Modern biology and its social impact

Report on the second ESRC Genomics Network / National Natural Science Foundation of China Expert Meeting

Xishuangbanna, China, 3-4 December 2007

1 Background

The ESRC Genomics Network (EGN) is a major investment by the Economic and Social Research Council (ESRC) in the area of genomics. The EGN comprises three research centres – Egenis, based in the University of Exeter; Cesagen, based at the Universities of Cardiff and Lancaster; and Innogen, based at the University of Edinburgh and the Open University – plus the ESRC Genomics Policy and Research Forum, based at the University of Edinburgh, which undertakes policy and public engagement work in collaboration with the three research centres.

The National Natural Science Foundation of China (NSFC) is China's main government funding body for basic scientific research. The NSFC funds research across the basic sciences in institutions throughout China.

The first EGN/NSFC Expert Meeting on "Modern Biology and its Social Impact" was held in Edinburgh 22-24 March 2006. The meeting was intended to initiate a collaborative exploration of social issues in the life sciences, with the longer-term goal of advancing mutual understanding of the social context and impact of biological research and technology through dialogue between China and the UK. Following a successful and wide-ranging programme of discussion, it was agreed that a second meeting should be held in China in spring of 2007.

2 Practical details

Arrangements for the second meeting were delayed owing to a change in the directorate of the Genomics Forum, which had represented the EGN in organising the first meeting. However, in March 2007 Prof Lu Rongkai, Director of the Division of Western Europe in the Bureau of International Cooperation at the NSFC, reopened discussions with the Forum's new Director, Prof Steve Yearley, and in June Robin Williams and Xiaobai Shen

of the Innogen Centre met with Prof Lu in Beijing. It was agreed to hold the meeting in early December 2007. It was also agreed that the programme should have a somewhat narrower focus than the first meeting, which had undertaken a wide-ranging preliminary review of the social impacts of contemporary life sciences. Consequently, it was decided that the first day of the meeting should be devoted to a discussion of agricultural biotechnology, while the second would focus on new medical technologies. Each day would be divided into three sessions on "retrospects and prospects", "social, economic, environmental, ethical (etc.) implications", and "regulation and public policy". A final closing session would provide an opportunity to review the proceedings and consider future activities.

Further planning and coordination on behalf of the EGN was undertaken by Dr Steve Sturdy, Deputy Director of the Forum. A UK delegation of eleven members was assembled, including two or more members from each EGN research centre, plus a representative from the UK government's Human Fertilisation and Embryology Authority and one from the Human Genetics Commission. Delegates were selected to provide expertise across the full spread of agreed topics. Unfortunately, two of the Cesagen delegates – Profs Ruth Chadwick and Brian Wynne – had to withdraw for health reasons, though the remaining delegates were still able adequately to address the agreed topics. For the NSFC, Prof Lu assembled a Chinese delegation of fourteen members with a similarly broad spread of subject expertise, including practising scientists from some of China's leading biological research centres, as well as leading ethicists, law scholars, and social scientists. In a spirit of collegiality, each side included delegates proposed by the other, ensuring complementarity of interests and a good basis for discussions. Particularly welcome was the inclusion in each delegation of a number of junior as well as senior academics, giving a new generation of scholars an opportunity to learn from and contribute to these important international discussions.

Back row (l to r): Lv Lan, Zhu Wei, Yang Litao, Li Moxuan, Peng Yufa, Zhu Zhen, Xue Dayuan, Shen Xiaobai, Li Zhen, Yang Nini, Liu Yinliang, Fan Yingjie

Front row (l to r): Robin Williams, Peter Robbins, Lu Baorong, John Dupré, Hu Qingli, Steve Sturdy, Han Jianguo, Neva Haites, Shen Mingxian, Sarah Cunningham-Burley, Qiu Xiangxing, Steve Hughes

Also present but not in photograph - Søren Holm

The meeting was held in the very comfortable surroundings of the Dai Garden Hotel, Xishuangbanna, China on 3-4 December 2007. All local arrangements were made by NSFC. The participants would like to thank the Foundation, and especially Prof Han

Jianguo and Ms Fan Yingjie of the Bureau of International Cooperation, for all they did to make the meeting a success, both intellectually and socially.

3 Overview of the proceedings

The proceedings opened with a welcome and introduction by Professor Han Jianguo, Director General of the NSFC Bureau of International Cooperation, and a short response by Dr Steve Sturdy, Deputy Director of the ESRC Genomics Policy and Research Forum. There followed two very full days of presentations and discussion. The participants represented a genuinely interdisciplinary mixture of scientists, social scientists and philosophers from both countries, and the meeting was distinguished by excellent presentations and by full, open and friendly discussion throughout.

A number of key themes emerged in the course of the discussions. These themes were interconnected and overlapped with one another, but can usefully be summarised under three headings as follows:

Social and economic aspects of agricultural biotechnologies

Relative to its overall size and population, China possesses only a limited supply of agricultural land. Much of that land, moreover, is subject to extreme climatic and environmental conditions. China is therefore under severe pressure to maximise the productivity of prime land, and to exploit marginal land wherever possible. Consequently, there is a strong incentive to look for innovations in agricultural biotechnology as a means of addressing these needs. This is reinforced by China's impressive and rapidly expanding indigenous capability in plant biotechnology. It is also sustained, at least for the present, by a widespread view among farmers and the general public that the while biotechnological innovation is not without risks, those risks are greatly outweighed by the likely benefits; this situation as regards public perceptions is clearly dynamic, however, and may well change as biotechnologies become more embedded in agricultural and consumption practices.

However, a number of questions arose in the course of the conference about how China might best pursue the benefits of agricultural biotechnology. In this respect, there may be much to be gained from looking more closely at how the organisation of agricultural production and innovation in China both resembles and differs from that in Western Europe and North America. In parts of the West, agriculture is conducted on an industrial scale with large, highly mechanised farms and a high level of managerial expertise; while in other parts, small-scale farming continues, often with overt state support. By contrast, Chinese agriculture continues to rely heavily on relatively small units of production and highly intensive cultivation methods. In the past, in China as in Europe, agricultural systems have developed in a notably localised manner, with local farmers breeding a wide range of varieties specifically suited to local circumstances and cultivation methods. New breeding techniques, including older hybridisation methods as well as genomic technologies, plainly offer ways of both speeding up the rate of production of new crop varieties and introducing novel traits into crops that would not be possible by more traditional methods; indeed, China has led the way in rolling out F1 hybrid rice with a considerable degree of success. However, the centralisation of plant breeding in the case of hybrid rice threatens to create a disjunction between local

agricultural knowledge and the development and cultivation of new varieties. It was suggested that development GM varieties offers an opportunity to innovate in ways that are more sensitive to local expertise networks; if so, this would represent a distinctively Chinese innovation system.

Specific issues that arose in the course of discussion, which have implications for European as well as Chinese agricultural biotechnology, included:

- how best to disseminate knowledge of new crop varieties at the local level, so that farmers can obtain the maximum benefit from them.
- how to prevent the circulation of counterfeit, sub-standard seed as proprietary products replace local seed stock.
- how to ensure that centrally-developed and centrally-marketed hybrid and GM crops are as well suited as possible to local requirements and conditions.

As regards this last point, the questions of how best to evaluate the risks and benefits of novel crop varieties, and how best to safeguard biological diversity and sustainability, pose particular challenges. In the Chinese setting, considerable advances are plainly being made in pursuing scientifically rigorous methods of both benefit and risk assessment. But scientific test stations do not necessarily replicate farm conditions in every respect, and scientific rigour alone may not be sufficient to determine how well novel crop varieties will succeed in the very different ecological and social settings in which they are actually to be cultivated. Careful consideration needs to be given to such issues, as there is much at stake. If novel crop varieties turn out to generate more problems than benefits for local farmers, there is a risk that they may undermine public confidence in agricultural biotechnology more generally.

Consequently, more attention might usefully be paid to the organisation of the innovation system in both China and Europe, and particularly to ways in which local and central initiatives might be brought into closer harmony with one another. Moreover, the rather different historical and contemporary circumstances of agriculture in China compared to parts of the West implies that China's problems will most likely not be solved by simply importing Western modalities of agricultural innovation. In this respect, China is already making notable advances in developing indigenous methods of GMO surveillance. But as in Europe, efforts to tune the agricultural innovation system should probably not focus solely on GM crops; conventional hybridisation techniques also bring many of the same problems, for instance, but are largely excluded from current regulatory requirements; marker-assisted breeding techniques may offer many of the same benefits while being more compatible with local traditions of crop breeding.

Public attitudes to biotechnology

China is currently undergoing a process of remarkably rapid economic and industrial development, that is broadly welcomed by the population as offering a solution to a wide range of social problems. Such research as has been conducted indicates that in this setting, public attitudes towards biotechnology and biotechnological products are generally very positive. This contrasts with the situation in Europe, where the public are more sceptical about the risks and benefits associated with at least some biotechnological innovations, in particular GM foods. It seems unlikely that European doubts about GM foods can be attributed to recent food scares, since both China and Western Europe have recently been exposed to health scares associated with modern food production methods. Rather, the differences between Europe and China are more

likely to be attributable to a number of other contributing factors. First, the perceived need for increased agricultural production apparently makes Chinese consumers more tolerant of the risks associated with biotechnology. Secondly, Chinese research indicates that consumers there generally have a very low awareness of the incidence of GM products on the market, or of the nature of those products, compared to the relatively higher levels of awareness among European consumers. This is in keeping with research in the UK and elsewhere which indicates that increased public awareness of biotechnology and GM foods tends to lead to greater distrust of that technology, and particularly to the commercial context in which that technology is embedded. Thirdly, consumer fears in Europe have arguably been stimulated by high-profile campaigns by anti-GM activists.

However, other UK research makes clear that public distrust of new biotechnologies is not uniform, nor is it necessarily undiscriminating. On the contrary, the public are far more accepting of medical biotechnologies, and indeed are often prepared to participate in research endeavours such as biobanks, where they perceive a genuine likelihood of public benefit, even if such benefits may only be delivered in the longer term. Moreover, public distrust is generally directed, not towards the science or technology itself, but towards the institutions – and particularly the commercial institutions – that have charge or make use of that technology. In this respect, public institutions, and institutions with a professed philanthropic orientation, are commonly regarded as much more trustworthy than commercial bodies. Similar sentiments seem to be common in China also, where government agencies, in particular, apparently command considerably more trust than commercial organisations.

This raises questions about what kinds of public engagement strategies around science might usefully be undertaken in China. The UK experience with GM crops makes clear that public engagement exercises do not necessarily allay suspicion, and may damage public trust. But more sophisticated public engagement strategies, such as those undertaken in connection with British biobanks, or by the Human Fertilisation and Embryology Authority around issues of stem cell research, offer at least the potential of bringing scientific research, technological innovations and public expectations more closely into alignment with one another, and of fostering a sense of public ownership of research. Seen in this way, it is possible that certain kinds of public engagement activities might also prove useful in China, for instance for facilitating appropriate forms of innovation around GM crops, or for ensuring that medical biotechnologies develop in ways that best meet the needs of patient populations. Here as elsewhere, however, public engagement strategies would need to be tailored to the particular social and political circumstances that pertain in China. Not least, the sheer size and diversity of the Chinese population must surely challenge any simplistic idea that there exists a single “public” that speaks with a single voice, or that any kind of public engagement activity could be uniformly administered throughout the entire country. What this might mean for any development of public engagement in China was not explored, but the issue may well be worthy of further exploration. Indeed, further comparison between the Chinese and UK situations may prove particularly illuminating. By highlighting the similarities and differences in attitudes towards transparency and dialogue, and towards authority and dissent, researchers from both countries may learn much about how best to pursue effective public engagement around new science and technology in their own national contexts.

Ethics, regulation and civil society

The meeting helped to clarify some of the striking differences between China and the UK as regards the development of ethical and regulatory procedures, their institutional realisation, and the extent to which they command the attention, assent and compliance of scientists, doctors and the wider civil society.

China has recently made and continues to make dramatic advances in establishing ethical guidelines and legal regulations to govern both agricultural and biomedical biotechnologies. However, it remains unclear how far and in what direction such developments will proceed in future. In a context of rapid industrial development and economic growth, much of it technology-based, public attitudes towards new gene technologies are generally uncritical or positive. Consequently, Chinese government apparently sees little need to enforce strong regulatory interventions or oversight. Moreover, it is unclear how much compliance new regulations and guidelines command among Chinese scientists and doctors, at least some of whom evidently regard such controls as intrusive and unnecessary. While this regulatory vacuum currently presents scientists with few problems, the longer-term consequences may be more difficult. Public confidence may be challenged if scientists fail to deliver hoped-for benefits, or if unregulated innovation leads to unanticipated economic, ecological or health problems. Meanwhile, the absence of effective ethical and regulatory procedures is potentially damaging to China's standing in the global scientific community, and could lead to increasing isolation of Chinese scientists from developments elsewhere.

In Britain, by contrast, regulatory legislation and ethical guidelines command widespread assent and compliance by scientists and doctors. Compliance with such measures is valuable both in securing public legitimacy and in promoting forms of scientific and medical practice that conform to nationally and internationally agreed ethical standards. An important factor in bringing about the smooth working of this regulatory system, particularly in the area of medical biotechnologies, has been the creation of a number of organisations, including the Human Fertilisation and Embryology Authority and the Human Genetics Commission, which enable diverse scientific and lay interest groups to participate in legislative and regulatory processes. These organisations also engage in a variety of public engagement exercises designed to assess public attitudes, and build such attitudes into their regulatory and advisory processes. Public engagement activities are also undertaken by large population-based genetic experiments such as UK Biobank and Generation Scotland. It is not clear whether such exercises actually ensure that medical biotechnologies develop in ways that best serve the public interest, but they do help to frame the ethical and legal protocols and practices adopted to govern biotechnological research and innovation. As such, public engagement activities do seem to be effective in reinforcing the legitimacy of the new sciences.

The meeting did not explicitly consider whether similar institutional models for participatory regulation would also prove to be valuable in the Chinese context. However, the question was raised on several occasions, and would seem to be worthy of further consideration. In the field of medical biotechnologies, it might be worth asking whether some system of participatory involvement of scientists, medical researchers and others, similar to that run in the UK by the Human Fertilisation and Embryology Authority or the Human Genetics Commission, should be established; whether such a system would help to secure voluntary compliance with ethical guidelines by ensuring that those guidelines were supported by appropriate expert groups; and whether such a body

would provide an acceptable means of monitoring and auditing compliance within the relevant Chinese scientific and medical communities. Such measures might prove particularly effective if it was more widely accepted that compliance is will be necessary in order to improve international recognition and collaboration for Chinese scientists. Similarly inclusive and participatory procedures may also be worth considering in the field of agricultural biotechnologies, not just as a means of promoting compliance with national and international expectations; they may also provide a means of ensuring that the regulation of R&D and innovation is not simply driven by Western standards, but is suited to the specific socio-economic circumstances of Chinese agricultural production.

4 Outcomes

The meeting was distinguished by two full days of illuminating discussion of the social, ethical and legal aspects of the new life sciences in China and in Britain. In particular, the participants gained considerable insight into how the social circumstances and trajectories of biotechnological development in China differed from developments in Britain. Perhaps most importantly, the participants gained a deeper awareness of the fact that while new biotechnologies offer remarkable opportunities to bring social benefits to China, they also carry a potential risk of social disruption and popular disillusionment with science and technology. While new biotechnologies currently enjoy widespread governmental support in China, attention may need to be paid to implementing effective ethical and regulatory procedures, and to undertaking new forms of public engagement, if new biotechnologies and public expectations are to continue in harmony with one another. Attention to ethical and regulatory matters may also be vital if Chinese scientists and doctors are to participate in international collaborations.

In the course of these discussions, a number of issues emerged as particularly deserving of further attention and action, and several ways were identified of taking this forward:

- More **research** is needed into the development of biological science and technology in China, for instance into the socio-technical aspects of agricultural innovation, as well as the implications of modern agricultural technologies for biological diversity and its conservation within agro-ecosystems. The meeting identified a number of opportunities for collaborative research, and for securing appropriate funding, which will be taken forward by the researchers concerned.

- Further **expert workshops** will be valuable for pursuing a more focused exploration of particular issues such as the role of institutional and social arrangements in achieving effective regulation of biological research and development in both agriculture and medicine. Opportunities for funding such workshops were identified, and concrete proposals will be developed in due course.

- There exists a need to build greater understanding of the social, ethical and legal aspects of new life sciences and technologies in China, particularly among younger researchers. Collaborative **summer schools** were identified as a particularly worthwhile means of building such capacity. Again, opportunities for

funding such summer schools were identified, and concrete proposals will be developed shortly.

Overall, the meeting was notable for fostering an enthusiastic spirit of cooperation and mutual understanding between the Chinese and UK participants, and an active desire to work together to develop the themes and issues identified in the course of discussion. This is a most valuable outcome, and augurs well for future activities in this area.

Delegate list

Professor Sarah CUNNINGHAM-BURLEY	Human Genetics Commission	University of Edinburgh
Professor John DUPRE	Egenis	University of Exeter
Ms FAN Yingjie	Bureau of International Cooperation	National Natural Science Foundation of China
Professor Neva HAITES	Human Fertilisation and Embryology Authority	University of Aberdeen
Professor HAN Jianguo	Bureau of International Cooperation	National Natural Science Foundation of China
Professor Søren HOLM	Cesagen	University of Cardiff
Professor HU Qingli	Office of the President	Shanghai Jiaotong University
Professor Steve HUGHES	Egenis	University of Exeter
Professor LI Zhen	Institute of Animal Science and Veterinary Medicine	Shanghai Academy of Agricultural Sciences
Professor LIU Yinliang	Bio-Law Research Centre	China University of Political Science and Law
Professor LU Baorong	Institute of Biodiversity Science	Fudan University
Professor LU Lan	Department of Social Sciences	Hangzhou Dianzi University
Professor PENG Yufa	Institute of Plant Protection	Chinese Academy of Agricultural Science
Professor QIU Xiangxing	Chinese National Human Genome Centre	Shanghai Jiaotong University
Dr Peter ROBBINS	Innogen	Open University
Prof SHEN Mingxian	Chinese National Human Genome Centre	Shanghai Jiaotong University
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Professor ZHU Zhen	Institute of Genetics and Developmental Biology	Chinese Academy of Science