Agricultural Biotechnology Council of Australia

Developing countries and biotechnology

The world population is growing at a rate of 1.2 per cent, or 77 million people per year according to the United Nations (UN). This information paper investigates the impact of biotechnology on developing countries, where nearly all of the population growth is predicted to occur.

Already, widespread hunger exists in the world. Factors such as local conditions, politics and food distribution contribute to this hunger, with 830 million people being hungry and chronically malnourished, ad 96 per cent of these people live in developing countries.

It is projected that by 2100 there will be about 9.3 billion people in the world — more than two billion more than the current population. Producing enough food to meet the needs of this future population will be a major challenge.

An adequate food supply is critical to social stability. To maintain and improve the current standard of living, developed countries need to ensure that people in developing countries have sufficient food.

There are two options through which agricultural production can increase, firstly, through the intensification of production on existing land; or secondly, by increasing production through the expansion of agricultural land.

Increasing land use is very difficult to achieve, given that it is a limited resource and expansion of agricultural land results in other land use being reduced. Intensification also places greater pressure on existing land and can result in problems such as salinity and soil erosion. As population increases so do the demands on land use. This means that the burden of food production will need to be addressed by agricultural intensification.

Supply and distribution of food is a complex issue involving much more than just production. However, improving the agricultural output in developing countries would significantly help to meet this need in a sustainable manner.

In developing countries, it is estimated that 650 million of the poorest people live in rural areas where food production is the main source of income. Without successful agriculture, these people have neither employment nor food. Global food distribution problems do need to be improved however improving distribution is not the only solution. For example, if biotechnology can help farmers grow their own food they could feed their families and communities, and potentially sell food and become self-sufficient rather than rely on aid.

Biotechnology as a tool

The UN Millennium Development Goals present eight challenges to UN Member States, and all 191 members have pledged to meet the following goals:

- promote gender equality and empower women
- reduce child mortality
- improve maternal health
- combat HIV/AIDS, malaria and other diseases
- ensure environmental sustainability
- develop a global partnership for development
- achieve universal primary education
- eradicate extreme poverty and hunger.

Targets need to be met by 2015 for each of these goals. Biotechnology has the ability to help meet these goals, particularly in relation to the medical, sustainability and hunger/food production targets.

According to the UN's Food and Agriculture Organisation (FAO), the major breeding and crop management applications to-date for developing countries have come from the non-GM biotechnologies such as mutagenesis, marker-assisted selection, and micro-propagation. Biotechnology also offers important tools for the diagnosis of plant diseases of both viral and bacterial origin, and immuno-diagnostic techniques as well as DNA-based methods are commercially applied for this purpose in many developing countries. Biofertilizers are also being used in developing countries both to augment the nutritional status of crops and as alternatives to chemical supplements. Further, biotechnologies such as cryopreservation, artificial seed production, somatic embryogenesis, and other forms of in vitro cell or tissue culture are also extensively used for the conservation of genetic resources for food and agriculture in developing countries.

GM crop impacts

Genetically modified (GM) crops are already having an impact in developing countries. In 2011, of the 16.7 million farmers growing GM crops around the world, 15 million were resource-poor farmers from 19 developing countries according to the International Service for the Acquisition of Agri-Biotech Applications (ISAAA). Genetically modified crops have resulted in higher on-farm incomes due to yield increases and a reduction of pesticide use.

In particular, the cultivation of insect-resistant (Bt) GM cotton has had a very positive impact on farmers in India and China.

With a population of more than one billion India is highly dependent on agriculture with 70 per cent of the population employed by the sector. India is the largest cotton growing country in the world. GM cotton was first adopted in India in 2002 and was grown across 50,000 hectares. This area has grown significantly. In 2011, seven million farmers planted GM cotton across 12.1 million hectares, averaging 1.5 hectares of cotton each, and this represented 88 per cent of the nation's cotton crop.

According to ISAAA, Bt cotton has increased yield, halved insecticide applications and increased income by US$250 per hectare. According to PG Economics, India's farm income from GM insect-resistant cotton was improved by US$9.4 billion in the period 2002 to 2010.

In China, seven million resource-poor farmers also grew GM cotton across an area of 3.9 million hectares.

In the pipeline

Scientists in Switzerland have modified rice containing vitamin A (**Golden Rice**) and iron. Vitamin A deficiency causes two to three million childhood deaths per year and results in half-a-million cases of permanent blindness. Correction of such a deficiency would save the lives of many and reduce the morbidity associated with this condition.

Some have claimed that 'Golden Rice' offers 'zero-benefit' to those suffering Vitamin A deficiency in developing countries because it will not provide them with the Recommended Daily Intake (RDI). The developer of the rice, Ingo Potrykus responded to the claims saying that the amount of Vitamin A needed to prevent severe symptoms of deficiency is significantly lower than the RDI. Golden Rice is already in the 20 to 40 per cent range of the daily allowance, and the vitamin A content can be increased over time.

The first countries expected to commercialise Golden Rice are the Philippines and Bangladesh. Field trials in both countries are currently underway, and Golden Rice is expected to be released in the Philippines in 2013–2014.

Iron is the most common deficiency in the human diet affecting an estimated one to two billion people resulting in substantial morbidity, especially in women and children. As rice feeds a third to half of the world, GM iron rich rice, currently under development, could help improve the nutrition of a large sector of the worlds disadvantaged. Proof-of-concept research undertaken by Australian scientists has seen GM rice grains containing up to four times more iron than conventional rice using the plant's own abilities to acquire more iron from soil, which is in turn transported to the grain. Further trials are now being undertaken. Scientists from the International Rice Research Institute (IRRI) are conducting field trials in the Philippines using a similar super grain.

Cassava is the staple food of around 500 million people around the world. It tolerates drought and is the primary diet of small-scale farmers in areas with unfavourable conditions. The problem with cassava is that it contains carbohydrate and little else that is beneficial and can also release cyanide into the body. Work is underway to try and improve cassavas nutritional quality by using gene technology to boost its iron, protein and Vitamin A content. A second research focus involves the use of gene technology to reduce the level of cyanide, making the crop much safer.

In conclusion, according to a UN report, there are some key areas which could ensure the benefits of agricultural biotechnology reach the poor. They are:

- biotechnology can benefit the poor when appropriate innovations are developed and when poor farmers in poor countries have access to them on profitable terms
- biotechnology should be part of agricultural research programs but should not replace conventional research areas
- public sector research is necessary to address the public goods overlooked by the private sector and public-private partnerships should be encouraged
- appropriate regulation is essential to ensure that the environment and public health are protected
- capacity building for agricultural research and regulatory issues related to biotechnology should be a priority for the international community.

Further information

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