to animal feed (only a quarter is consumed directly), and meat consumption could be halved without harming dietary needs. Moreover, much food that appears as ‘consumption’ is actually not eaten, but wasted”. The findings suggest that the European food system is rather robust in terms of food availability, with surplus domestic production, and strong purchasing power to acquire food on the international market. The dependence on international food markets is low, except for soy bean, which suggests that calamities within the borders of Europe might impose the biggest risk, more so than calamities related to trade (Bindraban et al., 2008). In the next section, some major threats to food security are further examined.

Table 1. Production, Consumption and Trade – EU25, 2005

Product (mio tons)	Production	Consumption	Import	Export	Net trade	Percentage net trade of consumption
Cereals	253.2	246.4	10.5	21	10.6	4.3
Wheat	123.4	117.0	7.0	13.6	6.6	5.6
Maize	47.7	49.3	2.5	2.0	- 0.5	1.0
Butter	2.2	1.94	0.08	0.34	0.3	15.5
Cheese	8.5	8.0	0.1	0.5	0.4	5
Meat	41.0	39.8	1.3	2.5	1.2	3.1
Soy bean	1.1	44.1	44.3	1.2	- 43.1	**97.7**
Vegetable oils and fats	10.3	16.5	7.1	0.95	-6.2	**37.3**

Source: Bindraban et al., 2008

2. Risk assessment

This section explores some of the major threats to food security in Europe, as well as the impact of previous calamities on the European food system, such as droughts, plant and animal disease outbreaks, a nuclear catastrophe and large fires.

Bindraban et al. (2008) assess the impact of some of the global developments on the European food system, such as trade liberalization, climate change and the increasing demand for biofuels. Concerning trade liberalization and climate change, their main conclusion is that is not likely to have a strong impact on food security (until 2020). They argue that “…under continued global liberalization an increasing proportion of food production may concentrate in North-western countries, while southern nations will experience an overall decline in production and might be exposed to increasing risks due to more frequent extreme climatic events”. However, this concentration of agricultural production in North-western Europe might lead to higher risks, compared to a regionalization scenario, since in the latter scenario all EU-27 countries would continue to engage in agricultural production. Also the effects of climate change are likely to become increasingly important in the long term (IPCC, 2007) but this is beyond the scope of the conducted study (a time frame up to 2020). However, there seems to be a special role for biofuels in the discussion. Recently an EU biofuel policy has been proposed for obligatory blending targets of 10% biofuels for the transport sector in 2020 (EC, 2007d). Banse et al. (2008) show that policy (e.g. tax exemptions, investment subsidies and obligatory blending of biofuels) is the main driver of biofuel production in the EU, USA and Canada, and is even more significant than the influence of the oil price. These policies however, are still under debate, since research on the impact of cultivation of energy crops and the use of biofuels on climate change and biodiversity is still being conducted (Bindraban et al., 2008). Also the ability of biofuels to make a significant contribution to energy security and to reduce greenhouse gas emissions is a part of the debate (e.g. OECD, 2008). Although not much yet can be said about the effect of biofuels on food security, Bindraban et al. (2008) speculate that "if the demand for food by humans and for biofuels exceeds the increase in crop productivity, food prices very likely will rise due to biofuel production".

Also an assessment of the impact of previous calamities was done by Bindraban et al. (2008). The results show that the occurrence of single calamities so far have not caused problems of food insecurity in Europe. To start with, the drought in Europe in 2003 mostly affected producers, and not consumers, since the production shortage was imported from the world market and stocks were used (COPA-COGECA, 2003 and Olesen and Bindi, no year). When it comes to the impact of previous animal diseases, meat consumption is reduced and consumers also change their diets, but overall dietary needs were never jeopardized (Blayney et al., 2006 and Nowicki et al., 2006). The extensive fires in Greece destroyed many olive oil production sites, but only 5% of total European olive oil production was affected and this was actually compensated by a higher production in Spain (Zervas and Eleutheroxorinos, 2007). Furthermore, the nuclear disaster in Chernobyl seriously affected local agriculture but there was no effect on the overall food system in Europe (Chernobyl Forum, 2003-2005). From this assessment of potential risk and recent calamities, it seems the European population is not likely to experience fierce shortages in food availability in the near future. However, the findings suggest that the largest sensitivity of the European food system is related to the imports of soy bean. This sensitivity is due to the fact that soy bean and meal is imported for almost 100% from Latin America, which makes Europe very dependent on this flow of imports. If imports would collapse, there would be no soy bean available for Europe. This is very different from a product such as grain for example, since grain is produced on numerous sites in Europe and is also available in many different countries on the world market. Furthermore, Europe has virtually no soy bean stock compared to the rest of the world. Global soy bean 'stock to use ratios' exceed 25% and large stocks are mostly kept in the large soy bean producing countries such as the USA, Argentina and Brazil (Bindraban et al., 2008). However, the European stock to use ratio is less than 3%, indicating a very low buffer capacity. Therefore in the following section, a collapse of soy bean imports is analyzed to assess the quantitative implications and to reason possible externalities.

3. The soy bean case

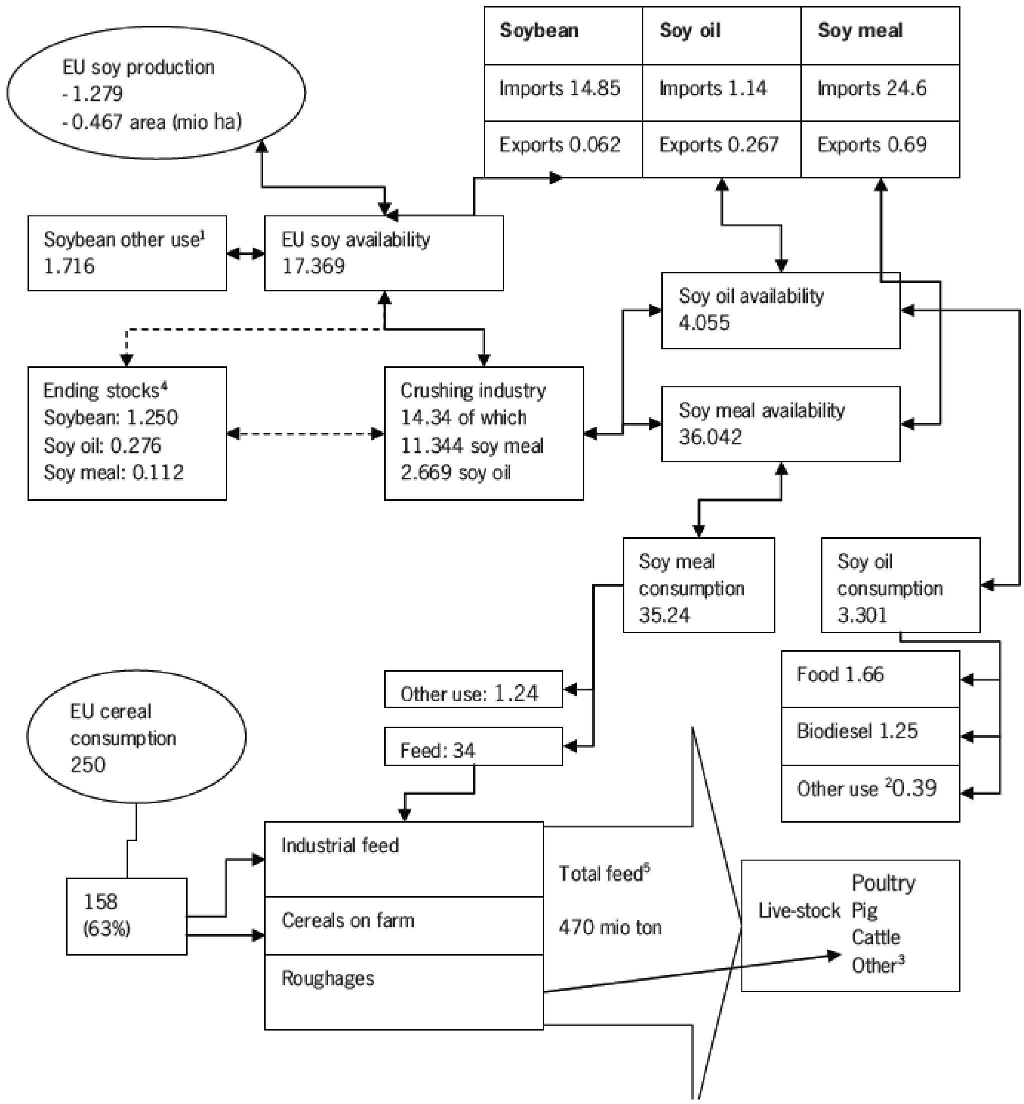
3.1 Soy bean in Europe

In this section, the effect of a collapse of soy bean and soy meal imports is examined. Soy bean is a versatile crop that is used for many purposes. The demand for feed for pork and chicken in Europe and China mainly drives global soy bean production. After crushing the beans, soy bean meal is used as an ingredient for feed and soy bean oil is mostly used in the food industry sector. It is also a major source for the chemical industry for the production of different bio-based products. The oil could also be potentially used for the production of bio-diesel, a practice already being performed in Brazil (Bindraban et al., 2008). Furthermore, soy beans are also used directly for food consumption.

As mentioned earlier, soybean is an example of a commodity for which the EU is heavily dependent on imports. Of total world trade, the EU-27 imports account for 21% of total soybean trade, 45% of total soybean meal trade and 11% of total soybean oil trade (Fediol, 2007). Furthermore, these volumes and demand from the EU-27 are projected to remain virtually unchanged up to 2020, also under full trade liberalization (FAPRI, 2002). Main producing countries of soy bean are the USA, Brazil and Argentina, with a current total global production of 235 million tons (ISTA Mielke, 2007).

Currently the EU has a zero-tolerance policy for GMO products, although these products are more accepted globally and produced world wide (Bindraban et al., 2008). A collapse in imports of soy bean and soy meal could occur due to this policy, in the case that only GMO products would be available. If this would be the case, outside the EU soy bean and soy meal would be available while the EU would face a serious deficit of soy bean and soy meal. Furthermore, a disruption of soybean imports could also be the result of a calamity, which would affect for instance the soybean production in Latin America. In that case, there would be a global shortage of soybean meal.

Figure 1. Soy flow chart for the EU-27, 2006



Notes to figure 1: All numbers are in million ton, availability includes stocks
[1] Soybean other use goes to the food and feed industry
[2] Other use from soybean oil goes to industry
[3] Production of other meat includes sheep, goat etc
[4] Change in stock are 0.037 for soybean, 0.0047 for soy oil and 0.029 for soy meal for the year 06/07
[5] Data for feed apply to the EU-25
Source: Bindraban et al., 2008

Figure 1 schematically shows the flow of soy bean products in the EU and its link to the feed industry. In the flow chart it becomes clear that the soy bean meal from the EU industry and the imported meal add up to 34 million tons and are directly used in the feed sector. The soy bean produced in Europe seems to be very small relatively to the amounts imported. Furthermore, soy oil in 2005 contributed to 10% of European vegetable oil consumption (ISTA Mielke, 2007).

3.2 Collapse of soybean imports

First, in order to get an idea of the size of the effect on meat production due to a collapse of soy imports, the study 'Economic impact of unapproved GMOs on EU feed imports and livestock production' (EC, 2007b) was investigated, which looks at the impact of a possible disruption in soybean meal and soybean imports because of the GMO-policy of the EU. The focus was on the worst case scenario of the study since this scenario is closest to a total collapse of soy bean (meal) imports. The worst-case scenario as described in the EC study is an interruption of US, Argentinean and Brazilian soybean (meal) imports without compensation from other exporting countries. This would leave an import deficit of 32.3 million tons in soybean meal equivalent, resulting in a net shortage of soybean meal of 25.7 million tons (Bindraban et al., 2008). In the flow chart it becomes clear that this does not correspond to a total collapse of soy meal availability, since the total amount would be 34 million tons. However, this scenario is very close to the full collapse of imports. It must be mentioned that the authors of the EC study note that the impact goes well beyond the technical limits of the model used for the analysis in the provision of precise and reliable estimation. The outcome can thus be used as an indication, only. According to this study, the prices of soy bean (meal) in the EU will increase due to reduced availability, which leads to lower consumption levels of approximately 50% in this worst-case scenario. The study gives the impact of the soy bean meal shortage on the meat production industry as deviations from the baseline in percentage as presented in table 2.

Table 2. Impact on EU pig meat, poultry and beef sector, in case of 32.3 million tons import deficit of soy bean.

Deviation from baseline, %	Pork		Poultry		Beef	
	2009	2010	2009	2010	2009	2010
Net production	-29.3	-34.7	-29.2	-43.9	-1.1	-2.1
Import	637.0	5461.0	92.5	158.3	397.4	295.8
Export	-86.0	-85.3	-100.0	-100.0	-100.0	-100.0
Consumption	-23.9	-17.4	-15.7	-26.3	30.2	23.1

Source: EC, 2007b

Table 2 presents the expected results from the EC study in percentages. It seems that the changes for all meat products are very significant. Due to the soy import disruption, the production of pork, poultry and beef in the EU in 2009 is projected to decrease from 41 million tons to 31 million tons, while consumption decreases from 40 million to 36 million tons (calculations based on projections of EC, 2007a).

The EC study has showed the changes in production, consumption in trade due to a (almost) collapse of soy bean imports, but it does not go further into detail about the reactions of producers and the substitution possibilities. The analysis is on an aggregate level. However, Bindraban et al. (2008) go further into detail and examine the substitution possibilities and market responses due to a total collapse of soy bean imports at the farm level. These findings will be used later when looking at coping and response mechanism in the next section. Bindraban et al. (2008) focus on pig meat production since it has the largest share in the meat production in the EU, and also about 36% of total soybean meal consumption is used as pig feed (Bindraban et al., 2008). Furthermore, it makes averaging animal feed composition (and therefore calculations) easier since pig feed composition is intermediate between ruminant and poultry (Gatel and Porcheron, 2003).

The result of Bindraban et al. (2008) is in size quite similar to the results of the EC study. The hypothesized collapse of soybean and soybean meal imports will affect pig meat production in Europe significantly. If it is assumed that no substitution of soybean (meal) takes place and that protein is the limiting factor in pig meat production, then the pig meat production will decrease by 38%[1]. Based on the pig meat production for the EU in 2006, this would imply a decrease of 8.3 million tons pig meat (Fefac, 2007). In the EC study, pig production drops with 29% due to disruption of soybean meal imports, and substitution with available rapeseed and sunflower meals.

For meat producers, a collapse in soy bean imports would be a serious calamity and might result in the closure of farms and firms. However for the consumer, this would mean a per capita decrease in meat consumption of about 8 kg, assuming a population of 493 million people in 2009 (EC, 2007c).The reduction in meat consumption is not likely to jeopardize health conditions of the average European, as current average annual consumption of 93 kg is well above the nutritional requirement (The Netherlands Nutrition Centre, 2008).

4. Coping and response

4.1 Availability of substitutes

Bindraban et al. (2008) identify different possible substitute sources (e.g. rape seed and pulses) of protein in case of a collapse in soy imports. It seems, however, that the

[1] The required pig feed (complete feed requirement) in the EU-27 was calculated, based on parameter values given by Van Cauwenberghe et al. (2003). For the estimation, pig feed conversion rates (of 3.1) were taken into account as well as the various European practices in terms of nutrients levels and in terms of ingredient selection. Furthermore, also the various types of pig feed, from piglet to sow feed, with the emphasis on growing and finishing pig diets (as they represent the biggest pig feed tonnage) were taken into account. The proposed formula is modelled to average the above mentioned aspects, but it must be mentioned that feed composition is variable and depends on various aspects such as: local commodity prices and volumes, quality of feed, environmental constraints or nutritional concept implemented. For detailed calculations and numbers, refer to the WUR working paper of Bindraban et al., 2008.

amounts required to substitute soy in the feed composition are currently not produced in the EU. A first response would thus be to call upon the world market for substitute sources of proteins and substitute meat. However, looking at the amounts traded at the world market of these alternative protein-rich crops compared to the amounts needed in Europe might raise some concern. The data on global trade volumes of oil seed meals shows that the required amounts of oil meals and pulses to fully substitute the shortfall in soybean are currently not traded at the world market (ISTA Mielke, 2007). However, although the required amounts of substitutes are not traded, global production is high enough to cover the European deficit. Whether the required substitutes will be available will thus be determined by purchasing power. In case the interruption of soybean meal imports is caused by a zero tolerance policy of GM-soybean, the sudden surplus might push down soy prices, and soybean meal will become available at the world market as a cheap feed ingredient for non-EU countries (Bindraban et al., 2008). In this case, alternative protein feed ingredients (e.g. palm kernel seed and cottonseed) could possibly become available in higher volumes, since users might choose to switch to using soy bean. Still however, it is very likely that the prices of these substitutes are relatively high compared to soy bean meal, which implies an impact on European meat production.

4.2 Stocks

As mentioned earlier, soy bean stocks in Europe are very low, with a stock to use ratio of less than 3%. Remarkably, in the rest of the world and especially in the producing countries, stocks are much higher (stocks to use ratios exceeding 25%). Keeping stocks would however allow Europe to mitigate adverse short–term effects. According to Bindraban et al. (2008) "higher stocks in the EU could reduce price shocks and smooth any transition to other feed sources". They suggest a stock of 10 million tons could cover about 3 months' consumption, which should provide enough time to secure other sources of proteins. Although stocks stabilize prices, a drawback of having high levels of commercial stocks is that they tend to depress average prices somewhat. However, strategically, policy (such as tax exemptions to private stockholders or government stockpiling) could promote keeping higher levels of stocks to reduce the vulnerability to shocks in the soy bean supply.

4.3 Cultivation

Next to looking for protein crop substitutes on the world market and using stocks, Europe could respond to a collapse in soybean (meal) imports by cultivating more protein-rich feed crops on its own territories. If the collapse would occur in the very near future, the complete cultivation of substitute crops would require about 27 million hectares[2] (which is about 13% of total UAA) and about 20 million hectares in 2020 (Bindraban et al., 2008), due to productivity increase. In the very near future, this land requirement can only be met by using formerly set-aside land and cultivating less of other crops. However, in 2020 this land requirement can be more easily met, since over time less land will be used for agriculture (expected decrease in UAA up to 2020 is about 26 million hectares) (Bindraban et al., 2008). In order to preserve this land for agriculture, policy incentives would be needed to make the cultivation of these energy

[2] Total Utilized Agricultural Area (UAA) in the EU-27 in 2000 was 203 million hectares (Nowicki et al., 2006)

crops economically attractive. However, this is unlikely to happen under a trade liberalization scenario. In the case biofuel policies influence the cultivation of biofuels in Europe, there might be an interesting synergy between biofuel crops and protein requirements for feed. Namely the cultivation of biofuels (using 1st generation food-based technology) has proteins as a by-product. According to Bindraban et al. (2008) under a cultivation of biofuel scenario, "the available oil meals and distiller's dried grain soluble (DDGS) produced in Europe could replace much of the current soybean imports". But they also mention that further analysis is needed to properly evaluate the contributions of such dual-purpose crops.

5. Conclusion

The findings of report by Bindraban et al. (2008) suggest that trade liberalization will not further promote regional specialization to a significant degree, nor will it highly increase risk to the food system, since European and global trade flows are expected to remain relatively similar to the current situation. Also climate change does not affect food security; the European food system is not expected to become less resilient to calamities until at least 2020. The only vulnerable area of significance appears to be the import of soy beans for fodder and vegetable oil, almost exclusively from South America. But even a total collapse of that import, while causing heavy price shocks, would not jeopardise the nutritional needs of the European population. Even more so, the affluent European diet is more than sufficient and well above the nutritional requirement when it comes to meat consumption. This creates a buffer for possible reductions in food availability since, as mentioned earlier, about 60% of the EU cereal consumption is destined to animal feed and meat consumption could be halved without harming dietary needs. European food security therefore seems to be very resilient to possible calamities.

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