Chapter 12
Conclusions: Incorporating Ethics into Science and Technology Policy

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The rapid developments in science and technology raise many ethical questions and regulatory challenges. To address these, we need to understand the impacts of such developments and how society should develop frameworks and institutions to address them continually. In post-World War II Europe and the USA, many initiatives have been taken to address ethical issues, including the development of institutional frameworks based on ethical guidelines and values, and of appropriate international protocols and guidelines. The World Health Organization, the United Nations Educational, Scientific and Cultural Organization and other international institutions including professional bodies have played an important role in the internationalization of ethics in science and technology.

In developed countries, various bodies and independent initiatives carry out some form of social-ethical analysis. Often organizations conducting technology assessments or advising governments on such assessments perform this function. In the USA, the Presidential Commission for the Study of Bioethical Issues undertakes

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the task when required, and the erstwhile Office of Technology Assessment used to include social-ethical analysis in its findings and reports. But the social-ethical analysis of technologies received a boost when, as part of human genome research, studies on ethical, legal and social issues were funded in the USA and Europe. There are many bodies in Europe that can undertake technology assessment and/or analyse ethical, legal and social issues in new technologies. In China there are initiatives in this direction, but not many bodies to undertake such assessment, nor is there a single organization with this role. In the case of India, the Technology Information, Forecasting and Assessment Council was established with a mandate to perform technology assessment, but it has not done much work in that area.

As is clear from the preceding chapters, Global Ethics in Science and Technology is a project that seeks to contribute to these assessments and processes by developing frameworks that facilitate dialogue and by improving practices that bring together policy-makers and stakeholders.

12.1 State of the Art of Debates in the Three Regions

Naturally the three regions have different needs, perspectives and priorities in science and technology developments that in turn influence debates on ethics and the social impacts of science and technology. Nevertheless, many similarities are evident in the roots, processes and even resolutions of some debates. The starting point of the comparison undertaken in this book was to look at the roots of attitudes and perspectives in value and belief systems in the three regions.

The value systems display perhaps the most obvious differences between the three regions. The Enlightenment-derived values of justice, dignity, freedom, citizen's rights, solidarity and equality in Europe appear rather different from those of progress, affluence, peace and harmony that we see in China, or those of development, self-reliance and scientific temper that are pursued in India. This is perhaps not surprising, as the trajectories of science and technology and historical developments are different in each region. But, as we have seen in the cases of India and China, a contemporary understanding of ethics is not necessarily attached to traditional belief systems. Instead, those systems derive their logic from notions of development (mainly economic), social progress and social coherence. These appear less contradictory to contemporary European values that derive from the common understanding of a new humanism than the prescriptions of traditional belief systems deriving from religion. There are similarities among regions at the level of applying science and technology.

There are similarities in the official ethics advisory structures of the three regions. All three have also established quasi-official institutional ethics advisory structures at the level of professional associations, health care practitioners and environmental organizations. There is a clear trend in all three regions towards the institutionalization of ethics advisory mechanisms within the official decision-making structures that permeate most national science and technology bodies.

Our comparison of lay morality indicators was drawn mainly from public perception survey data, mainly in China and Europe. We found that the European

public appear to have a twofold, and perhaps contradictory, view of science and technology—simultaneously positive and extremely cautious—while the Chinese public seem more inclined towards a categorically positive view. For instance, 89 % of Chinese respondents agree that 'science and technology make our life healthier, easier and more comfortable', compared to 66 % of Europeans. Similarly, on the other side of the spectrum, only 14 % of the Chinese questioned agree that 'scientists are scary because they have the knowledge and capability to change the world', compared to 53 % of Europeans. The limited data that we examined in India point in the general direction of a highly positive view of science and technology, with some reservations when it comes to developments that have created intense public debate, such as genetically modified foods.

In the case of Europe, the strong civil society culture has a direct influence on various debates about specific technologies (e.g. genetically modified foods and nanotechnologies), whereas far more limited but nevertheless intense civil society participation is evident in China and India. The Chinese government's most recent science and technology programme explicitly promotes public participation in decision-making, although it is uncertain how this will be realized. In India, civil society groups are organized around specific themes (e.g. the genetically modified Bt brinjal), with activities focusing on the empowerment of marginalized groups to influence policy processes.

The development of participatory technology assessment has also been widely dissimilar in the three regions. This approach is well established in Europe as a means of bringing about a structured stakeholder debate on science and technology. In China, which has an energetic but unstructured civil society sector, participatory technology assessment is recognized as a positive development but not applied widely yet: the occasional exercises in this form of assessment are the result of isolated institutional initiatives. In India there is no evidence of such development at either governmental or institutional level.

Based on this comparison, the parameters were identified on which to base an analytical methodology that could produce in-depth comparisons between the three regions on the discussion and adoption of ethics. The methodology was designed to compare debates on values, rights and ideals aiming at engagement in public discourses on regulations, politics and governance. These debates are historic, influenced by cultural norms, and reflective. They focus on the risks and side effects of science and technology, but also on goals and problem-solving possibilities, and thus address in addition the chances for innovation in socio-economic contexts.

12.2 Mainstreaming Socio-ethical Analysis in the Three Regions

Mainstreaming social-ethical analysis in science and technology policy is an important objective, and there are many ways of achieving it. This is not so easy, however, when social-ethical analysis is considered irrelevant or an impediment to policy-making. The dearth of institutions that give priority to mainstreaming or

integrate it as part of their mandate constrains mainstreaming. Another important issue is that of the values and normative guidelines that should help mainstreaming. Often the introduction of universal values and claims that seek to guide institutions is resisted, as they are perceived to be impositions from abroad, or the values are perceived to be out of context or likely to create conflicts with current practices. The challenge lies in addressing these concerns, but this can be done by identifying values that are acceptable and during the process of framing ethical issues.

In China and India, the innovation discourse is the dominant discourse, and science and technology policies have objectives that are closely linked to national development, economic competitiveness, self-reliance and strategic interests. Hence the science and technology policy-making process is more influenced and directed by actors and agencies that articulate visions embracing such objectives. Elsewhere in Asia, in countries where the hands of the developmental state not only point the direction but also set the objectives, this has had significant impacts on science and technology policy. Thus the experience of India and China indicates that the science and technology policy process has provided little scope for other voices and discourses, and social-ethical analysis has not been given the importance it deserves. This is changing, however, as evident in India's Science, Technology and Innovation Policy and in the initiatives taken by the Chinese government to assess public opinion and perception, as well as the increase in importance given to ethical, legal and social issues in science and technology policy.

Mainstreaming social-ethical analysis does not mean that India and China should replicate structures and processes that are found in Europe or the USA, nor that they should adopt the same policies. Mainstreaming as a process will take time to take root and expand. Hence the modalities of mainstreaming have to develop, taking into account the science and technology contexts, the relationship between science and technology and society, and the diversity in stakeholders in either country.

India and China have agencies for technology assessment and significant power to undertake social science research involving social-ethical analysis. Scientific bodies and scientists' organizations often express interest in understanding social-ethical implications and in issues of science, technology and society. With policy-makers acknowledging the importance of understanding social-ethical implications, the modalities of mainstreaming can be developed. Both countries need to expand their institutions for technology assessment and to broaden the mandate of those institutions to include social-ethical analysis. The use of public perception surveys should be expanded in China, and in India such surveys need to be undertaken systematically. Science academies, universities and publicly funded institutions can act as bridges between policy-makers, those who undertake social-ethical analysis and those who represent other voices.

Mainstreaming can thus be achieved by giving due weight to modalities, institutionalizing and mutual learning. Such an approach will help develop mainstreaming that is contextual and appropriate, and this will contribute to understanding convergences and divergences in approaches and the comparative analysis of value systems and ethical principles in the three regions.

12.3 Food Technologies in the Three Regions

Mainstreaming social-ethical analysis in food technologies is an important task, but as social impacts and implications are considered in policy-making and in technology assessment, the major task lies in incorporating ethical concerns and linking them with the technology assessment and social impact assessment of food technologies. As discussed earlier, the idea of ethics varies from region to region, depending on each region's unique value system. China has ample experience in this context, as the frequency of such surveys has gone up recently. Both India and China have robust systems for assessing gains in productivity and measuring economic benefits from technological interventions. These can be used effectively to develop the analysis of socio-economic impacts and also to investigate whether technological interventions enhance access to better technologies.

Mainstreaming social-ethical analysis in food technologies means going beyond a productivity-oriented innovation discourse in assessing technologies and incorporating wider concerns and values. For this, the capacity of the current system to address these concerns has to be improved. The institutional capacities have to be strengthened so that, through dialogue and consultation, the experts, lay public and farmers can interact and come to know and understand the positions and views of other stakeholders. India and China have a long way to go in this, and can learn from Europe, which has rich experience of stakeholder engagement and getting feedback on technology from consumers. At the same time, however, Europe can also learn from the strong focus in China and India on societal goals as part of science and technology programmes.

Similarly, India and China can jointly assess the technological options and what social-ethical aspects need to be studied as a priority to ensure that policy-making is sensitive to the different concerns of different stakeholders. Europe can learn from the experience of India about how to deal with different technological solutions and how to develop approaches to food technology that go beyond simply taking a stance for or against genetically modified foods.

12.4 Nanotechnology in the Three Regions

Our brief survey, as evident from the case studies, reveals that innovation is the dominant discourse in all three regions, while the risk discourse does not have the same importance. The power and control discourse, which is articulated through important actors who are also the promoters of nanotechnology, in conjunction with the innovation discourse, sets the baseline for policy-making. While nanotechnology is an emerging technology with universal appeal and application, the capacity of countries to invest in and apply it is not uniform. A social-ethical analysis of nanotechnology needs to be mainstreamed, and would not be the antithesis of innovation discourse. If this is understood clearly, then it will be easy to evolve policies to mainstream.

In the case of nanotechnology, modalities to mainstream range from institutionalizing structures supporting research into ethical, legal and social implications to integrating socio-ethical assessment into decision-making. But when innovation discourse dominates the policy discourse and regulatory issues are neglected, mainstreaming has to begin with the task of advocacy and arguing for socio-ethical analysis, to gain space for such thinking in policy-making. Dialogue with policy-makers and scientists, and creating an understanding that mainstreaming socio-ethical analysis will not hinder innovation or the funding of nanotechnology, can be used as the first two steps in convincing the policy-makers and other actors about the need for mainstreaming. Simultaneously it is important to contextualize mainstreaming on the basis of relevant issues and concrete objectives. For example, environmental, health and safety issues can be emphasized in relation to the need to avert disasters like the Bhopal gas tragedy, while the safety of products can be stressed as a precondition for winning consumer acceptance.

12.5 Synthetic Biology in the Three Regions

The innovation discourse in synthetic biology capitalizes on the potential of this field and emphasizes the new avenues that it opens up. In Europe this discourse integrates synthetic biology with the knowledge-based bioeconomy perspective, which envisages a greater role for biotechnology and synthetic biology in the transition to a bioeconomy. In contrast, the innovation discourses in India and China do not give emphasis to the idea of bioeconomy and perceive synthetic biology more as a continuation of the biotechnology and genetic engineering paradigm. In China the innovation discourse highlights opportunities for China to leapfrog its competitors using synthetic biology and considers this a great frontier of modern biotechnology. While the risk discourse in China underscores the case for cautious optimism, there is also a perception that considering ethical issues and risk dimension at an early stage hinders progress. In India, while the innovation discourse is dominant, concerns about societal issues and risks are also expressed. In the case of India, the task force report takes a comprehensive approach to synthetic biology, recognizing its potential. At the same time it draws attention to regulatory, ethical and social issues, pointing out that these have to be addressed, and also gives prominence to public engagement.

In Europe the discourses on synthetic biology have gone beyond innovation and given weight to risk aspects too, particularly the issue of dual use. Moreover, studies on ethical, legal and social issues in synthetic biology have contributed to policy-making in this field. Thus Europe has a better understanding of and road map for synthetic biology, and the innovation discourse is tempered by risk discourse and social-ethical concerns. This has influenced the policy-making process too. In India and China, the risk dimension is underplayed or considered a technical issue, while in Europe it is assessed differently, focusing on regulation, biosafety and stakeholder involvement in decision-making. While public engagement is virtually absent from the discourses in India and China, it is given enough importance in Europe.

But as synthetic biology is in its nascent stages in India and China, and is yet to get major support from governments, we can expect more vigorous debate and discussion in future. At the same time, because these countries have not paid any attention to ethical, legal and social issues so far, while Europe has given them some weight, discourses on social-ethical analysis may not evolve rapidly. Since industry and scientists are aware of issues in biosafety and risk, which are becoming increasingly important to research and development, it is likely that even if civil society is not active in this area, industry and scientists will press for greater biosafety and more comprehensive regulation and harmonization with global standards and practices.

Mainstreaming therefore has to be done taking into account the contexts and issues. For this it is better to start with technology assessment mechanisms. Since some scientists are concerned about biosafety and regulation, persuading them that, while these are important, there is also a need for the broader perspective that social-ethical analysis can provide will enable more support for mainstreaming. Because synthetic biology is more complex than biotechnology or genetic engineering, it would be useful to form interdisciplinary groups of scientists to address issues, and more interaction with stakeholders would help create awareness and open up spaces for dialogue and debate. National academies of sciences and professional bodies can play an important role in this.

Another important issue is that of assessing lay perceptions and values, and the public's understanding of synthetic biology. China has carried out many surveys on public perceptions of science and technology, but India has yet to begin. Mutual learning between India and China in addressing social-ethical issues is desirable. As both countries are in the initial stages of development in synthetic biology, now is the time to initiate these efforts. For example, India and China can develop models for public engagement, identify key issues in biosafety that are of interest to both countries and consider joint programmes for developing biosafety regimes and regulating synthetic biology. As both countries have to take positions at global level on dual use and on the linkages between synthetic biology and the Biological and Toxin Weapons Convention, the Cartagena Protocol on Biosafety and the Convention on Biological Diversity in addressing issues of global governance, the scope for joint work on these issues is immense. This work can also be used in social-ethical analysis. Hence India and China can explore options for greater collaboration and mutual learning in synthetic biology.

12.6 Conclusion

Mainstreaming ethics in science and technology policy-making is a major challenge that needs to be addressed flexibly. Given the diverse contexts, and the influence of various discourses in policy-making and the normative values embedded in them, it is not possible to suggest a one-size-fits-all approach or solutions based on that. The innovation discourse on science and technology for development is dominant in China and India, while in Europe the institutional mechanisms are in place

to consider stakeholder views and introduce ethical values into technology assessment exercises. Mainstreaming can be achieved in many ways, and the outcomes need not converge but can result in divergences that are relevant and suitable to the given national context. Besides the suggestions made in the various case studies, the project has found that a number of specific steps would be necessary to make mainstreaming more acceptable and relevant in the three regions.

- *Establish common global deliberation platforms on the social determinants of science and technology*

Global Ethics in Science and Technology has been the start of such a deliberation platform. Establishing a permanent forum that includes all major global science and technology players will provide space for global deliberation. This will need a specific programme with wide membership and equitable financial contributions to set up a regular platform for discussion and to initiate research programmes on specific global challenges in science and technology.

- *Initiate capacity-building programmes for common structures on ethics policy advisory*

Our review has shown that proper ethics institutionalization requires official structures to analyse relevant issues and accordingly advise policy-makers on the options available for action. Technology assessment has taken up this role in most European countries, while participatory technology assessment has specialised in drawing in divergent stakeholders and engaging the public in the process of issue analysis. Such an institutional function and setting would be welcome in China and India. There is scope to initiate capacity-building programmes on (participatory) technology assessment methodologies in order to allow similar initiatives to take hold in the particular context of India and China.

- *Promote the development of common social impact indicators for science and technology*

Impact assessment is important in establishing socio-ethical analysis in any region. Impact indicators are a complex but necessary step in such assessment. The Organisation for Economic Co-operation and Development has already started by bringing together an expert group to work on improving the current set of indicators. The United Nations Educational, Scientific and Cultural Organization and other relevant United Nations organizations can contribute. In this context, developing such indicators for emerging technologies is very important, and will be relevant for studies on responsible research and innovation.

- *Develop comparative systematic public perceptions databases*

Public perception surveys on science and technology in general or on specific technologies are important sources of feedback and information. Unfortunately, such surveys are not widely used, which hampers the possibility of direct comparisons between countries and cultures. Directly comparable public perceptions data will be needed if a common understanding is to be reached and a common analysis

pursued. This can be done with the establishment of an expert group to devise a common survey to capture the diversity of values and local perceptions of risk and benefit.

- *Promote common templates of public engagement*

This is a serious challenge in all three regions. Europe has a clear tradition of public engagement, while India and China are willing to develop structures to promote it locally. It would be desirable to develop common templates and structures of public engagement in order to allow for direct comparisons where possible. With respect to national traditions in public discussion and decision making, it would be possible to develop common programmes of engagement through established participatory technology assessment methodologies.