This response was submitted to the consultation held by the Nuffield Council on Bioethics on Emerging biotechnologies between April 2011 and June 2011. The views expressed are solely those of the respondent(s) and not those of the Council.

How have political factors and public acceptance shaped the development of emerging biotechnologies?

Biotechnology is the application of biological knowledge to manufacture products. It proves to be a highly lucrative and beneficial application of biological research. This research often explores unusual and new territories of development and is thus subjected to greater scrutiny by the public. Public acceptance of biotechnologies can be influenced by social, geographical or cultural factors. The purpose of this essay is to explore how these aspects have affected the emergence of different biotechnologies. It will be addressed in light of political traditions and conditions. The role of politics and public in shaping the future of novel biotechnologies will also be discussed.

Social and Geographical Factors

Social acceptance of biotechnology can be largely based on trust. Public mistrust of proponents of genetically modified organisms (GMO) has led to rejection of biotechnology despite the dire need to relieve starvation. In dry, drought-prone countries of the African subcontinent, GMOs have the capacity to increase crop yield and quality. In 2001, 28% of the population in Zambia was at risk of starvation and the US offered to donate its genetically modified (GM) maize to relieve this situation[1]. The offer was rejected because the social belief was that the US promoted the GMO out of self interest rather than for the good of the Zambians. Furthermore, the social rejection of GMO by Europe has increased the mistrust of GMO in Zambia. This indicates that societies can also follow the decisions of others in areas where their own research

capacity has not yet reached its full potential. In contrast, African countries, such as Kenya and South Africa, that have the research and developmental capacity to investigate further into GMO technology have been more willing to accept GMO because the research has been done by Africans themselves and thus more likely to be trusted by the local population.

Geographically, some argue that although dry and arid African lands would benefit from GMO to increase food production, focus on other areas of improvement of farming are also just as likely to raise productivity with little risk[1]. Small-scale farmers can increase yield by having greater access to basic farming needs like fertilizer and better irrigation systems. This would be a more holistic means to improving output compared to GMO.

Cultural factors

Culturally, activists and overregulation can play a part in dividing people on the issues surrounding biotechnology. In Europe for example, GMOs have been less welcomed compared to the United States (US). European environmental groups such as Greenpeace have exerted political pressure on the government and biotechnology industry and experimental fields have been destroyed by anonymous activists in protest[2]. In contrast, less resistance has been shown by the Americans towards field testing of GMOs, perhaps because activism is quickly quietened and not as thoroughly covered by the media. Regulation of growth and testing of GMOs in Europe has been more stringent than in the US. It can be argued that while European populations are more homogeneous and thus more likely to share similar beliefs against GMOs, the American population is a heterogeneous mix with many differing views.

Furthermore, religious views can influence acceptance of biotechnology. This includes decisions related to physiological treatment and research. For example, a Jewish patient would be against xenotransplantation, in particular a body part from a pig as this would go against his/her religion. Similarly, a Hindu would be against cow tissue

transplantation. However, the majority of the public see animals as commodities and so when presented with an animal organ will generally accept the option.

Transplantation in general too, faces opposition by particular groups within society. An example of this is Jehovah's witnesses, who believe that tissue transplantation, including blood transfusion, is religiously unacceptable and so will refuse treatment. Again, however, this is a small minority of people and the majority see organ transplantation as the way of as a life saving treatment.

In research, stem cell progression is sometimes halted by religious acceptance. Such research is frowned upon by many religions, particularly Catholics, who believe that the embryo has a soul as soon as conception occurs, making stem cell research unethical. As a result of this religious belief, stem cell research had traditionally been banned in the US on the grounds that the embryo is alive and that any destruction of 'human life in the hopes of saving human life is not ethical'[3] . However, this ban has been removed with the coming of power of the Democratic Party in 2008.

Political traditions

In our democratic society we have freedom of speech to question the decisions of our government including their policies on biomedical research. While this is both necessary and welcome in a civilized society, one could argue that the general public is insufficiently informed to make judgments regarding the ethics and applications of some areas of life science research.

As discussed previously, the American stem cell debate is a recent example of how political traditions have shaped potential merging biotechnologies. While former president George W. Bush was in administration, he vetoed the Stem Cell Enhancement Research Act of 2005[4] and 2007[5]. This led to a dramatic decrease in funding of stem cell research[4-5]. Due to the influence of US on the global scientific community, Bush's

decision potentially hindered the development of novel biotechnology. Arguably, this delayed the progression of biotechnology significantly. President Obama had an outlook on stem cell research that was in opposition to that George W. Bush. Subsequently he allowed the bill to be considered by The House of Representatives and Senate, who approved the bill.

Political conditions

Historically, a country's political situation has inevitably influenced its scientific research and development. One of the most influential of such situations is the unpredictable and vital pressure of necessity. During World War II, there was a heightened interest in the development and the mass production of penicillin. Increased funding in penicillin research contributed to the eventual success of Florey and Chain in their efforts to mass produce the antibiotic.

A fine example that necessity cannot only be reactive but proactive is the mass production of Quorn[6] in the late 1960s. There was a worry that there would be a global food shortage as a result of the rising human population. Consequently, governments invested in research into the mass production of Quorn[6] as a substitute for animal protein-based foods. Although there was no such severe food shortage, the Quorn[6] industry has proved to be highly lucrative in its catering for vegetarians.

Clearly a country's economic climate dictates the level of investment in biomedical research. In response to the recent economic disaster, universities were informed of a proposed 66%[7] cut in their government funding for scientific research. It is reasonable to assume that such changes will result in the decline of biomedical research and thus subsequent biotechnologies. Unfortunately this is a fine example of how political conditions can severely dampen or slow the emergence of novel biotechnologies. We would assert, however, that if the government were to prioritize biomedical research in

its budget cut considerations, the subsequent increase in short term expenditure would give rise to positive financial and humanitarian gains in the long term.

Conclusion

The development and usage of genetically modified organisms have been affected socially, geographically and culturally which has led to a slow progression of the technology, both in the western world and in those countries that are less economically developed. Transplantation too, both between humans and animals and humans themselves has been affected by religious views shared by different elements of the community. Furthermore, stem cell research has been affected by strong religious views and subsequent political interference in its development. With political power comes the obligation of the government to make decisions in the best interest of the population. As highlighted, the concept of “best interest” is inevitably shaped by political opinions and conditions of the time. The examples of potential food shortage and war emphasize how biotechnology has played a fundamental role in satisfying past political necessity. It is likely that it will play a major role in shaping the future of medicine. However, its success and mere existence is at the mercy of politics and public perceptions.

References

[1] Jennifer G Cooke and Richard Dowie (2010). African Perspectives on Genetically Modified Crops – Assessing the Debate in Zambia, Kenya, and South Africa. A Report of the CSIS Global Food Security Project. *Center for Strategic & International Studies.* Accessed June 28, 2011. Available on the World Wide Web: http://csis.org/files/publication/100701_Cooke_AfricaGMOs_WEB.pdf

[2] Zechendorf, Bernhard. (1998). Agricultural biotechnology: Why do Europeans have difficulty accepting it? *AgBioForum*, *1*(1), 8-13. Accessed June 28, 2011. Available on the World Wide Web: http://www.agbioforum.org.

[3] Stolberg Sheryl Gay (2007). Bush Vetoes Measure on Stem Cell Research. *New York Times*. Accessed 28th June 2011. Available at http://www.nytimes.com/2007/06/21/washington/21stem.html

[4] 19 July 2006; Bush uses veto on stem cell bill. *BBC news*. Accessed 29 June 2011. Web address: http://news.bbc.co.uk/1/hi/5193998.stm

[5] 20 June 2007; President Bush Vetoes Stem Cell Research for a Second Time. ABC News. Accessed 29 June 2011. Web address: http://abcnews.go.com/GMA/story?id=3297142&page=1

[6] Copyright © Marlow Foods Ltd 2011. Accessed 28 June 2011. Web address: http://www.quorn.co.uk/The-Quorn-Story/

[7] Sean Coughlan. 2 February 2011; University cuts 'Pfizer warning'. *BBC news.* Accesed 28 June 2011. Web address: http://www.bbc.co.uk/news/education-12344506[6] Ester

General reading: Boserup. 1965; The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure

---