

Indian agriculture is facing unprecedented challenges. While Indian economy is one of the fastest growing economies of the world with annual growth rate of more than 8%, agriculture is in crisis with a growth rate around 2.0%. This coupled with high dependency of population on agriculture and widening regional disparity has accentuated rural distress. A large number of rural poor are somehow managing to survive on the edge of vulnerability and poverty. The fundamental question confronting the policy makers today is what should be the long-term strategy to reduce vulnerability of rural poor and accelerate agricultural growth. How can agricultural R&D leverage this development process?

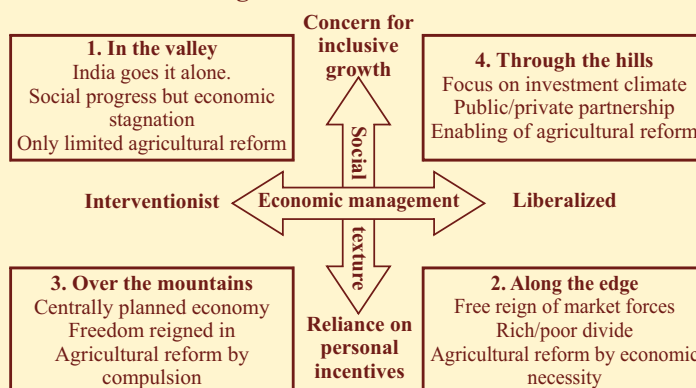
Scenario Planning is a powerful tool to guide long-term policy and strategy. It attempts to account for intrinsic uncertainty of the future by considering the merits and demerits of options in different accounts of the future, called scenarios. The scenario development process explicitly considers “pre-determined” or “anticipated” changes which are already in pipeline. These changes along with some assumptions about fundamental uncertainties and their likely interactions with “pre-determined” elements form possible scenarios. These scenarios are usually in set and give broad contours of future environments in which policies will play out. These by no means provide any normative policy prescription, but can be described as macro alternative stories of the future. In this way the scenarios help look at the sector as a portfolio, rather than its individual components, and provide useful input to strategic planning. This exercise was carried out to explore the future of Indian agriculture. This note discusses salient features of different scenarios and their implications for agricultural R&D policy.

### The Agriculture Scenarios

In the scenario development process, a group of experts were brought together to discuss the key driving forces. These include changing national and international market conditions, low productivity and fragmented agriculture, regulatory framework, growing economic inequalities, and government support to smallholders. In order to sustain economic take-off, surplus labor from agriculture sector has to be absorbed gainfully in non-farm sector and small-scale operations have to be aggregated for value addition and increasing economic efficiency. Such a take-off will be confronted with two key uncertainties regarding (a) social choice about equity versus efficiency, and (b) the approach of economic liberalization versus government interventions. Structuring of different assumptions about these uncertainties in a 2by2 matrix resulted into four scenarios. These scenarios for 2030 are shown in Fig. 1.

The four scenarios describe different paths of agricultural reforms, resulting into varying rates of growth. In the first scenario (Valley) agricultural reforms fail due to lack of alternative employment opportunities, and political preference swings towards more government interventions and community-based growth, at the cost of efficiency and individual opportunities. As an additional complication, climate change leads to lower aggregate freshwater availability. In the other three scenarios agricultural reforms take place, paving the way for ‘aggregation process’ and value chain development. In the Edge scenario portraying ‘joyless growth’ i.e. high growth with rising inequality, the reforms are economic necessity. Unviable land holdings force people to migrate in search of alternative employment opportunities and the ‘aggregation’ of production takes place through innovative institutional arrangements like ‘reverse tenancy’ and contract farming. In the Mountains, agricultural reforms are ‘managed’ by the government, which is a dominant player in guiding and organizing economic activities. In the last scenario (Hills), government facilitates the reforms, and economic incentives and employment opportunities in other sectors pull out the labor force from agriculture.<sup>2</sup>

Fig 1. The Four Scenarios



### Assessing the Implications

Some important implications can be drawn from these scenarios. First and foremost is the growing interdependence between agriculture, social and economic development. Rapid developments in the Indian economy will influence the nature of changes in agriculture, and actors in development, sources of knowledge, institutions and even scale of operation may change. Stagnant agriculture with a high growth in non-agricultural sector may not be sustainable because of deteriorating investment climate (due to social unrest on account of rising unemployment and economic inequality) and lack of market

<sup>1</sup> Principal Scientist at National Centre for Agricultural Economics and Policy Research, New Delhi-12. The scenario analysis was undertaken with the World Bank for preparation of the National Agricultural Innovation Project of ICAR. Thanks are due to PK Joshi, Willem Janssen, Kees van der Heijden and Mruthyunjaya for their valuable inputs. Usual disclaimer applies.

<sup>2</sup> For detail discussion on methodology and the scenarios, see *Scenario Planning to Guide Long-term Investment in Agricultural Science and Technology*, ARD Discussion Paper 29, World Bank, 2006.

demand. Therefore, agricultural sector must contribute to the overall economic growth. This could be possible when (a) there is persistent growth in agricultural productivity, (b) farm income is increased through production diversification, value addition and better market access, and (c) surplus labor is transferred from agriculture to other sectors of the economy, including rural non-farm sector. Undoubtedly, the efforts to conserve our natural resources (land, water, biodiversity, non-renewable energy) and environment need to be made more intensive and effective.

How can these growth conditions be met? The four scenarios explore the plausible strategies, not necessarily mutually exclusive. In market-driven economic scenario, changes in demand pattern, institutions and policies will be as important sources of growth as technological change. New knowledge and emerging demand pattern will create better opportunities and incentives to organize agricultural activities (resource, services, production, processing, distribution etc) in an efficient manner. These process changes or innovations will take place across all types of institutions, including economic, social, political, legal, etc. and will add value to existing practices and improve their outcomes. The capacity to generate, integrate and apply new knowledge will be critical to the innovation process. Hardcore infrastructure, facilitating regulations and other domains like information services, credit and rural institutions, social (e.g., gender) groups, etc. will also influence the innovation process. In the absence of these innovation-promoting conditions, substantial government interventions will be required to sustain the growth process, as well as to manage economic disparity and vulnerability, if any.

#### Agricultural Scenario Compared, 2030

Item	Base 2004	Scenarios			
		Valley	Edge	Mountains	Hills
Rural Population (%)	71	66	26	45	38
Poverty (%)	26	11	19	16	14
Per capita income (000 Rs)	28	63	189	130	162
Fresh water availability (km <sup>3</sup> /year)	1280	1000	1280	1320	1280
Share of AgGDP (%)	21	21	10	15	11
Average farm size (ha)	1.4	1.7	12	10	9
Employment in agric. (%)	65	55	20	25	30

Source: see footnote 2

Given the diversity of agricultural systems in the country, it is quite likely that the implications of the scenarios and underlying innovation process may not be uniform across the regions and therefore a differentiated strategy may be required to promote innovations. This implies that the strategy should balance various kinds of forces and tensions to encourage region or enterprise-specific innovations. For example, appropriate roles of the public and private sectors (the Hill), management of bureaucratic inefficiencies (the Mountains), promoting investment climate in rising inequality and unemployment (the Edge), and controlling brain drain (the Valley) could be major factors influencing the innovation process.

#### Implications for R&D Policy

Creation and application of new knowledge will be central to agricultural innovation process, and some major changes will unfold in this context. There will be multiple providers of new knowledge and technologies. Private R&D will expand rapidly (more so in the Hill and Edge Scenarios) and it will be main source of mechanical, bio-chemical, and post-harvest technologies. This trend will increase the overall research intensity and help promote diversification towards high value agriculture. The public R&D will now be required to work in partnership with the other actors and help integrate knowledge and technologies from all sources, including traditional knowledge of farming community. IPR policy may be tuned to attain this objective and facilitate international transfer of knowhow and technologies. Also, the public R&D has to be self-sufficient in making technologies available to increase efficiency and sustainability of agricultural production systems. This is because flow of such technologies is likely to slow down with shrinking resources for international agricultural research and thereby weakening priority for productivity-enhancing research. A strong public R&D is also justified by the possibility of the Valley, or the Mountain Scenario in some parts of the country.

The mechanism of delivery of knowledge and technology will also go under significant change attracting multiple actors. Besides public extension system, contractual arrangements, partnerships and market transactions will also facilitate flow of knowledge and technology to the end-users. Most of these institutional developments will take place around the value chains, having two major impacts. First, those intermediaries which are not adding any value will disappear and thereby improve the cost-effectiveness. Secondly, agricultural production will become more demand-driven through direct linkages between consumption and production. This means that agricultural R&D should consider changing demand and taste preferences in research priority assessment and strike a balance between R&D needs of the traditional (the Valley) and commercial system catering to premium markets (the Edge and the Hills). Innovations in funding mechanism, management of intellectual property and improvement in the governance will help balance the research portfolio and optimize the institutional arrangements for accelerating innovation-driven agricultural development.

To sum up, this note has explored the possible scenarios of Indian agriculture and their implications for development policy in general and R&D in particular. These are broader canvas for discussion. Sector- or region-specific implications and impact of the innovations process on 'scale of operations' require further study and discussion.