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Second Prof. Dayanatha Jha Memorial Lecture

Emerging Trends in Indian Agriculture: What Can We Learn from these?¹

Ashok Gulati*

Director in Asia, International Food Policy Research Institute, New Delhi - 110 012

Professor Dayanatha Jha.....

Prof. Dayanatha Jha was a renowned agricultural economist who made seminal contributions to the area of agricultural economics. His contributions in the area of agricultural policy research and technological change are recognised internationally. His work on research investment and its impact on agricultural productivity and growth and resource allocation is widely acclaimed. His in-depth understanding of micro-dimension of technological change such as fertilizer response in dryland areas, pest and irrigation management, small farm considerations, and supply response led to significant contributions to the area of agricultural economics. Advancement of the agricultural economics profession and institutional development were very close to his heart. It was due to Prof. Jha's vision and leadership that National Centre for Agricultural Economics and Policy Research (NCAP) could become a centre of excellence and institution of international repute. It is a befitting tribute to this great scientist, teacher, researcher philosopher, and human being par excellence that NCAP has started Professor Dayanatha Jha Memorial Lecture from the year 2008.

The first Professor Dayanatha Jha Memorial Lecture was delivered by Dr S. Mahendra Dev, the then Director, Centre for Economic and Social Studies, Hyderabad on the Annual Day of NCAP in New Delhi.

Chief Editor

In this lecture, I would like to touch upon three key issues, which I feel are the emerging trends in Indian agriculture, with a view to learn some important lessons from these trends that can hopefully take Indian agriculture on a higher growth trajectory, and help alleviate poverty much faster than has been the case so far.

Emerging Trends in Indian Agriculture

- The increasing role of the corporate sector in agriculture by infusing new technologies and accessing new markets. And the key issue here is: **will the next revolution in Indian agriculture be triggered by the corporate sector?**
- Increasing integration of agriculture with the new emerging agri-system comprising Rural Business/

Service Hubs (RBHs) at the back end, and agro-processing industry and organized retailing at the front end — primarily driven by the corporate sector. And the issue here is: **can the fast scaling up corporate sector in agri-business mainstream the fragmenting smallholders?**

- There is a wide variation in agricultural growth across different states in India at least during the last five-seven years or so. At one end of the spectrum there are states like Gujarat that are showing strong growth of 8-10 per cent per annum in agriculture, while at the other end are states like Uttar Pradesh, West Bengal, etc., that are growing barely at 1-2.5 per cent per annum. And the issue here is: **can these laggard states learn some lessons from the fast moving states and pull up the overall performance of Indian agriculture?**

Let me try to elaborate these three points to make clear the issues under discussion, and thereafter I would

* Email: a.gulati@cgiar.org

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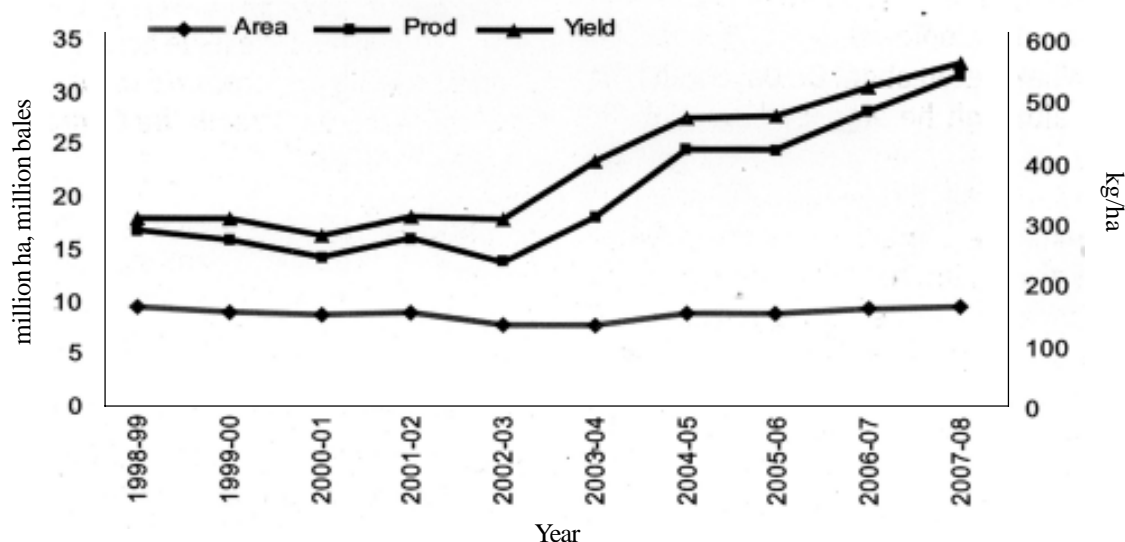


Figure 1. Area, yield and production of cotton, All India: 1998-99 to 2007-08

Source: Cotton Advisory Board (2009).

like to share my understanding of the changes that are needed in institutions, incentives and investments to accelerate growth in agriculture which can make it more competitive, inclusive, sustainable and scalable.

1. Technology, Markets and the Increasing Role of the Corporate Sector

After the green revolution in wheat and rice during the late-1960s and early-1970s, which was driven largely by the government², if there is any other crop that has registered a phenomenal growth during the last 6-7 years, it is cotton. Cotton production in India has doubled, from 15.8 million bales in 2001-02 to 31.5 million bales in 2007-08, and is expected to hit 32.2 million bales in 2008-09 (Cotton Advisory Board, 2009) (see Figure 1).

We all know that this is primarily the result of introducing Bt (*Bacillus thuringiensis*) technology in cotton. This new technology was formally released in 2002, although it had sneaked into farmers' fields in Gujarat somewhat surreptitiously in 2001. The farmers in Gujarat and elsewhere in India, who used Bt seeds

of cotton, found dramatic turnaround in their yields, almost doubling over the period 2000-01 to 2008-09 (see Figure 2). Not only they gained in terms of yields, but there was a substantial reduction in the use of pesticides, which augmented their net incomes.

This increased their profitability leading to almost a scramble for new technology, which spread like wild fire. Within seven years, more than 80 per cent of the cotton area has come under Bt (see Figure 2).

It is interesting to observe that in 2008, there were 30 private sector companies that together sold 274 Bt cotton hybrids. There was only one public sector institution [Central Institute of Cotton Research (CICR), Nagpur and University of Agricultural Sciences (UAS), Dharwad, Karnataka] in Bt cotton seeds. While technology played a catalytic role in triggering a change in cotton sector, it would be naive to presume that this could have been achieved without good markets which the farmers got for cotton. India's consumption of cotton hovers around 20-24 million bales, while the production went to more than 30 million bales. This would have led to a major market crisis if the surplus cotton could not have been exported. Raw cotton exports increased from less than a million bales in 2002-03 to more than 8 million bales in 2007-08 (see Figure 3).

This is the highest ever export of cotton from India during the past sixty years. This was achieved when

² This was done in association with international research organizations, like CIMMYT and IRRI from where the original seeds came, and national institutions like ICAR and state agricultural universities that indigenized those seeds, and Agricultural Prices Commission and Food Corporation of India that ensured "remunerative prices" to farmers for their produce.

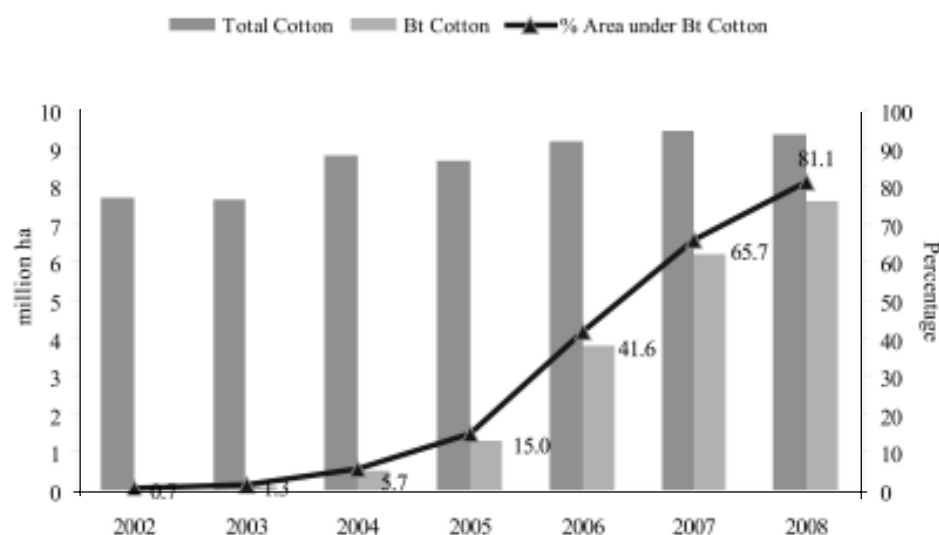


Figure 2. Area under total cotton and Bt cotton, All India: 2002 to 2008

Source: Cotton Advisory Board (2009) and James (2008)

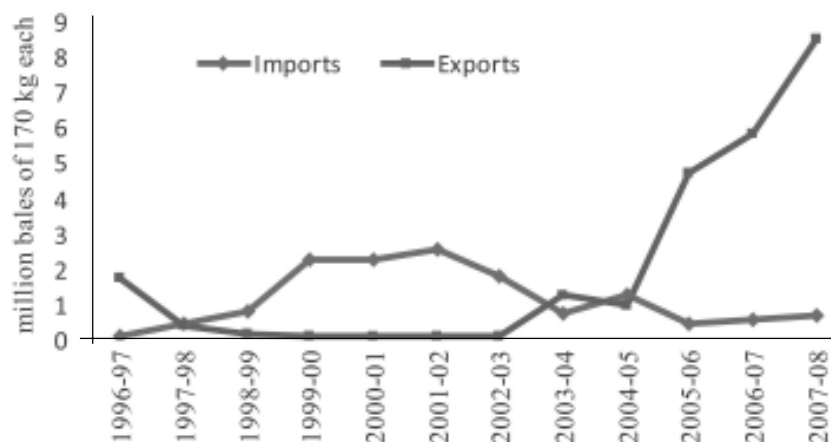


Figure 3. Export and import of cotton, All India: 1996-97 to 2007-08

Source: Cotton Advisory Board (2009).

the global economy was in upswing and textile sector was doing very well, and even China started importing raw cotton from India for its textile and garment sector. But, since the recession hit the western world in 2008, demand for textiles and garments has been declining in the US and Europe, leading to a major crisis in China which is drastically cutting down imports of cotton from India. As a consequence of this shrinking market, the expansion and benefits of cotton revolution in India will now hit a major road block. This clearly speaks of two important lessons, given in Box 1.

It may be worth bringing out here that the cotton story earlier had been associated more with the

unfortunate incidents related to farmers' suicides, and people have given somewhat lesser attention to the positive aspects of changes in the cotton sector that I have highlighted above. In any case, the cotton story cannot be completed unless we also try to respond to the suicides cases. At IFPRI we took up this issue very seriously, especially after the visit of Mr Sharad Pawar to IFPRI in 2006, wherein he emphasized that this was a major concern of the Government of India. IFPRI researchers (Guere *et al.*, 2008) worked very systematically on this issue, digging out official and unofficial records of farmer suicides from sources ranging from the NGO community, media, and

Box 1**Two Important Lessons**

1. The corporate sector has an important role to play in generation and diffusion of technology in the years to come. This can be a major driver of change in Indian agriculture. However, technological advancement alone, without access to markets, is not sufficient to bring about a revolutionary change.
2. With increasing production in the face of recession in the global economy, there will be a battle for markets. Some developed countries are even likely to subsidize their produce to retain their markets (as was the case with US in early years of 2000). For developing countries like India and Brazil, there is a need to remain alert and take up such issues in the WTO negotiations to streamline distortions in world agriculture (as Brazil did for cotton). This also speaks of the need to remain actively engaged in WTO negotiations for agriculture, which has a separate component for cotton. An over-defensive posture in WTO negotiation may not be very useful in the years to come.

National Crime Records Bureau. The concentration of suicides was in Vidharba district of Maharashtra, northwest Andhra Pradesh, and northern Karnataka. An analysis of data, however, shows that farmer suicides constituted about 15 per cent to 16 per cent of the total suicides in India, and the trend between 1998 to 2006 has been flat. Notably, the rate of suicides (per 100,000 population) is much lower amongst farmers (ranging between 1.42 and 1.71 during 1997 to 2005 without any trend) than in the non-farming community (around 10 to 11 per 100,000 population over the same period). The farmer suicides in certain pockets were high due to various factors such as: farmers were unable to adopt Integrated Pest Management (IPM); borrowed money at high rates of interest (24 per cent to 48 per cent) from informal sources; planted Bt cotton in rain-fed areas and when rains failed they suffered heavy losses in the absence of any weather insurance. So, it speaks of failure on extension front with respect to IPM, on credit front with respect to lack of formal credit facilities from the banking sector, on irrigation investment front as large tracts remain rain-fed, on insurance front as weather insurance has not been made available to cotton farmers in any meaningful way, and finally on governance front as much of the seeds or pesticides are of low quality and even spurious. Bt cotton seeds *per se* cannot be blamed for these

unfortunate suicides. Despite all these odds, Bt cotton, driven by the corporate sector, has spread to more than 80 per cent of cotton area in the country, much more than that found in China. More than 5 million farmers have adopted it, which itself speaks of a sort of success of cotton story. The weighted average of peer reviewed studies reported by IFPRI shows that the net returns from cultivation of Bt cotton increased by more than 52 per cent (Gruere *et al.*, 2008)³. This perhaps explains the rapid adoption of this technology by the farmers. The challenge now is to sustain it over the next five years or more as the global markets are melting down.

Expanding Reach of Technology from the Private Sector

The next crop to experience Bt technology maybe eggplants (brinjals). Monsanto/Mahyco's Bt brinjal has gone through several hops, ranging from laboratory stage, to green house trials, to confined field trials, to multi-location research trials, to large scale field trials, and now is in seed production stage. The commercial release can be any time in 2009 or 2010 (Choudhary and Gaur, 2009). "*Mahyco has donated this technology to public sector institutions not only in India but also to public sector institutions in Bangladesh and the Philippines*" (James, 2008; p. 68). It would be interesting to watch what happens to this crop which uses maximum pesticides amongst all vegetables. And this is the first food crop of India that is genetically modified. The Supreme Court has already lifted restrictions on the release of GM food crops in India in 2008.

There are several other biotech crops that are at field trial stage. Most of them are food crops such as cabbage, cauliflower, okra, potato, tomato, groundnuts, corn and even rice. If India succeeds in having more drought-tolerant rice and maize, there could be major gains in staple crops, and hence food security of a large mass of people can be ensured. In any case, the stage seems to be getting ready for the next technological infusion in Indian agriculture, and much of this has been triggered by the private sector, although lately

³ These results of IFPRI study are at variance with those reported by Mitra and Shroff (2007), especially related to increase in incomes due to adoption of Bt seeds. For that matter this issue still remains open for further research. However, the fact that more than 80% of the cotton area has come under Bt speaks itself of the gains that farmers must have got out of this new technology.

Government of India is also increasing its investments in biotechnology, though nowhere near what China is planning in this field.

The next big cereal crop that is experiencing reasonably healthy change in production is maize, up from 12 million tonnes in 2000-01 to 19.3 million tonnes in 2007-08, registering a rise of 60 per cent over seven-year period. The increase in production comes partly from area increase as also productivity enhancement driven by hybrid seed technology led by the corporate sector, and supported by expanding market for maize for poultry as well as exports.

While we talk of emerging crop technologies that may change the future course of agriculture, it may be worth mentioning about mycorrhizal technology that TERI has been developing for quite some time. The field trials of this factory produced fungal material (mycorrhiza), show that by coating it on crop seeds it can enhance crop nutrition and yields by 5 per cent to 25 per cent, but more importantly reduce fertilizer consumption by 25 per cent to 50 per cent (TERI, 2009). TERI has developed a patented production process of this technology and has devised a low-tech, labour-intensive method to multiply it. It is being commercially produced by certain companies (Cadila, and KCP Sugars), and the breakthrough lies in making this technology available to the farmers at large scale, and at competitive prices. If this technology takes off, it can lead to huge savings in fertilizer subsidy, which in turn, can be invested in developing irrigation in drier areas or in developing road network in rural areas.

2. The Rise of Corporate Sector in Indian Agri-system: Consolidating Top and Fragmenting Bottom

Structural Transformation of Agri-system

Another noticeable trend in recent years is that of a structural transformation in the agri-system which can have significant repercussions for agriculture in due course. The traditional agri-system that stretches from input dealers to farmers to aggregators, wholesalers, processors and retailers, has witnessed a new trend during the past 6-7 years; namely, the entry of major corporate firms. These players are entering at the front end in organized food processing and retailing, as well as at the back end as input service

providers through an innovative model of Rural Business/Service Hubs (RBHs) (*see* Figure 4).

As a result of this growing integration, farmers are likely to experience much greater interface with corporate world, some working very closely with them and others in tandem. But, the fact is that in the years to come, agriculture (or farming) cannot remain insulated from the structural changes in larger agri-system. The key issue that remains for us is to see how it can benefit the farmers. Will the growing competition amongst the front-end players deliver better prices, markets and value chain services to the farmers? It will be interesting to observe if these processes of change generate positive synergies within the system that can catalyze a win-win situation.

But before we do that, let us try to understand the nature and pace of this change.

The Rise of Organized Retail

During the past five years, particularly 2002-03 to 2007-08, there is a new phenomenon on the Indian landscape; rise of the organized food and grocery retail sector. The organized food and grocery retail which was almost non-existent seven years back has been growing at a phenomenal pace. The top 10 Indian food and grocery retailers, for example, have grown at an average annual rate of more than 70 per cent per annum during 2002-07 (*see* Figure 5).

This has been perhaps the fastest growth in the Asian sub-continent *albeit*, India started from a low base. This trend is likely to continue for the next 10-15 years not to rule out some bumpy ride during 2008-2010. What's more, the sector is primarily driven by domestic conglomerates. If the government opens it to foreign direct investments, there will be a flurry of foreign players who will not only bring in investible funds but also global expertise and knowledge, much needed to develop this growing sector. There is a big divide on whether this revolution in the organized food and grocery retail will eventually result in a large number of gainers or losers. While one cannot ignore the process of "creative destruction" (Schumpeter, 1942), there will emerge opportunities of mainstreaming and co-opting. As the share of organized retail reaches 20 per cent to 30 per cent of the retail sector, it will start impacting significantly various stakeholders in the agri-system. Also, as the system gets increasingly organized,

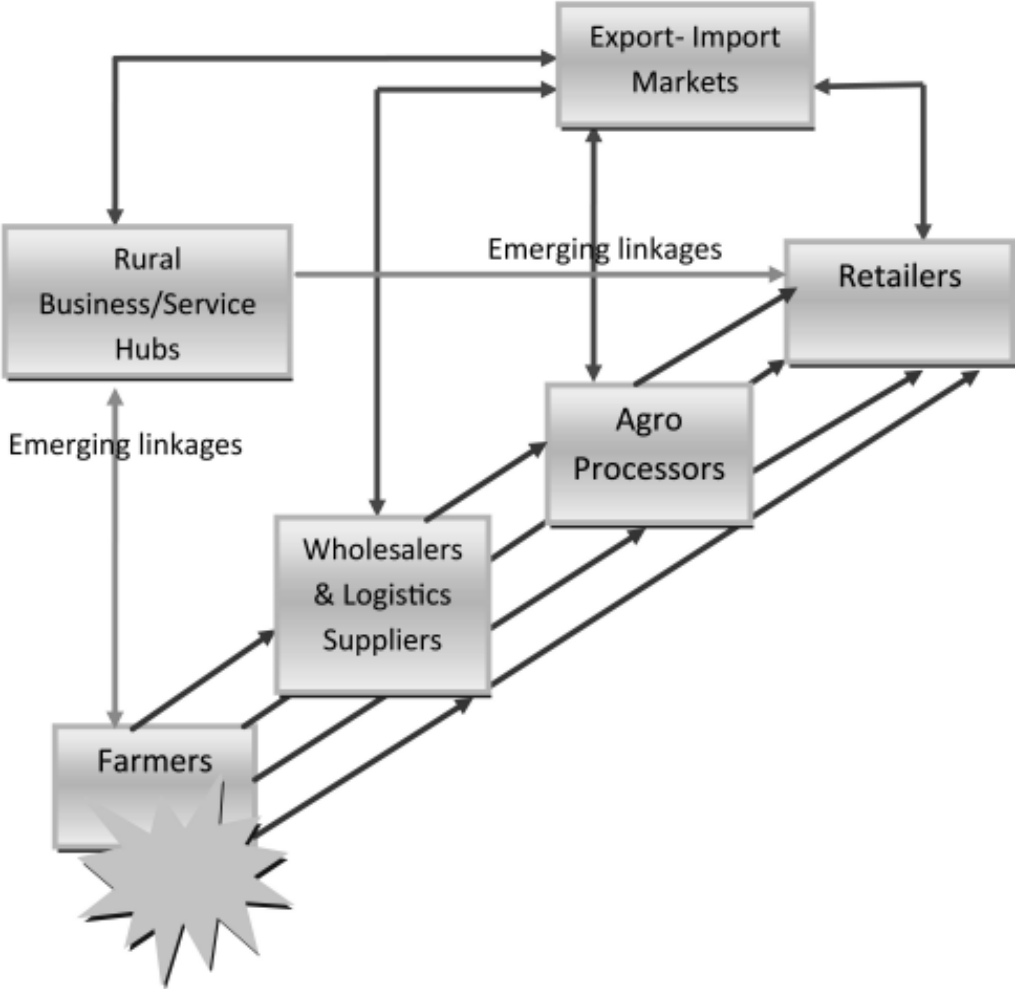


Figure 4. Dynamics of the modern agri-food system
Source: Gulati and Ganguly (2009)

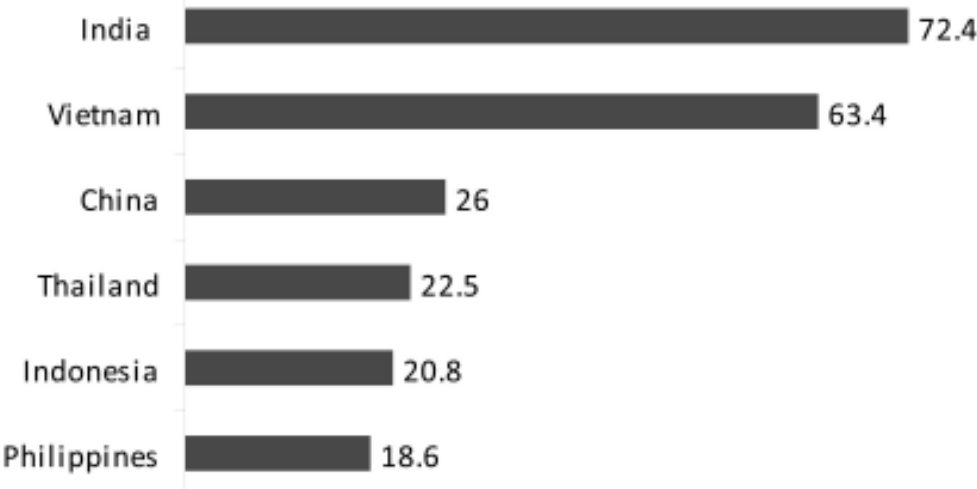


Figure 5. Top 10 food and grocery retailers - Average annual per cent growth in sales: 2002 to 2007
Source: Planet Retail (2008)

it is likely to have a spillover effect on the unorganized segment in terms of generating greater employment opportunities for the commission agents, small traders and even modernization of the traditional segment.

Fragmenting Farms and Consolidating Food Industry

One of the key stakeholders is the farming community, whose average holding size has come down to 1.06 hectares in 2003 (GoI, 2006). As per NSSO data, about 88 per cent of the holdings in India are of less than 2 hectares which together operate about 44 per cent of gross cropped area and contribute 51 per cent of the value of agriculture output (*see* Figure 6).

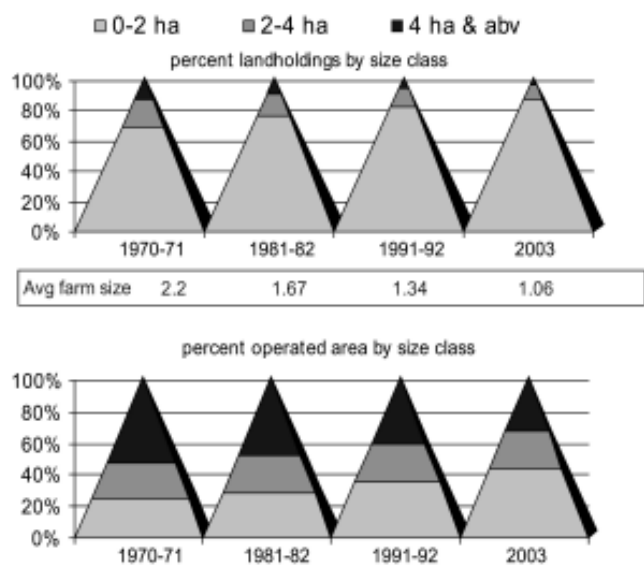


Figure 6. Fragmenting bottom of the agri-food system

Source: 'Some Aspects of Operational Holdings in India 2002-03,' (2006)

Report No. 492. NSSO, Government of India, New Delhi

Shrinking farm sizes in India cannot be wished away and hence prudence lies in being able to innovate to do business with these smallholders. Strengthening firm-farm linkages will be inevitable as the front-end players expand their business. There are examples of farmers coming together as co-operatives or farmers' organization to do business with the corporate, be it in dairy; poultry or horticulture. The challenge lies in multiplying these ventures across geographies and commodities and ensuring that these models do not fizzle out over time.

The organized food processing industry, which is growing very fast and where the organized segment contributes about 81 per cent of the gross output, and demands large quantities of raw material supplies from the agriculture sector. Unlike in the west, processed food items are much expensive in India than fresh. In India, one finds that on an average when tomatoes are sold for Rs 3 per kg, value-added tomato ketchup is marketed for nearly Rs 70 per kg (Aneja and Bhalachandran, 2009). At present, given the complexity of weak firm-farm linkages and inefficiency in the value chains, level of value addition is quite low. Just to cite an example of traditional wholesale (mandi) system. A commission agent at the Azadpur market in Delhi can legally have 6 per cent commission for an auction that takes just five minutes. The Vashi market in Mumbai legally specifies commission at 8 per cent. Although in practice, these commissions go up to 10 per cent in Azadpur market and 15 per cent in Vashi market. This is a huge 'fat' in the system which needs to be reduced or eliminated altogether. It can be done only if the enabling environment is created for direct buying and selling between the organized retailers, food processors and farmers. This needs a change in the APMC Act as well as land-lease act to facilitate firm-farm linkages. While milk producers receive nearly 66 per cent of the consumer price, farmers cultivating fruit and vegetables receive less than 20 per cent (Aneja and Bhalachandran, 2009). Other studies conducted by IFPRI, World Bank and others confirm that farmers' share in the consumer price is quite low and moving towards private marketing networks benefits the farmers (IFPRI, 2008; World Bank, 2007a).

Firm-farm Linkages

Contract farming as an intermediate institutional arrangement has been operational in India for a long time now. However, the experience has been a mixed bag. Studies at IFPRI have shown that farmers in contract farming have gained, augmenting their incomes either through access to better technology or better prices for quality produce or by having an assured market for their increasing production (*see* Figure 7).

It is not just contract farming but any institutional arrangement, be it co-operatives, farmers' organization and the like can help achieve a win-win situation for the farmers, processors and retailers provided both are on a level playing field. However, to strengthen the

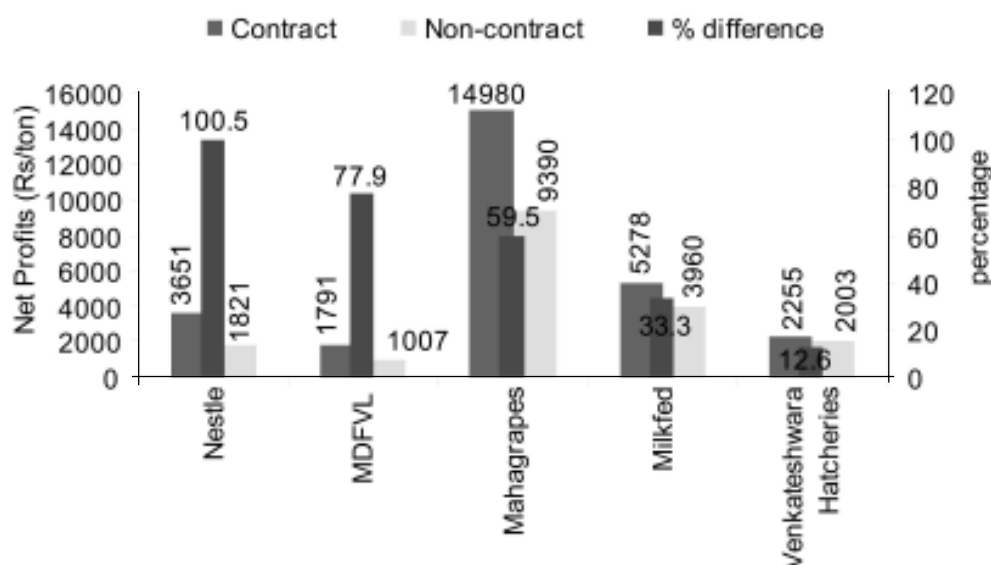


Figure 7. Net profits* earned by contract and non-contract farmers

Source: Nestle and MDFVL-Birthal, *et al.* (2006), Milkfed-Gupta, *et al.* (2006) and Mahagrapes-Roy and Thorat (2008)

Note: *For Mahagrapes, operating profits are reported

bargaining capacity of the farmers in India with large processors and retailers, it is necessary for the farmers to come in groups, be it in the form of cooperatives, farmer companies or farmer clubs. This will not only reduce the transaction cost of doing business but also correct the balance of power within the stake holders (organized retailers, processors and farmers) in negotiating the terms of doing business, especially prices.

The dairy sector in India is a classic example of how clustering of small milk producers through co-operatives brought about a revolution “operation flood”. Cooperatives which dominate the sector are likely to be overtaken by the private players who have entered the market in a big way after the amendment of the MMPO in 2002. The share of private sector is likely to increase to 20 per cent as compared to 10 per cent of the cooperative sector in 2011 (Dairy India 2007). It is possible to create a win-win situation in a cooperative or private sector led model by linking farmers to the markets. As mentioned by Kurien in his interesting autobiographical sketch, **“One of the earliest lessons I had learnt was that Amul existed because, barely a few hundred kilometres away, Bombay existed... Indeed there would have been no Anand if there were no Bombay”** (Kurien, 2005;

p.56). Today, there is not just one mega city but several such cities (more than 30 with a population of more than 1 million), which have become major demand drivers not only for milk but for several other agricultural products also. The existing system of supplying the farmers’ produce from rural hinterlands to these cities can be further developed and strengthened, and many major corporate firms are taking up the challenge of reforming it with a view to promote efficiency and competitiveness on a sustainable basis as a business model.

Within the horticulture sector, there are several smaller success stories, both in increasing production as well as capturing even the most difficult export markets in Europe and elsewhere. They range from individual farmers, farmers’ companies, and corporate houses, and in myriad commodities ranging from grapes to bananas, from baby corns to gherkins, and so on. In several cases, where the scaling up is taking place fast, it is driven by the entry of corporate. Just to cite one or two examples about how the role of corporate firms is increasing in horticultural commodities, it is interesting to note that Mahindra Shubhlabh Services Limited (MSSL) entered the grape exports business in 2005 by exporting 6 containers, and by 2008, they have become the largest exporter of grapes in the country by exporting

more than 280 containers (each container of roughly 14 tonnes), and expecting to export anywhere between 350 to 400 containers in 2009 (AsiaFruit, 2009), beating its nearest rival Mahagrapes, a farmers' company, which has been in business since 1991 and could export only about 180 containers in 2008. About 2,250 grape growers from 16 grape grower cooperatives from 5 districts (Sangli, Solapur, Latur, Pune and Nasik) in Maharashtra, supply to the export market through Mahagrapes. But MSSL sources grapes from about 300 registered growers and 2,000 acres of table grape vines in Maharashtra (AsiaFruit, 2009). There are several other private players in the fresh market who are tying up with farmers and hence there is a need to strengthen the institutional framework to allow fair business practices. Similarly, Bharti Del Monte India Private Limited, which started its operations in 2004 operates on roughly 400 hectares of land and has shipped 200 tonnes of baby corn in 2008-09, becoming India's biggest exporter of baby corn (AsiaFruit, 2009).

While I could share many such stories that are unfolding in large numbers, the point I want to highlight here is the increasing role of corporate sector in a demand-led business environment. But, the key issue for us to know is how Indian companies are tying up with farmers for their business operations, and how good a deal it is for the farmers.⁴ And this brings me to the second main point of my lecture.

Emergence of Rural Business/Service Hubs

As the front end is rolling out, the demand for input services is increasing and given a vacuum of services in rural areas, the pressure at the backend is also building up. Many private retailers/processors are feeling the need to streamline the supply channels and forge better firm-farm linkages. This has given rise to a class of service providers who specialize in providing agri-inputs and services and are entering the domain of organized food retail as third party service providers. While some have the advantage of having worked directly with farmers for a long time, others are still experimenting. Private players like ITC (*Choupal Saagar*), DSCL (*Hariyali Kisaan Bazaar*), Tata (*Kisan Sansar*), and Future group (*Aadhaar*) are some of the key players

⁴ Also, it is important to know whether Indian companies have got massive subsidies from the government agencies (such as APEDA) for freight, or for cooling/chilling plants, etc., which would reflect the sustainability and scalability of the model.

operating in this segment of the agri-system (see Figure 8).

The origin of this model lies in the Public-Private-Panchayat Partnership (PPPP) model led by Confederation of Indian Industries (CII) and the Ministry of Panchayati Raj which aims to develop villages into business hubs. Some of these RBHs are similar to rural malls which offer not only agri inputs and services but also consumer goods, household items, grocery, food courts, fuel stations and also medical services. They are also in the process of developing buyback arrangements with the farmers who avail these services or otherwise, as being done by ITC led Choupal Saagar in procuring soya directly from the farmers. Here in a rough taxonomy based on a four-quadrant classification is given, with the service categories as the quadrants: (1) output procurement; (2) input provision and related services, extension and credit; (3) consumables retail; (4) other services (health, education/training, insurance (see Figure 9).

The concept of RBHs is still evolving in the Indian agricultural scenario; players are toying with various ideas and experimenting the same. Some of them are even scaling up very aggressively, e.g. Hariyali Kisan Bazaar has doubled its stores within two years. In 2009, they have about 300 outlets (80 centres and 220 stores). With huge investments flowing from the private sector and the public sector playing the role of a facilitator, these hubs can be instrumental in filling up the service vacuum which exists in the rural areas and also emerge as procurement hubs for agricultural commodities. Also, these serve as a platform to envisage public-private partnerships, particularly for extension services that play a critical role in a diversifying agricultural economy. While it is not enough to criticize the shortcomings of the public sector led extension service network, it will be worthwhile to explore opportunities of coming together and incentivizing the system to deliver services to the farmers. For example, sending public sector extension personnel on deputation to these RBHs can be a catalyst of change. Those on deputation can be given extra 20-25 per cent salary by the private sector to make it work more efficiently.

3. Spatial Variation in Agricultural Growth and What Can We Learn from it?

The third main point of my lecture is looking at spatial dispersion in agricultural growth across states

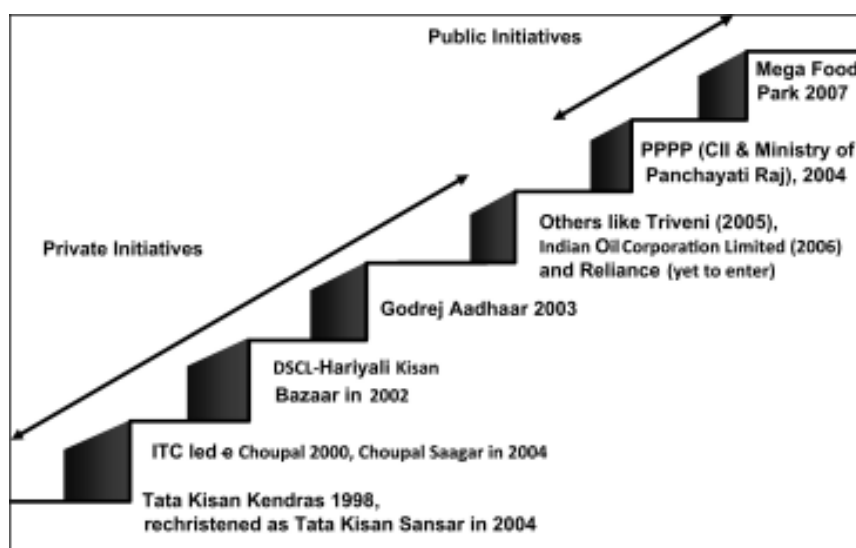


Figure 8. Emerging models of rural business/service hubs

Source: Gulati and Gupta (2008)

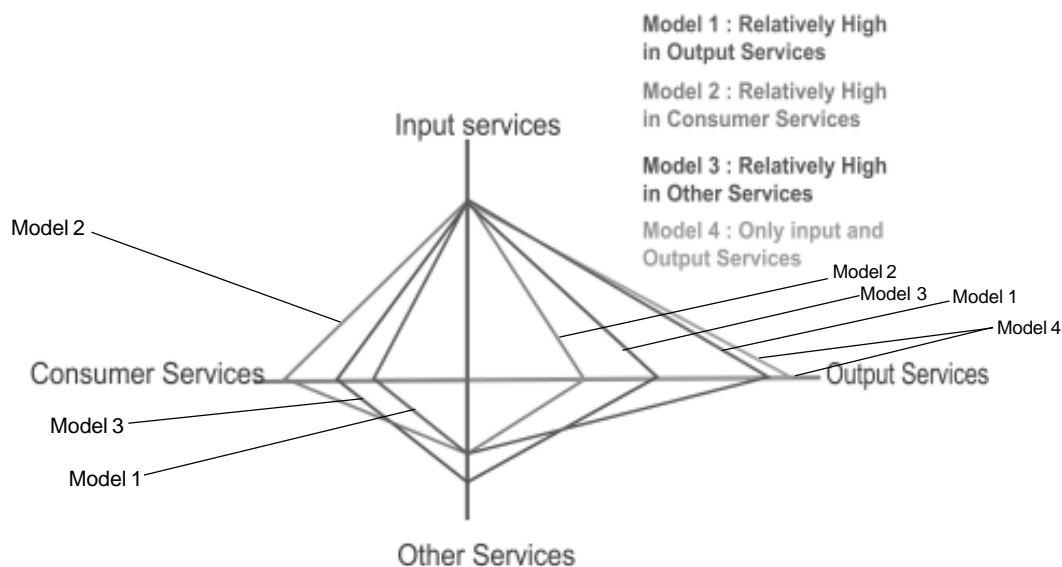


Figure 9. Taxonomy of services provided by rural business service hubs

Source: Gulati and Gupta (2008)

in India. Agricultural performance has been subject to wide fluctuations and a similar pattern is observed during the period 2000-01 to 2007-08. Gujarat tops the list with its agricultural sector growing at 9.6 per cent during 2000-01 to 2006-07, while the all-India figure is 2.9 per cent for the same period. However, agriculture in major agricultural states like Uttar Pradesh, West Bengal and even Tamil Nadu has been growing at less the national average (*see* Figure 10). This has aroused curiosity amongst researchers to dig deeper and try to

understand what is going on in the agricultural sector in Gujarat and also whether this can show light to other states in India.

The story of agricultural growth in Gujarat is quite interesting and there are various hypotheses at present in terms of various possible drivers of growth (Gulati *et al.*, 2009). One of which is the success of Bt Cotton in the state. Some farmers in Gujarat were the first ones to adopt it in 2001 (even before formal approval

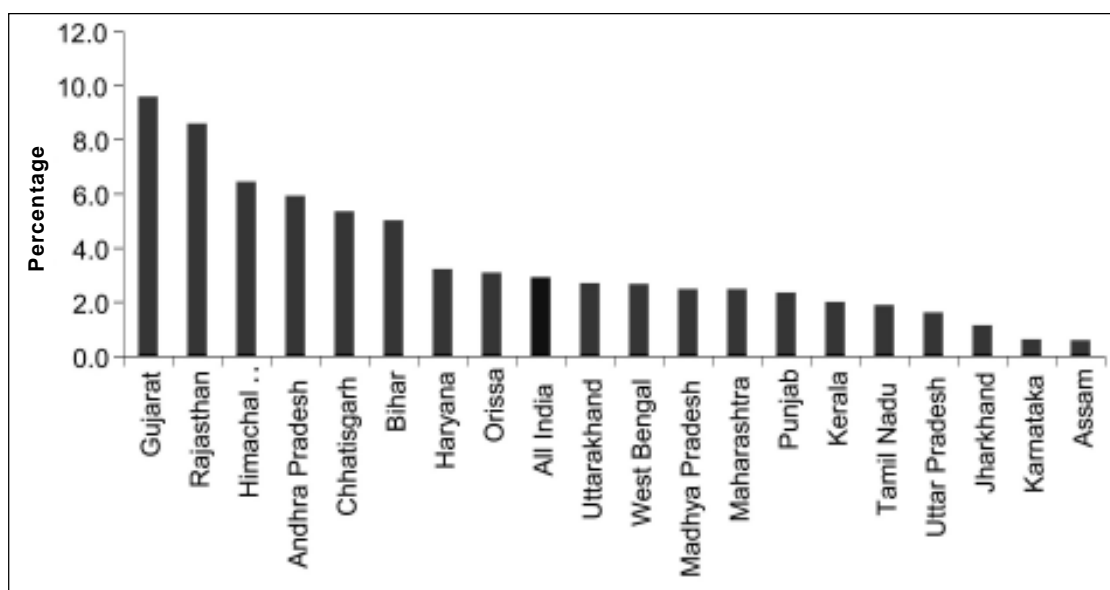


Figure 10. Average annual growth rates of gross domestic product from agriculture: Major states and all-India (%): 2000-01 to 2007-08

Source: Central Statistical Organization, Government of India (2009).

Note: Average annual growth rate for all states are from 2000-01 to 2007-08, except for Gujarat, Madhya Pradesh, Maharashtra, Uttarakhand and West Bengal for which latest data is up to 2006-07.

was granted) and they have not looked back since then. The share of cotton in Gujarat agricultural output has increased from 6 per cent to 12 per cent within a span of 6-7 years. Also, the share of high-value agriculture, especially bananas and dairy in the value of output has been increasing in the state. Production of fruits and vegetables segment has registered a robust growth of 12.8 per cent during 2000-01 to 2007-08, more than double of what it was during the 1990s. Agriculture in Gujarat has been diversifying and is perhaps growing at a much faster rate compared to other states.

Perhaps the Gujarat government has played a very proactive role in developing the agricultural sector through investments in infrastructure, irrigation networks and other public goods. Augmenting water supplies for irrigation has been one of the key points that the government has worked on. This has been done by increasing the water supplies through Sardar Sarovar project, the designed discharge capacity of which is 40,000 cusecs at the head reach and 2,500 cusecs at the Gujarat-Rajasthan border. This is supplemented by more than 100,000 check dams and major program on Khet Talavadi (water ponds in the fields). All these together have augmented the water supplies, and at places also re-charged the water table,

thus improving the groundwater irrigation. This in turn has helped crops like bananas which need more water and also potatoes, onions, and even cereals like wheat. Wheat for example, has been growing at the rate of more than 40 per cent per annum during the past five years in the state and has led to structural transformation in the cereal basket of Gujarat. Behind all this is also a major dairy sector which has flourished over years since Operation Flood during 1970s, and is growing at an impressive rate of about 7-10 per cent.

Incidentally, Gujarat is perhaps the only state in India which has also carried out reforms in the power sector, separating out the feeder lines and agricultural operations from household consumption. This has reduced the power theft in the rural areas and given new lease of life to the non-farm sector in the rural areas. The investment in roads in Gujarat perhaps is the best in the country. IFPRI's research shows that investment in roads is the most powerful way to alleviate poverty and accelerate agriculture growth (Fan *et al.*, 2008). Another innovative change that Gujarat has done with respect to agricultural sector is to restructure the Gujarat Agricultural University into four separate universities, and rejuvenating its extension program under Krishi Mahotsav. This is

spearheaded by the Chief Minister whereby he himself spends about a month in the rural areas and the agricultural scientists and bureaucrats follow to demonstrate the best of their technologies and innovations to farmers. This seems to have led to a fundamental change in the culture of doing business in agricultural universities, which is making them more accountable to the demands of their stakeholders, namely farmers. All these factors, i.e. generation and diffusion of new technologies, higher investment in water augmenting structures and roads, and institutional reforms in agricultural universities, especially extension, possibly explain the major changes sweeping Gujarat agriculture. If these lessons can be learnt by other states, the Indian agriculture growth story will be very different.

4. What Can We Learn from these Emerging Trends and Innovations?

All three points that I have mentioned in the above paragraphs point to some important lessons.

Private Sector for Productivity and Public Sector for Governance

First, that with increasing role of the corporate firms in technology generation and diffusion, as has been the case in cotton, there are potential gains that the society can have in terms of higher production, exports, and farmers' incomes, provided the policy environment is conducive to it. However, this is not to downsize the role of the public sector as it remains responsible for creating an enabling environment for the corporate players to operate. To carry forward the agriculture-for-development agenda amidst a rising class of corporates in the agricultural sector, the government needs to play a more proactive role as a coordinator, facilitator and also a regulator (The World Bank 2007b). The issue is not private versus public but of the two sectors working in partnership in tandem with civil society, farmer groups and the like. This is particularly desirable in reaching out new technologies to the farmers through an informed network.

Mainstreaming Small Holders

Second, with the entry of large firms in agri-system, the value chains can be improved, compressed, and made more efficient with higher investments in logistics, etc. Farmers can also gain from available technologies

and assured markets, if one could evolve appropriate institutional structures for their mainstreaming. This needs rational thinking and innovative approaches, and it is a challenge to researchers, government bodies, as well as to business sector that are driving and implementing many of these changes.

Governments Need to Invest in Infrastructure and Reform Institutions

Third, government has an important role to play, not just in regulating the business, but also investing in basic infrastructure like roads, canal waters, watersheds, check dams, and khet talavadi, as Gujarat has done, and where business firms normally do not enter due to classic problem of market failure. Perhaps this can be instrumental in attracting private investments in other areas of the supply chain; exploiting the complementarity of public-private investments.

At present, there is a deficit of trust amongst the firm and the farmers, owing to an uneven playing field. There is a need to bring about certain institutional reforms that promote firm-farm linkages. Implementation of the Model Act (amended Agricultural Produce Marketing Committee Act) across all states is essential to allow direct purchase and sale of agricultural commodities between the corporate and the farmers. Also, opening up of the land lease markets will be important in legalizing land leasing. This will help the owner lease out without the fear of losing the ownership. Computerization of land records although recommended, needs to be put in place to ensure greater transparency in land deals.

Let Hundred Flowers Bloom

At the end, what I would like to put on the table is that given the vast diversity; geographical, and socio-economic condition, India has to innovate in its own way, to devise business models which can work with millions of small and fragmented peasants. They will quickly adopt new technologies, if they find it useful and can augment their incomes (as is demonstrated by the Bt cotton experience). But, they will also need assured markets, be it for the domestic consumers or for export markets. The present concern is not just to augment supply but ensure proper management of the supplies and also identify markets. And perhaps, the corporate, in their own interest are in a better position

to provide markets than the government. Government can adopt a policy to create synergy between private sector, cooperatives, and government institutions. And there is no one size that will fit all, but many experiments need to be undertaken.

We may choose to ignore these emerging changes, but certainly cannot restrict them. As researchers, we need to map the spread of these emerging trends, particularly the rise of new and innovative institutional arrangements, followed by a scientific evaluation of these on the scale of CISS – Competitiveness, Inclusiveness, Sustainability and Scalability. At IFPRI we have made a beginning in this direction, but institutions like NCAP, IIMs, and many others need to launch several such studies with a view to see how best the process of growth can be rendered inclusive. The main challenge for India will be to ensure that the smallholders are mainstreamed in the new emerging agri-system, and how they can gain from these changes.

If our research helps bringing significant gains to smallholders on sustainable basis, it would be the best tribute to Dr. Jha's dreams.

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About the Author

Dr Ashok Gulati is currently International Food Policy Research Institute's (IFPRI) Director in Asia, based in IFPRI's New Delhi Office. During January 2001 to February 2006, he was Director of the Markets, Trade and Institutions Division of IFPRI in Washington D.C. Before joining IFPRI, Ashok Gulati was a NABARD Chair Professor at the Institute of Economic Growth in Delhi ; Chief Economist at the National Council of Applied Economic Research, Delhi.

Dr Gulati has been a member of the Economic Advisory Council of the Prime Minister of India; a member of the State Planning Board of Karnataka; a member of the Economic Advisory Council of the Chief Minister of Andhra Pradesh; a member of the Board of Directors of ICICI Banking Corporation; and many other such positions. Dr Gulati has done Masters in Economics and Ph.D. from Delhi School of Economics.

His special areas of research include analysis and policy advice on issues related to agricultural markets and development of value chains; agriculture trade liberalization and negotiations in WTO; reforms in public irrigation and power systems; role of government, corporate, and civil society in development of agriculture and rural areas in Asian countries, etc.

Dr Gulati has published widely in national and international research journals, rendered policy advice to the Government of India, and interacted closely with the corporate sector involved in agri-business, the farmer groups, and the civil society organizations.