Challenge	Industry	Solution	What sciences are involved with these solutions?
High water loss (<40%) through evaporation in water storages	Cotton	Development of an ultra-thin film (monolayer) evaporation mitigation system	Chemical Engineering
High demand crop requiring water	Cotton	Development of genetic varieties suitable in drier conditions	Biology Biotechnology/Genetics Cell biology Chemistry Plant pathology
High pesticide use to combat damage to the crop and subsequent reduction in yield caused by the helicoverpa caterpillar	Cotton	Development (through genetic modification) of plant varieties which contain two genes that produces two proteins in the leaves that are toxic to heliothis (Bollgard II®). When the helicoverpa ingests a small part of the cotton plant, the Bt protein disrupts the caterpillar's digestive system and it dies. Subsequent reduction in pesticide use of 85% over the past decade.	Entomology Chemistry Biology Physiology Plant breeding
Not enough people to work on farm during harvest - a time when the demand for labour is at one of the peaks	Cotton	Development of the round bale picker. Replaces three vehicles and 4 people with one.	Engineering - mechanical - environmental - agricultural - robotic - software
Soil compaction (and subsequent reduction in yield) because of too many passes of heavy machinery	Cotton	No till or low till farming involving planting directly into the stubble of the previous crop, machinery with thin wheels, reducing the number of vehicles required to pick a crop from three (picker, boll buggy and tractor) to one.	Engineering - mechanical - environmental - agricultural - robotic - software Microbiology Soil biology Soil Physics

			Land resource science
Need to produce more crop with less water	Cotton	Development of soil moisture monitoring tools like electromagnetic induction (EM) surveying, used in conjunction with soil sampling to map soil variations across fields. This allows irrigation scheduling that applies the right amount of water, in the right place at the right time to maximise production and water use efficiency.	Engineering - environmental - agricultural Science Extension Geophysics Geoscience Plant physiology Irrigation and soil science Soil Physics Land resource science
Need to produce more crop with less water	Cotton	Converting furrow irrigation to overhead irrigation	Engineering (Agricultural, mechanical) Science Extension Plant physiology Plant pathology
Need to produce more crop with less water	Cotton	Using precision irrigation systems that automatically and continuously re-adjust the irrigation application decision based on the environment	Engineer (Agricultural, multidisciplinary) Plant pathology
Depletion of wild stocks in their natural environment	Fisheries	GPS mapping of catch zones for abalone for future management	Technology/GIS Biology Management/Policy
Poor decision making on when to harvest	Forestry	Lidar and GIS mapping of biomass for harvesting	Geography GIS Technology Biology/Botany
Errors in planting crop	Grain	Precision Agriculture using GPS in tractors to accurately plant rows of wheat to ensure no overlap or gaps	Digital Technology GIS mapping
Not enough feed for herd	Dairy	Pasture management using aerial surveillance	Biology Technology GIS
Pig waste has harsh environmental	Pork	Environmentally friendly pigs - Genetic modification has	Biology

impacts		helped to create pigs that can digest phosphorous better, which decreases the pig's phosphorous output. The result is that manure, which is often made from pig waste, is less destructive to the environment due to its lower phosphorous content.	Biotechnology Chemistry
Depletion of wood stocks to use in construction and paper products.	Forestry	Faster-growing trees - Demand for wood can be met by trees that grow faster than average. Genetic engineering has produced trees that can ward off biological attacks, grow more quickly and strongly, and create better wood than trees that are not genetically modified.	Genetics Biology Gene technology
Slow growing Salmon	Fisheries	Salmon that grow faster - Salmon do not produce growth hormones year-round, so scientists have looked toward genetic engineering and found a solution: a modification that allows salmon to grow twice as fast than those that are not engineered.	Biology Gene technology Chemistry
Pest and diseases in crops and the need for vaccines.	Crops	The banana vaccine - Bananas were developed through genetic modification that offer vaccine against diseases such as cholera and hepatitis. Just like with a needle vaccine, people who eat them develop disease-combating antibodies that make them immune to a disease.	Gene technology Plant Pathology Biology
Piglets at risk of being squashed by mother pig, therefore decreasing litter size/piglet welfare problems. (Need to protect the piglet!)	Pork	Breed for mothering ability Suitable shed infrastructure to maximise piglet security (e.g. use of a piglet protection pen)	Animal behaviour Genetics Physics Engineering
Need to produce high muscled pigs with minimum fat (consumer demand)	Pork	Development of genetic lean varieties	Biology Chemistry Biotechnology Reproduction
Increase the amount of piglets weaned per sow	Pork	Use sows, which have a high born alive number to increase herd production.	Biology Chemistry Biotechnology

			Reproduction
Increase the wean weight of piglets	Pork	Breed with sows which have a high milk production (and high quality milk)	Biology Chemistry Biotechnology Reproduction
Effective fishery management requires knowledge of the impact of fishing on stocks. Lack of effective monitoring means loss of catch, income and recreation and jeopardises sustainability.	Commercial and recreational fishing sectors	The Genetag Hook is a fishing hook designed to remove tissue samples from the mouth of a fish, without harming the fish. This biopsy tissue sample becomes a DNA tagging system for fish research. This information is vital for managing fish stocks Genetag technology uses the same technology that forensic scientists use for genetic fingerprinting to identify individual fish that have been previously "tagged".	Fisheries science Genetics Statistics
Measuring harvest rates by tagging fish, catch/release tagged fish has some flaws. Conventional tagging can result in post-release mortality of tagged fish, tags can be lost, and fisheries managers rely on tags being returned by fishers. (e.g. Spanish mackerel in the Northern Territory.)	Commercial and recreational fishing sectors	A special lure was invented that takes a tiny flesh sample from a fish without having to catch it. The lure barb is made of copper which straightens when the fish strikes it, but the sharp copper point retains a small amount of flesh, which is sent to the laboratory where its DNA will be extracted and recorded into a database. Managers can DNA fingerprint data can help calculate fish harvested and fish movements can be measured.	Fisheries science Genetics Statistics **Watch the video:** Andrew Ettinghausen talks about Genetag https://www.youtube.com/watch?v=fAHKt9HfvPA
Reliance of Australian prawn farming on spawning of wild caught prawns	Aquaculture	CSIRO to develop new breed of domestic prawns with improved growth and survival rates. Higher quality product with more control over the production cycle. A 10-year selective breeding program, using genetic markers to identify family lines. Natural mating is now a cost-effective alternative (boosting pond yields by >50%) to rearing each breeding family in separate tanks. Viral screening technology is assisting the industry to develop breeds that are highly tolerant to endemic diseases.	Biology Genetics Microbiology Pathology **Read more and watch the video** http://www.csiro.au/en/Research/AF/Areas/Aquaculture/Premium-breeds/Black-tiger-prawn