



Thai Rice Industry at Risk

The costs of a possible GE contamination of Thai rice

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Conversion rates used in this report:
Baht to Euro conversion: 1 Baht = 0.02109 Euro
Euro to Baht conversion: 1 Euro = 47.415837 Baht

GREENPEACE

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All expert opinion expressed herein is that of the author of this report.

Prologue by Greenpeace International

In 2006 the global rice trade was shaken by a genetically-engineered (GE) rice contamination scandal originating in the US. The United States Department of Agriculture (USDA) had announced that the US rice supply was contaminated with LL601, a GE rice trait developed by the multinational company Bayer. The contamination is estimated to have cost the US rice industry between \$741 million US dollars (€591 million) and \$1,285 million (€1,024 million).^a The EU, Japan and other countries stopped or decreased their rice imports from the US due to consumer rejection in their countries, resulting in many of these costs. The industry was damaged not only by the reduction in US rice prices following the announcement, but also the costs of having to store the crop on-farm for a long period of time, a reduction in the availability of seed stocks in 2007, and the costs of testing requirements and a clean out of the rice merchandising system.

Since this contamination event, the international biotech industry and other institutes have continued to push for the approval of GE rice globally, leaving open a distinct possibility that a similar contamination event could occur. Greenpeace has commissioned this report to show the possible economic effects that a case of GE contamination would have on the Thai rice industry.

Thailand is the largest exporter of rice in the world, and the Thai rice industry is therefore heavily dependent on the perceptions of its export customers. An unintended release of GE rice would disrupt Thailand's rice grain merchandising system and jeopardise its worldwide reputation as being a premiere rice exporter.

In 2010, as this study is being published, there are major developments in GE rice varieties occurring in large seed companies, government-funded research institutes and the International Rice Research Institute. The development and testing of GE rice poses a risk for Thailand's rice merchandising system. If the US experience with LL601 rice is indicative, any unintended or accidental GE rice release within Thailand will have severe economic consequences for Thai rice exporters.

Several scenarios are presented here that determine the possible economic losses that would occur if GE rice were to be found in Thailand's rice industry. These losses arise from trade stoppages, with estimates ranging between 16,560 million Baht (€349 million) to 85,860 million Baht

(€1,811 million). The most likely scenario, based on the US experience following the LL601 contamination, would result in a short-term reduction of Thai rice exports by 2,369,059 tonnes, valued at 47,343 million Baht (€998 million), or a 27% drop in Thai rice exports. In addition to these short-term losses, there would be long-term European export losses of 25,386 million Baht (€535 million), and testing and segregation of merchandising/processing systems would incur costs of up to 23,599 million Baht (€497 million).

Adding these long-term export and merchandising/processing costs to the most likely short-term impacts, based on the US case, could mean total economic losses and costs totaling as much as 96,327 million Baht (€2,031 million). While this amount takes into account export losses over four years, it is the equivalent of 56% of the value of Thai rice exports in 2009.

Even though costs that the Thai rice exporters face are easier to predict, farm-level costs would be largely hidden, as they would need to be absorbed by farmers and are particularly hard to calculate. These include the cost of decontaminating fields and equipment as well as testing seed to verify that it is GE free. It is likely that these costs would be several magnitudes greater than the total impacts on Thai exports and would be a crushing burden on Thai rice farmers.

The outcomes of this report indicate that the Thai government needs to be extremely diligent in protecting its rice supply from GE contamination. If GE rice were to contaminate the Thai rice supply, the Thai government and rice industry would have to engage in a series of costly actions to ensure that the GE contamination was cleared from the rice merchandising system. These would include seed testing protocols, certified seed sampling, crop producer certifications, establishment of a task force to educate rice producers and a moratorium on GE seed.

There are currently no GE rice field trials or commercial cultivation in Thailand. In order to keep Thailand's rice supply GE-free, the Thai government should immediately ban any GE rice from the country, including field trials, rice for import and, of course, cultivation. Other pre-emptive measures should include continuous monitoring of food imports, maintaining surveillance of GE crop development - especially for rice in surrounding countries - and communications with Thailand's foreign rice trading partners.

^a For more on this contamination case, see: Blue, E. Neal. 2007. Risky Business. Greenpeace report, November 6, 2007



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Introduction

Thailand is the largest exporter of rice in the world, followed by Vietnam, India, United States, Pakistan and China.¹ As such Thailand's rice industry is heavily dependent on the perceptions by its export customers of its quality and reliability as a supplier. An unintended release of rice with any genetically engineered (GE) event would disrupt Thailand's rice grain merchandising system.^b This system includes exporters, grain merchandisers, brokers, farmer cooperatives, and farmer/growers. In addition, such an event would have indirect effects on businesses allied with the rice merchandising industry, such as seed producers, equipment dealers, fertiliser dealers, and other businesses supplying the rice producers. Lastly, Thailand's worldwide reputation as being a premiere rice exporter would be in jeopardy.

This report highlights the possible economic impacts in Thailand of a contamination of rice by GE events. First, an overview of the Thai rice industry is detailed including production and exports. Next, economic changes occurring as a result of a rice GE event are discussed using the US LL601 rice contamination event and other crop GE contamination events as a guide. Lastly, long-term ramifications are discussed.

The data presented in this report that describes the Thai rice industry are taken from the Customs Department – Kingdom of Thailand², the United Nations – FAO³, and International Rice Research Institute⁴. Details regarding facts and figures used in estimating export and merchandising impacts from a discovery of a GE event in the Thai rice industry are referenced at the end of this report. Lastly, projections of economic impacts arising from a GE event are based on a 2009 baseline.

^b A genetic event refers to the unique DNA recombination event that took place in one plant cell, which was then used to generate entire transgenic plants.

Overview of genetically-engineered rice development

Currently, there are major developments that are occurring at large seed companies investigating GE rice varieties, including herbicide tolerance (Liberty Link (LL) by Bayer) in the US and rice that produces pharmacologic agents (Ventria BioSciences).^{5,c} In addition to the private sector, governments and research institutes are also engaged in the development of GE rice. Bt rice, a rice resistant to insects, is being developed by governments, particularly China, the International Rice Research Institute (IRRI) in the Philippines and at national rice institutes.⁶ So called “Golden” rice, a GE rice with enhanced levels of beta carotene, is being bred and tested in the Philippines, Bangladesh, India, Indonesia and Vietnam.^d

The Center for Environmental Risk Management indicates that only three rice GE events are registered globally: LL601 and LL06/LL62.^e Registration of a crop genetic event means that a particular government has allowed for its commercial production and/or consumption. LL06/LL62 are only registered in Australia, Canada, Mexico, and the US and LL601 is only registered in the US. LL601 and LL06/LL62 rice varieties are rice varieties developed by Bayer Crop Science to resist Liberty Link herbicide (glufosinate ammonium).

Since all GE rice varieties, with the exception of LL06/LL62 and LL601 events, are not legally registered for any type of use with any governments of the world, any unintended releases of rice GE varieties under development would have negative economic consequences. Over the past 10 years, unintended releases of GE crops into the environment have resulted in economic losses. The United States Government Accountability Office detailed these events in their report on the state of the US regulatory approach towards GE crops. Unintended releases of GE crops have occurred in the US that resulted in economic losses in corn (Starlink Bt, Syngenta Bt10, and Prodigene events), and rice (Bayer events LL601 and LL604).⁷

In Canada, the discovery of Triffid GE flax 10 years after it was voluntarily withdrawn from the market threatens the 320 million dollar Canadian flax industry.⁸ It is estimated that Canadian Farmers have lost 106 million dollars or more from the value of their harvest as a result of the contamination.⁹

The two most prominent unintended GE crop releases, Starlink corn and Liberty Link rice, resulted in large economic losses to US farmers. Starlink Bt corn was released under a livestock feed use label, but contaminated the US food system. It has been estimated that the Starlink GE event caused US corn producers to lose between \$26 and \$290 million in revenue.¹⁰

Liberty Link rice contamination event

In 2006, the global rice industry was negatively impacted by the release of an unapproved genetically engineered (GE) rice variety called Liberty Link (LL) 601 in the United States.¹¹ LL601 rice, a herbicide tolerant seedline, was undergoing development by Bayer CropScience, LP in the US from 1997 to 2001. At the time when LL601 was found in the US rice supply, it was never approved for cultivation by the United States Department of Agriculture’s Animal and Plant Health Inspection Service (USDA-APHIS).

Traces of LL601 rice were discovered in the rice grain merchandising system in Europe, Africa and Asia in August 2006. Soon after the discovery, many countries, particularly Europe and Japan, immediately halted imports of long-grain rice from the United States. The discovery of LL601 in the US rice supply in 2006, decimated US long-grain rice sales to the EU - reducing exports from 311,000 metric tons (MT) in the marketing year prior, to below 100,000 MT in recent years.¹² Given the US is one of the largest exporters of rice in the world, the US rice industry experienced substantial impacts largely driven by export losses. It was estimated that world-wide losses caused by the accidental release of LL601 GE rice ranged from \$741 million to \$1.285 billion.¹³

c For further developments in GE rice, see GMO Compass - Rice. <http://www.gmo-compass.org/eng/database/plants/64.rice.html>

d Syngenta has donated Golden Rice via royalty-free humanitarian sublicenses for use in variety development and production. See: The Golden Rice Project report by Jorge E. Mayer, Peter Beyer, and Ingo Potrykus. See http://www.goldenrice.org/PDFs/The_Golden_Rice_Project_Mayer_et_al_2006.pdf

e See Center for Environmental Risk Assessment (CERA) for a listing of GE event registrations for rice in the various countries of the world. See <http://cera-gmc.org>

Overview of the Thai rice industry

Rice production and exports are a dominant part of agriculture in Thailand and the area devoted to rice production has increased over time. From 2000 to 2010 the total area devoted to rice production has ranged between 9.98 and 10.66 million hectares (Figure 1). The yield per hectare reached a maximum of 3 metric tonnes/ha in 2007 (Figure 2).¹⁴ At the producer level, Thailand has 16.2 million people (or 3.7 million households) who are rice farmers. Each household farms 2.75 hectares of rice.¹⁵

Thailand's total rice production ranged from 25.88 million tonnes in year 2000 to 32.09 million tonnes in 2007. In the same time period, exports of all rice products increased from 6.25 million tonnes to 10.22 million tonnes. Typically, Thailand's exports are 25-35% of its total rice production (Figure 3). At these export levels, Thailand is the largest rice exporter in the world.¹⁶

Figure 1.

Thailand - Arable Land and Rice Harvest Area, 1990-2008 (Source: IRRI-FAO)

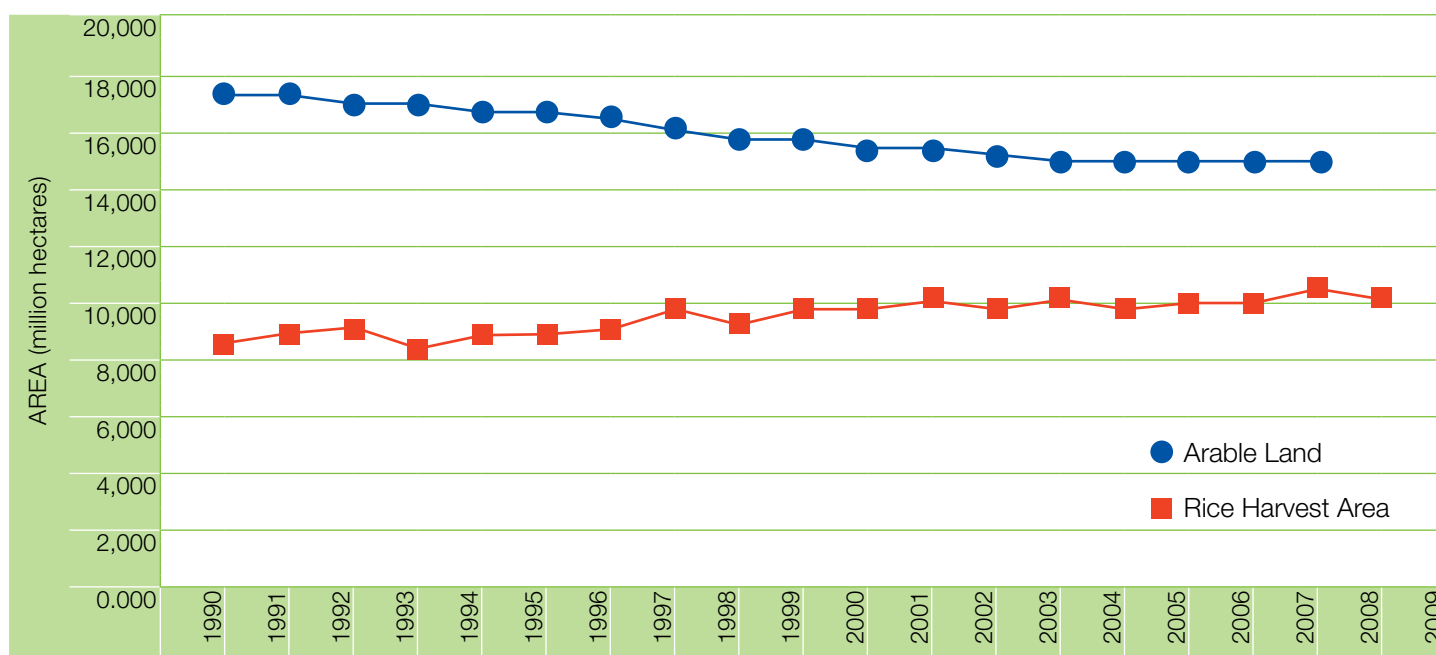


Figure 2.
Thailand - Rice Yield, 1990-2008 (Source: IRRI-FAO)

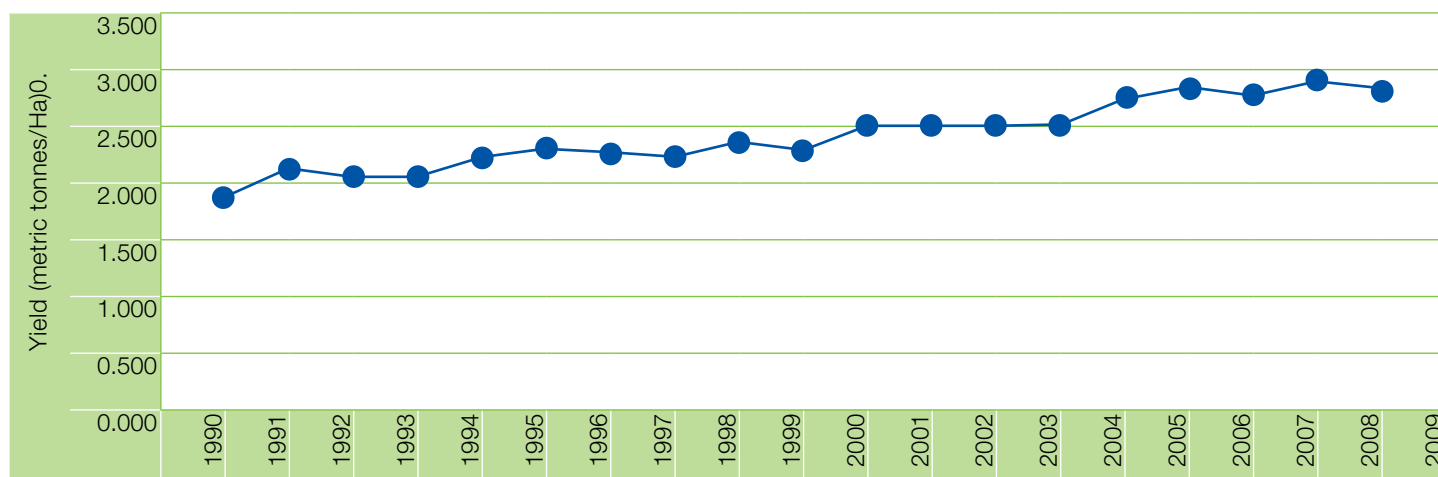
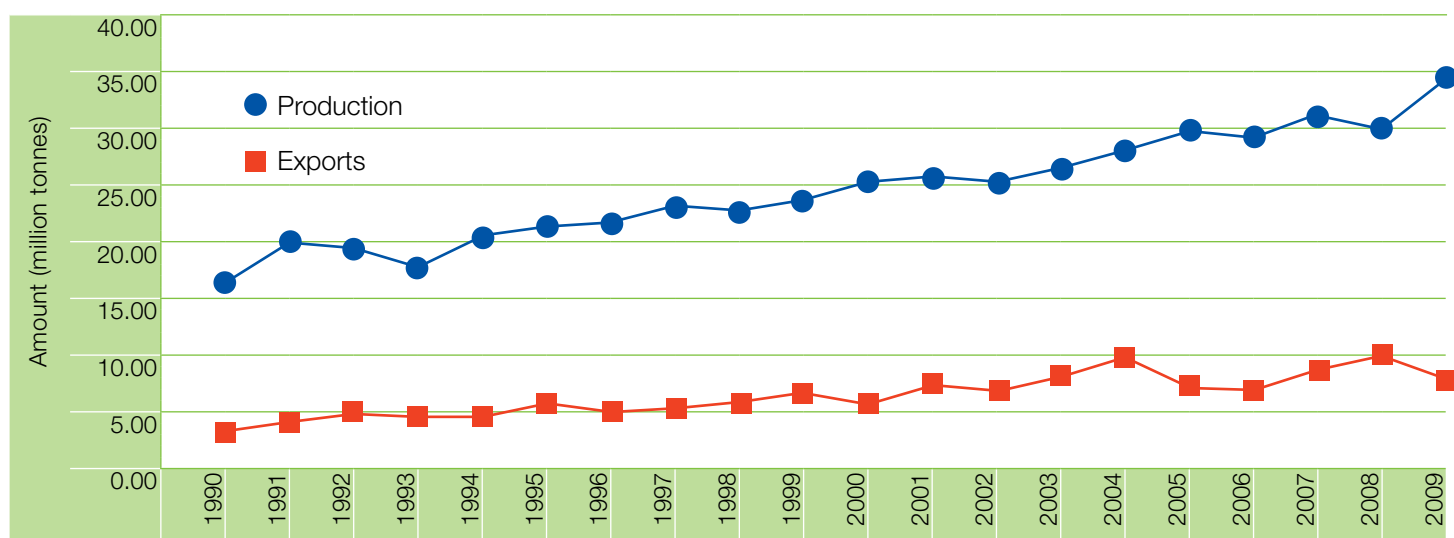


Figure 3.
Production and Export of Rice in Thailand, 1990-2008 (Source: FAO)



Most of the Thai rice exports go to Africa (about 54%) followed by Asia (21%), the Middle East (10%), Europe (7%), The Americas (6%), and Oceania (2%) (Table 1). The 10 largest export customers are as follows: 1) Nigeria, 2) South Africa, 3) Benin, 4) Ivory Coast, 5) USA, 6) Senegal, 7) China, 8) Iraq, 9) Hong Kong and 10) Japan (Appendix Table 1).¹⁷

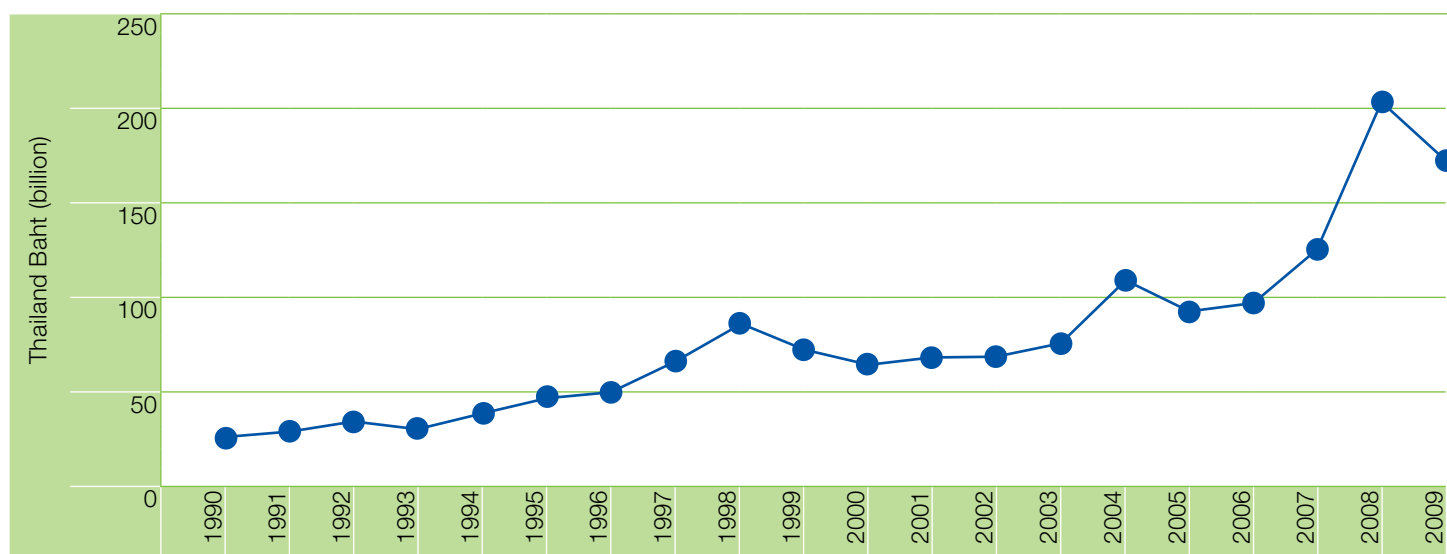
The total export value of Thai Rice has steadily gone up over time and peaked at 205 billion Baht or 4.3 billion Euro in 2008. In 2009, the value of rice exports amounted to 175 billion Baht or 3.6 billion Euro (Figure 4).¹⁸

Table 1.
Thailand's rice export destinations by continents, 2009.

Export Destination	Export (Tonnes)	Export Value (Million Baht)	Export Value (Million Euro)
Africa	4,621,295	92,351.9	1,947.70
Asia	1,763,635	35,244.5	743.31
Middle East	898,508	17,955.8	378.69
Europe	564,577	11,282.5	237.95
EU-27	454,705	9,086.8	191.64
Americas	540,896	10,809.3	227.97
Oceania	203,920	4,075.1	85.94
Total	8,592,830	171,719.0	3,621.55

Source: Chamber of Commerce of Thailand and Bureau of Import Export Product Standard

Figure 4.
Thailand Rice Export Value, 1990-2009 (Source: FAO & Thai Rice Exporters Association)



Economic impacts arising from a GE event

Based on what happened during the LL601 rice contamination event in the US and other well-known unintended GE releases as a reference, the discovery of GE rice in Thailand's rice supply would immediately cause exports to be negatively affected.

The cessation of rice trade will have immediate impacts on Thailand's agricultural system. All the stakeholders of the rice production and merchandising system will be affected including: 1) producers, 2) agribusiness and coop units handling the grain from the farmer to the processor, 3) processors, and 4) exporters.

The degree of export losses will be dependent on the reaction of Thailand's export customers. The next section of this report will discuss who will likely cease imports once a GE event is discovered to be in the system. These projections are based on importing countries' reaction to the LL601 rice event in the US in 2006. In addition, the 2009 year will be used as a baseline for which projections are made.

Immediate export effects and losses (first year effects)

If the US 2006 experience with GE rice holds true, the detection of a GE rice event in Thai rice would result in the immediate cessation of Thailand's rice trade with European countries as well as Japan. African countries, particularly those in the sub-Saharan region of the continent, are also likely to cease or sharply reduce exports because of their proximity with the EU. As such they are heavily influenced by European trade and food policies, including the tight regulation of GE crops.^{19, 20} South American and Central American countries, given their rapid adoption of GE crops, may stop trade to evaluate the situation and then resume rice trading. After the US rice debacle, some countries including Central and South American countries resumed trade. In addition, US rice trade resumed with Japan, Philippines, Taiwan, and Korea but only after the US made guarantees of GE free status.²¹ In some cases, countries will tolerate a GE contamination in the imports at levels of 1 to 5%.

Based on the experiences in the US, the immediate Thai rice export losses will likely last one or two crop years depending on at what time of the growing season the contamination is discovered. This length of time is needed to clear out the grain merchandising system and enact a testing regime to insure a GE free crop. If this is done successfully, trade can be expected to resume to near-normal levels. As an example, in the year following the LL601 rice contamination the total US rice exports fell from 3,789.2 million tonnes (2005/06) to 3,125.8 million tonnes (2006/07), an 18% decline. However, in the 2007/08 marketing year US rice exports were 3,616 million tonnes, a 5% decline from the 2005/06 marketing year.²² One factor driving the resumption and normalisation of trade patterns was the sharply increasing commodity prices for all food grains from 2005 to 2008.

To estimate the Thai export losses arising from a GE contamination, US export patterns are evaluated following the LL601 rice contamination event in 2006. US export volume changes to Africa, Asia, Middle East, Europe, the Americas and Oceania are evaluated from the 2005/06 year to the 2006/07 marketing year. These patterns are discussed in the following sections. The percentage drop found in US rice exports to Africa, Asia, Middle East, Europe, the Americas and Oceania regions are then applied to Thai exports to the same regions. These regional export changes are discussed in the following sections.



Europe

Current EU regulations dictate a zero tolerance for any unregistered GE event.²³ At the current time, no GE rice varieties are registered in the EU for cultivation or food/feed use. European countries not part of the EU^f would probably also cease imports of Thai rice because of their proximity to the EU as well as having a similar regulatory regime as the EU. The EU-27 bloc would immediately cease imports if the European Food Safety Authority detected an unregistered rice GE event in Thai rice.

Following the discovery of LL601 rice in the European rice supply, US exports fell from 332,000 tonnes in 2005/06 to 53,900 tonnes in 2006/07, an 83% drop in imports.²⁴ If Thai exports to Europe fell at the same percentage it would mean the loss of 474,245 tonnes valued at 9,477 million Baht (200 million Euro).

If 100% of the European nations would cease Thai rice imports this would mean the loss of 564,577 tonnes valued at 11,282 million Baht (237.95 million Euro) (Table 2).

Asia

Asian nations are also expected to curtail Thai rice imports if GE rice is found in the rice supply. In 2009, Thailand exported 1,763,635 tonnes of rice valued at 35,244.5 million Baht (743.31 million Euro) to Asia (Table 1). Japan, Taiwan, Philippines, and South Korea have limited or controlled imports of products with GE events. Japan will likely also cease imports of Thai rice until Thailand can show that it can deliver GE free rice.

In the LL601 contamination event, Japan suspended all long grain rice imports from the US. Although only the long grain rice in the US was contaminated, Japan later extended testing to all US rice, including both medium and short grain rice. In Thailand, the small geographical area of the country means that the contamination of one type of rice with a GE event will likely spillover to other types of rice. As such, Japan will likely require GE testing of all rice shipments.

In addition to Japan - Korea, Taiwan, and the Philippines stopped importing US rice after the LL601 rice was discovered. However, US rice trade with these countries soon resumed.²⁵ Countries in Asia as a whole reduced US imports by 18% in the year following the discovery of LL601 in the US rice supply. An 18% drop in Thai exports to Asia countries would mean a loss of 317,454 tonnes valued at 6,344 million Baht (134 million Euro).

If all Asian countries would cease exports for 1 year this would result in Thai export losses of 1,763,635 tonnes valued at 35,244 million Baht (743 million Euro) (Table 1).

^f Including the Former Soviet Union, Switzerland, and Norway



Africa

Taken as a whole the African continent is the largest export volume destination for Thai rice. At the current time, there are no commercially planted GE crops in Africa, with the exception of South Africa, Burkina Faso and Egypt²⁶. Since more than 50% of Thai rice exports go to African nations, the discovery of GE rice in Thailand could dramatically impact exports. In the year following the LL601 rice event, US exports to Africa were reduced by 26%. If Thai rice exports to Africa fell by the same percentage, the loss would be 1,201,537 tonnes valued at 24,011 million Baht (506 million Euro) (Table 2).

In 2009, Thailand exported 4,621,295 tonnes of rice to Africa valued at 92,351 million Baht (1,947 million Euro). There could be a remote chance that all rice importing countries of Africa would cease Thai imports due to their proximity to the European trading bloc. This would result in the loss of 4,621,295 tonnes of rice valued at 92,351 million Baht (1,947 million Euro).

Middle East, Americas and Oceania

The three remaining importing regions of the world, the Middle East, Americas, and Oceania import small amounts of rice from Thailand compared to Asia and Africa. There is less likelihood that these three regions would cease exports if GE rice were found in the system.

During the LL601 rice event, nations in these three regions stopped trade for a very short time and resumed trade under more generous testing thresholds than those seen for the EU and Japan.²⁷ US rice exports to the Middle East, Americas, and Oceania, fell 23, 3, and 75%, respectively. If Thai exports were reduced in a corresponding manner to these regions, the export losses would be a) Middle East, 206,657 tonnes valued at 4,130 million Baht (87 million Euro), b) Americas, 16,227 tonnes valued at 324 million Baht (7 million Euro), and c) Oceania, 152,940 tonnes valued at 3,056 million Baht (64 million Euro).

Export loss scenarios

Five export loss and associated cost scenarios are detailed and presented in Table 2 and Table 6. Short term rice export losses are presented in Table 2. In Tables 3, 4, and 5, other associated costs related to GE contamination are presented.

Table 2.
Short-term (1 year) export impact scenarios for Thailand using 2009 data as a baseline

Importers (reduced imports)*	Tonnes	Million Baht	Million Euro
Scenario 1			
Europe (100%)	564,577	11,283	238
Japan (100%)	264,084	5,278	111
Total	828,661	16,560	349
Percent export impact	9.64		
Scenario 2			
Europe (84%)	474,245	9,477	200
Africa (26%)	1,201,537	24,011	506
Asia (18%)	317,454	6,344	134
Middle East (23%)	206,657	4,130	87
Americas (3%)	16,227	324	7
Oceania (75%)	152,940	3,056	64
Total	2,369,059	47,343	998
Percent export impact	27.57		
Scenario 3			
2 month export stoppage	1,431,565	28,608	603
Percent export impact	16.66		
Scenario 4			
4 month export stoppage	2,863,990	57,234	1,207
Percent export impact	33.33		
Scenario 5			
6 month export stoppage	4,296,415	85,860	1,811
Percent export impact	50.00		

Notes: *Reduced imports or Thailand's reduced exports.

**Europe – European Union 27 plus non-EU member European Countries

Table 3.

Thailand's long-term export losses in years 2, 3 and 4 following the discovery of a GE contamination (assuming a 2009 base year).

Long-term export losses	Tonnes	Million Baht	Million Euro
Europe: 3 years at 75% export loss	1,270,298	25,386	535

Table 4.

Farm-level effects of GE contamination in Thailand.

Farm-level effects	Million Baht	Million Euro
Seed testing**	454	10
Total	454	10

* Assumes a testing cost based on the U.S LL601 experience = \$0.50 per acre.

2009 currency conversion rate: 34 Baht = \$1 USD

1 hectare= 2.471 acres

Cost per hectare = 42 Baht

Scale up over 10.8 million hectares

Total seed testing costs = 454 million Baht

Table 5.

Grain merchandising impacts.

Added merchandising costs	Million Baht	Million Euro
Grain testing for GE events*	11,531	243
GE grain segregation**	12,068	254
Total	23,599	497

* \$180 cost for 910 bushels or 18.57 metric tonnes.

Using a conversion rate of 34 Baht per dollar.

329.56 Baht (6.95 Euro) per tonne test cost

Scale up over 35,000,000 tonnes

Total cost of GE testing 11,531 million Baht

** \$0.207 USD per bushel assumption of segregation cost

1 metric ton = 48.992 bushel

48.992 x \$0.207 USD = \$10.14 USD = 344.80 Baht per tonne

Scale up over 35,000,000 tonnes.

Total segregation cost = 12,068 million Baht

Longer-term export impacts

Long-term export losses are hard to determine because of economic and political uncertainty and weather changes, which affect global rice supply. To estimate such impacts caused by a GE discovery in the Thai rice system, it is instructive to look again at the EU reaction to discovering LL601 in its rice supply originating from the US. The discovery of LL601 in the US rice supply in 2006, decimated US long-grain rice sales to the EU - reducing exports from 311,000 metric tons (MT) in the marketing year prior, to well below 100,000 MT in recent years. This amounted to a 73% export loss per year over several years.²⁸

From 2006 to 2010, the EU mandated testing of all US rice shipments. Even into 2009, the US never fully recovered its EU exports. In 2009, the US exported 82,798 tonnes of rice, down from 311,000 tonnes of rice exported in 2005.²⁹ The key factor driving this outcome is the zero tolerance of unapproved GE crops in the EU. Just recently, in 2010, the EU relaxed its requirement for a mandatory regime for US rice.³⁰

While US rice exports to Europe appear to have permanently fallen, trade with other regions of the world seems to be restored. US rice exports to the world fell in the year following the discovery of the LL601 contamination in 2006. However, within the second year following the contamination event, the US rice exports went back up to pre-contamination export levels.³¹ Extrapolating these long term effects to Thailand in a similar fashion would suggest the only long term effects would arise from the European rice market. Approximately four years have elapsed where the US had to engage in a mandatory testing regime of its export rice to the EU. Based on the US experience, Thailand would probably face the same proportional loss and similar mandatory GE testing regime. Assuming a 75% reduction in EU exports for the second, third and fourth years beyond the initial year would mean that an export loss of 1,270,298 ((564,577 - 75%)x3) tonnes over a three year period would occur (Table 3). In monetary terms this amounts to a loss of 25,386 million Baht (535 million Euro).

Farm-level effects

Once a rice GE event is discovered within Thailand, a series of regulatory provisions will have to be implemented to restore customer confidence in the rice industry, these include seed testing protocols, certified seed sampling, crop producer certifications, establishment of a task force to educate rice producers, and a moratorium on GE seed.

At the producer level, Thailand has 16.2 million people (or 3.7 million households) who are rice farmers.³² Each household farms an average of 2.75 hectares of rice. All these farmers will be affected by the provisions listed above to insure a GE free rice supply. These costs are not taken into account in this report's calculations, due to the focus on the Thai rice export industry. It should be noted however, that as in the US example, any contamination event in Thailand will have an extremely detrimental effect on Thai rice farmers, and they will possibly incur costs several times greater than the total export losses outlined in this report.

Farm clean-out

The cost of testing and cleaning requirements to meet export requirements will add to the cost of producing a bushel of rice. Cleaning requirements for each farm will vary depending on the size and the amount of on farm storage. These costs could include the harvesting and destroying contaminated rice.

Seed testing

In addition to cleaning out the farm to insure a GE free rice crop, GE free seed will have to be planted. Using 0.50 US dollars per acre as a base rate³³ for seed testing, a 2009 conversion exchange rate of 34 Baht to 1 US dollar, and 1 hectare= 2.471 acres, it will cost a Thai farmer an additional 42 Baht per hectare to plant GE free seed. When this is scaled up over 10.8 million hectares, the overall national cost for seed testing to insure a GE free rice crop is 453.6 million Baht (10 million Euro) (Table 4).

Grain elevator/processor impacts including testing costs

In the US, rice processors and handlers had to engage in a testing and cleaning regime to insure that all incoming rice was GE free for the 2007 harvest. If GE contamination were to happen, the Thai rice processors would have to do the same. A system will have to be set up to insure all rice is tested as it goes through the grain merchandising system. In order to estimate the cost of this regime, estimates were derived from the grain merchandising literature dealing with identity preserved segregation. The costs of paperwork and grain testing make the protocols associated with rice handling analogous to an identity preservation system. The extra costs arising from cleaning out and ensuring GE free rice grain storage and processing arise from a) sampling and testing, b) maintenance, c) mistakes or misgrades in rice sampling, d) disputes, e) labour and f) other costs.

A standard truckload contains 910 bushels or 18.57 metric tonnes⁹⁴. Two major genetic testing laboratories were consulted to determine the cost of genetic testing of grain.⁹⁹ Both laboratories charge 6120 Baht (128 Euro) for a qualitative genetic test that meets EU's GE regulations. If every truckload of Thai rice is tested, this means that the cost of rice grain testing is 329.46 Baht (6.95 Euro) per tonne. Using this testing cost scaled over all Thai rice production for 2009 (35 million tonnes) generates a cost of 11,531 million Baht (243 million Euro) (Table 5).

In addition to the genetic testing costs, other elevator segregation (misgrades, maintenance, disputes/labour, and other) are calculated.⁹⁵ These costs amount to 344 Baht/tonne. When this cost is scaled up over all Thai rice production in 2009 (35 million tonnes), the total cost to segregate GE rice from non GE rice is 12,068 million Baht (254 million Euro). Both the genetic testing and GE grain segregation costs add up to 23,599 million Baht (497 million Euro) (Table 5).

Summary of estimated total costs arising from GE rice contamination

The discovery of a widespread genetic contamination in Thailand's rice industry will have consequences that are both important and fundamental. Once an unregistered genetic event is discovered in the grain merchandising system costs will be incurred to insure that adventitious GE grain is cleared out of the system. These costs include short term export losses, long term export losses, and added grain merchandising costs. These costs are detailed in Table 6.

If a GE event is discovered in the Thai rice system, Thailand's export customers will cease trade in the short term (one year). The most variable loss depending on the scenario investigated is the short term export loss. In this investigation, the short term export loss ranges from 16,560 million Baht (349 million Euro) to 85,860 million Baht (1,811 million Euro). A most likely scenario that will occur is where Thai exports may react in a similar way as the US export experience when LL601 was discovered in the US system (Scenario 2 - Table 6). Here, Thailand would experience a short-term export loss of 2,369,059 tonnes valued at 47,343 million Baht (998 million Euro). This 27.57% of Thailand's total rice exports.

In this analysis, Thailand's long term export losses will come mainly from Europe due to its stringent GE regulatory approach. Given the US GE rice experience with the EU, this analysis assumes three additional years of export losses accruing to Thailand beyond the initial first year loss. Long-term export losses are expected to be 1,270,298 tonnes valued at 25,386 million Baht (535 million Euro) (Table 6). The discovery of a GE event in Thailand will result in additional merchandising expenses of 23,599 million Baht (497 million Euro). These merchandising expenses include seed testing, grain testing, and segregation expenses.

In the various scenarios investigated in this paper, the most likely scenario that will occur is where Thai exports respond in a similar manner as the US exports following the LL601 contamination. This is detailed in scenario 2 in Table 6. Here all short and long-term export losses and elevator/processor effects add up to 96,327 million Baht (2,031 million Euro). As a possible illustration of an extreme event, Scenario 5 details a 6 month trade stoppage in Thai rice exports combined with long term export declines, and elevator/processor effects. The total economic loss arising from this extreme event including all costs is 134,844 million Baht (2,843 Euro)(Table 6).

⁹⁴ Eurofins Genescan and Genetic ID estimate that it costs 128 Euro to test 910 bushels (18.57 metric tonnes).

Table 6.

A summary of all economic losses occurring in Thailand's rice system as the result of genetic contamination.

Summary of losses	Million Baht	Million Euro
Scenario 1		
Europe & Japan 100% stopped trade - 1st year	16,560	349
Europe: 75% export loss for years 2, 3, and 4	25,386	535
Added merchandising and processing costs	23,599	497
Scenario 1 - Total losses	65,544	1,382
Scenario 2		
Thai export changes similar to US after LL601	47,343	998
Europe: 75% export loss for years 2, 3, and 4	25,386	535
Added merchandising and processing costs	23,599	497
Scenario 2 - Total losses	96,327	2,031
Scenario 3		
2 month Thai rice export stoppage	28,608	603
Europe: 75% export loss for years 2, 3, and 4	25,386	535
Added merchandising and processing costs	23,599	497
Scenario 3 - Total losses	77,593	1,636
Scenario 4		
4 month Thai rice export stoppage	57,234	1,207
Europe: 75% export loss for years 2, 3, and 4	25,386	535
Added merchandising and processing costs	23,599	497
Scenario 4 - Total losses	106,218	2,239
Scenario 5		
6 month Thai rice export stoppage	85,860	1,811
Europe: 75% export loss for years 2, 3, and 4	25,386	535
Added merchandising and processing costs	23,599	497
Scenario 5 - Total losses	134,844	2,843

Notes: Analysis uses 2009 baseline data.

These scenarios assume that short term export trade disruptions last one year and are based on Thailand's 2009 production baseline. Scenario 1 details a situation where only Europe and Japan totally cease exports for one year. Scenario 2 details a very likely situation where Thai exports fall by the same percentages for the year following contamination for all world regions that the U.S experienced when LL601 rice was discovered in its exports. Scenarios 3, 4 and 5 detail Thai export losses when trade is completely stopped for two, four and six months.

These last three scenarios details the outside possibility that trade is completely stopped for a short time, when the government and rice industry participants engage in a corrective plan of action. While it is hard to predict export losses, scenarios 3, 4 and 5 illustrate what is at stake for Thailand's timely response if GE rice is found in its system.

In Scenario 1, Thailand will lose 9.64% of its rice export markets in the first year if only Europe and Japan totally cease Thai rice imports. This monetary impact will be 16,560 million Baht (349 million Euro) (Table 2). While this is the smallest export loss presented in all the scenarios detailed in Table 2, this result indicates, that at a minimum, a substantial export loss will occur.

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Scenario 2 details Thai rice exports falling by the same percentages for all regions of the world as happened to US rice exports upon the discovery of LL601 rice contamination, and is therefore the most likely scenario. From 2005/06 to 2006/07 US rice exports fell – Europe (84%), Africa (26%), Asia (18%), Middle East (23%), Americas (3%), and Oceania (75%). If Thai rice exports to these same regions fell by the same percentages, the overall percentage of Thai exports that would be impacted would be 28%. In absolute terms the largest export losses are shown for Africa (24,011 million Baht) followed by Europe (9,477 Million Baht) and Asia (6,344 million Baht) (Table 2).

Scenarios 3, 4, and 5 illustrate what would happen if Thai rice exports were totally stopped for two, four and six months, respectively. Based on yearly exports, two, four and six month trade stoppages would indicate 16.66, 33.33, and 50% export impacts, respectively. The two-month trade stoppage, an event not beyond the realm of possibility, would mean that 1,431,565 tonnes of Thai rice would be impacted short term. Economically this would amount to a 28,608 million Baht (603 million Euro) loss (Table 2).

Appendix

Table 1. Thailand's Rice Export Destinations by Country, 2009.

Export Destination	Export (Tonnes)	Percentage of Exports	Export Value (Million Baht)	Export Value (Million Euro)
Nigeria	1,070,927	12.5%	21,401.40	451.36
South Africa	743,835	8.7%	14,864.80	313.5
Benin	610,926	7.1%	12,208.70	257.48
Ivory Coast	525,330	6.1%	10,498.20	221.41
USA	440,367	5.1%	8,800.30	185.6
Senegal	433,899	5.0%	8,671.00	182.87
China	328,238	3.8%	6,559.50	138.34
Iraq	282,024	3.3%	5,636.00	118.86
Hong Kong	268,401	3.1%	5,363.70	113.12
Japan	264,084	3.1%	5,277.50	111.3
Indonesia	219,643	2.6%	4,389.30	92.57
Yemen	188,768	2.2%	3,772.30	79.56
Singapore	187,860	2.2%	3,754.20	79.18
Cameroon	186,336	2.2%	3,723.70	78.53
Mozambique	175,446	2.0%	3,506.10	73.94
Saudi Arabia	174,184	2.0%	3,480.90	73.41
Ghana	167,208	1.9%	3,341.50	70.47
Malaysia	162,437	1.9%	3,246.10	68.46
Philippines	156,033	1.8%	3,118.20	65.76
Australia	129,040	1.5%	2,578.70	54.39
Mauritania	125,841	1.5%	2,514.80	53.04
Belgium	104,599	1.2%	2,090.30	44.08
Angola	92,898	1.1%	1,856.50	39.15
United Arab Emirates	92,184	1.1%	1,842.20	38.85
France	86,256	1.0%	1,723.70	36.35
Canada	83,209	1.0%	1,662.80	35.07
Other	1,292,788	15.0%	25,835.30	544.84

Source: Chamber of Commerce of Thailand and Bureau of Import Export Product Standard

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