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**Tracing policy connections: the politics of knowledge in the
Green Revolution and biotechnology eras in India**

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Summary

This paper explores the dynamic interaction of global and more local knowledge about agriculture, food and rural development through a comparison of policy-making during two periods in India – the “Green Revolution” and “biotechnology” eras. The paper highlights how the biotechnology era differs in a number of key respects from the Green Revolution. These include: the nature and complexity of policy narratives associated with agriculture, food security and poverty; the types, numbers and networks of actors inside and outside the state involved in policy-making; the form and location of expertise and sites of policy-making, from the local to the global; and the nature and extent of policy debate, controversy and dissent. Between the two eras, the paper shows how policy emphases have shifted from a focus on national food self-sufficiency and nation-building in a planned economy to engaging with a liberalised, highly unequal and uncertain global market economy and, with this, from Cold War security concerns to liberalisation and trade issues. Agricultural policy debates have thus shifted from small-scale farming for food production to agriculture as a globally competitive industry. The result has been a move from the involvement of relatively few players in the policy process to multiple players, including many non-state actors (such as NGOs, private sector corporations, the media), each with global connections. Funding flows too have changed from international philanthropy with state support to an increasing reliance on the private sector. This is associated with different practices of science – from field based to lab based – and from research premised on the free exchange of knowledge to research governed by intellectual property concerns and commercial confidentiality. Despite the easy similarities and apparent continuities between the two eras – used prolifically in popular and policy discourse – the paper argues that the biotechnology era is unquestionably different. There is not going to be a simple replication of the great Green Revolution story in India, and, the paper argues, more attention needs to be paid to the important differences in policy context and process if some of the challenges of the biotechnology era are to be met.

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Preface

Biotechnology Policy Series

This IDS Working Paper series emerges from a series of three interlinked projects. They involve collaboration between IDS and the Foundation for International Environmental Law and Development (FIELD) in the UK and partners in China (Center for Chinese Agricultural Policy (CCAP)), India (Centre for the Study of Developing Societies, Delhi; Research and Information Systems for the Non-Aligned and Other Developing Countries (RIS), Delhi; National Law School, Bangalore), Kenya (African Centre for Technology Studies, Nairobi) and Zimbabwe.

Three key questions guide the research programme:

- What influences the dynamics of policy-making in different local and national contexts, and with what implications for the rural poor?
- What role can mechanisms of international governance play in supporting the national efforts of developing countries to address food security concerns?
- How can policy processes become more inclusive and responsive to poor people's perspectives? What methods, processes and procedures are required to "democratise" biotechnology?

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1 Introduction

One important, yet often under-appreciated, element of globalisation is the relations of knowledge that underpin it. Particular types of knowledge frame the way globalisation and poverty reduction challenges are seen, reflecting particular interests, actors and power relations. This paper explores the dynamic interaction of global and more local knowledge¹ about agriculture, food and rural development through policymaking in two periods in India – the “Green Revolution” (GR) and “biotechnology” eras. In the vanguard of the Green Revolution in the 1960s and now a vibrant centre for the development of agricultural biotechnology, India is an interesting case through which to trace these connections across both space and time. Its institutions for agricultural research are well established and policy is generally well-documented, making it possible to discern quite clearly the links between knowledge, policy-making processes and, indeed, policy outcomes. Analysis of the two periods offers insight into policy-relevant questions that may be raised in other country contexts, including: in what ways has the status of food security on agricultural policy agendas changed over time? How does the promotion of food security, as a policy goal, fit within a development path that increasingly emphasises trade and financial liberalisation? What are the implications of a configuration of different actors (with different relative strengths) for the way policy is made?

In India national policy debates have been influenced – and sometimes in turn influence – globalised narratives for policy. Such narratives, which define both the assumed problem and proposed solutions in often neat, appealing storylines (cf. Roe 1991), are promulgated through key actors and their networks. In discerning this complexity and tracking the dynamics of policy processes, personal, institutional, political, business and other connections are important (Keeley and Scoones 1999). However apparently globalised knowledge is neither uniform, nor immutable. Further, there is always an interchange between local settings and global processes. National bureaucratic cultures, the path dependence of institutions, national economic and political imperatives, and the influence of key individuals all come into play, to disturb any neat mapping of the global onto the local.

To examine these local-global connections in knowledge relations surrounding science and technology, this paper focuses on policy debates surrounding agricultural technology in two contrasting periods in India – the so-called Green Revolution era (from the late 1950s to approximately 1970) and the more recent biotechnology era (from around 1990 onwards). This historical contrast highlights a number of key continuities as well as a number of significant disjunctures between these eras. While in policy rhetoric in India and internationally much play is made of the successes of the Green Revolution being a precursor to similar advances for the biotechnology era, some caution is suggested in extrapolating too much.

The implications of these similarities and differences for understanding the nature of policy-making, and particularly the political economy of global and national knowledge relations, is the subject of the

¹ The terms “global” and “local” knowledge are used in this paper more in a figurative (rather than literal) sense as a way of referring broadly to different sites of knowledge.

remainder of the paper. The next section highlights the contrasting contexts and structural conditions in the two periods, showing how wider political and economic circumstances shape ideas that are constructed and taken up in policy. The third section examines the discursive framing of debates, both global and Indian (and the many hybrids), in the two periods. It begins with an examination of the different constructions of “development”, and particularly agricultural development, and considers how science and technology are viewed within these as a means towards some form of “modernisation”. The penultimate section analyses how these narratives have been deployed in particular sites of policy-making, highlighting the changing role of the state and external actors in the two eras. The political and bureaucratic influences on policy are examined in more detail, with particular attention given to institutions and individuals identified as central in both the Green Revolution and biotechnology eras. The final section considers the foregoing comparison of the two periods, highlighting change and continuity between them.

The paper demonstrates how different narratives about science, technology and food security are associated with different networks of actors, and emerge out of particular contexts and conditions. In contrasting the two eras, it is the diversity and complexity of the contemporary policy context that sets the biotechnology era apart. While global connections were of course important in the Green Revolution era, as the paper shows, these were fairly limited and quite predictable. Today globalised connections are much more complex, contested and variable, linked as they are to the global market interests of multinationals (MNCs), the political posturing of a range of countries, and the array of networks that make up modern biological and crop sciences. Whereas the Green Revolution represented very much a coincidence of interests between US concerns with national security and population growth with India’s concern for national food self sufficiency, in the biotechnology era, because of the wider range of actors involved, interests are more fractured, representing often deeply divided sets of perspectives. What remains the same, however, is that scientists and science are in the middle, pulled in different ways, but today, as the paper shows, the political economy of knowledge is far more fraught, with MNCs, Indian corporates, industry lobbyists, governments, international agencies, non-governmental organisations (NGOs) and farmers movements all claiming “science” to be on their side.

2 Policy contexts and conditions: political and economic framings

How debates are framed and the ways policies are executed depend, at least in part, on the larger contexts and conditions prevailing at a particular time. This section looks at how the international and national concerns with security were important in the Green Revolution era, whereas liberalisation and economic growth in a globalised economy are more significant in the biotechnology era. The ways issues of science, technology and food security are in turn viewed are, not surprisingly, different, conditioned by this broader political economy.

In India, the Green Revolution era was heralded by the introduction of dwarf wheat varieties imported from Mexico that showed the potential for massive yield increases, and the opportunity for a

major technological boost to the agricultural sector². In the biotechnology era, the projected and assumed potentials of transgenic technologies promise higher yields, reduced pest and disease incidence, and resistance to stresses of various sorts, from drought to salinity to poor soil fertility. For the advocates of both, the future is mapped out in terms of a scientific and technological revolution, where global science and collaborative research partnerships would result in major development gains. Yet, despite some similarities, there are of course many differences, not least in the political-economic settings for these debates.

The initial movement toward technology-driven increases in agricultural production occurred in the shadow of India's independence in 1947, and in the midst of the Cold War. These two phenomena provide an important context within which to situate Green Revolution narratives of agricultural development and technology. The struggle for, and acquisition of, independence from Great Britain in 1947, powerfully influenced India's development path in subsequent decades. This path was defined by the project of nation building, and inspired by ideals of *swaraj* (self-rule) and *swadeshi* ('of one's own country') drawn from the independence movement. These ideals were re-interpreted in the emergent post-colonial context, such that the achievement of national self-sufficiency was an important component of nation building. Jawarharlal Nehru observed:

the objective for the country as a whole was the attainment as far as possible of national self-sufficiency. International trade was certainly not excluded, but we were anxious to avoid being drawn into a whirlpool of economic imperialism . . .

(Nehru 1946: 398)

Indeed, during the early decades of independence, development was defined against the history of colonisation. The principle exponent of this development path was Nehru who carried this discourse across colonial and post-colonial epochs, in his capacity as freedom fighter and then as India's first Prime Minister. Under Nehru and his chief economic advisor, P.C. Mahalanabois, India pursued a policy of import-substitution industrialisation (ISI).

Although agriculture was acknowledged as important for development, Indian planners prioritised industrialisation. This emphasis did, however, generate intra-bureaucratic and intra-governmental controversy and debate: the Planning Commission broadly, was a proponent of rapid industrialisation, while members of Cabinet and state Chief Ministers sought a more prominent place for agriculture in development policy. Nonetheless, achieving self-sufficiency in food production was an objective – if not a priority – at this time. Indeed, in 1947 the Foodgrains Policy Committee stipulated that dependence on

² There is a vast literature on the Green Revolution, particularly in India. For early analyses, see Farmer (1977), Frankel (1971). For more recent reflections, see Bayliss-Smith and Wanmali (1984); Conway and Barbier (1990) among many others.

food imports should be phased out and that India's food problem, consisting of the chronic shortfall of the actual from the required quantity of food produced domestically, should be solved by increasing domestic agricultural production (Chopra 1988: 122).

The development of the Cold War during the 1950s and 1960s increased the strategic significance of South Asia and influenced India's agricultural policy and development in several ways. India, like many other newly independent developing countries, responded to the Cold War by adopting (at least in principle) the position of non-alignment as a key element of its foreign policy. The philosophy of non-alignment and its attendant emphasis on economic sovereignty was, however, amenable to India's own agricultural policy goals of food self-sufficiency. Thus, the heightening of Cold War tensions imbued food self-sufficiency with renewed relevance, as did its 1965 war with Pakistan. In this sense, the international political situation both shaped and reinforced nationally defined development objectives.

Donor strategies and policy priorities, especially those of the US, add a further dimension to the global-national interplay around India's agricultural development. In 1956 India (revealing one of many internal contradictions in its policy of non-alignment) signed a Public Law-480 agreement, under which it received US grain on concessional terms. Insofar as PL-480 played an important role in the US strategy of containing communism, US foreign policy and India's agricultural development policy became intertwined.

It is in the context of this intertwining that neo-Malthusian discourses of a population "explosion" acquired salience in donor policy during the Cold War. Citing population growth in the developing world as an issue relevant to its perspective on national security, the US intellectual and policy elite posited a causal link between "overpopulation", hunger, political instability, and communist insurrection (Perkins 1997: 119–20). Curbing population growth and hunger became priorities in the American development agenda, and breaking this chain of causation involved the 'enlightened transfer of modern technology' (Perkins 1997: 133). In combating hunger, the efforts of agricultural science to increase yields figured prominently.

The involvement of the US philanthropic foundations in India's agricultural development must, therefore, be understood in this context of interwoven development and security agendas. Beginning in the mid-1950s the Rockefeller Foundation supplied scientific advisors and funds to increase cereal production and improve the Indian Agricultural Research Institute (IARI). A report by the Foundation, published in 1969 noted:

India is not only winning the battle to feed herself . . . but is also breaking out of a centuries-old bondage to mere subsistence into an era in which her hundreds of millions of people can face the future with confident self-reliance . . . India has, then, bought a few years time – some say 10 years – in which to get her population growth slowed down while she pushes her level of food production

still faster. Current estimates indicate strongly that she will have to use this time to the utmost; for she has not yet won her race with food shortage, and indeed may well be on a collision course with it again in a few years.

(Streeter 1969: 4)

The narrative articulated by the Foundation neatly weaves together the notion of a battle against population growth, the need to increase food production (depicted as a race against time) with the ideal, more resonant in India, of 'confident self-reliance'. Connections between US foreign policy, development assistance and foundation philanthropy, and state building in India are thus co-constructed at this time, often through networks of influential individuals, both in the US and in India. For example, there were strong connections forged between the Rockefeller Foundation, the US aid programme, and the Indian government at this time. In 1966 Dr A.H. Moseman, Assistant Administrator for Technical Cooperation and Research, USAID was on leave from Rockefeller, and had close relations with the Indian government. In the same way the now world famous commentator on food and environment issues, Lester Brown, was in the mid 1960s a staff economist with USAID, and was quoted by the Union Minister of Agriculture in India, and by the Rockefeller Agricultural Science Programme when, in 1966, he sounded the alarm by observing: 'The less developed world is losing the capacity to feed itself'.

Attention to agricultural development exhibited by the major US philanthropic organisations was also displayed by multilateral institutions, particularly the World Bank. In 1965 it published an extensive report, known as the Bell Report, on India's economic policies. The review of the agricultural sector, written by Sir John Crawford, criticised the secondary status of agriculture in India's planning policy. The Report's recommendations (which provide a striking contrast to the Bank's current policies) included: public sector intervention through price supports, a public system of grain procurement to regulate prices, increases in fertiliser imports, greater supply of improved seeds, agricultural credit and subsidies to encourage the use of inputs, and expansion of the irrigation system (Lele and Balu Bumb 1995: 10).

In the post-independence period, therefore, global political circumstances – chiefly the Cold War – became inter-linked with India's agricultural development, producing a seemingly paradoxical convergence, riddled with contradictions, of the US strategy of containment and India's goals of food self-sufficiency. The mobilisation of knowledge and expertise within international development circles proved important in bringing about this convergence, as we shall see in more detail below. A network of actors, drawn from across the world, but particularly the USA, rallied around a neo-Malthusian discourse with emphasis being placed on the rapid increase in yields through the application of agricultural technology. The policies and projects associated with these international (though basically American) donor discourses, became in turn linked with a set of different and distinctly Indian narratives that instead wedded science and agricultural production to nation-building, sovereignty, and self-reliance, through a different alliance of scientists, administrators and politicians.

While the Green Revolution technologies must be understood in a post-colonial and Cold War context, the emergence of agricultural biotechnology has been shaped far more by economic reforms of

the 1990s and particularly by the globalisation of trade and production. Indeed, in the current period the political economy of international trade and economic liberalisation dominate policy debates on agricultural development and increasingly frame issues of food security and poverty. In 1991, India accepted a six billion dollar loan from the International Monetary Fund (IMF) which, among other things, obliged it to liberalise its industrial licensing policy and relax the terms on which multinationals could enter the Indian economy. The New Industrial Policy was implemented in response to these conditionalities, and gave automatic approval to foreign technology agreements, and to Indian subsidiaries with up to 51 percent foreign equity. The completion of the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) and the subsequent creation of the World Trade Organisation (WTO) in 1994, of which India is a member, were watersheds for contemporary forms of globalisation, and hold many implications for the biotechnology policy debate which are considered below.

As a result of these economic changes nationally and globally, private sector involvement in India's agricultural sector has increased. Indeed, in the contemporary period it is private companies (Indian and multinational) that are the key players in the development of new seeds and biotechnology, rather than public research institutes and private philanthropic organisations and donors, as in the Green Revolution era. While the rate of annual growth of investment in public research fell between the period 1971–80 and 1981–93 (Chaturvedi 2001: 8), private sector investment in research and development (R&D) has increased significantly since the reforms (Pray *et al.* 2001: 6). Thus, for example, the number of private seed companies engaged in research and development (R&D) rose from 9 in 1985 to 40 in 1995 (Rao 1987: 48). Correspondingly, R&D expenditures between 1987 and 1995 also grew in real terms (1981/2 prices) from 13.1 million rupees to 46.5 million rupees (Pray *et al.* 2001: 6).

How the economic reforms play out in practice in India is of course another story, based on complex political compromises and accommodations, at both state and national levels. Within the agricultural and food sectors, for example, a decade after reforms were announced, many areas remain heavily under state patronage and control. Biotechnology, however, is seen very much as part of the “new economy”, with the private sector leading the way, usually in alliance with multinational players. While government, through the Department of Biotechnology and the Indian Council for Agricultural Research (ICAR), provides some support for research and development, this pales in comparison to the resources available from private sector players such as Monsanto, Dupont or Syngenta. Much policy talk today is about public-private partnerships, trade agreement compliance, and patents, not about major state supported programmes and national projects.

The contexts and conditions that the Green Revolution and biotechnology debates are clearly shaped by the different prevailing politico-economic circumstances in each period. Accordingly, the role of particular actors, such as the public sector, private sector, and philanthropic organisations, has also changed. How has this affected the way development, agriculture and food security are talked about? This is the subject of the next section.

3 Policy narratives: positioning debates about food and agriculture

Both Green Revolution and biotechnologies have been constructed through narratives as responses to a wider “development” challenge in India, with science and technology at the forefront. At one level there are striking similarities: in both cases the proponents argued for a science based “revolution”, transforming “backward”, “inefficient” agriculture into a new vision of modernity. In the contemporary policy rhetoric about biotechnology the continuity is of course emphasised, with the Green Revolution highlighted (despite the critiques) as one of India’s great science and development success stories. Yet, despite commonalities, it is also instructive to examine how the broader conception of “development” has changed over time, and how, in particular, science and technology fits within this. Not surprisingly, given the contexts and settings just discussed, development in general, and agricultural development in particular, are differently framed and constructed in policy across the two periods.

Though development is quite often a technocratic concept, associated with notions of modernisation and linear progress, the history of India’s agricultural development in the post-independence period demonstrates that this was not always the case. Changing constructions of development, and in particular rural and agricultural development, are traced here through India’s Five Year Plans. Following independence, development was linked with the achievement of equity and social justice, which were together constructed as the engines of agricultural growth. Bhatia (1988: 20) writes that social justice was ‘perceived to be, in itself, an instrument of growth because of its potential for releasing the productive energies of the farmer who had long suffered oppression from the state revenue authorities, the money-lender, the landholder and the trader’. The term modernisation had not yet entered the development lexicon, and agricultural policy in the First and Second Five Year Plans (1951–6, 1956–61) was directed toward tenurial reforms, institutional credit, strengthening of panchayati raj institutions, cooperative farming and large-scale irrigation (ibid).

The Community Development (CD) programme, initiated in 1952 with funding from the Ford Foundation, defined the approach to agriculture during this period. This was India’s first rural development programme, and its approach to development emphasised the integrated nature of village life, and the inter-relatedness of development challenges. This ethos is evident in the First Five Year Plan, which states:

The peasant’s life constitutes an integrated whole and his problems interact to such an extent that he does not see them in their compartments. In the same way, in approaching agricultural development, the peasant’s life and problems have to be viewed together, no doubt selecting the points at which special emphasis is needed, but aiming always at a comprehensive and many-sided effort to transform the peasant’s outlook and environment.

(Planning Commission 1951)

This excerpt also demonstrates the construction of development, specifically rural development, as a socially transformative project designed to achieve uplift.

Although the approach to development was based on social reform rather than technological progress, the transmission of knowledge was an important component of the programme. To this end, a National Extension Service (NES) was established, in which village level workers acted as conduits for the transfer of knowledge from agricultural experts at the project headquarters. Revealing the missionary-like quality of the programme Rajendra Prasad wrote in the mid-1950s that the extension workers were ‘the carriers of the message to the door of the villager’ (1955: 3). Although knowledge in contemporary analyses is most often connected with high science and advanced technologies of the present era, insofar as infrastructure was established to facilitate its diffusion and application, it was clearly also an important preoccupation of the pre-Green Revolution period.

The pursuit of equity and social justice was very much a state-led endeavour. Indeed, the Second Five Year Plan states that

[i]n a growing economy which gets increasingly diversified there is scope for both the public and the private sectors to expand simultaneously, but it is inevitable, if development is to proceed at the pace envisaged and to contribute effectively to the attainment of the larger social ends in view, that the public sector must grow not only absolutely but also relatively to the private sector.

(Planning Commission 1956)

This Plan, crafted by Mahalanobis, is most typically described as the Nehruvian vision of development in which emphasis is placed on the development of heavy industry, and agricultural development is instrumentally important to industrialisation.

Beginning with the Third Plan period (1961–66), the focus of agricultural planning went through something of a shift. Greater emphasis came to be placed on agro-chemical inputs and technology as the driving force of agricultural modernisation and progress. There was a shift from broad, holistic objectives of social transformation to targeted interventions. Goals of equity and social justice, while still acknowledged as important, were no longer paramount, and tenurial reforms (which had been implemented unevenly anyway) become ever-more peripheral. This Plan introduced the Intensive Agricultural District Programme (IADP), another Ford Foundation scheme that was grafted onto the Community Development programme. The approach of the IADP, however, differed substantially from the Community Development programme. In a strategy termed ‘betting on the strong’, fifteen districts were selected based on assured rainfall and irrigation, as well as the receptiveness of farmers to new technologies. In contrast to the broad spectrum reforms associated with the CD programme, the IADP intended to demonstrate ‘the potentialities of increase in food production through a multi-pronged, concentrated and coordinated approach to agricultural development in areas which can quickly respond to such efforts’ (Department of Agriculture 1965: 43).

It was at this time, in the mid-1960s, that technology-driven modernisation discourses acquired particular salience, reinforced and were reinforced by development programmes such as the IADP. The emergent narrative of agricultural development in the 1960s was premised less explicitly on the idea of the

nation-building ideals of social transformation and uplift (though these were by no means denied as ideals), but instead drew on the powerful discourse of an historic, universal, and linear trajectory of modernisation. This is manifest in the 1965 report, *Agricultural Development: Problems and Perspectives*, published by the Department of Agriculture:

[The] [h]istory of economic development in general and agricultural development in particular of other countries of the world shows that transformation of traditional agriculture is possible through strong injection of modern technology and scientific technique on a massive scale (1965: 3).

Technology and scientific knowledge occupy a privileged position in modernisation discourses and, as evident in the above excerpt, possess a universal applicability across both space and time. This does not mean, however, that they are imposed from outside, but rather are taken up and translated in national contexts and discourses.

The Third Plan period was interrupted by the Indo-China war (1962), Indo-Pakistan war (1965), and severe drought in 1965–6. These events brought into clear relief India’s vulnerability in the realm of food production. Other significant events at this time included the harvesting of high-yielding varieties of wheat, brought to India from Mexico by Norman Borlaug. The death of Nehru in 1964 also had important implications for India’s agricultural development. Agriculture emerged from the shadow of Nehruvian socialism and under Lal Bahadur Shastri and his Minister of Agriculture C. Subramaniam, became prioritised in India’s development planning. The Shastri-Subramaniam period saw the reorganisation of the ICAR in 1965, the creation of agricultural universities and all-India agricultural research projects, and the formation of the National Seeds Corporation and Agricultural Finance Corporation. Though Shastri’s tenure in the office of PM was brief, as we will show below, much work was done to initiate the Green Revolution in India.

The Fourth Plan (1969–74) marked a decisive break with previous plans in terms of agricultural development. It notes that ‘a new emphasis has come to be attached to the role of agricultural technology as a major aspect of agricultural production.’(Planning Commission 1969: 114). Despite this shift, however, the state remained the pre-eminent actor in agricultural development, though its role altered from achieving equity and social justice to facilitating a “strong injection” of technology and scientific expertise.

Elements of continuity with the framing and construction of development during the Green Revolution are evident in the contemporary period. The development vision is still one of modernisation and technical progress through the application of scientific knowledge, though in the present, emphasis on advanced technologies/high science and information technologies has perhaps surpassed or displaced the focus on heavy industries. Equity and social justice remain beacons, at least in India’s development planning, though they also find expression in slightly different form and frame on poverty agendas and uplift of the “weaker sections”.

Despite these threads that link past and present, important differences between the two periods are also evident. In particular, the construction of development in Indian planning has, in the last decade, been importantly influenced and changed by its liberalising economic reforms. The Eighth Five Year Plan (1992–97), crafted under the leadership of Narasimha Rao and Manmohan Singh who introduced the reforms, reflects a marked shift in the approach to planning and development. In line with the overall reduction of state control over and intervention in the economy required by liberalisation, the Eighth Plan states that '[f]rom a highly centralised planning system we are gradually moving towards indicative planning.'(Planning Commission 1992: ii). It further states that '[t]here is today a recognition that in many areas of activity, development can be best ensured by freeing them of unnecessary controls and withdrawing from State intervention.'(1992: i). The retreat of the state on several (inter-related) fronts (regulatory, trade, fiscal etc.) opens up space for increased private sector activity, which receives substantial promotion in the Ninth Five Year Plan:

One of the strengths of our economy is that we have a strong and vibrant private sector, including large, middle sized and small enterprises . . . Our development strategy must be oriented to enabling our broad based and varied private sector to reach its full potential for raising production, creating jobs and raising income levels in society. A vigorous private sector, operating under the discipline of competition and free markets, will encourage efficient use of scarce resources and ensure rapid growth at least cost. Our policies must therefore create an environment which encourages this outcome.

(Planning Commission 1997)

In this sense, the efforts of the state in the contemporary period are, as the Plan suggests, directed toward creating an environment amenable to the growth of the private sector. This is a marked contrast to the Green Revolution in which the role of the state in shaping agricultural development was far more direct.

In addition, and often in parallel to, the statements about economic reform and liberalisation some attention has been given to wider issues of environmental sustainability, consumer choice and rights in policy discussion in recent plans, economic surveys, and government statements. Here advocates of biotechnology have picked up the international discourses of sustainable development and environmentalism. For example, Alam (1994) notes that although it remains necessary to maintain and increase levels of food production, the intensive use of chemical inputs associated with Green Revolution technologies is no longer sustainable. To resolve this dilemma, he suggests that:

Recent advances in biotechnology have increased the options available to policy-makers and farmers considerably. Many of these developments have the potential of increasing agricultural productivity without a corresponding increase in the consumption of agro-chemicals. If successfully developed and widely diffused, these technologies can greatly contribute to environmentally friendly and sustainable agricultural development (1994: 65).

The biotechnology policy debate, then, must balance multiple perspectives. On the one hand, biotechnology promises to provide food for the masses, countering any Malthusian future, and on the other it also promises a future of industrial, globally competitive agriculture. Both scenarios are, in turn, intended to be environmentally sound and be governed by policies with sound regulatory checks and balances. M.S. Swaminathan dubs the biotechnology era, the “evergreen revolution”, explaining to a group of media representatives in 1999:

The use of GMOs has the potential to be of help in promoting an evergreen revolution rooted in the principles of ecology, economics, equity and ethics. GMOs can confer real benefits in agriculture, food quality, nutrition and health. However, consumer confidence based on an appreciation of the scientific evidence and the regulatory checks and balances will ultimately decide whether or not GMOs make a significant contribution to feeding the 8 billion people who are likely to inhabit our planet in 2020.

(Swaminathan 1999)

Swaminathan’s vision links the biovillages of Tamil Nadu and Pondicherry to the latest of transgenic technologies, making the most of the new biological sciences for the benefit of poor and marginal people in an environmentally sustainable manner. At a stroke, biotechnology is seen to offer the solutions to any impending Malthusian crisis as well as offering a green future, rooted in the villages of India. The rhetorical twists ensure all bases are covered, and a coalition of rural development practitioners, hi-tech scientists and politicians is forged (Visvanathan and Parmar 2002).

In addition to broad narratives of development, particular narratives around food security shaped the policies of both the Green Revolution and biotechnology periods. As we have seen, the neo-Malthusian narrative of a population explosion and food crisis gained currency prior to and during the Green Revolution through the influence of external actors and, particularly, US-based philanthropic organisations. Neo-Malthusian thinking, for example, provided the narrative framework of the 1959 Ford Foundation publication, *India’s Food Crisis and Steps to Meet It*, and helped to shift and shape India’s agricultural development strategy in the 1960s. The preface of the report stated that:

India is facing a crisis in food production. More specifically, it is a crisis in *food-grain production* because food grains comprise two-thirds of the caloric intake of the average Indian. The crux of the problem is food enough for the rapidly increasing population.

(Ford Foundation 1959: 11)

Warning of an ‘impending gap’ (1959: 1) between actual and target rates of production, the report draws on the imagery of a crisis to call for ‘Emergency Measures’ in which the application of technology figures prominently. In this respect, the report marks a shift away from notions of growth through equity, and

associated strategies of tenurial reform which typified development debates in the previous decade. Indeed, support for the latter is tempered/circumscribed:

We recognise the need for considering programmes of relief for those who have no land, and of those who cultivate too little land. But it is *imperative to achieve this objective in ways that will not retard the increases in food production which are vital to national welfare . . . Care should be exercised, however, so as not to break up farms that are efficiently and productively operated* (1959: 29; italics in original).

In the place of discourses of equity and social justice emphasis was then placed on the use science and technology to increase agricultural production. A technology focused strategy for development required the creation of a network of experts who would drive forward the vision, both in technical terms, but also as administrators, strategists and political advocates. These people became the core group of a new and important policy network, which incorporated both Indian and US expertise. The importance of a core group of technical expertise is further evident in a 1970 Ford Foundation Report, *Indian Agriculture into the 1970s: Components of Modernisation*. The Report links modernisation with the need for expertise, and argues that:

For the process of modernisation . . . there would be an increasing need for staff with technical competence to undertake the needed strategy thinking. It is necessary to recognise that it is more of a technical rather than an administrative function. The problems of modern agriculture are too complex and too technical to be dealt with by the rule of thumb methods by which those of traditional agriculture used to be dealt with by general administrators in the past (1970: 78).

This understanding of the “modernisation” of agriculture as a technical enterprise, allowed for the co-construction of science and policy during the Green Revolution era. This was led by a relatively small science-policy network, supported by “technical assistance” and foreign aid, which established a powerful agricultural bureaucracy that in many ways persists today.

These key reports spawned a range of practical development interventions on the ground, extending the visions of modernisation into implementation programmes. For example, the 1959 Ford Foundation Report, spurred the creation of the IADP in 1960. Although the IADP pre-dated the introduction of high yielding variety (HYV) seeds in India, the programme put in place the basic organisational apparatus for the subsequent development of the Green Revolution through its “package” approach to agricultural development, in which inputs, technologies, and services such as extension and credit, were supplied in combination.

The arrival of high yielding varieties was greeted in similar terms by Indian politicians and administrators. The Union Minister for Agriculture in 1965, C. Subramaniam noted in a speech entitled ‘Indian Agriculture on the eve of a breakthrough’ to the governing body of ICAR: ‘The slogan most suited to India today is ‘reduce the growth of human population and increase the density of plant population in

the field' (Subramaniam 1965: 8). Referring to Lester Brown (see above) on the dangers of continued population growth provoking a food crisis, the Minister put his faith in a scientific revolution in all spheres:

The current crisis illustrates more than anything else that India cannot continue to remain in the same state as before. In particular, it has focused the need to introduce in a committed way science and technology into our administration, our economic activity and on defence. The scientific revolution has a great role to play in making our society strong and successful (op cit, .7).

A year earlier, the new director of ICAR, B.P. Pal justified a new commitment to a science-led agricultural revolution in the following terms:

The present stagnation on the agricultural front, which is primarily due to the technical backwardness of our agriculture, will be broken only through the intensification of agricultural research . . . It is only through the adoption of science and technology that we would be able to transform agriculture from predominantly a traditional way of life to an industry . . . [This is] crucial to the success of agricultural plans and the growth of the national economy as a whole [and will require a] well knit, coordinated and integrated system of agricultural research, education and extension in the country.

(Pal 1964: 4–5)

Neo-Malthusian scenarios and associated narratives of technology and expertise retain their currency today. M.S. Swaminathan – one of the great promoters of the Green Revolution from the 1960s (see for example Swaminathan 1965a,b; 1973; 1983), as IARI scientist, coordinator of national demonstrations, director of ICAR, member of the Planning Commission and, later, Director General of the International Rice Research Institute (IRRI), notes that challenges to food security continue to be posed by, among other things, rising population, increased per capita food-grain requirements resulting from higher per capita incomes, and environmental degradation. He argues that:

There is no option but to produce more food and other agricultural commodities from less arable land and irrigation water . . . We need to examine how science can be mobilised to raise further the biological productivity ceiling without associated ecological harm.

(Swaminathan 1999a: 37)

The Nobel laureate, Norman Borlaug, another hero of the GR, is a firm believer in the potentials of the biotechnology revolution:

Even if current per capita food consumption stays constant, population growth would require that world food production increases by 2.6 billion gross tons – or 57 per cent – between 1990 and 2025. However, if diets improve among the destitute who live in hunger, estimated to be 1 billion people living mainly in Asia and Africa, world food demand could increase by 100 percent – to above

9 billion gross tons – over this 35-year period . . . To meet the projected food demands . . . the average yield of all cereals must be increased by 80 per cent between 1990 and the year 2025 . . . [G]enetic engineering will permit another 50 per cent increase in yields over the next 35 years.

(Borlaug 1997: 3, 4)

Although there is clearly continuity in the kinds of narratives around poverty and food security during the two periods, circumstances today are considerably different from those that prevailed during the Green Revolution. Specifically, the supply of food (purely in terms of the quantity produced) is not as urgent a concern as it was during the 1950s and 1960s. Despite the continued resilience of Malthusian narratives, the conceptualisation of food insecurity in academic and policy discourse altered as greater emphasis came to be placed on what came to be termed the “paradox of plenty”. While neo-Malthusian scenarios conceptualised food insecurity as a problem of supply (and therefore focused attention on increasing food production), the present paradox raised the question of how ‘famine could exist in the midst of plenty’(cf. Sen 1981). It thus shifted focus from the supply of food, in terms of aggregate production, to demand and, specifically, people’s ability to command food (Sen 1981; Drèze and Sen 1989, among many others).

Agricultural biotechnologies are thus being promoted in a very different food security scenario compared to the 1960s. Given this change in context, what narratives are used to justify their promotion? As hinted at before two somewhat contradictory stances are taken with respect to agriculture and the food sector. The most common is that, despite the current glut, this will not last, given continued population growth, growing consumer demands and so on. By 2020, for example, Bhalla, Hazell and Kerr (1999) estimate that a deficit of some 36–64 m tons of cereals will exist. The current stagnation of agricultural growth is also highlighted as an ominous sign, with yield growth, employment levels and other key indicators all dropping. National food self sufficiency is therefore seen still as a central goal in the eyes of many influential policy-makers, and ensuring this continues requires continued investment in new biotechnologies to push the yield frontiers and reduce losses from both biotic and abiotic stresses. In other words, the Malthusian spectre has only been offset temporarily, and continued technological efforts to assure national food security are required.

The second narrative focuses less on food self sufficiency and meeting impending production gaps, but on increasing efficiency and so competitiveness in global markets. In the protected economy of the 1960s, such concerns about the impact of trade on the agricultural sector were largely absent; the emphasis instead was on national objectives of food self sufficiency and self reliance. But today, with the opening up of trade under WTO rules, there is much debate within India about the likely impacts of the removal of quantitative restrictions on agricultural imports, and the continued imbalance in world trade in agricultural commodities, given the protectionist policies of the US and Europe. In this narrative the future of agriculture is very much in the competitive export sectors, with large, consolidated and mechanised farms competing with their equivalents in other parts of the world for high value export markets. Biotechnologies are then expected to contribute by cutting costs (labour, fertiliser, pesticides), reducing losses (from drought, pests, post-harvest losses etc.) and improving quality (vitamin or lysine

enriched products, longer shelf lives etc.). The future envisioned is not one of peasant agriculture on small farms, but of large, consolidated, commercial farms competing on the world market, making use of high technology to deliver economic growth. Under this scenario the poor, marginal small scale farming sector – the focus at least in rhetorical terms of the Green Revolution narratives – are not really part of the picture, being seen more in terms of state obligations for welfare support, and as part of a more general encouragement of deagrarianisation and diversification away from agriculture.

4 Making policy in the green revolution and biotech eras

Inevitably changes in both the politico-economic context and the character of narratives and knowledge relations between the two periods shape the nature of policy-making. This section considers and compares the making of policy during the Green Revolution and biotechnology eras. It highlights the interplay of international forces and institutions with domestic policy-making processes and actors in each period. Particular emphasis is placed on the changing position of the state in policy, the ascendance of the private sector, and on key actors that move and shape policy-making. The analysis draws out similarities and differences in the ways policy is both conceived of and made across the two periods, suggesting that policy-making processes around biotechnology are far more complex and contested than they were during the Green Revolution.

An underlying theme in this analysis is the changing role of the state in the policy-making process across the two periods. Prior to, and during, the Green Revolution, the central Indian state assumed an active role in agricultural development (see above). In particular, its role within the framework of the new agricultural policy was to create public institutions that would support the institutional requirements of the agricultural strategy. To this end, the Agricultural Prices Commission (APC) and the Food Corporation of India (FCI) were created to regulate and implement a system of price support and incentives, while the development of technology was supported through greater institutionalisation of public research.

The expansion of the state's role in agricultural development occurred in an international environment considerably different from the present, in which state intervention was not only tolerated and accepted but also actively supported. The Ford and Rockefeller Foundations, along with USAID, were key actors in developing India's agricultural bureaucracy and public sector research programmes (see above). Their support led to the establishment of India's agricultural universities, which were based on the US land-grant model, and to the creation of several coordinated all-India agricultural research projects. More specifically, while the Ford Foundation supported the Community Development programme and IADP, the Rockefeller Foundation funded visits of Indian scientists and researchers to US universities, and, in the early 1960s, facilitated the initial visits of Norman Borlaug to India from Mexico. These interventions created a network of actors – among scientists Borlaug from the International Maize and Wheat Improvement Centre (CIMMYT) in Mexico, Swaminathan from IARI and B.P. Pal, director of

ICAR – who became key players in the creation of the GR. Importantly, though, these players were located in publicly funded research institutions, part of a state-led and funded (although with external support) programme.

The high degree of involvement of both the Indian state and external actors in agricultural development raises the question of how the dramatic shift in agricultural strategy in the 1960s discussed above actually came about. Specifically, was the change the result of external pressure or, to the extent that the US government and philanthropic foundations were involved, were they merely ‘leaning against an open door’ (Rudolph and Rudolph 1987: 322)? Attention to domestic initiatives to bring about policy change and global pressures, suggests that an explanation may lie in the interaction of the two.

While explanations for the emergence of the Green Revolution in India have frequently accorded a prominent place to the role of the US government and philanthropic foundations (see, for example, Perkins 1997), the policy changes that brought about the shift in agricultural strategy were also, importantly, domestically generated. Although the influence of US interests was clearly present, the timing of the change is linked with specific domestic circumstances that bore on the policy process in India. The activities of the Ford and Rockefeller Foundations in the 1950s and early 1960s were important in creating an institutional framework for the Green Revolution, and building infrastructural momentum for a change to occur. But the Nehruvian emphasis on industrialisation, and the dominance of the Planning Commission which supported this vision, inhibited any substantial shift in agricultural strategy until the mid 1960s. The death of Nehru in 1964 and his succession by Shastri held significant implications for agricultural development. Although Shastri’s tenure as Prime Minister was short-lived (ending abruptly with his death in early 1966), during this brief period he was instrumental in initiating a substantial shift in agricultural policy. In a speech to the nation in October 1965, he noted:

I consider self sufficiency in food to be no less important than an impregnable defence system for the preservation of our freedom and independence . . . In the present emergency . . . every bit of land should be cultivated . . . Conspicuous consumption must be strictly avoided. Parties, dinners and lunches are not with the times at all.

(Shastri 1965: 4)

Considerably more pro-rural than Nehru in his policy orientation, Shastri appointed C. Subramaniam as Minister of Food and Agriculture. Somewhat ironically, Subramaniam – a strong proponent of the adoption of science and technology in policy (see above)— had been appointed as Minister of Steel and Heavy Industries by Nehru in 1964. He brought this orientation to the agriculture portfolio, later reflecting that ‘The fundamental departure that the new strategy involved was the emphasis on science and technology’ (Subramaniam 1968: 19). In his short tenure as Minister, he facilitated the introduction of HYVs, instituted a system of price incentives for farmers, and oversaw the re-organisation of public agricultural research. On celebrating the 60th anniversary of the Pusa Institute, Subramaniam called on the scientists at IARI ‘to provide the ideas and leadership for bringing into the field methods and techniques

which will effect a breakthrough in our agriculture and sustain its dynamic growth'. He went on: 'What is needed is a more efficient integration of research, education and extension work under the auspices of Central and State government agencies and universities' (1965b: 2).

Though Shastri and Subramaniam were clearly influential figures in bringing about the shift in agricultural strategy, an account of the domestic sources of change must also take into account of intra-bureaucratic politics. Specifically, considerable tension existed between the Planning Commission, which was generally the executor of Nehruvian vision and industrialisation, and others that sought a more prominent role for agriculture. Shastri created the Prime Minister's Secretariat, a close circle of elite policy advisors, which had the challenge of balancing the interests of the competing ministries concerned – Agriculture and Finance – and the still influential Planning Commission. Astute, careful strategising combined with the establishment of a strong, well connected network of respected scientists and established bureaucrats and politicians (see below) resulted in the creation of some 'room for manoeuvre' (Clay and Schaffer 1984), opening up a 'policy space' (Grindle and Thomas 1991), at a key moment. Thus, it was this change in the balance of bureaucratic influence which helped facilitate the establishment of the agricultural strategy. As Varshney (1989) argues, this occurred due to the particularities of the Indian context – combinations of personalities, politics and bureaucratic configurations – not just through the well documented external pressure of donors and foundations.

In contrast to the relatively homogenous narrative of the Green Revolution, biotechnology, as we already have seen, is much more varied. While there are of course echoes of the neo-Malthusian debates, and much faith in the powers of technology to deliver developmental benefits, there are other dimensions to the biotechnology debate that were absent 40 years ago. Many biotechnology advocates, as already noted, see agriculture as part of a bigger industrial enterprise, linked to export earning possibilities and global trade. For many, the future of agriculture is not for poor people without access to capital and technology, but for a new brand of entrepreneurs bringing the disciplines of industrial management and financing to the rural areas. Indeed, for many biotechnology advocates, the lines between agriculture and other productive sectors is fundamentally blurred by the life sciences concept. In the future farms are to become factories for pharmaceuticals, biofuels and other biotechnology products as well as food crops. With the agri-food business merging into a broader notion of a life science industry, the idea of small scale family farms, where poor people would gain the benefits of scale-neutral crop technologies, as envisaged in the GR, seems a long way away.

Proponents of biotechnology, by encompassing a far wider and more radical vision of agrarian change than the GR, must also respond to and accommodate the critiques of the GR. A huge literature grew up, particularly around the South Asian experience of the GR in the 1970s and 1980s, pointing to the slow progress of Green Revolution technologies in marginal areas and among poorer groups. Such studies also highlighted the dangers, both environmental and economic, of strong dependence on costly and environmentally polluting inputs, such as fertilisers and pesticides (Conway and Barbier 1990; Bayliss-Smith and Wanmali 1984). The pro-biotechnology narrative as we have seen in the commentaries presented earlier incorporate responses to all these critiques: biotechnology crops reduce inputs and are

environmentally friendly; unlike many Green Revolution innovations, biotechnology crops will be able to perform in marginal lands; and poor people, with the right credit support, will be able to afford the premiums required, or, if not, benefit from the new technologies by the generation of new life science/biotech industries in rural areas. Therefore while, riding on the wave of the GR, the biotechnology revolution must also distance itself from the problems, and suggest that the same problems will not be repeated.

At the same time, biotechnology policy must also deal with totally new issues, ones that were really not part of the debate in the 1960s and 1970s. Questions of biosafety – health and environmental impacts of release of GM organisms – have become a major public policy issue, both internationally (around the discussions leading up to and since the Cartagena Biosafety protocol) and nationally, within the Department of Biotechnology in India, as well as vigorous media and NGO debates and campaigns from the late 1990s onwards. These new concerns with risk and uncertainty, and a wider public debate about the consequences of new technologies, set the biotechnology era apart. These debates, of course, are global in scope, bringing in their wake an array of actors into the policy discussions not seen in the Green Revolution era.

The result has been much deliberation, within and outside government, around appropriate mechanisms for regulatory policy in particular. In India, over the last decade, this has become associated with a range of committees overseeing research (RCGM), monitoring and commercial release (GEAC) housed by different ministries, relating to different national laws and regulations and to different international agreements. The result has been a slow, and highly contested, process which resulted in the approval of a new GM crop – *Bt* cotton – for the first time only in 2002 (Dhar 2003).

The raising of issues of uncertainty and risk by the biotechnology debate has resulted in a range of public reactions, both in India and more broadly. Within India, protest has taken a number of forms: there have been symbolic burnings of crop trials, mass protests and demonstrations, including travelling caravans protesting biotechnology imports; well publicised tribunals and citizen juries have condemned biotechnology innovations; as well as much media campaigning and commentary. This reached a peak in 1998–99 when the so-called “terminator” controversy was in full swing. The controversy provided the opportunity for Indian NGOs and activist groups to link up with campaigners operating at the global level. Links with RAFI, GRAIN and other campaign groups were forged, and increasingly Indian activists became global commentators on the issue, on behalf of their assumed constituencies. The then head of the KRRS, the Karnataka State Farmers Movement, travelled to Europe, and on to the WTO meeting in Seattle to offer his views. Similarly Vandana Shiva, the articulate and well known campaigner and founder of RFSTE (Research Foundation for Science, Technology and Environment), was regularly in the international press. Links to international civil society movements, such as Via Campesina or Global Action Network, followed, with a number of key international meetings hosted in India, as part of the emerging “anti-globalisation” movement.

Biotechnology, then, has become part of a much bigger debate on globalisation. The scope has expanded significantly in a process of reframing, galvanised through connections that span the globe.

Narrow discussions about the efficacy and safety of a particular technology have been extended to issues of moral and ethical choice over the manipulation of nature; rights to and control over local resources in the face of multinational corporate domination; global environmental issues such as the future of agrobiodiversity and international economic relations and the role of trade liberalisation as a route to local economic development.

The broadening of the debate, and the highlighting of a wide range of risks and uncertainties, has been particularly assisted by the active engagement of the media, internationally and within India, and encompassing both conventional and new media. With globalised access to information, the debate can flourish fast. Connections can be made by email networks and alliances forged across boundaries. Vast amounts of information – from all possible perspectives – are increasingly available on the internet. Much of this is obviously highly positioned. Greenpeace compete with Monsanto in cyberspace and in the column inches of newspapers around the world. Claiming authority in this context is important, and the website hosts become key in presenting information from a range of sources. For example, the site hosted by CS Prakash, an Indian based currently in the US, has been very influential in providing a positive spin on the biotechnology controversy. But there are plenty of active detractors too – RFSTE (and Vandana Shiva in particular), Ag-Bio India (and Devinder Sharma) and Gene Campaign (notably Suman Sahai) have all added their voices through a variety of media routes. The press, always keen on a controversial story, have latched onto the debate, and invested in wide coverage for some time. The continuous flow of Monsanto press briefings into every newspaper office in the country has provided a useful starting point, and NGO and activist commentators are always available with remarks to make it a story with two sides.

In many ways, for the press, the biotechnology debate has summed up some of India's main dilemmas at the turn of the century – how was India, a decade after the announcement of the economic reform programme really going to fare in the new global economy? And was biotech, as successor to the great Indian IT success story, going to provide part of the answer? Or was this simply part of a larger attempt by multinational capital and western governments to (again) stitch things up in their own terms?

The broader debate surrounding biotechnology, rather than focusing on the technology per se, asked bigger questions about the future of development and India as a country in a globalised world. Viewed in this way, again in contrast to the GR, the emergence of biotechnology is, in some sense, the result of the wider processes of economic reform discussed earlier, many of which are not solely or explicitly linked to agriculture. As we have already noted, recent proclamations on economic policy from across the political spectrum envisage a future vision of “development” very much linked to the global, liberalised, technology-led industries, where foreign investment, from R&D through to marketing is seen as essential. Given the histories of debates about “development” in the Indian context discussed above, this vision is, not surprisingly, highly contested. This is so, of course, among so-called “anti-globalisation” activists, but also more broadly within government, within political parties and coalitions and among academics, where a more nationalist, protectionist discourse is evident. The slow pace of reform, particularly in certain sectors – and most notably agriculture – suggests a certain reticence on the part of some key players to embrace all the features of the new economy model, despite the outward rhetoric. Too much is bound up

in the “old” economy (from patronage politics, to bureaucratic procedures, to cultures and incentives of working) to assume a rapid change. The accommodative features of the Indian political system require compromises and trade-offs to be made, meaning that the brave new world of a liberalised economy is far from the reality in practice.

Among the reforms with most significant implications for the development of biotechnology are those that liberalise the investment regime, industrial licensing, and permit the entry of foreign pharmaceutical, agro-chemical and seed companies. A further trend has also been the move towards state level influence over policy-making, particularly in the context of the “new economy”. It is state governments who attract foreign investors and provide much of the support, infrastructure and incentives. Agriculture in particular is a “state subject”, although regulatory control over biosafety issues in the biotechnology area remains at the central level under the committees of the Department of Biotechnology and the Ministry of Environment and Forests. Unlike in the 1960s, under a centrally planned economy, with strong, directive control by central ministries, policy-making is much more diffuse today.

The dominance of the private sector in developing agricultural technology is a hallmark of the contemporary period, and offers a marked point of contrast to the “golden age” of public research during the Green Revolution. This has major implications policy and policy processes. Indeed, India’s liberalising economic reforms are associated with a “sea-change” in thinking about the appropriate role of the state and market in the economy and development. This change is captured neatly in a World Bank publication on the liberalisation of agriculture in India, which recommends ‘removing controls and distortions associated with the “food security” complex’ (Pursell and Gulati 1993: 19). This demonstrates the extent to which international support for state intervention has shifted since the Green Revolution – dismantling the very institutions that had been set up with the support of such agencies.

R.S. Paroda, then Director-General of the ICAR, tellingly acknowledges the increased role that private sector research will play in the development of biotechnology:

There are certain areas such as biotechnology where scientific advances can be made much faster through private sector involvement. Private sector and industry have also the comparative advantage in multiplying, provisioning, and marketing the end products ensuring required benefits to the end users. We need to create viable, legal, remunerative, and enabling environment for participation of the private sector in order to realise our goals of food, nutrition, and environmental security.

(Paroda 2001)

This rhetoric of public-private partnerships for R&D now dominates standard thinking on how research will be organised and paid for in the future. With the ICAR and the Consultative Group on International Agricultural Research (CGIAR) system – as with most previously purely publicly funded institutions – eyeing up the private sector as potential funders of research, the new knowledge relations that are emerging, governed by confidentiality agreements, intellectual property portfolios, and conditions on

release and marketing, are quite different to those that governed research and development for the Green Revolution. The paradox implicit in the retreat of the state from directing economic activity and guiding the course of development, is that it also, chiefly, orchestrates its retreat. The same question that was posed of the policy shift that occurred during the Green Revolution may be posed here: to what extent are the economic reforms the result of external pressure and to what extent are they a domestic initiative? In one sense, liberalisation may be seen as the result of compulsion rather than conviction. Facing a balance of payments crisis in the summer of 1991, India was compelled to take on a World Bank Structural Adjustment Loan, and a Stand-by Loan from the International Monetary Fund.

The external-pressure explanation, however, is challenged by those who accord greater weight to domestic factors in explaining the initiation of liberalising reforms. Thus, Byres notes that some precedent for liberalisation may be found in economic reforms undertaken by Indira Gandhi in early 1980s and, particularly, those undertaken by Rajiv Gandhi in 1985–6 (though they were subsequently abandoned in 1987). He notes, however, that the difference between these early efforts and that of 1991 was that the ‘liberalisation programme of the early 1990s...was a purposive and open attempt at root-and-branch transformation of the economy’s institutions and functioning’ (Byres 1997: 4). Bhagwati and Srinivasan, two prominent Indian neo-liberal economists, address the issue in a report commissioned by the Indian Ministry of Finance. Though they do not deny the significance of the external conditionalities, they argue that, rather than succumbing to outside pressure, the external intervention ‘strengthened our domestic will for reform’. In his study of the politics of economic reform, Jenkins also disputes that the balance of payments crisis compelled the government to respond. He notes that ‘[t]he existence of a crisis is no guarantee that a government will respond and that it will be successful in convincing interest groups that “something must be done”’ (Jenkins 1999: 29). Indeed, his analysis of reforms strangely gives little attention to the role played by external actors, and, instead, seeks explanation for the persistence of the reforms in domestic and local political manoeuvring. In contrast, Corbridge and Harriss argue that ‘the crisis of 1989–91 offered a window of opportunity for those amongst India’s business and financial elites who wanted to renegotiate the state’s relationships to private capital and so the process of accumulation’ (2000: 146).

As with the Green Revolution era, the making of policy in the recent period has been the result of an interplay between international and domestic processes. This interaction is played out in the global arena – in the WTO, through the multilateral banks, donor agencies and multinational companies etc – and at national and state levels in India through the manoeuvring of bureaucrats, politicians and business elites. With biotechnology being seen as a key “new economy” industry, part of India’s post-IT boom knowledge economy, many see the promotion of biotechnology friendly policies as central. The flurry of state level biotechnology policies, starting with Tamil Nadu, is evidence of the enthusiasm with which Chief Ministers and state policy-makers have latched onto the “IT to BT” hype (see Scoones 2002 for the case of Karnataka). Policy networks have linked biotechnology entrepreneurs with key areas of government to demand for business concessions and infrastructure support for biotechnology businesses, both local and foreign. Attracting investment is the buzzword, and much is done to entice those with the

capital funds and R&D capacity in biotechnology. Increasingly public funding for research and development is seen in this light too. The national Department for Biotechnology launched its ten year plan, highlighting the need to boost public research capacity in key areas that might contribute to the growing knowledge economy.

The private sector is seen very much as the driver of the new biotechnology revolution, and alliances between national and multinational firms are key to gaining access to the new technologies. For example, Mayhco, a long established Indian seed company has collaborated with Monsanto, the major US based multinational (now a 26 per cent shareholder in Mayhco) in the testing and now release of Bt cotton, the first transgenic crop in India. For some this has been seen as a model of collaboration, and perhaps the best way India can gain access to the new biotechnologies, most of which are controlled through patenting regimes by international companies. In the drawn out process of regulatory approval, the imperatives of national policy and politics – at both national and state levels – interact with a global push for biotechnology acceptance from Monsanto and other advocates.

Policy and policy-making has, it seems, meant different things in the two periods. In the Green Revolution era, the focus was essentially on implementation and, in particular, the creation of institutional mechanisms to get the new varieties adapted, demonstrated and available to farmers. This involved the elaboration of the integrated research and extension system through the new Agricultural Universities, the All India Coordinated Trials, the demonstration programmes and the extension system. There was broad consensus on the value and efficacy of the new technologies (or at least relatively little debate), so the challenge was how to deliver them. This did not engage the public or the media to any significant extent, except as allies in promoting the message. Nor did the policy come – at least early on – under much wider academic scrutiny. In the biotechnology era, by contrast, there has been much more dispute about the formulation of policy itself, and the underlying framing assumptions behind it. Global connections have proliferated, going beyond the narrow networks based on technical assistance and foreign aid. Multinational companies, global NGO networks, internet sites and the media have all ensured, in different ways, that the relations of knowledge, and the associated and competing networks of actors, embedded in biotechnology debates are far more complex and spread far wider.

Thus, although the co-construction of science and policy in both global (essentially US) and national (essentially Delhi) settings has been a feature across the two periods, the form this has taken has differed significantly. Despite being driven by many similar policy narratives and assumptions, and structured around many of the same institutional settings and bureaucratic practices, and indeed involving some of the same actors, there have been important differences in the making and shaping of policy. This, as we have shown, relates to the more disputed nature of the policy debate, the greater complexity of the policy networks and, more generally, the more contested nature of the political economy of knowledge and policy today.

5 Conclusions: continuity and change

In both the Green Revolution and biotechnology eras, then, the relations of knowledge between the global and national have been central to the policy processes that have emerged in India. In neither case has the process been one way. There has always been a complex interplay, rife with compromises and trade-offs, contingencies and serendipities. Across the periods, we have noted a degree of continuity in ideas, people, networks and institutions that have guided policy debates, both at the international level and within India. These continuities have reinforced some level of path-dependence on policy change. Certain institutional structures and practices are well embedded, with the result that new policy, however radical, will always be reflective of long standing institutional and bureaucratic practices and inertia. Continuity, at some level, is therefore assured, whether in the practices and cultures of science or the institutions of policy-making and implementation.

However, as we also have observed, there are some important differences between the two eras. The sense of continuity – whether in the physical presence of M.S. Swaminathan or Norman Borlaug or the procedures of ICAR and the All India Coordinated Trial Programme – should not blind us to important areas of change. The paper has highlighted how the biotechnology era contrasts with the Green Revolution in a number of respects, including: the nature and complexity of policy narratives; the types, numbers and networks of actors inside and outside the state; the form and location of expertise and sites of policy-making; the framing and content of debate, controversy and dissent.

As we have shown, the changes from the Green Revolution to the biotechnology era are characterised by policy narratives which have shifted from a focus on national food self-sufficiency and nation building in a planned economy to engaging with a liberalised, highly unequal and uncertain, global market economy, and from Cold War security concerns to liberalisation and trade issues. In this light, the construction of “agriculture” has shifted from small-scale farming for food production and with a poverty focus to agriculture as a globally competitive industry. The result has been a move from the involvement of relatively few players in the policy process, to multiple players, including many non-state actors (such as NGOs, private sector corporations, the media) each with global connections. Funding flows too have changed from international philanthropy with state support to an increasing reliance on the private sector. This has paralleled a shift in the nature of the key areas of expertise, from crop breeding to molecular biology and the life sciences. Accordingly, different practices of science prevail – from field based to lab based – and from public good research based on the free exchange of knowledge to research governed by intellectual property concerns and commercial confidentiality.

These new contexts for science and policy have emerged at a time when there have been major policy controversies internationally and within India about biotechnology, and, with this, the regulation of risks and more broadly the implications for directions for development as a whole. From a situation in the Green Revolution era where the debate was essentially about efficient implementation and not open to much debate or challenge, the domain of discussion is now far wider and more contested, encompassing questions about new risks and uncertainty, as well as moral, ethical and political issues.

In other words, despite the easy similarities, used prolifically in the pro-biotechnology rhetoric (biotechnology as the inheritor of the GR, but greener and more pro poor), the nature of policy processes surrounding biotechnology today is unquestionably different. Of particular significance here is shift in the role of the state from directing policy and shaping agricultural development to providing a legal, financial and regulatory environment amenable to agricultural research and development now led by the private sector. With changes of this magnitude, there is not going to be a simple replication of the great Green Revolution success story. From our analysis we would argue that more attention needs to be paid to the differences in policy context and process.

These differences have important implications for food security. Indeed, while in the Green Revolution food security was a priority for Indian policy-makers and international donors alike, recognition of its continued relevance for policy has perhaps been lost amid the profusion of diverse actors, agendas and associated discourses that characterise the policy context in the biotechnology era. Given the present focus of policies on creating “enabling environments” for private sector research and development, we would make two recommendations to help bring food security back onto policy agendas. First, there is a need for policy-makers to cultivate more strongly the links between such policies and specific strategies to promote food security. Second, food security may itself need to be reconceptualised to better accommodate the new issues and challenges (such as biosafety) presented by developments in agricultural biotechnology.

By taking an historical approach, we have tried to emphasise both continuity and change, and put these in context. By highlighting how policies have been and are being made in practice, we have noted the importance of the relationships between global and national (including sub-national/state) policy processes, and particularly how each context constructs particular types of knowledge relations. It is these relations, embedded as they are in complex networks of divergent and overlapping interests, that create a particular political economy of knowledge in the two eras. It is here – in the politics of knowledge – that some of the major contrasts between the Green Revolution and biotechnology lie, in turn directly influencing the politics and practice of policy-making.

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