GM stockfeed in Australia

Economic issues for producers and consumers

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Foreword

The use of genetically modified (GM) crops offers Australian farmers the opportunity to boost their productivity by reducing inputs, increasing yields or by doing both. An industry that is not generally considered in the GM arena is the livestock industry, where GM products are already being used in animal feed in Australia and around the world.

If crop yields increase and prices fall, the use of relevant GM crops in animal feed has the potential to reduce the cost of feed. In the future, the use of GM material in animal feed may be able to improve livestock productivity.

These potential benefits must, however, be weighed against the potential costs or concerns associated with the use of GM material in animal feed. The primary concern is that the use of GM material in animal feed may lead to market access restrictions or a decline in demand from consumers.

In this report, issues related to the use of GM material in animal feed are analysed. Specific issues relating to the cropping, stockfeed and livestock industries are considered as well as consumer acceptance of products derived from animals which have been fed GM material. Estimates of the current use of GM material in animal feed are also made for Australia and our major export competitors.

Phillip Glyde
Executive Director
January 2009

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Summary

The use of stockfeed containing genetically modified (GM) oilseeds already occurs both in Australia and in countries that compete with Australia in third markets for meat, egg and dairy products. Consumption of foods produced using stockfeed containing GM material is substantial. Potentially important issues related to the use of GM oilseeds in stockfeed are examined here. These include import regulations in Australia's major food export markets, domestic and international consumer awareness and acceptance, and the use of GM material in stockfeed by countries competing with Australia in third markets.

GM animal feed

- Globally, the uptake of GM crops has been rapid since first introduced in 1996, with the area planted to GM crops reaching 114 million hectares in 2007. The key driver for the adoption of GM crops by farmers has been the yield and production-cost advantages GM crops offer. The use of GM crops for the production of stockfeed is unlikely to raise many significant issues for GM crop producers as a number of GM feed ingredients currently in use are secondary products when compared with the primary products of oil and fibre. However, with much of the meal derived after processing GM grain and oilseed crops being consumed as animal feed, the effect of increased uptake of GM crops is expected to be more pronounced in other industries in the supply chain, in particular the stockfeed manufacture and livestock industries.
- The ability of the stockfeed manufacture and livestock industries to adapt to the increased availability of GM crop ingredients for stockfeed will be an important consideration for making future investment decisions. The issues raised in this report represent opportunities and challenges which need to be considered by these industries.
- In Australia, domestically sourced GM cottonseed meal and imported GM soybean and canola meal make up a minor but growing proportion of the ingredients used in some stockfeed mixes. In future years, domestically sourced GM canola meal will also form part of stockfeed mixes following recent approvals by state governments in New South Wales and Victoria of commercial growing of GM canola. In addition, following a lifting of the moratorium on GM cotton production in the Ord River irrigation area in November 2008 and announcement of commercial GM canola trials in December 2008, GM cotton and canola may be commercially produced in Western Australia in the future.
- GM fodder is not used in Australia as GM pastures are not currently in commercial production. However, grazing livestock may consume GM canola stubble in the future. GM varieties of ryegrass and white clover are currently in the research and development phase in Australia. If GM pastures are introduced in the future, it is possible GM fodder use may become more widespread. GM pasture has been used internationally, with the United States producing GM alfalfa between 2005 and 2007. In April 2007, a permanent United States federal court injunction was issued, prohibiting the sale of Roundup Ready® alfalfa seed until an environmental impact statement is prepared.

- In 2006-07, the major grains and oilseed products used in animal feed in Australia were wheat, barley and sorghum. The reliance on grains, pulses and oilseeds in stockfeed in Australia varies between livestock industries. Grain consumption by weight in the grazing beef cattle and sheep industries is estimated to be less than 10 per cent of total feed, 25 per cent of dairy feed, between 60 and 80 per cent for feedlot sheep and cattle, and virtually all feed consumed in the poultry and pig meat industries.
- The Gene Technology Regulator and Food Standards Australia New Zealand (FSANZ) are primarily responsible for the regulation of genetically modified organisms and GM food, respectively, in Australia. If required, the Gene Technology Regulator can impose conditions on licensed genetically modified organisms (GMOs) in relation to GM products (such as stockfeed) derived from GMOs. The labelling of animal feed containing GM material and products from animals which have been fed GM stockfeed is not required in Australia.
- No evidence of import restrictions on meat, egg and dairy products derived from animals fed with stockfeed containing GM material was found in any of Australia's major livestock product export markets considered in this study. There is also no evidence of regulations in any of Australia's major export markets for mandatory labelling of products from animals which have been fed GM stockfeed.

Feed production

- The use of GM material in feed is already occurring in Australia. In total it is estimated 487 200 tonnes of GM oilseeds and meal were used in animal feed in Australia in 2006-07, representing around 5 per cent of the total grain and oilseed products used in animal feed by weight that year. Around 9 per cent, or 20 600 tonnes, of canola meal used in stockfeed in 2006-07 is estimated to have been GM, and 92 per cent of cottonseed and cottonseed meal.
- The proportion of GM products in animal feed varied across the livestock industries. Stockfeed for the chicken meat and egg industries is estimated to have the highest proportion of GM products by weight, at 14 and 13 per cent, respectively. Feed for sheep for live export does not contain ingredients that could be GM, and GM ingredients are avoided for use in stockfeed for pigs.
- The Stock Feed Manufacturers Council of Australia has indicated segregation of GM material already occurs on a client needs basis. A system of segregation may need to be developed in the future as the adoption of GM crops increases, dependent on any potential demand for non-GM stockfeed mixes.

Presence of GM in feed

- GM animal feed is also being used by countries that compete with Australia in third markets for meat, egg and dairy products – Canada, the United States, New Zealand, Denmark and Brazil.
- Of these countries, Australia is estimated to use the least amount of GM feed in percentage terms, while Canada and the United States use the most. There is no reliable feed usage data for New Zealand.

Feed consumption

- The Australian pig meat industry and some sections of the chicken meat and dairy industries have indicated they avoid using stockfeed containing GM material because of market acceptance concerns. However, it is important to recognise that almost all imported pig meat consumed in Australia is likely to have been produced using at least some GM stockfeed. Therefore, this concern is likely to be limited to certain niche markets, both domestic and export.
- It is likely that avoiding the use of GM grains and oilseeds in feed mixes used by these industries will become increasingly difficult and expensive in the longer term, in an environment of increasing uptake of GM crops.

Livestock product consumption

- There is little information on Australian consumer awareness and acceptance of products from livestock fed with GM stockfeed. The few studies which have been conducted suggest most consumers believe if an animal is fed GM stockfeed, the meat, egg or dairy products from that animal is also genetically modified. However, these studies also indicate that over time, consumers are becoming more willing to purchase products derived from animals which have been fed with GM feed. Nevertheless, some studies show consumers are still slightly less confident in consuming products from animals fed with GM feed than consuming food containing a small amount of GM ingredients.
- Consumer awareness of the use of GM material in food and feed in Australia's major livestock and livestock product export markets varies widely. Consumption of meat, egg and dairy products from animals fed with GM stockfeed in these markets is likely to be widespread, with little consumer resistance or use of voluntary labelling to indicate GM feed was not used.

1 Introduction

Increased global production of a range of genetically modified (GM) crops has led to the increased availability and widespread use of stockfeed containing GM ingredients, hereafter termed GM stockfeed. The use of GM stockfeed in Australia has been increasing over time with the rapid adoption of GM cotton varieties by Australian farmers and GM soybeans and canola internationally. GM cottonseed meal, a by-product of cottonseed oil production, is used by stockfeed manufacturers as a key protein ingredient. Imported GM soybean and canola meal products are also ingredients used to boost the protein content of stockfeed. The increasing use of GM products in stockfeed in Australia mirrors developments overseas where the rapid adoption of GM soybeans, maize, cotton and canola have increased the availability of GM ingredients for stockfeed in those countries.

The use of GM stockfeed in Australia is likely to increase in the coming years. Recent announcements by the New South Wales and Victorian Governments enabled limited production of GM canola in 2008, with wider production expected over the longer term. In Western Australia, the present government lifted the moratorium on GM cotton production in the Ord River irrigation area in November 2008 and announced commercial trials of GM canola in December 2008. The availability of meal left after crushing canola and cottonseeds for oil production for use in animal feed is expected to increase over time.

In the future, potential adoption of GM pasture varieties may further increase the availability of GM fodder for use as stockfeed. There are currently no varieties of GM pasture approved for commercial release in Australia, although GM varieties of white clover and ryegrass are under research and development. International experience on GM varieties of pasture is also limited. Grazing on GM cotton stubble is unlikely to have occurred in Australia, but GM canola stubble grazing may occur in the future.

Increasing the proportion of GM products in the stockfeed mix may raise economic issues for the cropping, stockfeed and livestock product industries. In considering these issues, industry participants may benefit from an indication of consumer acceptance of livestock products from animals fed with GM stockfeed in local and global markets. The purpose of this report is to explore the key economic issues for supply chain participants associated with the use of GM stockfeed and to provide an indication of market acceptance of edible products from animals fed with GM stockfeed, such as chicken meat, eggs, beef, sheep meat, pig meat, dairy products, and live exports. Because of limited information on GM pastures, the focus of this research is on the use of GM crops as stockfeed.

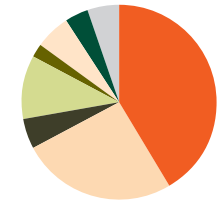
Chapter two provides an overview of the use of stockfeed in Australia and outlines the regulatory environment for GM material in stockfeed production both domestically and internationally. In chapter three, the issues associated with increased use of GM ingredients in the stockfeed mix for the cropping and stockfeed industries are discussed. Estimates of the current use of GM material in animal feed both domestically and internationally are presented in chapter four. In chapter five, the policies on the use of GM ingredients in stockfeed are explored for the beef, egg, dairy and sheep, pig and chicken meat industries. In chapter six, consumer acceptance, both domestically and in key international markets, is discussed. Finally, chapter seven contains the conclusions and findings from the study.

2 GM animal feed

Globally, the commercial uptake of GM crops has been rapid since their introduction in 1996, with the global area planted to GM crops reaching 114 million hectares in 2007 (James 2007). Over this period, both seed and meal products from GM crops have been used in stockfeed. In Australia, GM cottonseed and its derived meal product are used in stockfeed, as are imported soybeans and meal from the United States and Brazil. Canola seed and maize are imported in exceptional circumstances, generally from Canada for canola and the United States for maize, where GM varieties make up a large proportion of production. Australia's use of GM crop products in stockfeed will be further discussed in chapter four. This chapter provides a background on genetically modified crops, animal feed and the domestic and international regulations applying to use of GM animal feed.

a Feed consumption mix in Australia, by volume [a, b]

2006-07



	%
other	5
lupins	4
soybeans	6
canola meal	2
sorghum	11
oats	5
barley	26
wheat	41

a Based on the marketing year for each commodity; year ending February 2007 for maize and sorghum, March 2007 for cotton and soybean, September 2007 for wheat, October 2007 for barley, canola, field peas, lupins, oats, and triticale, and December 2007 for copra. **b** Field pea and lupin feed use is based on consumption data in ABARE (2008). As stockfeed use is not treated separately to human consumption, it is assumed that all lupins and field peas are consumed by livestock. *Source*: ABARE 2008, Australian Oilseed Federation 2008, USDA 2008a.

GM grains, pulses and oilseeds

The reliance on feed grain varies across the Australian livestock industry. Industry consultations indicate the use of grain in stockfeed can vary from less than 10 per cent of feed consumed by grazing beef cattle and sheep, to around 100 per cent for laying hens.

The grain component of feed may contain wheat, sorghum, maize, barley, soybean, canola, cottonseed, oats and their derived meal products. The specific mix of these grains will typically be determined by the nutritional requirements of the animals to be fed, but will also depend on the cost of grain commodities, seasonal conditions and availability of grains.

In 2006-07, wheat accounted for 41 per cent of the volume of grains used as animal feed in Australia. The second most common grain was barley (26 per cent), followed by sorghum (11 per cent), with the remainder being composed of 11 other types of grain, pulses and oilseeds, including cottonseed mainly as meal and maize (figure a).

Imported maize, canola and soybeans as well as domestically sourced cottonseed are all potentially GM (Lamb and Cunningham 2003; SFMCA 2007).

Some imported vitamins, additives and enzymes used in stockfeed are produced using GM raw materials or GM microbial organisms in the fermentation process (SFMCA 2007). As domestic production of GM canola has commenced, it is expected domestic canola meal used in stockfeed will contain GM varieties. If GM pastures are introduced in the future, it is possible that not only grazed pasture, but also hay and silage, may contain GM material.

GM varieties of lupins and field peas have been trialled, but not commercialised, in Australia. A GM variety of field pea which was resistant to pea weevil was developed by the CSIRO and field trialled between 1996 and 2001. The research was discontinued at the feeding trial phase as mice fed with GM field peas developed an immune response (CSIRO 2005). A number of first and second generation GM lupin varieties are currently in development in Australia (University of Western Australia 2007, CSIRO 2007). Field trials of a herbicide tolerant variety of lupin was conducted in Western Australia. However, intellectual property restrictions at the time prevented commercialisation (University of Western Australia 2007).

GM pastures and stubble

No GM pasture varieties are commercially produced in Australia. However, their development may lead to livestock producers using these pastures in the future. Depending on where research is targeted in the future, the agronomic benefits of GM pastures may be quite varied. Current Australian research on clover and ryegrass may lead to improved animal health by decreasing bloat, and improving nutrient uptake leading to increased milk and meat output (Agrifood Awareness Australia Limited 2006).

Stubble from GM crops currently produced in Australia such as cotton and canola can also be used for grazing. It is unlikely cotton stubble grazing occurs in Australia, given livestock health concerns stemming from residues from a number of pesticides on the stubble (NSW DPI 2007). However, there is evidence to suggest GM canola stubble or fodder is currently being or will be used in Australia, as failed canola crops have been used as livestock fodder (Farm Weekly 2008), and canola stubble for grazing (Butler and Croker 2006, GRDC 2007).

Australian research into GM pastures

Research into GM pastures is currently being undertaken in Australia at a range of institutions including the CSIRO, La Trobe University, University of Newcastle and the Department of Primary Industries in Victoria.

Perennial ryegrass which is high in energy has been developed and the use of this variety by dairy farmers may lead to an increase in milk production. The Victorian Department of Primary Industries has received approval from the Gene Technology Regulator to conduct field trials using this variety of ryegrass.

A number of varieties of GM white clovers have also been developed. These varieties display traits such as having larger leaves, producing more seeds, being of higher quality and being resistant to alfalfa mosaic virus. Use of these varieties has the potential to improve animal health by reducing bloat, and improving nutrient uptake leading to increased output.

Future research into GM pastures may look into resistance to adverse seasonal conditions including drought and tolerance of poor quality soils, salinity, high acidity and frost.

GM pastures worldwide

Monsanto, Montana State University and Forage Genetics International jointly developed a glyphosate resistant strain of alfalfa (lucerne) in Australia which underwent its first field trials in 1999. The use of the new strain of alfalfa showed no negative effects on forage yield compared with conventional alfalfa, and its resistance to Roundup® had advantages over other weed control strategies (Canevari et al. 2004). Weed free alfalfa has benefits for animal health and production (by reducing consumption of poisonous weeds and increasing the nutritional value of the forage), water quality (by reducing the use of contaminating herbicides) and productivity of the pasture (by reducing weed competition).

The strain was commercialised in the United States in 2005, and between 2005 and 2007, 102 000 hectares of GM alfalfa were planted (James 2007). In April 2007, a permanent injunction prohibiting the sale of Roundup Ready® alfalfa seed was issued until an environmental impact statement (EIS) is prepared. This decision resulted from a US District Court ruling in March 2007, where it was found an EIS was required because of the risk of GM alfalfa presence in organic and conventional alfalfa, and the impact of GM alfalfa on weeds resistant to Roundup® (United States District Court 2007).

Australian regulatory environment

Two federal government bodies, the Office of the Gene Technology Regulator (OGTR) and Food Standards Australia New Zealand (FSANZ) are primarily involved in the regulation of genetically modified organisms (GMOs) (from which GM stockfeed may be derived) and GM food, respectively, in Australia.

In Australia, dealings with live and viable GMOs are regulated by the Gene Technology Regulator under the *Gene Technology Act 2000*. The importation and environmental release of GMOs, including GM crops and grains intended for use as stockfeed, requires approval from the Gene Technology Regulator.

Before licensing a GMO, the Gene Technology Regulator must undertake a risk assessment and be satisfied that any risks to human health and the environment can be managed. If a GMO is to be used as stockfeed, this will be considered as part of the assessment.

FSANZ, an independent statutory agency established by the *Food Standards Australia New Zealand Act 1991,* undertakes assessments of GM products for their safety for human consumption. This assessment also occurs if the GM product is not primarily intended for human consumption, but could accidentally enter the human food chain. If a GM crop has not been approved for human consumption by FSANZ, the Gene Technology Regulator will impose licence conditions for commercial release requiring that the GM crop must not be used in animal feed unless it has been approved for human food by FSANZ (OGTR 2005).

All GM crops approved for commercial release in Australia to date have also been approved by FSANZ for human food use.

Imports into Australia of GM grains not licensed for commercial release from the Gene Technology Regulator may be approved but under conditions requiring strict containment and processing to devitalise the grain. The Gene Technology Regulator may also impose conditions requiring that the GM grain not be used for human food.

Regardless of its GM status, grain imports into Australia require an import permit from the Australian Quarantine and Inspection Service (AQIS). As for conventional grain or stockfeed imports, AQIS may inspect imported grain (processed or whole grains) for quarantine risk material, such as pests, diseases and other unapproved foreign matter.

Labelling of GM animal feeds and products from animals fed GM stockfeed is not required in Australia. Animal products are not required to be labelled as GM as the animal is not genetically altered by the consumption of such feed (FSANZ 2004).

International regulatory environment

There have been high rates of adoption of GM crops in animal feed in some countries which compete with Australia in third markets in the export of meat, egg and dairy products, such as the United States and Brazil. Use of GM products in stockfeed has also occurred in countries which have a strong stance against the use of GM crops for human food products. For example, in Denmark (an export competitor for Australia in pig meat products and also an exporter of pig meat into Australia), the use of some GM crop varieties have been approved for use as animal feed only, in line with EU regulations (see box 1).

There is no evidence of import restrictions on products from animals fed with GM stockfeed in any of Australia's major meat and livestock product export markets. There is also no evidence of regulations for mandatory labelling of products from animals fed with GM stockfeed in any of Australia's major meat and livestock product export markets. International regulations are further outlined in appendix A.

box 1 Regulation of GM stockfeed in the European Union

The European Union has some of the most stringent regulations for the importation of GM products, including stockfeed (Foster and French 2007). In recent times there has been considerable unease among EU farm groups because they are unable to access GM stockfeed from the international market for meat, milk and egg production.

Any GM grain for use in food or feed must be authorised for use before it can be grown or used commercially. All food and animal feed containing EU-approved GM ingredients above 0.9 per cent by weight must be labelled as containing GM ingredients. Products from animals fed GM feed are not required to be labelled.

The adventitious presence of GMOs of up to 0.5 per cent by weight is allowed for GMOs that have been assessed by the European Food Safety Authority (EFSA) as being safe, but final approval for commercial release is pending. There is zero tolerance for the presence of GMOs that have been assessed by EFSA to be unsafe or have not been assessed.

The average length of time for a GMO to be approved in the European Union is approximately 2.5 years, compared with 15 months in the United States (DG AGRI 2007). There are no studies on the average length of time for a GMO to be approved in Australia.

Recent feed grain shortages in the European Union and United Kingdom have been compounded by the European Union's strict import regulations for GM grain and lengthy approval process. It has been suggested the shortages will particularly affect the pig and poultry industries, which rely on imported maize and soybeans as a protein source (Surman 2008). A report commissioned by European grain traders, stockfeed manufacturers and livestock and meat traders suggests that not being able to use GM ingredients in stockfeed in the 2006-07 marketing year cost €2.5 billion more in feed costs than if GM equivalents were used (Cardy-Brown Co Ltd 2008).

Coinciding with rising concerns within the livestock and stockfeed manufacturing industries, a variety of GM soybeans was approved for use in the European Union (ICTSD 2008). There are also indications from the EU Health Commissioner that a faster approval process for GMOs is preferable to relaxing the tolerance level for unapproved GMOs (Agrafacts 2008).

3 Feed production

Increasing the adoption of GM crops by farmers in Australia will increase the availability of derived meal products for use in stockfeed. The potential use of GM crops in the production of stockfeed raises some key issues for consideration by decision-makers in the cropping and stockfeed industries.

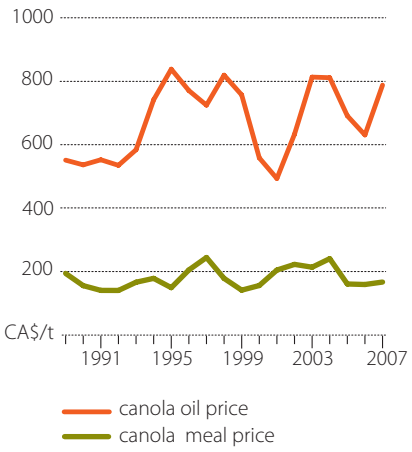
Issues for the domestic cropping industry

Domestic producers of field crops may benefit from adopting GM crops as a result of yield bonuses, lower production costs, or both (Acworth, Yainshet and Curtotti 2008). The magnitude of these benefits will determine the level of uptake of these crops in cropping industries. For example, since the introduction of GM cotton varieties in 1996, insect resistant, herbicide tolerant and stacked varieties of GM cotton have been widely adopted in Australia, accounting for 92 per cent of cotton plantings in 2006-07 (CRDC 2007). Pesticide and residual herbicide use has been reduced with the adoption of GM varieties of cotton in Australia, with insect resistant cotton requiring 82 per cent less insecticide than conventional cotton varieties, and herbicide tolerant varieties requiring 32 per cent less residual herbicide (CRDC 2007).

The adoption of GM oilseed crops is currently restricted in some Australian states and territories by moratoriums on the commercial production of these crops. For example, of the cotton producing states and territories, GM varieties can be produced in New South Wales, Queensland and Western Australia but not in the Northern Territory. Of the canola producing states, GM varieties can be produced in New South Wales and Victoria, but not in Tasmania or South Australia. A moratorium remains for the production of GM varieties of canola in Western Australia. However, in December 2008, the Western Australian Government announced commercial trials of GM canola would go ahead. These moratoriums were put in place because of concerns the adoption of GM crops would lead to restricted market access in export markets and concerns over market acceptance of food products containing GM crop ingredients. In early 2008, following reviews of state moratoriums, arrangements in New South Wales and Victoria were changed to permit the commercial growing of GM canola in those states from the 2008 growing season.

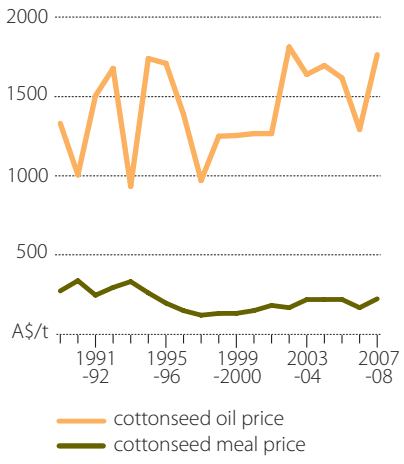
For oilseed producers, oil is the primary product from oilseed processing, while oilseed meal products are an important by-product. However, it is expected the production decisions of farmers growing GM crops are more likely to be influenced by the use of GM crops in the production of oil and fibre – the primary products – than decisions made by stockfeed manufacturers to use GM crops in feed. For example, canola meal is a by-product of canola oil production and is used in stockfeed which trades at prices significantly lower than canola oil (figure b). This is also true of cottonseed, where the value of cottonseed meal per tonne is significantly lower than the oil produced (figure c).

b Canadian canola prices
nominal



Source: Canola Council of Canada 2008.

c Australian cottonseed prices
nominal



Source: ABS 2008.

The price difference between canola oil and meal suggests demand for canola is driven mainly by canola oil rather than canola meal. For that reason, it would be expected the decision to plant GM canola would be influenced more by perceived consumer acceptance of products containing GM canola oil than perceived consumer acceptance of products from animals fed with stockfeed containing GM canola. Similarly, the price difference between cottonseed oil and meal suggests the decision to plant GM cotton is influenced more by perceived consumer acceptance of products made from GM cotton lint or cottonseed oil than GM cottonseed meal.

Issues for domestic feed manufacturers

Domestically produced cottonseed and meal, and imported soybeans and meal are currently the most widely used GM grains in stockfeed manufacture in Australia. The use of these high protein ingredients in stockfeed manufacture may be because of high availability (cottonseed and meal, canola seed and meal, and soybeans and meal) or reduced cost (soybean meal) when compared with non-GM varieties. The future development of GM grains with increased nutritional benefits (and which have the potential to improve livestock productivity) may influence stockfeed manufacturers' willingness to use GM ingredients in stockfeed.

Nevertheless, some manufacturers may be reluctant to include GM ingredients in stockfeed because of possible concerns by certain livestock producers of perceived low consumer acceptance of products from animals fed with GM stockfeed. Demand for non-GM stockfeed from livestock producers will have implications for the segregation of GM from non-GM ingredients by stockfeed manufacturers.

There is little data on how international stockfeed manufacturers have been affected by the use of stockfeed from GM crops. A survey of the use of GM ingredients in stockfeed in the United Kingdom showed a number of large feed companies used GM ingredients in their stockfeed mixes (Soil Association 2007). The survey also indicated that many of these

companies did not have any specific policy on the use of GM ingredients, but were driven by client demand.

Market acceptance and segregation measures

The Stock Feed Manufacturers Council of Australia (SFMCA), a body which represents manufacturers of more than 90 per cent of commercial stockfeed sold in Australia, has indicated GM and non-GM ingredients are already segregated on a client needs basis (SFMCA 2007). It has been highlighted that some Australian dairy milk processors require dairy farmers to supply milk from cows fed with stockfeed with a GM content of no more than 5 per cent by weight, while others do not place any restrictions on GM ingredients fed to dairy cows (SFMCA 2007). Industry consultations indicate requests for non-GM feed mixes are uncommon.

A segregation measure employed by the SFMCA is vendor declarations, where stockfeed deliveries are recorded as being at least 95 per cent GMO free, or not GMO free (SFMCA 2007).

Beyond measures employed by the SFMCA, a strict non-GM identity preservation system already exists for stockfeed in Australia in the organic stockfeed system, where the intentional use of GMOs is prohibited (Apted and Mazur 2007). Standards for organic livestock production from the National Association for Sustainable Agriculture Australia (NASAA) and Australian Certified Organic (ACO) encourage the use of organic feeds either sourced on farm or from other organic farms within the region (NASAA 2007, ACO 2006). Both the NASAA and ACO standards have strict guidelines governing the manufacture of organic stockfeed outside of organic farms, including how the grain is handled and milled, and how feed is stored. Records of outside sources of feed must also be kept.

There is evidence of a market to support the segregation measures employed by the Australian organic industry. According to Biological Farmers Australia (2007), organic beef and lamb attracted a 25 per cent price premium over non-organic counterpart, and organic chicken meat attracted a 200 per cent price premium in 2006. These price premiums reflect the increased costs of production, including increased segregation costs, involved in producing organic stockfeed and livestock products.

Industry consultations indicated there are few stockfeed manufacturers producing both conventional and organic feed mixes. The relatively small volume of organic feed required by the Australian organic livestock industry was cited as a major issue preventing stockfeed manufacturers from producing organic feed mixes. Given the widespread adoption of GM crops internationally, the small size of the Australian organic industry, and the encouragement of localised, non bulk-handled organic stockfeed sources, it would be difficult to use the current organic segregation system employed in Australia as a potential segregation system for GM products for use in stockfeed in general.

Current segregation of GM and non-GM ingredients in the conventional stockfeed market suggests that administration and segregation costs are already being incurred. Any additional administration costs associated with the increased supply of GM canola for use in stockfeed are unlikely to be significant, given the current use and associated documentation of GM

ingredients in stockfeed in Australia. Segregation costs will vary depending on demand for non-GM feed inputs. Where there is no or low demand for non-GM inputs, additional segregation costs are likely to be insignificant. If demand for non-GM inputs is high, segregation costs are likely to be high, as investment in infrastructure may be required to maintain the segregation system.

Stockfeed prices

As discussed for the cropping industry, the introduction of GM crop varieties has increased the productivity of field crops through either improvements in yield per unit area of land or lower input costs per unit of output. It is expected this would lead to an expansion in output. The extent of production, and in turn price changes, are in part determined by how widely the technology is adopted.

The effect of GM crop adoption on production and price has been seen in the case of soybeans. The widespread adoption of GM soybeans in Argentina was estimated to have contributed to 22 per cent of total growth in world soybean production and an 11 per cent drop in the world soybean price during the period 1996 to 2005, compared with the case of GM soybeans not being adopted in Argentina (Trigo and Cap 2006).

In the case of canola, GM canola varieties offer yield advantages over conventional varieties. In Canada, GM canola provides a yield advantage of between 6 per cent and 10 per cent, and results of Australian GM canola trials suggest there are yield advantages of between 8 per cent and 38 per cent (Acworth, Yainshet and Curtotti 2008).

The difference in prices for soybean meal imported into Australia from GM and non-GM producing countries indicates stockfeed containing a large proportion of GM soybean meal is likely to be cheaper than a mix containing the same proportion of non-GM soybean meal. As there are no labelling requirements for GM ingredients in stockfeed in Australia, stockfeed manufacturers that do not specifically produce non-GM mixes are likely to prefer the less costly GM meal.

Future GM crops

Stockfeed manufacturers' willingness to use GM ingredients in stockfeed may in the future also be influenced by the availability of feed ingredients with increased nutritional benefits. Examples of future GM crops which could have nutritional benefits for livestock include soybeans, maize and canola with increased amino acid levels, and wheat and barley with modified plant cell walls to improve digestibility (Glover et al. 2005). If such ingredients become available for commercial use, it will increase the desirability of GM ingredients in stockfeed because of their potential to boost livestock productivity.

A potential issue related to the development of GM crops specifically for animal feed use is segregation from the human food supply chain. An example of this is StarLink corn, a pest resistant variety of GM maize commercially produced in the United States between 1998 and 2000. StarLink was approved for use in animal feed, but not for human consumption because

of allergen concerns (FSANZ 2000). However, it was detected in food products in 2000, as a result of a failure in the segregation system for human food and animal feed (FSANZ 2000).

As indicated in the previous chapter, all GM crops approved in Australia to date have been approved for both animal and human consumption.

4 GM material in stockfeed

The proportion of GM material in stockfeed domestically and internationally can differ for a number of reasons. These include the types of grains used in the feed mix and the proportion of GM plantings both domestically and in countries from which grain is imported. As discussed in chapter two, the regulatory environment can also affect which, if any, GM crops can be used in stockfeed. Another aspect affecting the use of GM ingredients in stockfeed is consumer acceptance of GM feed in livestock and production, which will be discussed in chapter six. This chapter will provide estimations of the presence of GM material in stockfeed domestically and in countries competing with Australia in third markets for livestock products in 2006-07. These estimations are based on weight, rather than digestible energy or grain equivalent, and represent the average GM content of stockfeed across each country. Because of the differences in availability of domestic and international feed usage data and GM adoption rates, estimates of GM content are made for a single year, rather than an average of a number of years.

The estimated weight of GM grain used in animal feed is based on the proportion of GM plantings to total plantings of that crop, accounting for yield advantages for domestic and imported feed grain. It is assumed GM canola from Canada has a yield advantage of 7 per cent over non-GM varieties, based on Carew and Smith (2006), and that GM and non-GM soybean yields are the same, based on Acworth, Yainshet and Curtotti (2008). Studies of Australian GM cotton lint yield indicate there is no yield advantage over non-GM cotton (Acworth, Yainshet and Curtotti 2008). In the absence of data on GM and non-GM cottonseed yield differences, it is assumed that, like cotton lint, GM and non-GM cottonseed yields are the same.

The same assumptions are used in calculating the GM content of stockfeed in countries competing with Australia in third markets for livestock products. In the absence of national GM yield studies, the known yield advantage in other countries within the same region is assumed for the competing countries.

Domestic feed

GM material in animal feed is already in use in Australia, through GM cottonseed and its derived meal product, and imported soybean and canola meal products. However, there is little information on the actual volume of GM material currently used in animal feed.

Canola

In the 2006-07 marketing year, around 235 000 tonnes of canola meal were used in feed in Australia (AOF 2008). The meal used in feed came from the 587 000 tonnes of canola seed crushed in 2006-07 (ABARE 2008), which would have been likely to include 57 300 tonnes of seed

imported during the same period (ABARE 2007). Most of this imported canola came from Canada (UN Comtrade 2008), where 84 per cent of canola plantings in 2006 were GM (James 2007).

It is estimated that 20 617 tonnes, or approximately 9 per cent, of the canola meal used in Australia for animal feed in 2006-07 was GM. As domestic production of GM canola has commenced and is expected to increase in the coming years, it is likely the proportion of GM canola meal used in feed will also increase in the future.

Cottonseed

In the 2006-07 marketing year, around 75 000 tonnes of cottonseed meal was used in feed in Australia (AOF 2008), and 30 000 tonnes of cottonseed (USDA 2008a).

As there were no imports of cottonseed or cottonseed meal into Australia in 2006-07, it is estimated that 69 000 tonnes of meal and 27 600 tonnes of seed was GM, based on the proportion of GM cotton plantings in Australia in 2006-07 of 92 per cent (CRDC 2007).

Maize

In the 2006-07 marketing year, around 113 000 tonnes of maize was used in animal feed (ABARE 2008). Australia does not currently produce GM maize, and only a small amount of maize was imported in 2006-07 (approximately 500 tonnes, or around 0.9 per cent of total production (ABS 2008)). In 2006, the majority of maize imports came from Viet Nam, where GM maize is not grown. There were some maize imports from the United States, where 62 per cent of plantings of maize were GM (James 2006). However, the amount imported is estimated to have been approximately 18 tonnes of GM maize. As such, the GM content of maize used in stockfeed in Australia in 2006-07 is negligible.

Soybean

Around 615 000 tonnes of soybean meal was used in stockfeed in Australia in the 2006-07 marketing year (AOF 2008). It is likely the majority of meal was sourced from the 521 700 tonnes of soybean meal imported in 2006-07 (ABS 2008).

In 2006, around 63 per cent of Australian imports of soybean meal came from the United States, 14 per cent from Brazil and 5 per cent from Paraguay (UN Comtrade 2008). The proportion of GM soybean plantings in these countries in 2006 were 93 per cent, 55 per cent, and 100 per cent, respectively (James 2007).

It is estimated that around 71 per cent or 370 000 tonnes of the 521 700 tonnes of soybean meal imported by Australia in 2006-07 was GM. As imports make up the majority of domestic soybean meal supply, this estimate provides an approximation of the proportion of GM soybean meal used in animal feed in Australia.

Total GM presence in feed

In total, it is estimated 487 200 tonnes of GM material, by weight, was used in animal feed in Australia in 2006-07 (table 1). This represented approximately 5 per cent of all feed grains by weight used in that year, with proportions varying across the livestock industries depending on the feed mix used. The amounts of GM ingredients used by industry are estimated using the proportions of feed allocated by industry from an ABARE regional feed demand and allocation model used in Hagi Hirad et al. (2007), accounting for the actual use of feed grain in 2006-07.

1 Estimates of GM material by weight in animal feed in 2006-07 by industry and grain [a]

		chicken meat	eggs	pigs [b c]	beef feedlot	dairy	sheep for live export	grazing ruminants	others	total
Canola meal	kt	16.9	–	–	2.1	0.8	–	–	0.8	20.6
Cottonseed	kt	–	–	–	20.0	6.7	–	0.9	–	27.6
Cottonseed meal	kt	44.6	15.6	–	–	8.8	–	–	–	69.0
Soybean meal	kt	264.2	37.7	–	–	68.1	–	–	–	370.0
Total	kt	325.7	53.3	0.0	22.1	84.4	0.0	0.9	0.8	487.2
Proportion of GM in feed	%	14.2	13.1	0.0	0.6	3.2	0.0	0.2	0.3	4.5

a Year ending October 2007 for canola, and March 2007 for cottonseed and soybean. Totals may not add because of rounding. **b** Australian Pork Limited have made a statement indicating GM feed is not used in Australian pig meat production (APL n.d.) **c** Adjustments to GM feed grain usage has been made accordingly.
Source: Hagi Hirad et al. 2007; ABARE 2008; AOF 2008; US Department of Agriculture 2008a; ABARE estimates.

It is estimated the chicken meat industry on average used the largest volume of GM feed grain in 2006-07, followed by the egg and dairy industries. Broiler chickens are estimated to have the feed mix with the highest proportion of GM material by weight, at around 14 per cent of GM feed grain on average. The live sheep export industry did not use soybeans, maize, canola or cottonseed in their feed mix whereas the pig industry, while using maize, soybeans and cottonseed, avoided the use of GM varieties in their feed mix.

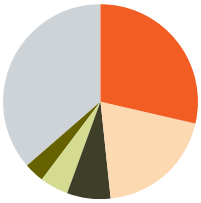
Information regarding the number of livestock and poultry fed with GM material is not available at present. It is important to note that because of quarantine restrictions, processed grain can be used without heat treatment within a 50 kilometre radius of the port of entry. This suggests that in some instances, the GM content of stockfeed consumed by livestock close to ports will be higher than a similar feed mix fed to livestock further away. The determination of the number or proportion of livestock or poultry that consumed GM feedstuffs is not pursued in this research as it would require production level data which is difficult to obtain.

International feed

The use of GM material in stockfeed, particularly in countries which compete with Australia in third markets, is of interest as it may be providing a competitive advantage over Australian producers through lower costs.

d Destinations for Australian meat, egg and dairy products

2002–06



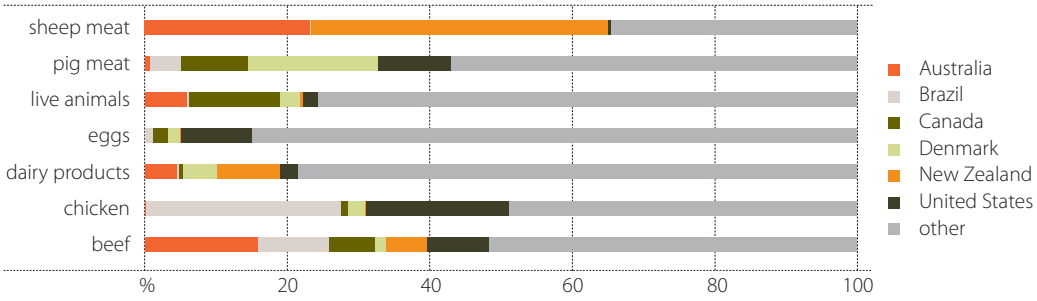
	%
Japan	29
United States	19
Republic of Korea	7
Indonesia	5
Saudi Arabia	3
other	37

Source: UN Comtrade 2008.

In the five years from 2002 to 2006, Japan was Australia's largest export destination for edible livestock products, taking around 29 per cent of the value of all edible animal product exports (figure d). The United States was the second largest (19 per cent), followed by the Republic of Korea (7 per cent), Indonesia (5 per cent) and Saudi Arabia (3 per cent).

Australia's major export markets for each of the livestock product industries are shown in appendix B. Australia's major competitors in these markets are shown in appendix C. An analysis of the average export value in each of these five major markets enables the identification and ranking of Australia's top five export competitors, namely Canada, the United States, New Zealand, Denmark and Brazil. Australia and these five competitors are major exporters of a number of meat, egg and dairy products, making up a large proportion of world exports in these products (figure e).

e World exports of live animals, meat, eggs and dairy



Note: includes intra-EU trade.
Source: UN Comtrade 2008.

Between 2002 and 2006, world sheep meat exports were largely from New Zealand and Australia; Canada, Denmark and the United States accounted for 38 per cent of world pig meat exports; Brazil was the largest exporter of chicken meat; and 35 per cent of world beef exports were from Australia, Brazil and the United States.

In addition to being competitors in third markets in meat, egg and dairy products, a number of these countries export edible animal products to Australia. Table 2 outlines the products Canada, the United States, New Zealand, Denmark and Brazil export to Australia, and the products in which each country competes with Australia in third markets.

2 Major exporters to Australia, and export competitors in third markets, by product, 2002-2006

country	exporter to Australia of	products in which those countries compete with Australia in third markets
Canada	Pig meat	Pig meat
United States	Dairy, egg products, pig meat	Beef, egg products, dairy, chicken meat, sheep meat, pig meat
New Zealand	Sheep meat, beef, dairy, live animals	Sheep meat, beef, dairy, egg products
Denmark	Pig meat, egg products	Pig meat
Brazil	–	Chicken meat, pig meat

Source: UN Comtrade 2008.

Three of these top five competitors grow GM crops extensively and are likely to have used GM ingredients, of varying amounts, in stockfeed. Estimations of the GM content of feed are provided in table 3. There are no records of any edible animal product exports from these competing countries being rejected by importers because of the use of GM stockfeed in livestock production.

3 Estimates of feed grain usage and GM content for Australia's major export competitors, 2006-07

	total feed used kt	GM feed used kt	proportion of GM feed %
Canada	28 059	9 486	34
United States	195 765	130 685	67
Denmark	19 769	1 481	7
Brazil	52 359	7 565	14

Source: US Department of Agriculture 2008a, Statistics Denmark 2008, ABARE estimates.

Canada

It is estimated 28.1 million tonnes of animal feed was used in 2006-07 in Canada (USDA 2008a). Barley and maize were the largest components of feed (see appendix D).

It is estimated around 34 per cent, or 9.5 million tonnes, of animal feed in Canada in 2006-07 could have been GM (table 3). This stems mainly from a high reliance on maize in feed grains, as around 77 per cent of maize grown in Canada in 2006 was GM (James 2006) and imports of maize into Canada are sourced almost exclusively from the United States, where around 62 per cent of maize harvested in 2006 was GM. It is assumed that Canadian GM maize offers a yield bonus of 6.5 per cent, based on yield bonuses in the United States of between 5 per cent and 8 per cent (Stone, Matysek and Dolling 2006).

Differences in the proportion of GM soybeans and soybean meal in Canadian stockfeed are the result of different proportions of imports from the United States. In 2006, soybean imports from the United States contributed 9 per cent of total supply of soybeans in Canada, whereas soybean meal from the United States made up 55 per cent.

United States

It is estimated around 196 million tonnes of animal feed was used in the United States in 2006-07 (see appendix D). In total, 67 per cent, or 131 million tonnes, of grain used for animal feed in the United States is estimated to have been GM (table 3). The high GM content comes primarily from the high reliance on maize and soybean meal in stockfeed and the high proportion of GM plantings for both crops.

New Zealand

There is no reliable data on total stockfeed usage across the New Zealand livestock industry. The New Zealand feed manufacturer's association (NZFMA), a body representing around 85 per cent of the total feed industry, indicates that more than 800 000 tonnes of stockfeed was produced in New Zealand in 2007 (NZFMA 2008).

New Zealand does not produce GM crops, making imports the only possible inclusion of GM ingredients in stockfeed. Imports of soybean and canola meal may be included in feed rations (NZFMA 2006). However, NZFMA does not include maize or cottonseed as an ingredient that can be imported (NZFMA 2006). As no distinction is made between GM and non-GM animal feed (USDA 2008e), GM ingredients, such as soybean and canola meal, can be imported.

In 2006, around 96 per cent of New Zealand's soybeans and meal imports came from GM soybean producing countries (UN Comtrade 2008). Accounting for the proportion of GM soybean plantings in these countries, it is estimated that around 68 per cent of soybean meal imports were GM. All imports of canola meal were from Australia, making all canola imports in 2007 non-GM.

As New Zealand does not produce soybeans (USDA 2008a), the reliance on imports means there is a high likelihood GM varieties are imported and included in stockfeed.

Denmark

As a member of the European Union, some GM crop varieties have been approved for use as animal feeds in Denmark, including maize, soybeans and canola. However, GM products are not grown in Denmark and so the only possibility for GM material to enter in animal feed is through imports.

The total GM presence in animal feed in Denmark is estimated to be approximately 7 per cent (table 3). Almost all of the GM content in Danish stockfeed in 2006-07 was from soybean imports from the United States and Brazil. Given the proportion of GM soybean plantings in those countries, the GM content of soybeans used in animal feed in Denmark could be around 81 per cent or 1.4 million tonnes.

Small volumes of maize imported from GM producers (the United States and Argentina) contributed a negligible amount of GM content from such sources to stockfeed used in 2006-07.

Brazil

Maize and soybeans made up the majority of the stockfeed mix in Brazil in 2006-07, accounting for 66 per cent and 27 per cent, respectively, of total grains used.

GM cotton plantings in Brazil are assumed to offer a yield bonus of 33 per cent, based on GM cotton in Argentina offering a yield bonus of between 32 per cent and 34 per cent (Qaim and Janvry 2003).

It is estimated that 14 per cent, around 8 million tonnes, of animal feed used in Brazil in 2006-07 could have been GM (table 3). The majority of the GM content comes from soybeans and meal, where 55 per cent of plantings in 2006 were GM (James 2007). Small amounts of GM cottonseed and meal were likely to have been included in stockfeed rations.

The GM content of stockfeed in Brazil is anticipated to increase in the future, as two GM maize varieties were approved for commercial cultivation in 2007 (James 2007). Plantings of GM cotton commenced in 2006 (James 2007), so the GM content of cottonseed used in animal feed is also expected to increase.

As shown in table 3, the United States, Canada and Brazil are estimated to have the largest GM content of feed grains of Australia's top five export competitors. This suggests GM inputs are widely used by the livestock industries in those countries. As these countries produce and export large volumes of meat, egg and dairy products, it is increasingly likely that the consumption of meat, egg and dairy products from animals fed with GM feed is likely to expand in these countries and in their major export markets.

5 Feed consumption

The use of GM material in animal feed in Australia will be determined by a wide range of factors including cost, market access and consumer preferences.

In some countries, livestock producers wishing to provide products from animals fed with non-GM stockfeed must have standards or certification in place to ensure feed inputs were GM free. An example of a non-organic segregation system for meat, egg and dairy products from livestock fed GM free feed is present in Germany. Here, if a producer wishes to produce meat, egg or dairy products from animals fed non-GM feed, they must source feed from identity preserved supply chains which are demonstrably aimed at producing feedstuffs with zero GM content, and maximum adventitious presence of 0.9 per cent (Koester 2008).

Issues for the Australian livestock industry

Beef and sheep meat

Feed grains make up a variable amount of beef and sheep meat feed intake. Industry consultations suggest the reliance on feed grain for grazing cattle and sheep is estimated to be a maximum of 10 per cent, only reaching that point under exceptional circumstances such as drought. In contrast, grains and oilseeds make up 75 per cent to 80 per cent of feed consumption for feedlot beef. In 2006-07, the beef feedlot industry is estimated to have used 33 per cent of all grains used in stockfeed by the Australian livestock industry, whereas the grazing ruminant industry, made up primarily of grass-fed cattle, lamb and sheep, is estimated to have used 4 per cent (Hagi Hirad et al. 2007).

It is estimated the GM content of total stockfeed consumed by feedlot beef was a maximum of 0.4 per cent in 2006-07 and negligible for grazing cattle and sheep.

Because of a low reliance on canola, cottonseed and soybeans (table 1), and the low content of grains used in the feedlot beef and grazing ruminant industries, the use of GM grain rations are unlikely to have had an effect on the price of feed for this industry to date. The introduction of GM canola may lead to small increases in GM content in feed through grazing on GM canola stubble. However, it is the possible introduction of GM pastures in the future that is most likely to increase the GM content in feed for grazing cattle and sheep.

The Australian Lot Feeder's Association (ALFA) indicates the use of GM ingredients in stockfeed will be important to the feedlot industry to remain internationally competitive in the future. While not a large user of the GM crops currently available, the possible development of GM grains in the future, 'such as drought and frost resistant varieties, and varieties that produce

higher or more consistent yields and lower agronomic costs', is seen as important to the Australian feedlot industry (ALFA 2007).

There are no public statements from other key industry players in Australia on the use of GM grains in beef production. This could be for a number of reasons, including the lack of consumer concern or awareness about use of GM feed, or the low reliance of grass-fed beef and sheep meat on GM inputs. With the development of GM pastures and the possible use of GM canola stubble for feed, grass-fed lamb and beef may consume stockfeed with more GM content in the future. This is unlikely to cause any concern for the beef and sheep meat industries, given ALFA's response to the use of GM ingredients in feedlot beef production.

Poultry

The Australian poultry industry, comprising chicken meat and eggs, sells most of its product domestically. In 2006, about 97 per cent of poultry production was consumed domestically (ABARE 2007), with no imports of fresh or frozen chicken meat (ACMF 2006b). There are no imports of fresh eggs to Australia because of quarantine concerns. However, egg products such as albumen, are imported in small quantities.

The Australian Chicken Meat Federation (ACMF), the peak body for the Australian chicken meat industry, supports findings that the use of GM ingredients in feed has no effect on consumer health (ACMF 2006a). Despite this, several large chicken meat processors have stated they use non-GM feed, depending on availability, quality and price (ACMF 2006a). These processors may be concerned about consumer acceptance of their products. For example, ACMF's statement, along with a statement from Ingham Enterprises, indicate the sourcing of non-GM feed for chicken meat production is driven by perceived consumer demand for chicken meat fed with non-GM feed (ACMF 2006a, Ingham Enterprises n.d.).

A number of poultry producers had used non-GM labelling on some of their products. However, in 2004, the Australian Competition and Consumer Commission (ACCC) found that as GM stockfeed could potentially be used by those producers, GM free labelling could not be used (ACCC 2004).

The reliance of the poultry industry on grains is high, making up 85 per cent to 95 per cent of feed for broilers (ACMF 2007) and almost all feed for laying hens. In 2006-07, it is estimated broilers used 21 per cent and layers 4 per cent of the main feed ingredients used in livestock production (Hagi Hirad et al. 2007).

Price, availability and quality prerequisites for the use of non-GM feed in chicken meat production highlighted by ACMF (2006a) suggest GM rations may still be used in chicken meat production. The use of non-GM feed in egg production appears to be intended for a niche market (Foster and French 2007), indicating that the use of GM stockfeed may be widespread.

It is estimated that within the poultry industry, GM feed grains made up 14.2 per cent of feed in 2006-07 by weight. The use of canola, cottonseed and soybean is relatively high for both the chicken meat and egg industries, making the proportion of GM ingredients higher than in

the feeds of other livestock (table 1). Because of the high consumption of protein, the poultry industry is most likely to get the biggest savings from any potential differences in the price of GM and non-GM rations out of the Australian livestock industry.

As the majority of chicken meat and egg production is consumed domestically, it would be expected that consumer attitudes towards the use of GM stockfeed in chicken meat and egg production would be the same. The differing positions on the use of GM ingredients in stockfeed from the chicken meat and egg industries suggest that concerns about the use of GM stockfeed in chicken meat production are coming from within the industry.

Dairy

While the grain feeding of dairy cows has been increasing (ABARE 2005), stockfeed is estimated to make up only 25 per cent of dairy cow feed (ACIL Tasman 2007). In 2006-07, it is estimated the dairy industry used 23 per cent of the main feed ingredients used in livestock production (Hagi Hirad et al. 2007).

The GM content of total dairy feed is estimated to have been less than 1 per cent in 2006-07. The low reliance on grains in feed generally, and the low reliance on canola, cottonseed and soybeans within feed grains used by the dairy industry, mean any costs savings from the use of GM grain rations are unlikely to have an effect on the cost of feed.

The GM content of feed for dairy cattle may increase with the potential introduction of GM pastures in the future.

The Australian Dairy Industry Council's (ADIC) position on the use of GM ingredients in feed is that 'providing the outputs of GM technology have been thoroughly assessed on a case by case basis and approved for human, animal and environmental safety under the national regulatory framework, the dairy industry should have the opportunity and choice of researching, testing and potentially using GM plants in the future.' (ADIC 2007a).

There is some sensitivity toward the use of GM ingredients in stockfeed within certain firms in the Australian dairy industry. For example, the use of GM ingredients in stockfeed for lactating dairy cows in Australia is limited to 5 per cent because of 'the requirements of export markets' (ACIL Tasman 2007). However, dairy manufacturer Parmalat Australia has indicated a preference for milk supplies from dairy cattle fed with non-GM feed, and that suppliers should request paperwork from stockfeed suppliers where there may be some uncertainty about the GM status of the feed (Parmalat Australia 2008). The release of Parmalat Australia's policy statement reflects a perception of consumer concerns about products from dairy cattle consuming stockfeed containing GM ingredients.

A report on GM technology by ADIC (2007b) indicates some Japanese importers require assurances no GM stockfeed was used in the production of dairy products. However, the report also indicates Japanese dairy producers are likely to be using GM stockfeed in the production of dairy products. The risk of market share loss through the use of GM stockfeed was assessed as being low (ADIC 2007b).

There are no other public statements from Australian dairy manufacturers, although some concerns about identity preservation and international market competitiveness have been raised by some Australian milk processors (ACIL Tasman 2007).

Pig meat

In 2006, 82 per cent of Australian pig meat production was consumed domestically and imports accounted for approximately one-third of consumption (ABARE 2007). More than 60 per cent of imports came from the United States and Canada, major users of GM feed grain, with almost all of the remainder coming from Denmark (UN Comtrade 2008).

Grains make up between 85 per cent and 90 per cent of total pig feed (Tasmanian Pork Alliance 2008). Fourteen per cent of feed grains used in 2006-07 were estimated to have been used by the pig meat industry (Hagi Hirad et al. 2007).

Within the Australian livestock industry, the pig meat industry is the most sensitive to the use of GM stockfeed. Australian Pork Limited's (APL) position is that remaining GM free provides a marketing advantage to Australian pork producers and increased use of GM ingredients in stockfeed will have a negative effect on demand for Australian pork (APL n.d.). This position is reflected in a statement made by the Australian pig meat processor KR Castlemaine, which indicates feed given to their pigs is free of GM products (KR Castlemaine 2008). APL has also stated Australian pork exporters must provide written assurances to Japanese importers that pigs' diets do not contain GM ingredients (APL 2008). However, there is no indication of the proportion of importers that require such assurances.

APL has acknowledged non-GM inputs are likely to become more expensive and difficult to obtain if the adoption of GM crops becomes widespread (APL 2008). Where price premiums for non-GM feed become evident, producer willingness to use non-GM stockfeed in pig meat production will be determined by the extent of consumer willingness to pay a price premium for such a product.

There are no reports of pig meat exports from countries competing with Australia in third markets, such as Brazil, Canada, the United States and Denmark, being rejected by importers because of the use of GM feed in pig meat production.

6 Animal product consumption

The use of GM inputs in stockfeed can benefit consumers if the use of GM stockfeed can lower production costs and can be passed onto consumers. However, there may be issues with consumer acceptance of products from animals fed with GM material. For example, some consumers may prefer not to consume products from animals fed with GM material. These issues may differ between countries.

Establishing if there is a market for meat, egg and dairy products from animals fed with GM stockfeed is difficult given the relatively small amount of data available and studies conducted in this area. However, the volume of certified GM free protein meal can indicate the possible size of the market for such animal products. For example, Brazil is a major producer of non-GM soybeans, with non-GM soybean varieties accounting for approximately 36 per cent of 2007-08 soybean plantings (James 2008). It is estimated 24 million tonnes of soybean meal was produced in Brazil in 2008 (USDA 2008a). During the same year, 2.5 million tonnes of Brazilian soybean meal was certified non-GM (Freire 2008).

Consumer benefits from the use of GM feed

There may be some consumers in the market who prefer to consume products from animals fed with non-GM feed and who are willing to pay more for them. However, as there are no requirements for products from animals fed with GM feed to be labelled as such, consumers are unable to differentiate between the two products. That is, in the absence of labelling, consumers pay the prevailing market price for the single (undifferentiated) product. In such a case, it cannot be tested whether or not consumers are willing to pay a higher price for meat, egg or dairy products from animals fed with non-GM feed.

If some producers perceive a market benefit in differentiating between products, such products may be differentiated by the producers themselves, through measures such as voluntary labelling. To achieve this, producers would need to incur additional costs in order to be able to differentiate their products.

An example of such costs include record-keeping of feed types and of animals on different feed types to verify that livestock products are not from animals fed with GM rations. The cost of labelling would also be incurred by producers. For the production and marketing of these differentiated products to be feasible, prices paid by consumers would need to be high enough to cover these extra costs.

Consumer awareness and acceptance in Australia

There is little information on Australian consumer awareness and acceptance of products from animals fed with GM stockfeed. Biennial studies conducted by Biotechnology Australia suggest low consumer awareness of what constitutes a GM product. They also suggest consumers are mostly unaware of the current amount of use of GM ingredients in stockfeed.

Results from the 2003 survey indicated most of those surveyed believed that products from animals fed with GM feed were genetically modified (Millward Brown 2003). This is despite studies showing GM DNA fragments are not found in the meat, egg and dairy products of animals fed with GM feed (MacKenzie and McLean 2002).

Consumer willingness to consume products from animals fed with stockfeed containing GM ingredients were assessed by the questions "How confident would you be eating meat from animals that have been fed with genetically modified stockfeed?" in the 2005 survey and "How willing would you be to eat meat and other products from animals that have been fed with genetically modified stockfeed?" in the 2007 survey. The results of these surveys indicate consumers are becoming more willing to consume products from animals fed with GM feed. However, they are still slightly less confident in consuming animal products fed with GM stockfeed than food containing a small amount of GM ingredients (Eureka 2007). Recent statements from the Australian livestock industries indicate consumer awareness of GM crops and their possible use as a stockfeed may be increasing (ACMF 2006a, Ingham Enterprises n.d., APL n.d., KR Castlemaine 2008).

Recent surveys indicate there may be some conflicting results in regard to consumer demand for GM labelling. Results from a study commissioned by Greenpeace in September 2008 suggest most consumers want labelling for all GM products, and products from animals fed with GM feed (Newspoll 2008). However, a survey commissioned by FSANZ in 2007 on food safety and labelling found most respondents did not express concern for the safety of GM products, relative to other food safety issues, and generally did not look for GM labelling on food products (FSANZ 2008).

Although there is some evidence of consumer demand for labelling of meat, egg and dairy products from animals fed with GM stockfeed, the costs associated with labelling may be considerable. For example, Sainsbury's, a major supermarket chain in the United Kingdom, has a policy of using non-GM ingredients, additives and derivatives in their own brand of food, drink, pet food, dietary supplements and flowers (J Sainsbury PLC 2008). However, this policy does not currently extend to meat, egg and dairy products as Sainsbury's 'found that this would significantly add to farmers' costs' because of the current absence of segregation in the stockfeed supply chain (J Sainsbury PLC 2008).

Consumer awareness and acceptance internationally

Consumer acceptance and awareness of products from livestock fed with GM feed in Australia's major livestock product export markets will be a key issue for Australian livestock product exporters if they are to commence or continue to use GM feed products as part of their input mix.

Australia's major export markets for beef, sheep meat, chicken meat, dairy products, egg products, pig meat and live animals between 2002 and 2006 are given in appendix B.

As is the case in Australia, there has been little research on consumer awareness and acceptance of products from animals fed with GM stockfeed in major export markets such as Japan, the United States, the Republic of Korea, South Africa, Hong Kong, Malaysia, Singapore, Indonesia and Saudi Arabia. The value of livestock product exports to these markets averaged around US$4.7 billion a year between 2002 and 2006 (UN Comtrade 2008).

Detailed available information on consumer awareness and acceptance in Japan and the United States is given below. For the Republic of Korea, South Africa, Hong Kong, Malaysia, Singapore, Indonesia and Saudi Arabia, there is little to no indication of the degree of consumer awareness and acceptance of products from animals fed with GM feed. Information on consumer awareness and acceptance for these countries is given in appendix E.

Japan

The most recent study of consumer awareness and acceptance of GM products in Japan was conducted in 2000. Results from this study indicated almost all consumers surveyed had heard of genetic modification (Macer and Chen Ng 2000).

There are no studies on Japanese consumers' acceptance of products from animals fed with GM stockfeed. However, there is anecdotal evidence to suggest there may be some awareness of the use of GM ingredients in stockfeed and some consumer resistance to their use. A line of beef sold in a large supermarket chain in Japan uses voluntary GM labelling on meat products, indicating only GM-free feed is used in production (Clemens 2003). APL (2008) has indicated that at least some Japanese importers require pig meat products from animals which have not been fed with GM feed. Industry consultations also suggest some sections of the Japanese dairy market are sensitive to the use of GM ingredients in feed for dairy cattle, requiring feed given to cows whose milk will become infant formula does not contain any GM ingredients. However, a report by ADIC (2007b) indicates consumer acceptance issues in Japan are focussed on GM ingredients in food, rather than GM ingredients in feed used in the production of meat, egg and dairy products, and that Japanese livestock producers are likely to use GM stockfeed.

While the information described above indicates there may be some acceptance issues among Japanese consumers, export competitors to Japan, such as the United States, are highly likely to use GM stockfeed in livestock and livestock product production. There are no reports of livestock products being rejected by importers in Japan because of the use of GM stockfeed in production.

United States

A survey of consumer awareness and acceptance in the United States conducted in 2004 indicated most consumers recognise the term genetic modification. However, 58 per cent of consumers surveyed on their awareness of genetics and GM food — using factual questions requiring a true or false response — answered most questions relating to genetic modification incorrectly (Hallman et al. 2004).

There is also evidence that consumers in the United States have a preference for products from animals fed with non-GM feed over products from animals fed with GM feed. A study of consumer demand for beef fed with GM maize indicates that while consumers in the United States are less concerned about consuming beef fed with GM maize than consumers in France, Germany or the United Kingdom, US consumers would prefer beef fed with non-GM feed to that from animals fed with GM stockfeed (Lusk, Roosen and Fox 2003). The survey, conducted in 2000, also found US consumers were generally willing to pay a price premium of between US$2.83 and US$3.76 a pound for beef not fed with GM feed. Nevertheless, there is no empirical evidence to suggest price premiums are being paid.

7 Findings and conclusions

GM crops are already used in stockfeed in Australia and in a number of countries which compete with Australia in third markets for meat, egg and dairy products. As commercial plantings of GM canola varieties commenced in New South Wales and Victoria in 2008 and may commence in Western Australia in the future, the use of GM ingredients in stockfeed in Australia is expected to increase further. Additional research into the development of future GM feed sources, such as GM pastures and crops, means the use of GM products in livestock production can be expected to increase.

There are no import regulations specifically for products from animals fed with GM feed in any of Australia's major livestock product export markets, nor is there evidence of mandatory labelling requirements either in Australia or its major export markets. This is also the case in the European Union, which is regarded as having some of the strictest regulations on GMOs.

Consumer awareness and acceptance of products from animals fed with GM feed, both in Australia and internationally, is an area requiring further market analysis as there are limited data and few studies on the issue. What is available suggests consumer awareness of the current use of GM ingredients in stockfeed appears to be low both in Australia and its major export markets for meat, egg and dairy products. The few studies conducted on consumer acceptance in Australia and the United States indicate some consumer aversion to consuming products from animals fed GM feed. However, there is no evidence to suggest this is lowering demand for products from animals fed with GM stockfeed. Of Australia's major export markets, only some sections of the dairy and pig meat markets in Japan have required that only non-GM stockfeed be used in livestock product production. However, it is highly likely Japanese livestock producers and export competitors to Japan use GM stockfeed in production. There are no reports of animal products being rejected by importers because of the use of GM feed.

Given current GM regulations, and degrees of consumer acceptance and awareness in Australia and its major livestock product export markets, it seems unlikely Australian livestock producers who choose to use GM feed will be disadvantaged. Market developments require ongoing monitoring from producers and suppliers as demand for products from animals fed GM feed may change as consumer awareness and acceptance evolves, and as more GM crops and pastures are introduced to livestock feeding systems.

appendix A International regulation of GM stockfeed

Japan

As Japan currently does not produce any GM crops commercially, their regulatory framework is based around the importation of GM products. GM crops intended for animal feed must be approved by the Minister for Agriculture, Forestry and Fisheries (MAFF), and jointly approved by MAFF and the Minister for Health, Labour and Welfare when the crop is also to be used for food.

Part of the approval process for GM crops for use as animal feed requires review of any possible human health effects arising from the consumption of products from animals fed the GM crop (USDA 2007d).

There is a tolerance of 1 per cent for the adventitious presence of unapproved GM products in animal feed. An exemption for this can only occur where the GM product is approved in the export country and the export country is recognised by Japan's Minister for Agriculture, Forestry and Fisheries as having a safety assessment program equivalent to or stricter than that of Japan (USDA 2007d).

Labelling is mandatory in Japan for all food with traces of GM DNA. However, animal feed and products from animals fed stockfeed with GM ingredients is not required to be labelled (USDA 2007d). An exception to this is products containing GM alfalfa as their main ingredient (USDA 2008c).

United States

The importation of GM products is jointly regulated by the Environment Protection Agency (EPA), Food and Drug Administration (FDA) and Animal and Plant Health Inspection Service (APHIS) (National Biological Information Infrastructure n.d). The EPA regulates GMOs and GM products which are resistant to pests, such as Bt cotton varieties. The FDA manages the human and animal health and safety aspects of consuming GM foods or feed and APHIS (part of the US Department of Agriculture) regulates the biosecurity risk posed by the importation of GMOs and GM products. There are no additional regulations in place relating to the import of products from animals fed GM stockfeed.

Labelling to indicate if a food is GM is generally not required in the United States. Exceptions to this occur where the modification results in the product being substantially different from its non-modified substitute in terms of its nutritional properties, composition or allergens (FDA 2001). There is no requirement to label products from animals fed stockfeed containing GM ingredients.

Republic of Korea

All GM crops that may be imported by the Republic of Korea must be approved for human consumption and are subject to an environmental risk assessment. These risk assessments are regulated by the Ministry of Food, Agriculture, Fisheries and Forestry (USDA 2008f). There appears to be no separation of GM crops intended for human consumption and those not intended for human consumption.

Animal feed containing GM ingredients requires labelling in the Republic of Korea, although products from animals consuming feed containing GM ingredients do not (USDA 2008f).

Indonesia

Regulations on the importation and use of GM crops and products are issued jointly by the Ministry of Environment, National Agency for Drugs and Food Control, and Ministry of Agriculture (USDA 2006).

There are no restrictions on the importation of GM grains or products, apart from a ban on the importation of certain soy products, such as soy flour (USDA 2007b).

There are regulations for the labelling of food products containing GM ingredients of greater than 5 per cent, though there are indications this regulation is not enforced (USDA 2007b).

Saudi Arabia

The importation and use of GM grain and food in Saudi Arabia is regulated by the Ministry of Agriculture and the Ministry of Commerce and Industry, respectively.

The importation of GM foodstuff, animal feed, fruit and vegetables into Saudi Arabia is permitted, providing the products are labelled and are certified by a government agency from the country of origin as being safe for human or animal consumption. There is an adventitious presence tolerance of 1 per cent. The importation of GM seed is banned (USDA 2007c).

There are no indications of import restrictions or labelling requirements for products from animals fed GM stockfeed.

Singapore

While Singapore does not have legislation specifically related to the regulation of GM products, approval is required from the Genetic Modification Advisory Committee (GMAC) for the importation of GM food or feed. The importation of GM food or feed is permitted where the product has been approved by the exporting country, and is in compliance with international safety standards. No further regulations exist for products from animals fed stockfeed with GM ingredients.

There are no requirements to label foods containing GM ingredients, or products from animals fed stockfeed containing GM ingredients.

Hong Kong

Hong Kong does not have any biotechnology policies in the areas of production, importation, use in foods or feed, or labelling. A recent government review of biotechnology food labelling found there was no call for mandatory labelling, as there is not an international labelling standard (USDA 2008d).

South Africa

Regulatory decisions on GMOs in South Africa are made by the Biotechnology Executive Council. The council has representatives from the departments of Agriculture; Science and Technology; Health; Environmental Affairs and Tourism; Trade and Industry; Labour; Water Affairs and Forestry; and Arts and Culture (USDA 2007e).

There has been an embargo on the clearance of applications for importing GMOs for use in food and feed since 2006, pending a report on the effect of GM imports on South African trade (USDA 2007e). As of August 2008, this report is yet to be completed (USDA 2008b).

South Africa has a 1 per cent tolerance for adventitious presence for GMOs that have not been approved by the Executive Council.

The South African Department of Health regulates the labelling of GM foods. Labelling is mandatory where the modification is significantly different to its unmodified counterpart in terms of its nutritional value, composition or mode of storage. Labelling is also required where the modification could lead to allergens being present or if human or animal proteins are present. Products from animals fed stockfeed with GM ingredients are not regarded as being GM foods, so do not require labelling (Department of Health n.d.).

Malaysia

A Biosafety Bill which would enforce the mandatory labelling of GM products passed through Malaysian parliament in early 2007 (Netto 2007). The Bill was due to come into force during 2008 (Sai Fong and Siaw 2008), however it is not clear if this has occurred. Prior to the Biosafety Bill, there were no import restrictions on GM food or animal feed.

appendix B Major export destinations of Australian livestock products

4 Average value of livestock product exports, 2002-06

beef			chicken meat			dairy products			egg products		
country	value $USm	% of total Australian beef exports	country	value $USm	% of total Australian chicken exports	country	value $USm	% of total Australian dairy exports	country	value $USm	% of total Australian egg exports
Japan	1 346	44	South Africa	2	19	Japan	267	16	Singapore	0.75	38
United States	930	31	Hong Kong	2	19	Malaysia	130	8	United States	0.34	17
Rep. of Korea	362	12	Kiribati	1	9	Philippines	126	8	Hong Kong	0.33	17
Other Asia	97	3	Philippines	1	8	Singapore	104	6	Philippines	0.13	6
Canada	67	2	Vanuatu	1	7	Indonesia	103	6	Syria	0.06	3
Total exports	3 045	100	Total exports	11	100	Total exports	1 640	100	Total exports	1.97	100

live animals			pig meat			sheep meat		
country	value $USm	% of total Australian live exports	country	value $USm	% of total Australian pig meat exports	country	value $USm	% of total Australian sheep meat exports
Indonesia	156	29	Singapore	58	46	United States	231	30
Saudi Arabia	62	11	Japan	32	26	Japan	69	9
Kuwait	59	11	New Zealand	21	17	United Kingdom	56	7
China	45	8	Rep. of Korea	4	3	Saudi Arabia	54	7
Jordan	39	7	Hong Kong	2	1	United Arab Em.	39	5
Total exports	546	100	Total exports	126	100	Total exports	781	100

Source: UN Comtrade (2008).

appendix C

Australia's major animal product export markets

5 Major competitors in Australia's major export markets by commodity group, average 2002-2006

	eggs and dairy			live animal			meat		
country	export value $m	% of total imports %	country	export value $m	% of total imports %	country	export value $m	% of total imports %
Japan								
Australia	267	28	United States	87	42	United States	1 906	26
New Zealand	162	17	Australia	32	15	Australia	1 621	22
United States	102	11	United Kingdom	23	11	Denmark	1 126	15
France	60	6	Canada	20	10	Canada	944	13
Netherlands	59	6	Ireland	8	4	Brazil	513	7
China	55	6	China	7	4	Mexico	212	3
Total	703	74		177	86		6 321	86
United States								
New Zealand	272	18	Canada	1 220	61	Canada	1 978	43
Italy	221	14	Mexico	476	24	Australia	1 302	28
France	136	9	Netherlands	72	4	New Zealand	764	16
Canada	126	8	Germany	47	2	Uruguay	221	5
Denmark	74	5	Ireland	43	2	Denmark	162	3
Australia	62	4	Australia	30	2	Nicaragua	51	1
Total	891	57		1 888	94		4 478	97
Republic of Korea								
Australia	49	22	United States	13	33	United States	444	32
New Zealand	42	19	Australia	5	14	Australia	410	30
United States	42	19	China	5	13	New Zealand	121	9
Netherlands	24	11	Germany	3	8	Canada	69	5
Canada	11	5	Japan	3	7	Belgium	51	4
France	11	5	United Kingdom	3	7	Chile	51	4
Total	180	81		32	82		1 147	83
Indonesia								
Australia	98	24	Australia	86	90	Australia	28	43
New Zealand	89	22	United Kingdom	3	3	New Zealand	24	37
Philippines	47	11	United States	2	3	United States	8	12
United States	44	11	France	2	2	Singapore	4	6
Netherlands	33	8	Netherlands	1	1	Canada	0	0
Singapore	23	6	Thailand	1	1	China	0	0
Total	334	81		95	99		65	99
Saudi Arabia								
Netherlands	159	18	Syria	269	50	Brazil	434	57
New Zealand	148	17	Sudan	112	21	France	98	13
Denmark	105	12	Australia	79	15	Australia	66	9
Australia	96	11	Jordan	19	4	India	48	6
Germany	65	7	Uruguay	13	2	New Zealand	35	5
France	58	7	Kuwait	9	2	Sudan	20	3
Total	630	72		501	93		702	92

Source: UN Comtrade 2008.

appendix D

GM content of feed grains in overseas countries Australia competes with in third markets

6 Estimates of feed grain use and GM content in 2006-07

	Canada				United States				Denmark				Brazil			
	total feed		GM feed		total feed		GM feed		total feed		GM feed		total feed		GM feed	
	kt	%	kt	%	kt	%	kt	%	kt	%	kt	%	kt	%	kt	%
Barley	8 896	32	–	–	1 209	1	–	–	2 797	14	–	–	–	–	–	–
Canola seed	387	1	347	90	23	0	20	88	–	–	–	–	–	–	–	–
Canola meal	473	2	425	90	2 078	1	1 837	88	438	2	–	–	–	–	–	–
Cottonseed	–	–	–	–	3 778	2	3 564	94	–	–	–	–	285	1	38	13
Cottonseed meal	–	–	–	–	1 028	1	973	95	69	0	–	–	1 046	2	137	13
Maize	8 456	30	6 472	77	142 191	73	92 060	65	5 019	25	40	1	34 500	66	–	–
Mixed grain	347	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Oats	1 628	6	–	–	2 104	1	–	–	292	1	–	–	450	1	–	–
Pulses	–	–	–	–	–	–	–	–	63	0	–	–	–	–	–	–
Rye	122	0	–	–	100	0	–	–	52	0	–	–	–	–	–	–
Sorghum	–	–	–	–	2 769	1	–	–	–	–	–	–	1 225	2	–	–
Soybean	401	1	260	65	4 040	2	3 689	91	–	–	–	–	2 910	6	1 497	51
Soybean meal	2 493	9	1 981	79	31 171	16	28 542	92	1 770	9	1 441	81	11 108	21	5 893	53
Wheat	4 328	15	–	–	3 293	2	–	–	4 089	21	–	–	200	0	–	–
Other	528	2	–	–	1981	1	–	–	5 180	26	–	–	635	1	–	–
Total	28 059	100	9 486	34	195 765	100	130 685	67	19 769	100	1 481	7	52 359	100	7 565	14

Canada: year ending July 2007 for barley, canola seed and meal, mixed grain, oats, rye, soybeans and meal; year ending August 2007 for maize. United States: year ended May 2007 for barley, canola seed and meal, oats and wheat; year ending July 2007 for cotton seed and meal; year ending August 2007 for maize, soy beans and meal and sorghum. Denmark: year ending June 2007. Brazil: year ending December 2007 for cotton seed and meal; year ending February 2007 for maize; year ending November 2007 for oats; year ending September 2007 for sorghum, soy bean and meal and wheat. Other includes peanuts and peanut meal, sunflower seeds and sunflower seed meal, fish meal, coconut oil, palm oil and fluid milk palm kernel meal, yeast, molasses, tapioca meal, citrus meal, guar meal, peas, and copra. The definition of other varies across countries.
Columns may not add due to rounding.
Source: US Department of Agriculture 2008a,Statistics Denmark 2008, ABARE estimates

appendix E Consumer awareness and acceptance in Australia's major export markets

Hong Kong

There is little information on the degree of consumer awareness of GM products in Hong Kong. While green and consumer groups in Hong Kong have lobbied for mandatory GM labelling, consumers are indifferent to the use of GM ingredients in food (USDA 2007a). This indicates there is at least some awareness among Hong Kong consumers, but the lack of concern suggests there would not be any market acceptance issues for products from animals fed GM feed exported to Hong Kong.

Indonesia

There has been little consumer opposition to the sale of GM products in Indonesia (USDA 2007b). In a public perception and understanding survey conducted in 2002, consumers in Indonesia were able to answer slightly more than half of a series of true or false questions relating to food applications of biotechnology correctly (ISAAA 2002a).

Malaysia

Consumer knowledge of biotechnology is moderate in Malaysia. In a survey conducted in 2002, Malaysian consumers were able to answer true or false questions for about half of the questions relating to food applications of biotechnology correctly (ISAAA 2002b).

Republic of Korea

A 2007 survey conducted for the Republic of Korea's Biosafety Clearing House indicated self-rated consumer awareness is high, with more than 70 per cent of surveyed consumers rating themselves as being somewhat or very aware of GMOs (KRIBB 2007). However, there was no indication of the accuracy of consumer knowledge.

It has been suggested in the media that consumers in the Republic of Korea are largely unaware of the availability of products from animals fed GM stockfeed (Jin-seo 2008).

Saudi Arabia

There are no known surveys of consumer awareness and acceptance of GM products in general in Saudi Arabia.

However, products requiring GM labelling (See appendix A) are not sold in supermarkets, because of food importer concerns about consumer acceptance (USDA 2007c).

Singapore

Consumer awareness of genetic modification is low in Singapore, where surveys of public awareness found 60 per cent of surveyed consumers had not heard the term (GMAC 2007). Of those consumers who were aware of the term, half had an accurate understanding of its meaning.

South Africa

Consumer awareness of genetic modification is very low in South Africa. A survey conducted in 2004 by a South African Government biotechnology awareness program found 88 per cent of surveyed consumers did not know what they thought when they heard the term 'genetic modification' (Rule and Ianga 2005). Of the 12 per cent who gave responses, many gave incorrect descriptions of the term.

Acronyms

ACCC	Australian Competition and Consumer Commission
ACMF	Australian Chicken Meat Federation
ACO	Australian Certified Organic
ADIC	Australian Dairy Industry Council
ALFA	Australian Lot Feeders' Association
AOF	Australian Oilseeds Federation
APHIS	Animal and Plant Health Inspection Service (US)
APL	Australian Pork Limited
AQIS	Australian Quarantine Inspection Service
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DNA	Deoxyribonucleic acid
EFSA	European Food Safety Authority
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency (US)
FDA	Food and Drug Administration (US)
FSANZ	Food Standards Australia New Zealand
GM	Genetically modified
GMAC	Genetic Modification Advisory Committee (Singapore)
GMO	Genetically modified organism
NASAA	National Association for Sustainable Agriculture Australia
NZFMA	New Zealand Feed Manufacturers Association
OGTR	Office of the Gene Technology Regulator
SFMCA	Stock Feed Manufacturer's Council of Australia

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