Risky Business

Economic and regulatory impacts from the unintended release of genetically engineered rice varieties into the rice merchandising system of the US

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Introduction

In 2006, the global rice industry was negatively impacted by the release of an unapproved genetically engineered (GE) rice variety called Liberty Link 601[1]. Liberty Link 601 (LL601) rice was a seedline under development by Bayer CropScience, LP[2] from 1997 to 2001. LL601 was never approved for deregulation by USDA. Bayer's Liberty Link rice varieties were genetically engineered to tolerate Liberty Herbicide (gluphosinate ammonium). While the initial details regarding the cause of the unintended release are fuzzy, the resulting economic effects are not.

Traces of LL601 rice were discovered in the rice grain merchandising system in Europe, Africa and Asia in August 2006. Soon after the discovery of LL601 traces in the grain merchandising system, many countries, particularly Europe and Japan, immediately halted imports of long grain rice from the United States. Subsequent actions by the United States Rice Federation dictated that 1) all rice merchandising channels be thoroughly cleared of rice containing traces of the GE rice varieties LL601, LL62 and LL06 and also conventional long grain varieties Clearfield 131 and Cheniere because they contained the GE contamination and 2) ensure all future export shipments meet importing guideline requirements for non GE status. In addition, the USDA and the Arkansas State Plant Board declared an emergency action dictating that Clearfield 131 and Cheniere long grain rice varieties not be planted in 2007 and 2008 because they were found to be GE contaminated. BASF Corporation's Clearfield 131 rice variety was found to be contaminated with a previously unknown genetic event LL604 - created by Bayer. It is unknown at this time how many LL varieties are or were under development by Bayer CropScience LP, beyond the four Liberty Link lines discussed in this document (LL601, LL62, LL06 and LL604). As of this time, the USDA still does not have an explanation of how or why the LL601 genetic event got into the US Rice production system on a wide scale.

The estimated economic loss resulting from export impacts in the 2006/07 crop years is estimated to be $254 million. The future export losses are estimated to be $89 million to $445 million depending on how long the two major export markets (EU plus the Philippines) remain closed. The direct and indirect negative effects experienced by the rice producers due to reduced prices, long on-farm crop storage time, reduced seed stocks in 2007, testing requirements, a clean out of the rice merchandising system and lost rice revenue are estimated to be $199 million to $201 million. Processors experienced at estimated loss of $88 million to $91 million. The BASF Company estimates that it lost $1 to $15 million because its Clearfield 131 seedline, a non GE rice line, was contaminated with LL62 and LL604. Food product recalls around the world are estimated between $85 million and $253 million. Export shipping losses from the loss of US exports amounted to $25 million. The worldwide estimated total economic loss due to the LL601 contamination event is estimated to range from $741 million to $1.285 billion.

A class action litigation against Bayer CropScience LP brought by US rice farmers is expected to cost Bayer (and/or its insurers) $1 billion in compensatory liabilities. In addition, litigation has been brought forth against Riceland Foods and Producers Rice Mill by British and German food processors. The estimated compensatory losses of $1 billion facing Bayer are in addition to the economic losses sustained by the rice industry world-wide.

1.0 Report Overview

The purpose of this report is to give a comprehensive overview of the Bayer Liberty Link 601 (hereafter called LL601) event in 2006 and its repercussions, both in terms of the economics of what happened in the rice merchandising system as well as the legal/regulatory ramifications arising from the unregulated release into the system. In addition, other rice varieties affected by the LL601 event are also reviewed, including the Clearfield 131 and Cheniere long grain rice varieties. Before covering the LL601 rice event itself and its ramifications, it is useful to give an overview of the rice industry worldwide and in the US. Afterward, the biotechnical development of Liberty Link rice lines is discussed as well as the regulatory approval process of some of the Liberty Link lines. Next, the LL601 rice contamination event is discussed as to how it got into the environment and how it was discovered throughout the US rice supplies exported from the United States. Economic reactions to the LL601 event are discussed as well as the possible losses to various groups involved in the LL601 contamination event. Lastly, the legal ramifications arising from the LL601 event are discussed. Finally several conclusions are drawn.

2.0 Overview of the World and US Rice Merchandising Industry

2.1 The World Rice Market

The world rice industry is wide ranging. It is segmented by type, form and quality. Four types of rice comprise a majority of the rice production in the world today; a) Japonica: 10%; b) Aromatic: 10%; c) Indica: 75% and d) glutinous; 5%. Rice is sold and marketed in three different forms a) milled rice, b) brown rice and c) rough rice. Lastly, rice is marketed by three quality levels, high, medium and low.

Figures 2.1.1 through 2.1.4 show the production, consumption, export and imports for the world rice industry for the 2006/07 crop year. China, India, Indonesia, Bangladesh and Vietnam are both the five largest producers and consumers of rice. In general, 90% of the rice in the world is produced and consumed in Asia.

In terms of international trade, the five largest exporters of rice are Thailand, Vietnam, India, United States and Pakistan (Figure 2.1.3). These five nation's exports constitute 82% of the world's total export market. The import market, however, is extremely fragmented (Figure 2.1.4). The main reason is that the international rice market trading volume compared to total production is thin. World rice imports are only 7 percent of total world production. Contrast this with wheat (19%), corn (12%), soybean (24%), barley (11%), sorghum (8%), oats (9%) and rye (4%). The five largest importers are Indonesia, Philippines, Nigeria, Iran and the EU-27 bloc (Figure 2.1.4).

Figure 2.1.1: World Milled Rice Production Shares in 2006/07

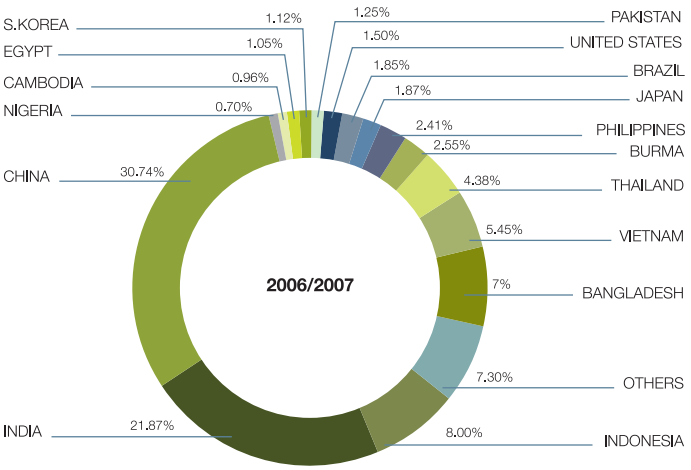


Figure 2.1.2: World Rice Consumption Shares in 2006/07

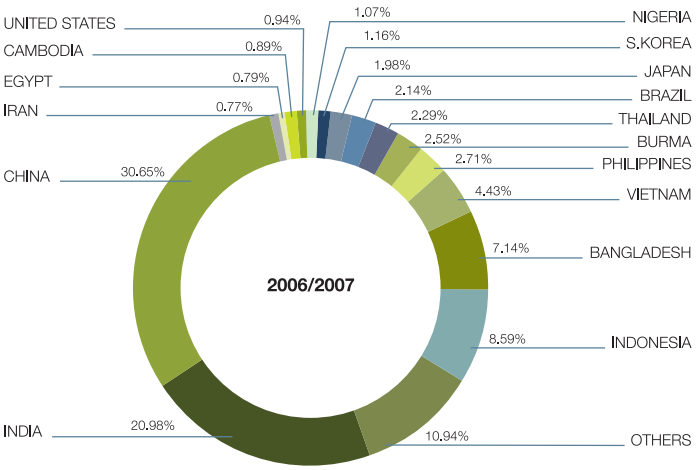


Figure 2.1.3: World Rice Export Shares in 2006/07

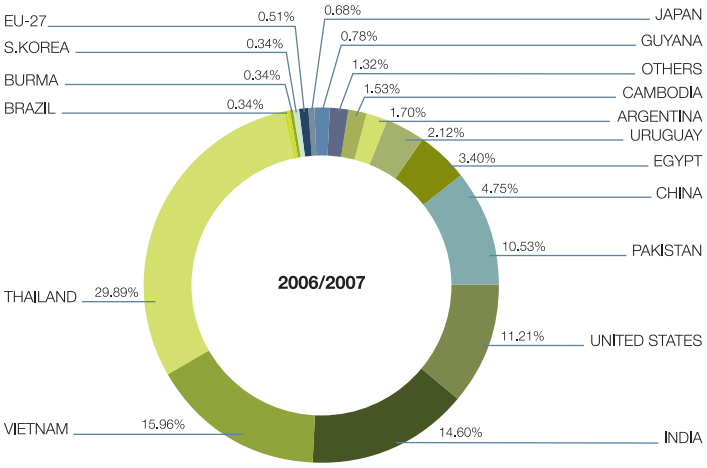
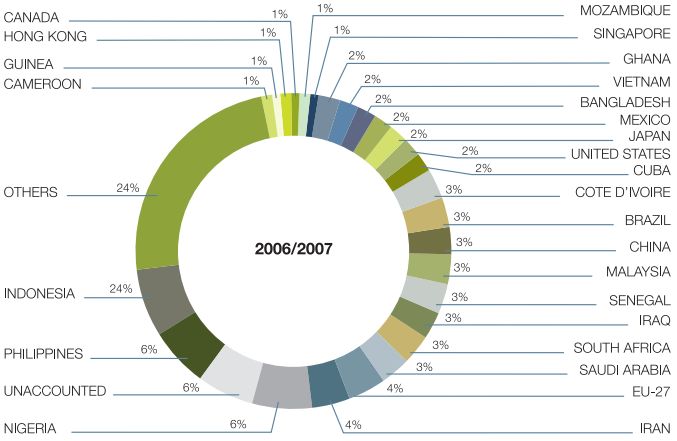


Figure 2.1.4: World Rice Import Shares in 2006/07



2.2 The United States Rice Market

The US rice industry is a high-cost, high-yielding, large-scale production sector that relies on the export market for almost 50 percent of its annual sales. The government programme payments to rice farmers on a per-acre basis are high compared to other farm programme crops. Compared to the total field crop sales in the US, rice accounts for 2% of the value of US field crops from 2002-2004. Table 2.2.1 presents some key facts that highlight the US rice industry.

Table 2.2.1. Key facts of the United States Rice Industry

- The average crop value of rice marketings for 2002-2004 is $1.44 billion.
- In 2006 the forecasted value of rice marketings is $1.88 billion.
- The US Census of Agriculture (2002) reports 8,046 farms grow rice.
- The average farm size of a rice producer is 397 acres.

Contrast this to other crop producers:

- Corn 196 acres
- Soybean 228 acres
- Wheat 269 acres
- Cotton 506 acres

- All rice is produced under controlled irrigation.
- In 2005 rice farmers received $168 per acre in government farm programme payments.

Contrast this to government payments for other crops:

- Corn $63/acre
- Soybeans $22/acre
- Wheat $35/acre
- Cotton $115/acre
- Peanuts $178/acre

Source: USDA/ERS - Rice Backgrounder[3]

Note: Government payments per acre assume a maximum countercyclical payment plus a direct payment[4] under the US 2002 Farm Bill legislation.

Virtually all US rice is grown in four distinct regions in the US: the Arkansas Grand Prairie; the Mississippi River Delta (parts of Arkansas, Mississippi, Missouri, Louisiana); the Gulf Coast (Texas and Southwest Louisiana) and; the Sacramento Valley in California. Arkansas is the largest rice producing state, followed by California, Louisiana and Mississippi.

In the US three types of rice are grown: long grain, medium grain and short grain. Long grain rice accounts for 70 percent of total US rice production. 80 percent of the long grain rice crop is destined for export markets. Medium grain rice is grown mainly in California and in the Southern US, and accounts for about 19 percent of the total US rice production. Short grain rice accounts for 1-2 percent of rice production and is grown exclusively in California.

Table 2.2.2 presents the US total rice acreage, yield, and total production in the US. The total production of US rice rose until 2005 and then declined in 2006 and 2007. The decreases in rice acres from 2005 to 2006 are attributed to the high energy and fertiliser prices - two key components in rice production. In 2007 rice acreage was 3.37 percent less than in 2006. Most of this decline occurred as the result of long grain rice acreage reduction. Arkansas, the main rice producing state, saw its total rice acreage fall by 7 percent from 2006 to 2007. Added cost of production, lack of adequate pricing opportunities, crop alternatives and trade barriers were the causes of reduced rice acreage in 2007[5]. In addition, the acreage reductions were also due to the shortage of Cheniere and Clearfield 131 rice varieties caused by the LL601 and LL604 contamination of the seed supply[6].

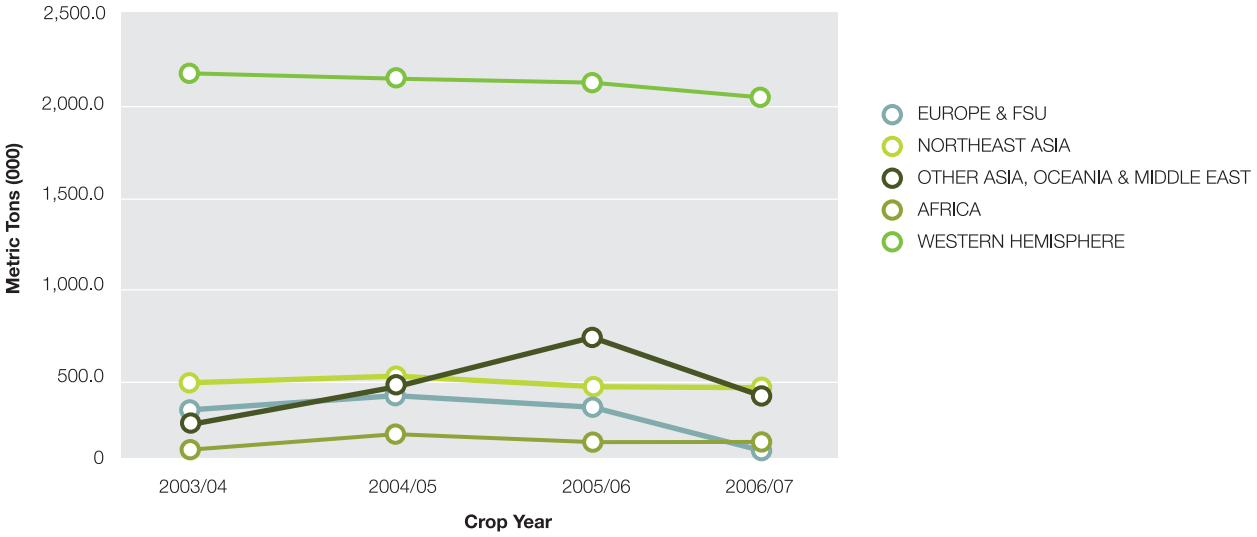
Table 2.2.2. US Rice Acreage, Yield, Production, Marketings and Average Price

Crop Year	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08*	% Difference 2007/08-2006/07
Harvested acres (millions)							
Long rice	2.512	2.310	2.571	2.734	2.186	2.082	-4.76
Medium/short rice	0.695	0.687	0.754	0.630	0.635	0.644	1.42
Total rice	3.207	2.997	3.325	3.364	2.821	2.726	-3.37
Average yield (cwt/acre)	65.78	66.70	69.88	66.36	68.68	69.84	1.69
Production (million cwt)							
Long rice	157.2	149.0	170.4	177.5	146.2	138.2	-5.47
Medium/short rice	53.7	50.9	61.9	45.7	47.5	53.6	12.84
Total rice production	211.0	199.9	232.4	223.2	193.7	190.4	-1.70
Marketings (million cwt)	158.65	147.32	169.94	183.24	148.69		
Average Price ($/cwt)	4.49	8.08	7.33	7.65	9.74	9.89**	

Source: Monthly issues of Rice Outlook, Economic Research Service: USDA
* 2007/08 numbers are estimated
** August 2007 mid-month estimate

Figure 2.2.1 Key facts of the United States Rice Industry.

Figure 2.2.1: **US Exports 2003-2007 (source USDA ERS)**



3.0 Overview of Bayer's Liberty Link Genetically Engineered Rice Varieties

This section will review the development of several GE rice varieties by corporate entities that were eventually purchased by Bayer CropScience, LP[7]. In addition, the non-GE rice varieties that are tolerant to herbicides are also discussed - as they too were eventually affected by the Liberty Link rice contamination event. Next, the unintended release of Liberty Link rice varieties into the rice merchandising system is discussed. A timeline of how the contamination was discovered and the reaction are discussed.

3.1 Development and Registration of GE rice varieties (Liberty Link 62 and Liberty Link 06)

Genetic engineering allowed plant breeders to create mutations in a plant's DNA by direct insertion of selected gene fragments into the genome of the plant. This is done to create plant traits such as herbicide tolerance, altered nutrition profiles and insect and disease resistance. In the mid to late 1990's genetically engineered crops became commercialised. From 1995 to the current time GE traits have been developed and commercialised in corn, soybean, canola, sugar beets and cotton. The technology of modifying plant traits with genetic engineering techniques has been controversial for several reasons: 1) it is not known how genetic modifications will express themselves physically in the short run and over many generations of plant growth; 2) there is concern that foreign proteins that are expressed in the process of plant genetic modification may cause negative effects in animals and humans; 3) there is a concern that traits introduced by genetic modification will drift into wild type and conventional plant populations, with potential impacts on biodiversity and ecosystems; 4) that gene drift caused by pollen transfer will contaminate seeds and crops of those producing conventional and organic crops, causing economic and financial harm.

At the current time, no GE rice varieties have ever been cultivated for commercial rice production in the world. There have been however, developments that have occurred at major seed companies investigating GE rice varieties, including herbicide tolerance (Liberty Link), elevated beta carotene levels (Syngenta's Golden Rice) and rice that produces pharmacologic agents (Ventria BioSciences). GE rice is also being developed by governments, particularly China and research and development is going on at the International Rice Research Institute (IRRI) in the Philippines and at national rice institutes. In the 1990's Bayer CropScience developed several GE rice varieties. The main work was centred on genetically engineering rice varieties to confer tolerance to Bayer's herbicide containing gluphosinate ammonium (sold under the trade names *Basta®, Rely®, Finale® and Liberty®)* thus allowing a post-emergent weed control regimen in rice production. LL62 and LL06 rice lines were field tested under APHIS authorisations since 1997 prior to deregulation. Twelve field tests of LL06 were conducted - ten in California and two in Puerto Rico in 1997 and 1998. Four field tests of LL62 were conducted - two each in Louisiana and Puerto Rico in 1997 and 1998. (For technical details of how LL62 and LL06 were developed see the AgrEvo petition for LL62 and LL06 in endnote[8]).

On 15 April 1999 APHIS deregulated transgenic rice events LL62 and L06 thereby allowing Bayer to pursue commercialisation of LL62 and LL06. While the rice events LL62 and LL06 were deregulated for commercialisation, Bayer CropScience never released them for commercial production - as the US rice industry refused to support commercial cultivation of GE rice because of fears of market rejection. Although LL62 and LL06 were deregulated in 1999, the US Environmental Protection Agency only registered gluphosinate ammonium for use in rice in 2002. Since 1999, applications for approval of LL62 and LL06 have been submitted by Argentina, Brazil, Canada, Mexico, and Russia for use in the environment as food and/or feed. An application for the approval of LL62 for food and feed use in Europe has been filed and submitted to the European Food Safety Authority (EFSA), 14 January 2005[9]. The EFSA accepted the application but has since requested additional information from Bayer. It is not known whether the additional information has yet been provided by Bayer. There are also current applications in Brazil for the importation, cultivation and field trialling of LL62. Canada gave 'post-contamination' approval as did Mexico, and the Russian approval does not seem to be live - as Russia has banned the import of long grain US rice. Other applications include South Africa, Australia-New Zealand (single regulatory body) and the Philippines - all for food and feed approval - not cultivation[10].

3.2 Development of Liberty Link 601 (LL601)

The rice transformation event LL601 was created at about the same time as the other rice transformation events LL62 and LL06. The APHIS petition details that the developer of LL601 rice event intended for it to be a backup line to LL62 and LL06[11] [12]. LL601 was deregulated based on its similarities to the previously assessed LL62 and 06 varieties. In fact there are significant differences in the event[13]. Bayer conducted field tests of LL601 under 9 APHIS authorisations at several locations including Louisiana State University's rice research station near Crowley from 1999 to 2001. Aventis then dropped the project without seeking government approval to market it.

4.0 Discovery of Bayer's LL601 in Commercial Long Grain Rice Market

On August 18, 2006 the USDA Secretary of Agriculture Mike Johanns made an announcement that Bayer's LL601 transgenic material was found in commercial long grain rice[14]. As it turns out the contamination occurred much earlier. In January 2006 an export customer of Riceland Foods, a farmer owned cooperative, tested a shipment and found that it contained some transgenic material. Riceland Foods initially thought that the transgenic material came from maize contamination in the rice. Riceland Foods tested rice samples from several grain storage facilities and found they tested positive for some transgenic event. In June 2006 Riceland contacted Bayer to find out if the contaminated strain was LL601. On July 31, 2006 Bayer contacted Riceland to confirm that the contamination was in fact LL601 and that the level of contamination was present at levels equivalent to 6 out of every 10,000 grains[15].

In addition to the USDA announcement, the US Food and Drug Administration: CFSAN/Office of Food Additive Safety went on to say that "*Based on the available data and information, FDA has concluded that the presence of this bioengineered (LL601) rice variety in the food and feed supply poses no food or feed safety concerns*[16]." On the other hand the European agency EFSA found that there wasn't sufficient data to make a finding that LL601 was safe for human consumption.[17]

Right after the August 18, 2006 announcement Bayer filed a petition with USDA APHIS seeking approval to have LL601 deregulated[18]. On November 24, 2006 USDA-APHIS approved the petition to deregulate LL601. The rationale to deregulate LL601 was based on the fact that both LL601 and LL62 expressed the same PAT protein. That rationale, however, failed to convince the European Food Safety Authority, which concluded that: *"Although extensive data have been presented regarding the molecular characterisation of the intended insert, no full molecular characterisation was presented and only limited summary data have been provided regarding the compositional analysis of the rice and agronomic and nutritional equivalence to conventional rice. It is therefore not possible to conclude on the safety of LLRICE601 itself, in accordance with the EFSA guidance for risk assessment.*[19]"

4.1 The Contamination is Discovered to be Widespread

After the August 18, 2006 USDA announcement, it became apparent that long grain rice grown in Arkansas, Texas, Louisiana, Mississippi and Missouri was contaminated with the LL601 rice event. This was quite surprising given that the LL601 was last grown in 2001. The US Department of Agriculture began an investigation into how the variety escaped from test plots into farmers' fields, where it was quietly amplified for years until its discovery. On October 5, the US Department of Agriculture completed its 14 month investigation into the contamination of the US rice system.[20] They failed to find the source or sources of the contamination, providing little confidence that they would be able to prevent a repeat of similar contamination in the future.

There is, however, much speculation on how LL601 got into the rice production system of the US It is speculated that foundation seedstock of several rice varieties may have been contaminated with LL601 when they were grown at the same locations as the LL601 rice. Either stray seeds got mixed in or LL601 pollen crossed with some Cheniere variety rice plants. One of the major long grain rice varieties planted in the Southern US was and continues to be Cheniere. Records indicate that the affected plot of Cheniere rice, which was used to grow "foundation stock" from which much larger amounts were produced over the next few years, was located at least 160 feet from the LL601 plot, farther apart than the

USDA required[21]. Analyses of samples of rice varieties that were grown over the years at the same research station found that at least one - Cheniere - was contaminated with LL601 at least as far back as 2003. Later testing confirmed that the 2003 Cheniere seedstock planted in 2006 was in fact contaminated with the LL601 rice event[22].

In response to the ongoing rice contamination event, the US Rice Federation sent an open letter to US buyers of rice. The letter laid out the rice contamination event and sought to reassure the buyers that the US rice supply was safe. On December 6, 2006, the US Rice Federation issued an industry-wide memorandum of recommendations *US Rice Industry Recommendations to Reestablish Supply and Marketability of US Rice*[23]. This document requested that state authorities in each rice state implement a series of regulatory provisions to restore customer confidence in the rice industry. The recommendations included: a) seed testing protocols; b) certified seed sampling; c) banning the planting of Cheniere seed; d) crop producer certifications; e) establishing an industry/landgrant university task force to educate rice producers.

However, the rice seed industry rejected the plan. In a statement they said the Federation's proposal "*will require substantial additional costs to the industry for no useful purpose, creating the risk that legal seed stocks could be eliminated from the marketplace.*" The seed industry does not want to do any more testing than is required by law. This conflict between the seed producers and rice growers will do little to alleviate the anxieties of food producers who have lost financially through product withdrawals[24].

Lastly, right before the 2007 planting season (28 December 2006) the State Plant Board of Arkansas made permanent its emergency rules that banned the planting of Cheniere rice in 2007 and 2008. In addition, they required that all rice planted in 2007 be tested for Bayer CropScience's Liberty Link traits[25]. The test is the 35S Bar on 3 samples of 10,000 kernels or an alternative equivalent sampling protocol. The sampling detection was set at 0.01% with a 95% confidence interval. This level of sampling meets the EU standard for detecting 0.02% based on the tests being used in the EU[26].

In addition to the US Rice Federation and Arkansas State Plant Board Actions, California's medium-grain rice growers demanded a statewide moratorium on any GE field trials to avoid the contamination recently plaguing long-grain growers in the South[27].

On 5 March 2007, USDA-APHIS alerted BASF Corporation that its Clearfield 131 seed stocks were found to have an unknown Liberty Link Event. BASF's Clearfield 131 rice seeds - developed as a non-GE variety - were at some point contaminated with experimental seeds produced by Bayer. USDA-APHIS reported that the BASF seed was contaminated with genetic material from Bayer's Liberty Link 604 rice event. LL604 was and still is not a deregulated event. On 5 March 2007 USDA -APHIS issued an emergency order prohibiting the planting of 2005, 2006 and 2007 registered or certified Clearfield 131 seed lines[28].

4.2 Discovery of Bayer's LL601 throughout the World

As mentioned earlier the genesis of the LL601 contamination scandal was the discovery of LL601 in an export shipment of rice sent by Riceland Foods, a farmer-owned cooperative. Soon after the 18 August 2006 USDA announcement of LL601 being in the US long grain rice stocks, the economic reaction was swift. Many importing nations immediately ceased imports of US long grain rice. Table 4.2.1 details the timeline of LL601 contamination events in some countries. Rice contaminated with LL601 has now been found across the world, including in nineteen European countries: Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Poland, Slovenia, Sweden, Switzerland and the UK. LL601 contamination has also been found in rice purchased in the United Arab Emirates, Dubai, Kuwait and the Philippines, food aid in Ghana and Sierra Leone and rice being imported into Russia[29].

Table 4.2.1. Timeline of LL601 Contamination Discoveries and Action Taken

August 18, 2006

USDA announces LL601 was discovered in US Food Supply.

August 20, 2006

Japan suspends all long grain rice imports from the US.

August 23, 2006

The EU issues Emergency Declaration (2006/578/EC) and immediately suspends all rice imports from the US[30].

August 31, 2006

The Food Safety Authority of Ireland implements a ban on the import of certain US long grain rice products unless certificates declaring them to be free of unauthorised GE rice accompany them[31].

August 31, 2006

The US Rice Federation sends open letter to all rice buyers trying to assure the buyers that the US rice supply is safe[32].

September 2006

Japan expands testing of US rice to include all US rice including short and medium grain rice.

September 11, 2006

European Union officials confirms that 33 of 162 samples tested by rice millers across Europe had shown traces of LL601. Officials in Sweden and France also said they found traces of the gene in commercially available rice.

September 27, 2006

Grupo Ebro Puleva, a Spanish grain merchandiser, the largest rice merchandiser in the world, halts all US rice purchases[33].

October 2006

France detects LL62 in the long grain rice. This represented a new contamination event as LL62 was not approved for use in the EU. Further testing reveals problem is widespread in US supplies.

November 2006

The European Commission introduces testing protocols for all shipments of rice into Europe, including both LL601 and LL62, another illegal GE variety of rice that was detected in imports of US rice into France in October 2006. The EU protocol was stricter than that proposed by the US and did not permit importers to rely on US assurances. This followed an event where two barges of rice arriving at the Netherlands were found to have LL601 when the US certificate stated there was none. US attempts to get the EU to agree to the US testing standards failed.

November 28, 2006

Rice producers from Thailand and Vietnam, together the world's biggest exporters, announce their commitment to only growing GE-free rice, in a new memorandum of understanding. These two countries account for more than half of all the rice traded in the world market today. and will put mounting pressure on other rice-producing nations to commit to a GE-free rice supply[34].

January 23, 2007
Riceland Foods and Producers Rice Mill, two major US rice processors are sued in US Federal Court by Tilda Ltd, a British company. Tilda Ltd. is seeking damages for finding traces of unapproved genetically engineered rice in the food supply[35].

February 8, 2007
The Swedish National Food Administration announces that traces of the unauthorised LL601 rice had been found in 600 metric tonnes (30 containers) of prepacked long-grain rice imported from the United States.

March 14, 2007
Mexico, the largest foreign market for US rice, sends tremors through the US rice sector when it stops shipments on the border out of concern the US cannot keep its experimental transgenic long-grain rice out of commercial crops[36].

August 17, 2007
A farmer named Kenneth Habetz files a lawsuit against Louisiana State University and Bayer CropScience, the developer of genetically modified rice, for allegedly contaminating the US rice crop and causing harm to his farm. He alleges that he and other farmers were faced with increased costs due to the need to maintain the integrity of their rice supply and for their efforts to keep ”LLRICE” from further entering supplies. Farmer Kenneth Habetz is seeking compensatory, exemplary and punitive damages, as well as injunctive relief[37].

August 21, 2007
Rickmers Reismuehle GMBH files separate federal complaints against Riceland Foods cooperative and Producers Rice Mill, both based in Stuttgart, Arkansas. Rickmers alleged the millers breached contracts by selling rice that did not meet the terms of a 2003 European Union ban on the importation and sale of genetically engineered foods[38].

5.0 Economic Impacts Arising from the Bayer LL601 Contamination Event

Prior to the August 18, 2006 announcement of the LL601 contamination, the rice producer price was going up in response to tight rice supplies. Futures prices for the nearby delivery months at the Chicago Board of Trade peaked at $10.38 per hundredweight (cwt). The USDA was projecting the 2006/07 season average farm price to increase to $9.00 to $9.50 per cwt, the highest it had been since 1998/99. The higher season average farm price was the result of a 9 percent contraction in the US rice supplies and higher global trading prices[39].

Once LL601 was found to be widespread in US long-grain rice, prompting Europe to cut off imports, the rice futures market went into turmoil. The futures contract prices at the Chicago Board of Trade fell from 9.83/cwt on August 18, 2006 to 8.99/cwt on August 25, 2006. This represented an immediate loss of 168 million dollars[40]. Right away producers were forced to hold on to their rice for a longer time following the rice harvest. What exacerbated the whole rice contamination scandal was having the announcement come right during harvest. Although futures prices recovered to their pre-event announcement levels, some farmers were reported to be holding on to their production longer to market it. In 2006/07 the reported marketings by US farmers were down 19% compared to the prior year (Table 2.2.2). This occurred in spite of the 2006/07 average price being higher than the 2005/06 price. In 2006/07 farm marketings were 76% of total production. The drop in farm marketings in 2006/07 appears to be a reversion to the mean percentage level of marketing of total production. In the 2005/06 crop year farm marketings were 82% of total production, a multi year high. This was high compared to the other years 2002/03 (74%), 2003/04 (74%) and 2004/05 (72%).

5.1 Farm Level Impacts

As discussed previously, the US rice industry began to implement a programme to ensure a GE-free rice supply. These included a) seed testing protocols, b) certified seed sampling, c) banning the planting of Cheniere seed, d) crop producer certifications and e) establishing an industry/landgrant university task force to educate rice producers. In addition, the Arkansas State Plant Board has a set of penalties for Arkansas producers who fail to test and provide certificates insuring GE-free rice production. Farmers had to and will continue to clean out all rice grain and seed hidden in farm equipment used for planting, harvesting, transporting and storing crops. The economic cost of this is the opportunity cost of the farmer's time. Smaller rice producers will feel the economic impact of the LL601 contamination incident much more than the larger farmers. Farmers will not be compensated for the extra costs and labour required to clean their equipment or fields to rid it of the traces of LL601. The ongoing litigation discussed later will be one avenue for farmers to recoup lost revenue arising from the LL601 contamination.

The cost of testing and cleaning requirements in the US 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. Assuming that it will take an average of 40 to 60 hours (at $9 per hour)[41] for a producer to clean his farm equipment and grain storage facilities, the cost per producer will range from $360 to $540. Assuming that 75% of the 8046 rice farmers in the US do this, the total costs of ensuring an LL601-free system would range from $2.172 million to $3.259 million[42].

Seed testing in Arkansas to meet state requirements for 2007 was estimated to be $600,000[43]. For the amount of rice planted in Arkansas in 2007 (1.22 million acres) the cost comes out to $0.50 per acre. Only Arkansas banned the planting of Cheniere seed. Other states did not ban the planting of Cheniere seed, however, given grain market tracing requirements that the rice industry implemented, seed producers in other states had to test for LL601. In 2007, in all other southern US states besides Arkansas, 888,212 acres were planted in rice. The seed testing requirement for these acres would be $444,106 - assuming a $0.50 per acre cost. The estimated total seed testing costs arising from the LL601 incident total $1,044,106 for the year 2007. Since the restriction on Cheniere seed also is in force in 2008, the same testing costs will occur in 2008. Thus for the 2007 and 2008 planting season the total seed testing costs will be $2,088,212.

Long grain rice acreage fell 4.76% (104,000 acres) from 2006 to 2007. However, medium grain rice acreage increased 9,000 acres from 2006 to 2007 (Table 2.2.2). The total net loss in rice acres (95,000 acres) was solely due to the loss in long grain rice acreage. Had these lost acres been planted in long grain rice with an expected 2007 yield of 69.84 cwt/acre, the extra production would have been 6,634,800 cwt. If this production were priced at the 17 September 2007 Arkansas cash price[43] of 10.30/cwt the total value of the lost rice production would have been $68,338,440. This value is strictly the lost total revenue of rice production foregone to the producers based on farm gate prices. This value occurs as a result of reduction of rice acres in 2007. What did the farmers plant instead of rice? In the Southern US in 2007, especially in Arkansas, land planted to rice, soybeans and cotton decreased while the amount of corn acres increased dramatically. In 2007 Arkansas corn acreage increased 195 percent over 2006. Most long grain rice farmers rotate between rice and soybeans in Arkansas. However, in 2007, the loss in rice acres was shifted into corn acres[45]. If the 95,000 acres planted to corn at an expected national 2007 yield of 155.8[45] bushels/acre were priced at $3.44 per bushel (see endnote 43) the expected corn revenue would be $50,915,440. The net reduction in rice acreage in 2007 resulted in a revenue loss of $17,423,000 to rice producers.

There will be a loss of government revenue to farmers due to shifting acres out of rice in 2007. Table 2.2.1 shows that in 2005, government payments to rice farmers were $168/acre versus $115/acre for cotton, $63/acre for corn and $22/acre for soybeans. In this analysis, it will be assumed that the decrease in long grain rice acres in 2007 was taken up by increased corn acres. If all 95,000 acres were planted into corn, the loss of government revenue would be $9,975,000 [(rice: $168/acre - corn: 63/acre) x 95,000 acres]. This calculation for determining government revenue loss from shifting out of rice and into corn assumes 2005 government figures shown in Table 2.2.1. Since all crop prices including rice have been increasing since 2005, the countercyclical payment portion of the government revenue will be slightly reduced from that seen in 2005. Thus the calculations shown here may slightly overstate government programme payments.

Much of the acreage reduction occurred as a result of the loss of the popular long rice seed lines, Clearfield 131 and Cheniere, for the 2007 and 2008 planting seasons. These two seed lines were banned for planting due to the Liberty Link contamination. BASF Corporation, the developer of the Clearfield 131, rice line reported it lost $1 million to $15 million due to the planting ban on Clearfield 131[47 48].

5.2 Grain Elevator/Processor Impacts Including Testing Costs

Rice processors and handlers had to engage in a testing and cleaning regime to ensure that all incoming rice was GE-free for the 2007 harvest. As previously mentioned the US Rice Federation issued a document *US Rice Industry Recommendations to Reestablish Supply and Marketability of US Rice*. This document requested state authorities in each rice state to implement a series of regulatory provisions to restore customer confidence in the rice industry. The recommendations included a) seed testing protocols, b) certified seed sampling, c) banning the planting of Cheniere seed, d) crop producer certifications and e) establishing an industry/landgrant university task force to educate rice producers. Given that the tone of the document was basically to have the industry GE-free, processors and handlers had to engage in extra paperwork to ensure that producers were delivering GE-free crops. In order to estimate the cost of this regime, cost estimates were derived from the grain merchandising literature dealing with identity preserved segregation. Even though the rice production coming off the farms in 2007 is not segregated per se, 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 processessing arise from a) sampling and testing, b) maintenance, c) mistakes or misgrades in rice sampling, d) disputes, e) labour, f) other costs. Maltsbarger and Kalaitzandonakes[49] estimated the identity segregation costs for a range of elevator sizes for identity preserved high-oil corn. Depending on the elevator size the segregation costs range from $0.021 to $0.049 per bushel. Of this, the sample testing analysis costs ranged from $0.011 to $0.031 per bushel.

For LL601 detection the testing costs will be much higher. In 2007 many processors including the two major rice cooperatives Riceland Foods and Producers Rice Mill are testing every truckload of rice for LL601[50]. A standard truckload contains 910 bushels[51]. Genescan[52] a GMO testing lab charges $180 for a bar 35S test that meets EU's GE regulations. If every truckload of rice is getting tested this means that the cost of LL601 testing is $0.197 per bushel ($0.197 = $180/910 bushels). Using this testing cost and the other segregation costs from Maltsbarger and Kalaitzandonakes (misgrades, maintenance, disputes/labour and other) the range of segregation costs for LL601 is $0.207 to $0.215 per bushel. Assuming these costs are applied to the expected total US rice production in 2007, Table 5.2.1 lays out the estimated total costs.

The total cost to the US rice industry to clean up and maintain GE-free status for 2007 ranges from $88 million to $91 million. These costs include the sum of all long grain and medium/short grain production in the US.

Table 5.2.1. Total Costs to the US Rice Industry in 2007 to Ensure a GE-free Rice Supply.

US Long Grain Rice	2007
cwt produced	140,000,000
bushels produced	311,111,111
Non GE regime cost - lower range ($/bushel)	0.207
Non GE regime cost - upper range ($/bushel)	0.215
Cost of GE clean up (lower range) $	64,400,000
Cost of GE clean up (upper range) $	66,888,889

US Medium/Short Grain Rice	2007
cwt produced	50,400,000
bushels produced	12,000,000
Non GE regime cost - lower range ($/bushel)	0.207
Non GE regime cost - upper range ($/bushel)	0.215
Cost of GE clean up (lower range) $	23,184,000
Cost of GE clean up (upper range) $	24,080,000

	2007
Total cost of GE clean up (lower range) $	87,584,000
Total cost of GE clean up (upper range) $	90,968,889

Notes: Numbers shown are rough rice produced.
The cwt to bushel conversion assumes 1 bushel of rough rice = 45 pounds
Source: Rice Outlook. August 13, 2007. UDSA - ERS. Publication RCS-07h
The 2007 numbers are estimated production from USDA-ERS
Costs come from Maltsbarger and Kalaitzandonakes (see endnote 48)

5.3 Export Impacts

In addition to the futures price drop at the Chicago Board of Trade, a majority of all the importers ceased import shipments from the US. Table 5.3.1 shows the reaction of the countries importing from the United States.

Table 5.3.1. US Rice Export Markets Impacted by the Presence of LL601

2006 Export Ranking	Country	2006 Exports ($ million)	Importer Reaction	Trade Impacted
1	Mexico	205	GE certification required: trade disrupted	yes
2	Japan	169	Testing required	yes
3	Iraq	145	Testing required; 1% threshold	yes
4	Haiti	112	Trade continues	no
5	Canada	107	Testing required; 5% threshold	yes
6	EU	69	Trade in long grain rice stopped	yes
7	Saudi Arabia	42	Trade continues; label for presence > 1%	no
8	Nicaragua	40	Trade continues	no
9	Cuba	40	Trade disrupted, situation is uncertain	yes
10	Honduras	39	Trade continues	no
12	Korea	32	Testing required; tender complications	yes
16	Philippines	20	Trade stopped	yes
18	Taiwan	20	Testing required	yes
Total Exports ($ million)		**1,289**	**Share of global exports impacted: 63%**	

Note: Russia has banned all US rice imports.
United Arab Emirates requires a GE-free status on US Rice.
Source: US Rice Federation

The share of US global exports impacted by the LL601 rice event is 63%. This translates into $812 million dollars of trade that was impacted by the detection of LL601. This does not mean that $812 was lost in exports. A direct loss in US exports can only be assessed with export data that has been generated since LL601 was identified in the rice supplies in August 2006. Since that time, noticeable trends in export patterns has emerged.

Figure 2.2.1 shows stable export trends for the different US export destinations until the 2006/07 crop year. Figure 5.3.1 shows the accumulated exports of all US Rice during the 2004/5-2006/07 crop years[53 54]. The LL601 event occurred at the beginning of the 2006/2007 crop year. This is a time when the harvest season is occurring. The EU market almost dried up. In addition to the EU export losses, the US experienced export declines in the African continent (mostly Ghana), Northeast Asia (primarily Japan) and Other Asia, Oceania and Middle East (primarily Iraq and the Philippines) (Table 5.3.2).

Figure 5.3.1: US Accumulated Exports by Month of All Rice: 2004-2005 to 2006/07 Crop Years (source USDA Rice Outlook)

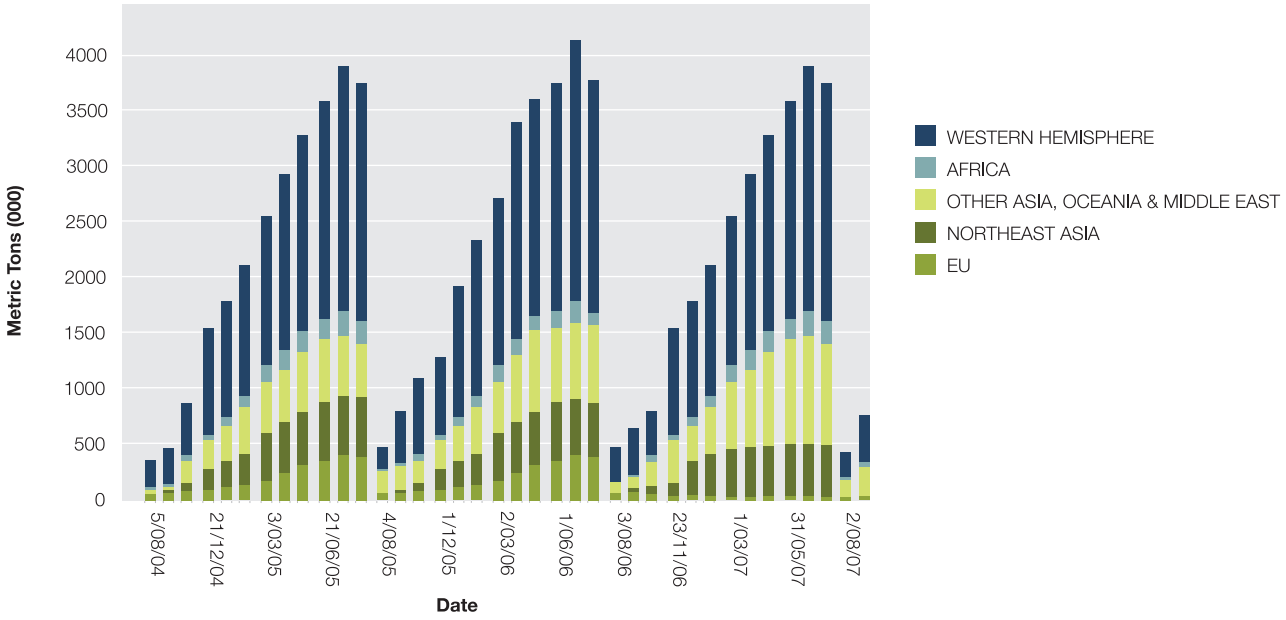


Table 5.3.2 US Export Tonnage Declines from 2005/06 to 2006/07.

2006 Export Ranking	Decline in Exports From 2005/06 to 2006/07 (000 metric tonnes)
Europe and FSU	336
Northeast Asia	17
Other Asia, Oceania, & Middle East	205
Africa	34
Western Hemisphere	71
TOTAL	**663**

Source: Rice Briefs, USDA ERS

Figure 2.2.1 shows that the United States has been shipping to the EU and the Former Soviet Union anywhere from 330,000 to 425,000 metric tons of rice per year in the past four years. In the 2006/07 crop year the US exports to Europe fell to less than 50,000 metric tons. The lost value of this product was $97 million[55]. The EU economic loss will be the most permanent loss experienced by the US rice industry. The EU has the most stringent food and safety regulations whose thresholds will not easily be met by the US rice industry. At this time it is not known how long the EU Market will be effectively closed to the US rice producers.

Other US export markets were totally shut down during the year following the LL601 announcement. The Philippines and Papua New Guinea totally closed their markets to US rice exports. Prior to the LL601 announcement the US exported $20 million dollars of rice per year to the Philippines and approximately $6.7 million to Papua New Guinea.

While some US export markets will be regained, some will be lost to Asian competitors - and possibly Uruguay. Ebro Puleva, the worlds largest rice merchandiser, has started sourcing their rice from Egypt, Thailand and Uruguay instead of the US[56]. At the time Uruguay was reported to be trialling a GE rice line. However, they have now made a GE-free rice commitment. Thailand and Vietnam have announced their commitments to GE-free rice. In addition, their export prices being more favourable than US export prices will allow them to take up the EU, former Soviet Union and Philippines export market lost by the US.

The export losses to Japan appear not to be permanent. Japan primarily imports short and medium grain rice from the US. In general, both short and medium grain rice were not contaminated with LL601 because they are predominantly grown in California. Japan was closed to US exports until a GE testing regime could be put in place.

As mentioned before, the US export losses can only be determined by what has transpired since the LL601 announcement in August 2006. The decline in exports from the 2005/06 crop year to the 2006/07 crop year is 663,000 metric tonnes (Table 5.3.2). Approximately 80% of the US rice exports are long grain rice with the remaining 20% being mostly medium grain rice (Table 5.3.3). This translates to export losses of 530,400 tonnes of long grain rice and 132,600 tonnes of medium grain rice. The reported 2006/2007 US rice price quotes for export were $407/metric tonne for long grain milled rice, $237/metric tonne for rough long grain rice and $538/metric tonne for medium grain milled rice. Approximately 63% and 37% of the exported long grain rice is sold as milled and rough rice, respectively. Almost 100% of the medium grain rice is sold as milled rice. Assuming these prices and export percentages the estimated export loss is calculated in Table 5.3.3.

At the most extreme if the EU and Philippine markets remain closed for 5 years the potential US export loss will be $455 million. This table shows that gaining back export markets will be no easy task for the US.

Table 5.3.3 Estimated US Export Losses Due to Export Reductions

Product Exported	Tonnes (000)	2006/07 Export Price Quote $ / metric tonne	Export Loss ($)
Long Grain Milled	334	407	136,081,915
Long Grain Rough	196	237	46,538,837
Medium Grain Milled	133	537	71,421,000
Export Loss ($)			**254,041,752**

Source: Rice Brief - ERS/USDA

The calculated US rice export loss occurring in the 2006/2007 crop year is estimated to be $254 million dollars.

Future export losses and/or gains are hard to determine because of economic and political uncertainty and weather changes. So far, it appears that US rice exports to the EU and Philippines, the two major markets listed in Table 5.3.1, market have not recovered. These two markets represented $89 million in sales in 2006. Typically, once a market is lost it will take time to recover that market. Table 5.3.4 estimates future losses to those major markets (EU and Philippines) that have been totally closed over the past year. Assumptions are made about how long the EU and Philippines markets remain essentially closed. The numbers generated in Table 5.3.4 represent extremes in export losses. However, these numbers represent real losses caused by LL601 contamination.

Table 5.3.4 Estimates of Future Export Losses of EU and Philippines - Assuming 1 to 5 Years of Market Adjustments

Likely Scenarios		Extreme Scenario	
Years to recover market	**Accumulated future export Loss based on Years to recover (million $)**	**Years to recover market**	**Accumulated future export Loss based on Years to recover (million $)**
1 year	0	1 year	89
2 years	45	2 years	178
3 years	89	3 years	267
4 years	134	4 years	356
5 years	178	5 years	445

Note: Table assumes 89 million dollar sales were lost based on Table 5.3.1.

5.4 Product Recalls

In the EU many grocery chains recalled rice products from the grocery shelves once it was announced that LL601 and LL62 were found in long grain rice products. While it is hard to ascertain how much product was recalled and at what prices it was sold, a good estimate of how much a product recall costs is to take the retail price of the product in the store. In the Netherlands a kilogram of rice costs 1.40 Euros[57]. Given that LL601 rice was found all over Europe it is safe to say that the total losses arising from product recalls is basically the retail cost of the rice itself. The retail cost captures the product cost and the lost marketing margin. Therefore, taking the retail price of rice in Europe would adequately capture the losses of product recall. The only information that is missing is how many months of rice stocks were present in the European food chain. Table 5.4.1 lays out various assumptions and presents the cost of the product recall. In the 2005/06 marketing year, the US exported 390,400 metric tonnes into the EU and Former Soviet Union (FSU). In the 2006/07 marketing year, US exports to the EU plus FSU dropped to 54,000 metric tonnes. This is a 336,400 metric tonne export loss sustained by the US.

In the period preceding the LL601 announcement the US was shipping approximately 32,000 metric tonnes of rice per month into the EU and the FSU. Table 5.4.1 presents estimated retail product loss due to product recall.

The product recall losses range from approximately 45 million to 134 million Euros. Assuming a 1 euro to 1.34 dollar exchange rate, this comes out to a $60 to $180 million loss. The calculations in Table 5.4.1 assume a total product recall. While a total product recall did not happen, the assumption of a total product recall and associated costs is reasonable given that higher value added retail products and other packaged goods must be removed from the grocery shelves.

There were efforts to recall rice shipments outside the EU system, particularly in the Philippines and in Ghana[58 59]. In 2005/2006, the US exported 65,200 and 91,400 metric tonnes of rice to the Philippines and Ghana, respectively. As was done in Table 5.4.1 there will be three assumptions about how much grain is in the food processing pipeline. Table 5.4.2 lays out the estimated monetary costs of food product recall in the Philippines and Ghana.

The Ghana and Philippine product recall losses range from approximately 18 million to 54 million Euros. Assuming a 1 euro to 1.34 dollar exchange rate, this comes out to a $24.481 to $73.445 million loss.

Table 5.4.1 Estimated Monetary Losses due to EU Food Product Recalls

Level of Rice Stock in EU Food System	Export tonnage	Export kilogram	Retail Cost Euros per kg	Total Retail Loss (Euros)
1 month rice stocks	32,000	32,000,000	1.4	44,800,000
2 months rice stocks	64,000	64,000,000	1.4	89,600,000
3 months rice stocks	96,000	96,000,000	1.4	134,400,000

Table 5.4.2 Estimated Monetary Losses due to Philippine and Ghana Food Product Recalls

Level of Rice Stock in Food System	Export tonnage	Export kilogram	Retail Cost Euros per kg	Total Retail Loss (Euros)
1 month rice stocks	13,050	13,050,000	1.4	18,270,000
2 months rice stocks	26,100	26,100,000	1.4	36,540,000
3 months rice stocks	39,150	39,150,000	1.4	54,810,000

5.5 Exporter Impacts

Export companies that deliver rice freight on board incur a charge for export. After the LL601 announcement US rice exports to many destinations dropped precipitously. Table 5.3.2 shows that the US rice exports dropped 663,000 metric tonnes. The export companies who deliver rice incur a loss in shipping US rice. Since August 2006 when the LL601 event was announced, ocean shipping rates from the US Gulf Coast to Rotterdam and Hamburg ranged from $25 - $50/tonne. The US Gulf - Japan ocean freight rates ranged from $40 to $80/tonne. From August 2006 to July 2007 the ocean freight rates increased. Taking the midpoints of the ocean shipping rates, the estimated shipper loss was $25.427 million (Table 5.5.1).

Table 5.5.1 Loss in Export Shipping Revenue

Export Destination	Decline in Exports from 2005/06 to 2006/07 (000 metric tonnes)	Freight Rate $/metric tonne	Lost Export Shipping Revenue, $
Europe and FSU	336	38*	12,615,000
Northeast Asia	17	60*	1,032,000
Other Asia, Oceania, & Middle East	205	38	7,778,600
Africa	34	38	1,292,000
Western Hemisphere	71	38	2,709,400
TOTAL	**663**		**25,427,000**

Source: Rice Briefs, USDA ERS. Ocean freight rates: Home-Grown Cereals Authority, Volume 10, Issue 4[60]

5.6 Summation of Estimated Total Costs Arising from the LL601 Rice Event

All the estimated costs discussed so far are put into Table 5.6.1 to generate a range of damage estimates attributed to their LL rice events.

The total costs incurred throughout the world as a result of the LL601 rice contamination are estimated to range from $741 million to $1.285 billion. In the ongoing class action litigation against Bayer CropScience LP, Riceland Foods and Producers Rice Mill, farmers who incurred direct and indirect costs will be able to recoup a part of the losses as a result of the Liberty Link rice contamination events.

Table 5.6.1 Estimated Losses Arising from the LL601 Rice Event

Loss Due to:	Cost Lower Bound $ millions	Cost Upper Bound $ millions
Farm cleaning	2.172	3.259
Seed testing	2.088	2.088
Producers, foregone rice revenue in 2007	17.423	17.423
Loss of government payments due to shift out of rice	9.975	9.975
BASF reported losses	1.000	15.000
Processor/elevator cleaning & testing	87.584	90.968
Direct export losses for 2006/07 crop year	254.041	254.041
Future export losses (EU + Philippines)*	89.000	445.000
Retail product recalls in the EU	60.032	180.000
Retail product recalls: Philippines & Ghana	24.481	73.445
Export shipping losses	25.427	25.427
Loss due to price drop on futures market	168.000	168.000
Total Losses	**741.223**	**1,284.626**

Note: *Assuming closed EU and Philippine export markets from 1 year to 5 years.

6.0 Litigation Arising from the Accidental Release and Spread of LL601

As soon as it was revealed to the world that rice with traces of LL601 had been unknowingly released into the grain merchandising system, recriminations began to fly against Bayer CropScience, LP, Riceland Foods and Producers Rice Mill. Several law firms began to enact class action litigation proceedings[61].

The first class action lawsuit was filed in the United States District Court for the Eastern District of Arkansas - Western Division (Case No. 4-06-CV-01078) on behalf of all rice farmers in the United States[61]. This case was filed August 28, 2006. The class action lawsuit seeks damages on behalf of a class of farmers who suffered from the depression of rice prices due to the contamination of the US rice supply with genetically engineered rice that was not approved for human consumption. The complaint charges Bayer CropScience US, Bayer CropScience LP and Aventis CropScience USA, Inc with negligence insofar as they had a duty not to contaminate the nation's rice supply with unapproved genetically engineered rice and that they breached that duty. The complaint alleges that in mid-August 2006, it became public knowledge that the US rice crop had been contaminated with unapproved genetically engineered Bayer CropScience rice found in commercial rice supplies in Arkansas and Missouri.

On April 18, 2007, Adam J. Levitt of Wolf Haldenstein Adler Freeman & Herz, LLC law firm and Don M. Downing of Gray, Ritter & Graham, LLC law firm became appointed plaintiffs' co-lead counsel in the legal case *In Re: Genetically Modified Rice Litigation, MDL 1811 (E.D. Mo.)*. This legal announcement basically joined together all class actions under one proceeding. Adam Levitt had experience with other agriculturally-related class actions, most notably the StarLink contamination case where unauthorised Bt-corn sold by Aventis (now part of Bayer CropScience) was found in the US food system. Since August 2006, Don Downing has filed suit on behalf of over 200 Missouri and Arkansas rice farmers. In the proposed class action, there are now some 460 rice farmers representing over 248,000 acres of rice. In an April 2006 class action filing, Downing said total compensatory damages for plaintiffs and other members of the proposed classes may approach or exceed $1 billion - and that's before taking into account punitive or statutory damages[63].

According to the author's research, as of August 15, 2007 there were 218 filings against Bayer CropScience, LP. The number of actual litigants is actually larger than 218 because many of the legal filings were filed as a “party et. al” versus Bayer CropScience LP. The actual number of litigants making a claim against Bayer CropScience, LP will be much higher[64]. Most of the litigation is directed against BayerCrop Science LP or Bayer CropScience et. al. (ie. Bayer CropScience US, Bayer CropScience LP and Aventis CropScience USA.).

In January 2007 Riceland Foods and Producers Rice Mill, two major US rice processors, were sued in US federal court by Tilda Ltd., a British company. Tilda Ltd. is seeking damages for finding traces of unapproved genetically engineered rice that were found in the food supply (Table 4.2.1).

On August 21, 2007 Rickmers Reismuehle GMBH, a German rice milling firm, filed separate federal complaints against Riceland Foods cooperative and Producers Rice Mill, both based in Stuttgart, Arkansas. Rickmers alleged the millers breached contracts by selling rice that did not meet the terms of a 2003 European Union ban on the importation and sale of genetically engineered foods (Table 4.2.1).

Lastly, a farmer filed suit against Louisiana State University for being a part of the LL601 contamination on August 18, 2007. A farmer named Kenneth Habetz filed a lawsuit against Louisiana State University and Bayer CropScience, the developer of genetically modified rice, for allegedly contaminating the US rice crop and causing harm to his farm. He alleges that he and other farmers were faced with increased costs due to the need to maintain the integrity of their rice supply and for their efforts to keep ”LLRICE” from further entering supplies. Farmer Kenneth Habetz is seeking compensatory, exemplary and punitive damages, as well as injunctive relief (Table 4.2.1).

The estimated compensatory damages facing Bayer may approach or exceed $1 billion. In addition there will be punitive and statutory damages imposed through litigation. At this time it is unknown what these damages will be. Punitive damages, also known as exemplary damages, are damages that are separate and in excess of the

compensatory damages awarded to a plaintiff in a legal suit that arises from the malicious or wanton misconduct of the defendant. Punitive damages are imposed to serve as a punishment for the defendant. The potential size of a punitive damages award is unpredictable and the process of arriving at it is just as arbitrary, although it is loosely based on the worth of the company. There are no maximums and no minimums as in criminal law - the jury alone determines the amount. While compensatory damages are insurable, punitive damages may not be. The situation differs from state to state. Some states permit insurance for punitive awards while others prohibit insurance on the basis that insuring these damages would be against public policy, believing that punishment should not be transferable[65].

Bayer's LL601 rice contamination scandal of 2006 follows an earlier disaster caused by Aventis CropScience, an agribusiness unit purchased by Bayer in 2001. Aventis was responsible for a massive GE corn contamination in 2000. Starlink corn was a GE corn hybrid line designed to be insect resistant. USDA-APHIS only registered Starlink corn for use in livestock feed. Starlink corn was discovered in the US food supply. Aventis agreed to pay out $110 million to buy back the Starlink corn[66]. In addition, the illegal presence of StarLink in food products and the grain commodity system had negative impacts on nearly every sector of agribusiness. Kraft and other food companies recalled StarLink-containing products. Aventis pulled StarLink from the market and cooperated with the USDA to offer premiums on StarLink corn to prevent further contamination of commodity supplies and channel StarLink for approved uses. This effort was estimated to cost Aventis an estimated $1 billion[67].

Since Bayer and its subsidiaries have ultimately been responsible for both Starlink corn and now LL601 rice, the US federal court will consider the Starlink case in awarding punitive damages. All that can be said is that the punitive damages that will be levied against Bayer will be higher than would otherwise be given - had the Starlink event not occurred.

7.0 Other Costs Arising from Bayer's LL Rice Contamination

Given the limitations of this study there are innumerable costs that are not calculated because they are not easy to estimate. Supermarket chains and food processors face damage costs that go beyond the direct costs of recall. Firms in Europe especially food marketing chains experienced a loss of rice brand intangible goodwill. The loss of brand goodwill takes a long time to rebuild after a product recall is implemented. Other costs that will come into play as a result of the LL601 event include legal costs due to regulatory compliance, dumping costs to get rid of contaminated product, logistical costs of product cleanout in the retail food supply chain and government (taxpayer) costs (testing, storage, compliance etc).

8.0 Conclusions

In 2006, the United States rice industry was negatively impacted by the release of an unapproved genetically engineered rice variety called Liberty Link 601. Liberty Link 601 (LL601) rice was a seedline under development by Bayer CropScience LP from 1997 to 2001. LL601 was never approved for deregulation by USDA. Bayer's Liberty Link rice varieties were genetically engineered to tolerate Liberty Herbicide (gluphosinate ammonium). While the initial details regarding the unintended release are fuzzy, the resulting economic effects were not.

Traces of LL601 rice were discovered in the rice grain merchandising system in Europe, Asia and Japan in August 2006. Soon after the discovery of LL601 traces in the grain merchandising system, many countries, particularly Europe and Japan, immediately halted imports of long grain rice from the United States. Subsequent actions by the United States Rice Federation dictated that 1) all rice merchandising channels be thoroughly cleared of rice containing traces of the GE rice varieties LL601, LL62 and LL06 and also conventional long grain varieties Clearfield 131 and Cheniere because they contain the GE contamination and 2) ensure all future export shipments meet importing guideline requirements for non GE status. In addition, the USDA and the Arkansas State Plant Board declared an emergency action dictating that the Clearfield 131 and Cheniere long

Economic and regulatory impacts from the unintended release of genetically engineered rice varieties into the rice merchandising system of the US

grain rice varieties not be planted in 2007 and 2008 because they were found to be GE contaminated. BASF Corporation's Clearfield 131 rice variety was found to be contaminated with a previously unknown genetic event LL604 - created by Bayer. It is unknown at this time how many LL varieties are or were under development by Bayer CropScience LP, beyond the four Liberty Link lines previously discussed. As of this time, the USDA still does not have an explanation of how or why the LL601 genetic event got into the US Rice production system on a wide scale.

The LL601 event led to a reduction in the number of rice acres planted in 2007. The total acres planted to rice in the US in 2007 was reduced by 3.37% due in large part to a reduction of available GE-free seed. Most of the acreage reduction was due to the decrease in long grain rice acres.

The estimated economic loss resulting from export impacts in the 2006/07 crop years is estimated to be $254 million. The future export losses are estimated to be $89 million to $445 million depending on how long the two major export markets (EU plus the Philippines) remain closed. The direct and indirect negative effects experienced by the rice producers due to reduced prices, long on-farm crop storage time, reduced seed stocks in 2007, testing requirements, a cleanout of the rice merchandising system and lost rice revenue are estimated to be $199 million to $201 million. Processors experienced an estimated loss of $88 million to $91 million to ensure a GE-free system. The BASF Company estimates that it lost $1 to $15 million because its Clearfield 131 seedline, a non-GE rice line, was contaminated with LL62 and LL604. Food product recalls around the world are estimated at between $85 and $253 million. Export shipping losses from the loss of US exports amounted to $25 million. The worldwide estimated total economic loss due to the LL601 contamination event ranges from $741 million to $1.285 billion.

As of this time a class action lawsuit with 218 plaintiffs has been brought against Bayer Crop Science LLP. This class action represents some 460 rice farmers covering over 248,000 acres of rice. Ultimately the class action lawsuit will represent thousands of farmers in the United States. In addition, litigation has been brought forth against Riceland Foods and Producers Rice Mill by British and German food processors. It is expected that the litigation against Bayer CropScience will total over $1 billion in compensatory liabilities. The punitive damages against Bayer are as of yet, unknown.

The laxities in the US regulatory environment contributed to the Liberty Link rice contamination events throughout the US and the world. There appears to be insufficient regulatory oversight in the environmental testing phase of GE crops. It is the outdoor environmental testing that led to the LL601 contamination. In addition, the laxities in the EU's food safety regulations allowed the LL rice to spread throughout the EU food processing system.

Appendix I.
GLOSSARY OF TERMINOLOGY

Agricultural Biotechnology: A range of tools, including traditional breeding techniques, that alter living organisms, or parts of organisms, to make or modify products; improve plants or animals; or develop microorganisms for specific agricultural uses. Modern biotechnology today includes the tools of genetic engineering.

Deregulated: If a GE crop has gone through the regulatory process for USDA to permit commercialisation, it is commonly referred to as being a deregulated crop. This is necessary before it is sold and produced commercially. It allows the product to be moved and planted freely without the need for notification or permits.

Gene: The fundamental physical and functional unit of heredity. A gene is typically a specific segment of a chromosome and encodes a specific functional product (such as a protein or RNA molecule).

Genetic engineering: Manipulation of an organism's genes by introducing, eliminating or rearranging specific genes using the methods of modern molecular biology, particularly those techniques referred to as recombinant DNA techniques.

GE: acronym for genetically engineered.

Herbicide-tolerant crops: Crops that have been developed to survive application(s) of particular herbicides by the incorporation of certain gene(s) either through genetic engineering or traditional breeding methods. The genes allow the herbicides to be applied to the crop to provide effective weed control without damaging the crop itself.

Protein: A molecule composed of one or more chains of amino acids in a specific order. Proteins are required for the structure, function and regulation of the body's cells, tissues and organs and each protein has a unique function.

Pharmacologic agents: Biologically active substances applied pharmacologically to the body for their therapeutic effects on one or more tissues or organs.

Regulated: If a GE crop has not gone through the regulatory process for USDA to determine if it can be safely commercialised, it is commonly referred to as being in regulated status or a regulated crop.

Variety: A subdivision of a species for taxonomic classification also referred to as a 'cultivar.' A variety is a group of individual plants that is uniform, stable and distinct genetically from other groups of individuals in the same species.

Economic and regulatory impacts from the unintended release of genetically engineered rice varieties into the rice merchandising system of the US

[1] For Glossary of Terminology see Appendix I.

[2] AgrEvo began the development of the Liberty Link rice lines. AgrEvo was purchased by Aventis in 1999. Aventis was purchased by Bayer Crop in 2002. Bayer's agribusiness unit is called Bayer CropScience, LP. All development by Bayer's predecessors will be referred to as having been developed by Bayer CropScience, LP.

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[9] Petitions of Nonregulated Status Granted or Pending by APHIS: AgrEvo Petition for LLRice 06 and LLRice62: Petition # 98-329-01p. Federal Register Notice # 98-329-01p_com. See: http://www.aphis.usda.gov/brs/not_reg.html

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[12] USDA Animal and Plant Health Inspection Service: LL62 and LL06 petition 98-329-01p Status: http://www.aphis.usda.gov/brs/aphisdocs2/98_32901p_com.pdf

[13] Petitions of Nonregulated Status Granted or Pending by APHIS: Bayer CropScience Petition for LLRice601 Petition # 06-234-01p. Federal Register Notice # 06-234-01p_com
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