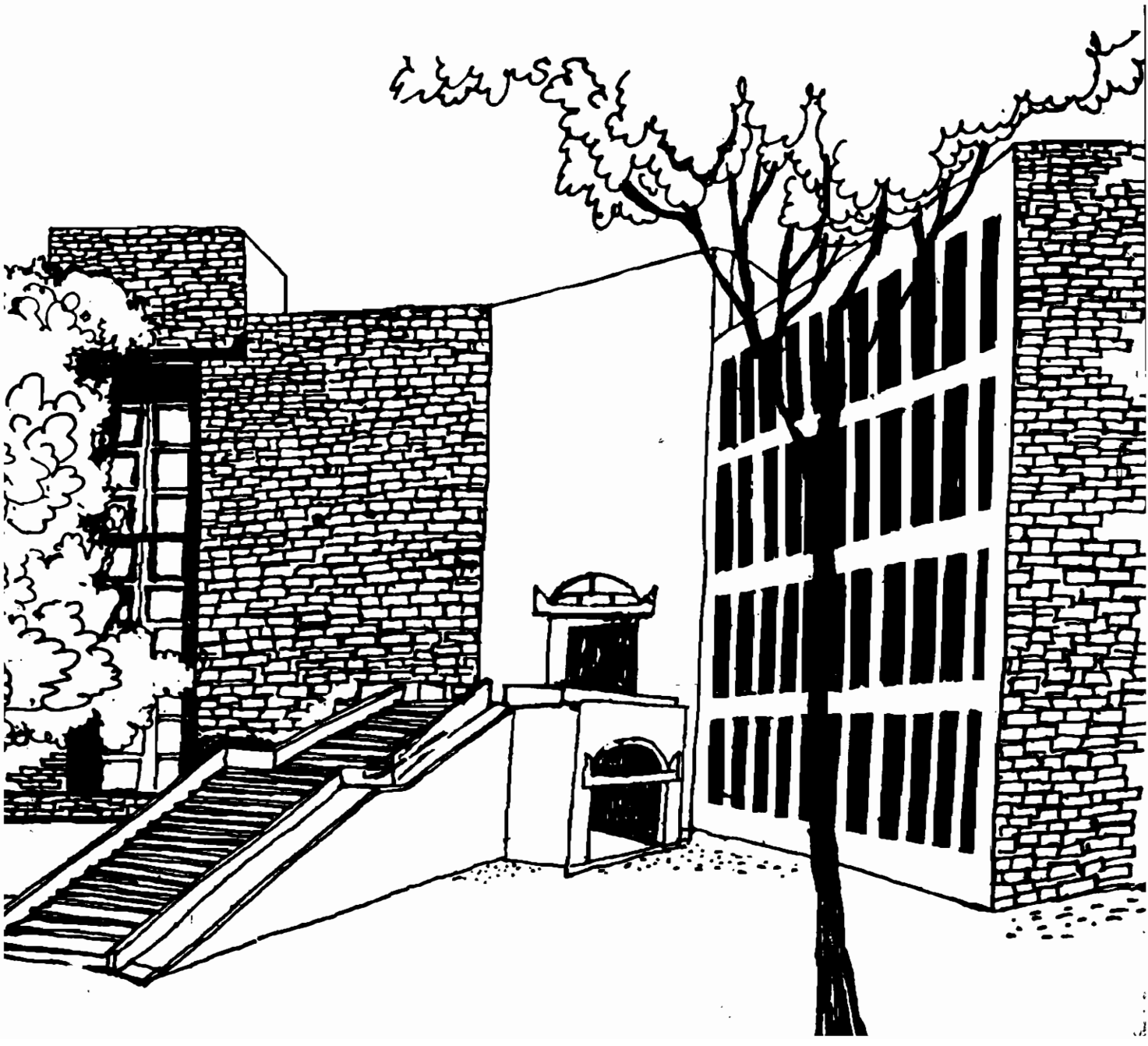
विद्यार्थिनियोगाद्विकासः

IIM

AHMEDABAD

Working Paper



THEORETICAL AND POLICY MAKING CONTRIBUTIONS OF RESEARCH ON AGRICULTURAL ECONOMICS: A SUCCESS OR FAILURE OR NEITHER?

By

Bhupat M. Desai

W.P.No.2000-06-07
June 2000 1607

INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD-380 015
INDIA

Theoretical and Policy Making Contributions of Research on Agricultural Economics: A Success or Failure or Neither ?*

Bhupat M. Desai

Centre for Management in Agriculture
Indian Institute of Management, Ahmedabad

June 2000

(*) A paper based on presentation made to the All India Seminar on "Indian Economy in the New Millennium" organized by the Centre for Advanced Study in Economics, Department of Economics, University of Mumbai, Mumbai on March 24-25, 2000. The author is grateful to the participants of the Seminar for their observations and comments on his presentation. Usual disclaimers, however, apply.

Content

Theoretical and Policy-Making Contributions of Research on Agricultural Economics: A Success or Failure or Neither ?

Bhupat M. Desai
Professor
Centre for Management in Agriculture
Indian Institute of Management, Ahmedabad

I. Prologue

This paper discusses following five issues by briefly considering the historical context of agriculture, innate biological nature of production process in agriculture, and initial conditions that agriculture inherited at the time of Independence in 1947:

1. Strengths and weaknesses of major research in agricultural economics (Section II),

2. Strengths and weaknesses of agriculture (Section III),

3. Impact on the political will of India to develop agriculture more rapidly (Section IV),

4. Changes required in research in and policies for agriculture and those in other major branches of economics for more rapid sustainable development of agriculture (Section V) and

5. A brief epilogue on the title of the paper (Section VI).

Before pursuing the next section nature and history of research in agricultural economics and historical perspective of agriculture, its innate biological nature, and its initial conditions in 1947 are briefly sketched.

Research in agricultural economics got initiated much before 1928 when Royal Commission on Agriculture was appointed by the then British Government in India (See, for example, Hunter 1868, Leather 1894, O'Melley 1912 and 1917, and Dubey 1920/21). It dealt with such topics as famines, food storages and inflation, farm indebtedness, land tenure, livestock, traditional outlook of farmers, agricultural practices etc. etc. But since around 1940 when some leading economists like D.G. Karve, D.R. Gadgil, Sir Manilal Nanavati, J.J. Anjaria, M.L. Dantwala, V.K.R.V. Rao, V.G. Panse, V.M. Dandekar, J.P. Bhattacharjee and K.N. Raj came on the scene this research became a nation and international-wide movement. Topics covered ranged from the sector's development for making contributions to economic development and welfare in general to those that are mundane and even populistic.

Good quality research dealt with the problems germane to agricultural change. It is very rich and highly scholarly, while some other research is indifferent in its quality and still some others is inferior. But there are three unique features of all these research which make it very different from the research on other branches of economics.

One, it was driven by a concern for a large mass of humanity engaged in agriculture and its drudgery. Two, it was prompted to create both professional and laymanish knowledge on the problems of agriculture. And three, it aimed at solving these problems just not for farmers but for the society at large also. In other words, it was not a knowledge for knowledge's sake.

Four major features of historical context of agriculture are (1) it was stagnant for first half of the Twentieth century (Blyn, 1966), (2) developing agriculture had a sole goal of meeting import needs of commercial crops like cotton, jute, spices, condiments etc. for Great Britain with consequent neglect of food crops which occupied over three-fourth of cropped area, (3) major policies centered around irrigation of protective nature, credit, cooperatives, market regulations with occasional price incentives, and (4) Great depression and inter-war years in general affected agriculture adversely.

On the innate biological nature of agriculture what is most crucial is that its production process is subject to Ricardo's Law of Diminishing Returns with consequent need to continuously introduce new technologies for adoption by farmers to improve the productivity. But this was mostly neglected; ICAR came into being only in 1930 and that too with a mandate that was more suitable for commercial crops and centralized rather than location-specific adaptive basic research and its transfer especially for food crops.

While preceding discussion has highlighted some initial conditions that agriculture inherited, some other major ones are (1) increasing incidence of intermediaries between the tiller and owner in which three broad types of land tenure system emerged, namely, Zamindari, Jagirdari, and Ryotwari which were all feudal and manipulated by the colonial power, (2) Independent India's share in population was 81 per cent, while in irrigated area and area under rice and wheat it was 69 per cent and that under jute it was 24 per cent, besides loosing cotton areas with better varieties and rice and wheat areas with yields that were higher by 15 to 20 per cent, (3) frequent food shortages and some localized famines like Bengal famine of 1942 with associated high inflation that required restrictions on marketing, rationing etc. which are now taking a long time to reform, and (4) agricultural indebtedness during Great depression period doubled from Rs.900 crore in 1929 and informal money lenders thrived.

II. Strengths and Weaknesses of Research on Agricultural Economics

As mentioned earlier problems studied are very many, highly important and topical and even somewhat insignificant which makes it difficult to cover them all in a paper like this. But considering relatively better quality research we approach them as the following six stylized themes and sub-themes related to each of them (for a similar conceptualization see, for example Desai, 1997):

1. Food Demand-Supply, Agricultured Growth and Poverty Alleviation

- Trends in these at all-India level and in different regions;
- Role of agriculture in economic development; and
- Food security.

2. Options for "Strategy" of Agricultural Growth and Their Impacts

- Extensive Farming
- Intensive Agriculture; and
- Scientific Knowledge-based Technical Change

3. "Sources" of Growth in Agricultural Production and Productivity

- Area and yield per hectare as sources of growth in overall and major crop-wise production at all-India level and in different regions;
- Area, yield per hectare, crop-pattern, location, and interactions among them as sources of growth in land productivity; and
- Growth accounting framework for total factor productivity in agriculture to decipher extent of contributions of different inputs and residual productivity i.e. technical change.

4. Institutional Factors for Agricultural Change

- Land reforms and its five instruments of updating land records, abolition of Zamindari (absentee landlord) system, land ceiling and redistribution, tenancy regulation, and consolidation of land fragments;
- Formal and informal rural credit and its two broad instruments of institutional development and interest rates;
- Imperfect and inadequate access of the poor to credit, inputs and other services;
- Imperfect and inadequate access of the poor to on and off-farm employment opportunities or labour market (!); and
- Agro-processing Industries

5. Technological and Environmental Factors for Agricultural Change

- Agricultural research and education to evolve location-specific new technologies and knowledge;
- Agricultural extension to transfer location-specific new technologies and knowledge;
- Market purchased farm inputs and assets in which new technology is embodied; and
- Environmental concerns of agriculture.

6. Economic Factors for Agricultural Change

- Farm product prices, terms of trade and market structure and its regulation;
- Government and private fixed and working capital investments;
- Farm taxation and subsidies; and
- Foreign trade in agriculture.

Strengths and weaknesses of research in these themes and their sub-themes are now discussed. Our purpose is to illustrate them rather than be exhaustive and comprehensive for want of space.

1. Food Demand-Supply, Agricultured Growth and Poverty Alleviation

The single most strength of the research on this has been that it shows that these three have no trade-off. This is especially so for absolute poverty i.e. Headcount Ratio/Sen's Poverty Index (See, for example, Dandekar and Rath 1971, Dantwala 1973, Minhas 1974, Narain 1986, Dantwala 1986, Mellor and Desai 1986, Ahluwalia 1986, Rao 1994 and 1997, Ninan 1994, Ravellon and Dutt 1995, Sen 1996 and Namboodiri and Desai 1998a)

Second strength is that the research on second sub-theme of role of agriculture in economic development suggests that this role is just not restricted to a source of food and raw material but making seven contributions of (a) national product, (b) low inflation, (c) alleviation of poverty, (d) providing a market for farm inputs and consumer goods, (e) saving to finance economic development, (f) foreign exchange earnings through exports and/or import-substitution, and (g) releasing labour for other sectors (Johnston and Mellor 1961, Dantwala 1962 and 1970, Kuznets 1965, Mellor 1976, ADB, 1976, Rangarajan, 1982, Bhalla et al, 1990, Haggablade et al, 1991, Hazell et al, 1991, and Desai 1999b). This suggests that developing agriculture is just not for food security but more importantly for livelihood growth and security not only for the poor but also for agricultural and non-agricultural sectors. This is because such a role facilitates relaxing wages goods constraint to employment - lead economic growth, poverty alleviation and self-reliance and just not self-sufficiency for rural non-farm activities, but also for the economy as a whole. This is because when this constraint is relaxed it reduces the prices of wages goods which in turn lowers the wage and/or raw material costs in various sectors including government with consequent improvement in their saving, investment, employment and growth, besides reducing absolute poverty. (Brahmanand 1954, Vakil

and Brahmanand 1956, Dantwala 1962 and 1970, Mellor and Lele 1971, Mellor 1976 and 1986, Lewis 1986, Mellor and Desai 1986, Chakravarthy 1987, Rao 1997, Oza 1997, and Desai 1997).

Thirdly, research on trends on demand for agricultural commodities indicates that it is income-elastic especially for superior cereals and foods other than foodgrains including livestock, poultry and fishery products and price-inelastic in general (see, for example, Mellor 1966 and Radhakrishna et al, 1990). Similarly, such research for food supply, agricultural production and poverty alleviation enabled identifiying areas wherefrom, and "strategies" and means through which these could be increased rapidly so that food shortages, associated inflation and increases in wage and raw material costs and poverty may be averted. (See, for example, Government of India 1959, Panse 1959, Panse et al 1961, Dantwala 1961, 1967, 1970 and 1986, Sukhatme 1962, Mellor 1962, Hopper 1962, Ensminger 1962, Krishna 1964, Blyn 1966, Ladejinsky 1969, GOI 1969, Dandekar 1970, NCA 1976, Abel 1971, Krishna et al 1971, and Bhalla et al 1979) Fourthly, region-wise research on these enabled addressing highly meritorious issue of making growth of agriculture broad-based, besides dealing with the issues of regional inequity which to an extent is inherent in agriculture due to differences in agro-climatic conditions and (natural) resource endowments (see, for example, Rao 1962, Dantwala 1976 and 1986, RBI 1984, Vaidyanathan 1987, Rao 1994, Vaidyanathan and Desai 1995, Sawant and Achutan 1995, and Ray 1998).

Three major weaknesses of the research on this theme are: one, this research does not reveal that eventhough percent share of agriculture in national income declines over 12 to 16 decades in the process of economic development (Kuznets 1957), this sector's value added in real terms in absolute amount grows over time (this has eluded almost all the past literature though one recent exception is Desai 1999b). This is mainly due to increases in agricultural productivity and demand for farm products being income-elastic and price-inelastic with consequent growth linkages for agriculture and economy at large. Overlooking this may have been responsible for casual, short-sighted and expedient approach to development of agriculture and policies required for it.

Two, earlier research on demand for agricultural commodities was based on functional forms that did not allow increasing/decreasing income elasticities/additivity constraint being satisfied/ignored prices of consumer goods (see for example, Mellor 1966 and Desai 1972). But more recent research overcomes most of these deficiencies as it is based on normalized quadratic function/generalized Leontief demand system/transcendental logarithmic system, though the model of food characteristics demand system gives results that are implausible and intuitively unconvincing (see, for example, Bhalla et al 1997, and Kumar et al 1997). And three, research on food security seems to be overconcerned with ensuring merely short-run requirement especially for the poor (see, for example, Bapna 1997).

2. "Strategy" Options for Agricultural Growth and Their Impacts

Three options for this are extensive farming, intensive agriculture and scientific knowledge based technological change (Mellor 1966 and 1976, Heady 1968, Dantwala 1967, 1970 and 1986, and Raj 1969 and 1983). Growth in agriculture can occur from bringing hitherto uncultivated land into cultivation (i.e. extensive farming). It can also occur from increased use of the same inputs such as land, labour, irrigation water, fertilizers etc. (i.e. intensive agriculture). And lastly it can occur from embodied and/or disembodied technical change that is scientific knowledge-based. Embodied technical change is usually associated with new biological, chemical and mechanical inputs, while disembodied technical change relates to improved farm practices (see, for example, Heady 1968 and Sankhyan 1988).

While these are some of the strengths of initial research on this theme, subsequent research has a strength in showing that first two options increases production at diminishing rate and lead to a trap into Ricardo's Law of Diminishing Returns and the third option overcomes this trap through a shift in production/cost function that is upward/downward and to the right (Mellor 1966 and 1976, Desai and Rao 1997, and Desai and Namboodiri 1997a). In other words, it means increase in production at the same level of inputs/same level of output is produced at a lower cost. Thus, it improves production by increasing total factor productivity (i.e. growth in output including product innovations minus growth in all inputs) (Mellor 1966, 1976, and 1986, Heady 1968, Jha et al 1973, Rosegrant et al 1994, Desai 1994, Desai and Namboodiri 1997b, Desai 1997, and Desai and Namboodiri 1998b). Such an improvement results into decline in unit costs/prices in real terms which benefits the poor most (see, for example, Mellor 1976, Kahlon et al 1983, Kumar et al 1992 and 1994, Singh et al 1995, and Acharya 1997). Yet another strength is that this research shows that absolute poverty ratio declines with the increase in total factor productivity (Desai and Namboodiri 1998a).

But four major weaknesses of this research are; one, some of them have treated intensive agriculture to include product innovations also (see, for example, Mellor 1966, Raj 1969 and 1983 and Anderson et al 1994). Two, most research on the first two options does not recognize that they create pressure on natural resources with consequent environmental degredation and increased (absolute) poverty (Mellor 1966 and 1976 and Anderson et al undated). Three, most research on the third option of technical change that is scale neutral assumes that it is also neutral in factor shares/functional income distribution (see, for example, Ladejinsky 1969a and b, 1970, and Mellor 1976). But this would be the case if social, economic and political institutions are also neutral to scale. However, as Kuznets has shown in the process of economic development initially the inequality in income increases. Hence, the policy choice is not to discontinue the third option. But to rely on other interventions such as land reforms, reservation of extension services and credit, and subsidized assets to deal with this problem. But technical change of Green Revolution type has been inherently scale-neutral, divisible and land, labour, intermediate inputs with complementary capital augmenting, besides dampening the effect on the rate of increase in foodgrain prices for consumers with consequent increase in absolute level

of income of various classes including landless (see, for example, Mellor 1976 and Ruttan 1977).

And lastly, while some of this research measures total factor productivity by an index underlying which there is a Cobb-Douglas production function and prefectly competitive framework, besides neutral and disembodied technical change (see, for example, Jha et al 1973 and Dholakia et al 1997), some other research uses Tornquist-Theil index that is derived from translog production function which allows for perfectly and imperfectly competitive frameworks and complementarity of agricultural production process, besides neutral as well as non-neutral and embodied as also disembodied technical change all of which is quite realistic (see, for example, Sidhu et al 1992, Kumar et al 1992 and 1994, Rosegrant et al 1994, and Desai 1994).

3. Sources of Growth in Agricultural Production and Productivity

On this two broad types of studies have been done. One of these considers area and yield per hectare as sources of growth in overall and crop-wise production. Its major strength is that it is quite simple in its framework and provides useful insights about these two sources of growth (see, for example, Sawant and Achutan 1995 and Naik et al 1997). Former study also introduced an innovation to decipher whether the growth is accelerating/decelerating by considering a quadratic term for time trend. If the co-efficient associated with this term is positive/negative it suggests acceleration/deceleration in growth. Studies that use this framework have three major weaknesses. These are (1) it ignores effect of changes in crop-pattern; (2) it cannot enable formalizing what are the determinants of growth in area and yields; and (3) growth in yield in per hectare does not necessarily represent the third strategy of technical change. Rather it could be a result of both second and third "strategies". Nonetheless, it is a useful approach inasmuch as its data requirements are limited and not time and cost-intensive.

Second type of studies on this theme considers several sources of growth in output/land productivity (see, for example, Narain 1977 and Vaidyanathan 1977). These are pure yield effect, pure area effect, pure crop-pattern effect, pure effect of location of shifting area from high-yield to low yield states and interactions among them. While Narain 1977 considers all these for growth in land productivity, Vaidyanathan 1977 considers area effect, irrigation effect, and fertilizer effect on growth of foodgrains production.

For a land scarce country like India pure yield effect and pure crop-pattern effect on land productivity rather than production growth studied by Narain 1977 unlike Vaidyanathan 1997, may be a good proxy for deciphering technical change. Moreover, Vaidyanathan 1977 does not consider many other inputs as well as changes in crop-pattern. But both the studies suffer from not being able to formally answer what influences the growth in these various sources. But as will be shown later growth accounting framework of determining total factor productivity is not only the true measure of technical change but also amenable to explaining what determines it.

4. Institutional Factors for Agricultural Change

The single most important strength of the research on this theme and its sub-themes is that it shows that these factors are a necessary but not a sufficient condition without technology and infrastructure related changes (see, for example, Dantwala 1967 and 1986, Ladejinsky 1970, Parshasarathy 1991, Dandekar 1993, Datta et al 1999, and Desai 2000). Moreover, Datta and Desai 1999 shows that in erstwhile Zamindari areas both land and labour productivity are influenced most by technology related variables of irrigation ratio and fertilizer use, while in erstwhile Ryotwari areas where tenancy is prohibited they are most explained by tenancy regulation, average farm size, and ratio of irrigation which is a leading input for technical change.

But some of the general economists (like Sen 1982, Bardhan 1984, Warriner 1984 and Dreze et al 1995) unlike agricultural economists (like Dantwala 1951, 1967, 1970 and 1986, Gadgil 1955, Thorner et al 1962, and Ladijinsky 1970 and 1972) do not distinguish five different instruments of land reforms nor do they much recognize the success story of abolition of Zamindari system. Secondly, they seem to overstate the (economic) feasibility of radical land redistribution.

Thirdly, earlier studies on tenancy farming consider it to be inefficient (see, for example, Khusro 1973). But more recent research shows it to be efficient **under given structure** (see, for example, Parthasarathy 1991). And lastly, most of the studies on the rapid success of Green Revolution in Punjab do not recognize its land consolidation policy as one of the important contributing factors.

On rural credit most studies suffer from inappropriate framework for studying the financial viability of the institutions as they show that lending is non-viable but institution as a whole is making a profit (see, for example, RBI 1989). This contradictory result is because of the arbitrariness in allocation of common transaction/administrative costs to lending which is an activity that is complementary and/or joint with deposits and/or borrowing. There are, however, a few exceptional studies like Desai 1994, Desai and Namboodiri 1996, Bhattacharjee, Desai and Naik 1997 and 1999, and Namboodiri 2000 which have studied this issue by considering Theory of Cost to find out existence of scale and scope economies and profitability model. These studies show that rural financial institutions have scale economies and/or constant returns to scale in their various costs associated with different portfolios, besides showing that these economies are invariably superior for lending rather than deposits. Just as these results are at variance with other studies Desai and Namboodiri 1996 and 2000 also show that there was hardly any subsidy on interest rate on rural credit compared to what Gulati and Sharma 1991 and 1994 show. This is because these latter two studies do not consider determining this subsidy as nominal rate being lower than some measure of expected inflation that financial liberalization literature advocates.

Studies on IRDP and special employment programmes have quite well identified reasons such as lack of backward and/or forward linkages, target-orientation, leakages etc. for

their limited achievements (see for example Rath 1985, Dantwala 1985, Hirway 1997, Dev et al 1991, Rao 1994). But some of them have such weaknesses as the two programmes being conceived as mutually exclusive alternatives (Rath 1985 and Dev et al 1991) and the authors prefer wage-paid employment programme, while Dantwala 1985 considers that both are needed and they should be integrated with sub-sectors like irrigation and watersheds, rural roads and communication, other rural infrastructure, besides agriculture, allied agricultural sectors, and rural non-farm activities.

Studies on agro-processing industries are scanty (see for example, Desai et al 1991, Bapna 1997, Patnaik 1997 and Desai et al 2000). This may be because of the "Machines First" strategy of industrialization that was prioritized since the Second Five Year Plan and under which both agriculture and these industries tend to get neglected (Oza 1997). But major strong features of some of these studies are that they show that these industries have the highest direct labour-capital ratio among all the manufacturing industries, share close to 50 per cent of manufacturing employment just in the organized sector, labour they need is less skill-intensive and they tend to be closer to their raw materials. All these make them eminently suitable for rural-lead industrialization. Some of the populistic studies emphasize agro and food-processing industries which are of exotic nature but are less labour-intensive and more skill-intensive. Moreover, it is the basic and mainstream agro-processing industries which need a greater priority for employment generation, better quality products and higher value addition. And such a priority may well be preferable because these industries account for larger share in output, value added, and employment, besides producing mass-based consumer goods.

5. Technological and Environmental Factors for Agricultural Change

First three sub-themes that relate to the theme of technological factor are first dealt with. There is a small body of research on first two sub-themes compared to the third one of market purchased inputs such as seeds, fertilizers, pesticides, irrigation, pumpsets and tractors. In other words, in the past there seems to be more research on embodied technical change characterized by biological, chemical and mechanical innovations than on disembodied form of technical change.

Nonetheless there is also a rich and quite comprehensive research on adoption of and diffusion of both these types of new technologies. This includes series of studies of HYVs programme done by various Agro-Economic Researhc Centres and individual scholars (see, for example, Desai et al 1967, Malaya et al 1967, Gupta et al 1967, Desai et al 1967, Desai et al 1969, Vyas et al 1969, Krishna et al 1971). And on the third sub-theme it also includes the studies on IADP and IAAP (GOI 1969), besides those done by individuals and some institutions. Before the strengths and weaknesses of the studies on the third sub-theme are discussed same may be done for the research on first two sub-themes.

As mentioned earlier, some of the studies on first two sub-themes (i.e. agricultural R&D and its transfer) have been able to quantify their contribution by considering growth accounting framework of total factor productivity. Desai and Namboodiri 1998b shows

that in pre-Green Revolution (GR) period relative contribution of TFP in agricultural growth was only little over 25 per cent, while in post GR it was close to 43 per cent which, though is still lower than two-thirds for U.S. agriculture (Ball 1985). It also shows that the absolute contribution of technical change to this growth in post-GR was two and a half-times larger. Secondly, such quantification has enabled estimating (marginal) internal rate of return of public expenditure on agricultural research and extension; for example, Desai and Namboodiri 1998b estimates it to be close to 21 per cent which compares very favourably with the social discount rate of 7 to 12 per cent. Rosegrant et al (undated) estimates this returns for crop agriculture to be in the range of close to 60 percent for public research, little over 50 per cent for imported HYVs, about 45 per cent for extension and about 30 per cent for private R&D.

Thirdly, these few studies attempt analysing change in total factor productivity (TFP) through a behavioural approach rather than merely a technocratic or price fundamentalism mode. Following this new approach Desai and Namboodiri 1998b, incorporates most of the variables related to the three themes of institutional, technological and economic factors. More specifically it considers inequality in land ownerd and operated, public expenditure on agricultural R&D and extension, banking and market infrastructure, public irrigation infrastructure, ratio of NPK nutrients, barter terms of trade and so on. The results for 1966-67 to 1989-90 show that 98 per cent of the variation in TFP is explained by these variables, and 87 per cent is accounted for just by the public expenditure on agricultural R&D and its transfer. Between the price and non-price factors it is the latter that is more important, besides showing that as barter terms of trade increases total factor productivity decreases. Such an effect of relative farm price is because its positive incentive effect on saving and investment is more than offset by an increased income that leads to increased consumption and hence decline in saving and investment for technical change. Desai and Namboodiri 1998b results could be also interpreted to argue that there has been an under-investment in public expenditure on agricultural R&D and its transfers; it being less than one-half of one per cent of agricultural GDP in late 1980s, which compares poorly with internationally recommended norm of 2 per cent. For a similar evidence for pre-GR period (see Jha et al 1973) and for more recent evidence (see, for example, Pal et al 1997, Desai 1997). Moreover, most of the funds gets utilized to pay for salaries at the expense of undertaking location specific field-based research for crops breeding and management, livestock breeding and management, and for resource management.

Fourthly, eventhough official policy on agricultural R&D and T&V system envisaged above mentioned basic, experimental and adaptic research that is more bottom-up and oriented towards farmers' participation to solve their problems, recent studies found it to be wanting in all these respects (see, for example, Benor et al 1984, and Manage 1997). While these studies do not comprehensively discuss the reasons for this they could be (1) under-investment of public funding, (2) very low extension worker to farmer ratio; it being 1:800/1000 which compares poorly even with a country like Zambia where it is 1:600, (3) weak planning, inadequate monitoring and incomplete feedback, (4) lack of career advancement opportunities and performance based incentives and rewards for subject-matter specialists (SMSs), agricultural extension officers (AEOs), and village

extension workers (VEWs), and (5) overall management and organizational structure being hierarchical and somewhat feudal that were inherited from the British time.

Some of the important weaknesses of these studies are: one, studies done by say Kumar et al 1994, Rosegrant et al 1994, and Kumar et al 1992 estimate astronomically high marginal internal rate of return to technical change. This may be because in their cases unlike in Desai 1994 and 1998b inputs considered to derive TFP are fewer, besides the fact that they do not consider output of allied sectors. Two, some of the research tends to advocate solutions that do not match well with the problems cited above. For example on under-investment private funding is considered as an alternative, on ineffectiveness of VEWs and their supervisors, what is being advocated is to enlarge their pool by relying on private and NGO sectors, and on lack of incentives for agricultural scientists and extension personnel what is being sought is to charge farmers user fees. But none of these solutions are suitable for agricultural R&D and its transfer as it being a public good private sector would not much undertake it except for hybrids in which pay back period is relatively shorter and investment is not as lumpy with outcomes that are less uncertain. As far as introducing price for farmers' use of agricultural R&D and its transfer it is not justiified on the ground of it being a public rather than private good with high externalities nor is it warranted to make this service scale-neutral which at present it is not (see, for example, Vivekananda 1999). Indeed, introduction of such pricing may accentuate this inequality in the access of different sized/types of farmers to this disembodied technical change with consequent adverse impact on their productivity and poverty. As far as entry of private and NGO sectors in agricultural extension services is concerned it is perhaps a good idea to make this service from the government more effective. But the funding of this must be from the public exchequer nor should there be any user charge for the reasons just explained. And if these non-governmental organisations do not respond adequately within 2/3 years government system must be expanded.

And lastly, none of these solutions addresses to the basic problem numbers (3) and (5) i.e. lack of planning, monitoring, and feedback, and the organizational structure that is high-handed. Both these problems could be alleviated by organizational style that is more transparent, participative, and pluralistic with a structure that is genuinely like a pyramid rather than an inverted one and better MIS that is perhaps computerized

On the third sub-theme, good quality research (for some references see select bibliography of Singh et al 1997, Desai 1997, Unni 1997, Desai et al 1997e, Narayan et al 1997, Dhawan 1997, and Gandhi 1997, besides Desai and Vaidyanathan 1995) has a strength in showing that (1) most of the market purchased inputs except tractors, harvest combines and tubewells being divisible and scale neutral even smaller farmers (can) use them, besides the fact that some of these exceptional inputs/assets are being used by them jointly or through custom hiring from larger farmers, (2) irrigation and watersheds and inorganic nutrients combined appropriately with organic nutrients are leading inputs in the sense that if access to them is inadequate, further stability and growth of output and productivity are curbed even if use of other inputs increases, (3) preceding suggests that most non-land inputs have high degree of technical complementarity, (4) Most of these

non-land inputs except herbicides and harvest combines do not displace human labour though tractors do displace bullock labour which is hardly questionable; on the contrary these are all land, (human) labour, and complementary capital augmenting, (5) pesticides unlike these other inputs is yield-saving input inasmuch as it averts a loss of production from pest attack, (6) improving access of farmers to all these inputs requires development of vast and time efficient marketing network with high density of field-channels, (7) demand for most of these inputs is influenced more by non-price factors than their prices. These factors could be extension service/knowledge as an input for their scientific use, timely and adequate availability of credit, density of field channels, infrastructure like rural roads, rainfall and its distribution, and so on, and (8) of late farmers' participation in irrigation and watershed management, besides other non-land inputs and rural credit is being emphasized to improve the delivery system (see, for example, NABARD 1995, Vaidyanathan 1999, Jairath 1999, and Brewer et al 1999).

Six major weaknesses of this research are: (1) complementary nature of the non-land inputs is not defined in a rigorous manner i.e. output response being larger when this is satisfied compared to the sum of effects of each such input used singly (see, Ishikawa 1967 and Reynolds 1977 for this definition) (2) input response function studies that are merely cast in neo-classical economics framework may not prove much useful, if not misleading, (3) similarly if an econometric study with a multi-variate framework does not consider the complementarity, then also results may be of limited value and this condition could be incorporated by specifying an interactive term of concerned inputs, (4) the notion of the non-land inputs other than tractors and tube-wells are largely used by big farmers is a misperception, (5) input subsidies are less regressive than product price support is not much recognized nor the underlying reason for the former unlike the latter which benefits even the net purchasers of food once he/she uses these inputs is much appreciated (three exceptions on this are Krishna 1967, Mellor 1976, and Barker et al 1976) and (6) the notion of X-efficiency rather than allocative efficiency of these non-land inputs is also not much appreciated nor the role of knowledge/extension services as an input and that of modernization of surface irrigation system through public investment to achieve this efficiency is well understood. All this suggest that in agriculture embodied and disembodied technical change are more often complementary rather than mutually exclusive substitutes.

On sub-theme four of environmental concern again there are very few field based high quality studies. Nonetheless these studies have strengths in indicating that overcoming these concerns lies not in discontinuing technical change but in three broad policy interventions of public investment, appropriate pricing and laws and restructuring organization of implementing agencies especially to enforce some regulations and to promote knowledge as an input to the farmers which may have their participation too. Secondly, among the four major environmental problems of agriculture, namely, irrigation-induced soil salinity, soil erosion due to land degradation and encroachment, chemicalization through use of fertilizers and pesticides, and over-exploitation of groundwater all these four except chemicalization are genuine problems (Rao 1994 and Joshi 1997). This is because dosages of fertilizers and pesticides used per hectare are not that high except in a few selected pockets.

The main weaknesses of these studies are two-fold. One, they do not propose the obvious need to convert the strategy of technical change into seed plus resource-centred rather than only seed-centered as was the case for Green Revolution or resource-centered as was initially the case for semi-arid and arid areas. And two, basic research should focus all on crop breeding and management, livestock breeding and management, and resource management that gives a legitimate place for developing soil and water harvesting, land levelling etc. so that seed-cum-resource centered technical change can be evolved and promoted.

6. Economic Factors for Agricultural Change

On this theme also there is more literature on the first sub-theme than the remaining three sub-themes. This was especially so in the past though in more recent times the emphasis of research on barter terms of trade is growing in the wake of macro reforms.

Question arises what may be the reasons for greater emphasis on the research on the first sub-theme ? Probable answers could be that some considered farmers to have perverse response to price incentives (see, for example, Schultz 1966) as they have tradition bound outlook that is not rational; some others thought that PL 480 imports were keeping relative price incentives low for the farmers (see, for example, Mason 1969, Schultz 1966, and Lipton 1969 and 1975) and still some others thought that market structure for agriculture is inefficient, extortionist and indulged in malpractices the controversy over which got compounded when producers levy and zonal restrictions on movement of agricultural commodities were introduced to ease the problems arising from temporary short supplies.

The strength of the studies on farmers' rationality and responsiveness to prices is that it once and for all established that they are responsive to absolute level of farm product (i.e. own crop and competitive crop) prices and farm input prices (see, for example, Krishna 1963, Falcon 1964, Mellor 1966 and Herdt 1971). They also show, secondly, that non-price factors are far more important than this price factor. And lastly they reveal that for individual crops the price response is quite elastic though for the aggregate supply it is inelastic. Moreover, former is better for superior cereals and highest for cash crops like cotton, jute and sugarcane. While there are many studies showing these results on response to absolute level of prices, there are very few studies on response to barter terms of trade.

Studies in the 1960s on this latter topic were rich in showing that marketed surplus response to this relative farm prices could be either positive or negative depending on the strenghts of income and substitution effects and hence a priori indeterminate (see for example, Dandekar 1959 and 1965, Mathur et al 1961, Krishnan 1965 and Narain 1986). This is especially so for subsistence crops. But since then the literature on this topic overlooked this a priori ambiguous impact of barter terms of trade. Indeed, it assumed that it has positive response (see, for example, Ahluwalia 1996, Thamarajkshy 1977, Mungetkar 1992, Singh 1994, Kahlon et al 1983 and Misra 1998). And based on that

some of these studies advocates favourable such terms of trade (see, for example, Kahlon et al 1983 and Misra 1998). But this has been comprehensively questioned by Desai and D'Souza 1999, Desai 1999b, and Desai and Namboodiri 1997, 1999 and 2000 though an important contribution of the former group of studies is that what matters for growth in farmers' income is better income terms of trade (i.e. BTOT ΔMS (see, for example, Thamarajkshy 1977 and Mungekar 1992 and 1997). But this requires more direct improvement in growth of output and TFP. And both of these in turn needs government expenditure on agricultural and general infrastructure (Desai 2000) rather than the favourable barter terms of trade which can hurt the consumers and net purchasers of food in particular, besides the fact that output response to it is inelastic and could be negative as its substitution, income and wealth effects work in opposite directions (Desai and Namboodiri 1997b and 1999a and Desai and D'Souza 1999).

Three major comprehensiveness added by this latter group of studies are: one, the impact of barter terms of trade is studied for output as well as marketed surplus of four major commodity groups, besides aggregate agricultural output and marketed surplus. Two, wealth impact of this relative prices in terms of substitution between labour and leisure is also additionally conceptualized. It is also shown that a priori ambiguous impact of such prices is perfectly "rational" for a decision making unit/level at which consumption, saving, investment, labour supply and production are all intertwined (Behrman 1968). Thus ex-post negative "net" impact of such prices may not be interpreted to indicate perverse behaviour of farmers (see also Reynolds 1977). And three among the policy options for maintaining barter terms of trade the new one which the past literature has overlooked is neutral/harmonious such terms of trade relying largely on market forces assuming normal conditions.

Early studies on market structure have a strength in that they broadly show that it is quite competitive and efficient with high integration (see, for example, Jasdanwala 1966, Lele 1967 and 1972 and Cummings 1967). Second strength is that whatever inefficiencies they find are more due to infrastructural constraints such as poor communication and roads. It is this phenomenon which was also considered responsible for the malpractices that are commonly known about the traders engaged in agricultural marketing (see, for example, Subba Rao 1986). Broadly, these results follow from both the methodologies of marketing margins and structure, conduct and performance of markets.

But the critique of marketing restrictions like zonal restrictions seem to have had (see for example, Gulati et al 1991) a neo-classical economics orientation which does not necessarily ensure equity objective (see, for example, Subbarao 1986). However, such public intervention, besides producer levies, are also considered to lead to efficient pricing, in addition to serving the interests of producers and consumers as the weighted average price under non-levy market and that under levy is closely comparable to free market price (see, for example, Subbarao 1978a and b and 1986).

The main weakness of the studies on the first sub-theme as it relates to market structure and its regulation is that they have much less formal framework to simultaneously analyse its efficiency and equity goals. Perhaps it is difficult to do so and hence only

partial and static models with results that are explained by a huristic dynamic framework are only plausible.

Literature on public (including government) and private expenditure in agriculture is of recent origin except that Professor Dantwala considered that public investment both "on" and "for" agriculture are essential. The former includes irrigation, agricultural research and extension etc., while latter includes fertilizer plants, electricity, rural roads etc. Major strengths of this recent literature are four fold.

One, it quite extensively and rigorously discusses the rationale for public expenditure by considering both "market failure" and "structural view" of changing agriculture from oppressive to liberalized and egalitarian conditions (see, for example, Desai and Namboodiri 1997a and references cited in it). Two, it also categorizes this expenditure such that it shows how it can shift the production possibility frontier (PPF) upward through technical change and/or increased capital stock, or through it being towards the origin due to unemployed and underemployed resources caused by market and institutional imperfections by relaxing institutional rigidities, besides considering the movement along a given PPF through manipulation of product prices, barter terms of trade and output-input prices (see, for example, Desai and Namboodiri 1997 and 1998(a) and (b)). Three, it intuitively shows that these two investments are complementary and not substitutes (see, for example, Rao 1997, Mishra 1997, and Desai and Namboodiri 1997d and 2000). And four, these investments have positive impacts on agricultural output, marketed surplus, poverty alleviation, and technical change, besides demand for credit. For some of these it has even more powerful impact than other non-price and price factors. The only weakness of these studies is that the analysis of complementarity of public and private investments suffers from a data on public investment that excludes such items as rural electrification and roads (Rao 1999).

While the literature on farm taxes is quite extensive and old, that on farm subsidies is relatively new. The strength of the former is that the burden of taxation on agriculture is quite comparable to that on other sectors when both direct and indirect taxes are considered. But the burden on rural rich is lower than their counter parts in urban areas. This is partly explained by the differences in their consumption patterns besides higher share of consumption of items that are self-produced (see, for example, Gupta 1986).

One of the strengths of the literature on farm subsidies is that it is quantified considering cost-based pricing except for subsidy on interest rates. But its major weaknesses are: One, subsidies are not viewed as a part of public finance framework and principles but in a narrow perspective of reducing fiscal deficit. Two, they are also not seen as a part of pricing issues though of late there is some beginning at the policy level. And three, they are viewed with an allergy in most quarters rather than on their merits and demerits.

On foreign trade in agriculture earlier literature had a strength in conceptualizing it as making a contribution to foreign exchange earnings through both import-substitution and export promotion. This may be because of low production and productivity and large domestic demand, besides foreign demand for agricultural commodities being income-

inelastic and relatively unstable and infrastructural bottlenecks that would constrain foreign trade (see, for example, Mellor and Lele 1975, Nayyar 1976, and Panchmukhi 1986).

More recent literature of the post-macro reforms period seems to assume that exports of non-basmati rice, hi-tech agriculture, fruits and vegetables etc. are a panacea, besides arguing that lowering of restrictions on (foreign) trade in agriculture in general would improve agricultural growth (see, for example, Gulati and Sharma 1991 and 1994, Singh 1994, and Ahluwalia 1996). But there are several limitations of this literature. One, trade is not required to enlarge the demand as domestic demand is not a binding constraint to growth. Two, while trade provides an opportunity to introduce product innovation to shift PPF it by itself cannot overcome Ricardo's Law of Diminishing Returns which applies to the production process of this very innovation. Thirdly, trade enables this shift through an exchange relationship which follows rather than precedes production process the constraints of which should be overcome first rather than those of the former (Desai 1999a and Desai et al 1999a). And this in turn requires priority for public investment in agricultural R&D and its transfer, besides other production infrastructure, over that in ports, cargos, etc. (see, for example, Desai 2000) Fourthly, the kind of commodities for which trade liberalization is advocated India has hardly a competitive advantage, besides needing to protect the domestic industry, consumers and farmers from anti-dumping and shortages. And lastly, as regards agriculture being implicitly taxed the argument is based on domestic farm prices being lower than border prices (i.e. net protection coefficient). But lower domestic prices largely result from our different resource endowments and less capital intensive technology in agriculture. Moreover, these very studies in the same breadth also argue that Indian agriculture has a comparative advantage eventhough it is implicitly taxed!

III. Strengths and Weaknesses of Agriculture

Following Desai 1999c and other literature these are as follows:

Strengths: Agriculture is the single largest private sector. Decision-makers in this sector are rational, efficient, and responsive to change under given agro-climatic resources, and agrarian and technological structures. Most of the 109 million farm-households are owner-operators. Tenant farmers are more in Eastern India. But even this region has of late an accelerated growth in crop-yields and agricultural production in general (Rawal and Swaminathan 1996). Long term agricultural growth in post-Independence period was close to 3 per cent per annum which is higher than the 2 per cent growth in population. Indeed, agricultural growth in 1970s and 1980s has become broad-based in terms of crops/enterprises, farms, and regions (Sawant and Achutan 1995, Sawant 1997 and Ray 1998). Annual compound growth rate of crop-agricultural output during mid-1980s to mid-1990s was 3.58 per cent. Milk production growth was 4.5 per cent per annum, while annual meat production growth was 7.6 per cent and egg production growth was 5.68 per cent during the same period (Ranjhan 1997). Fisheries

sub-sector had also better growth during this period; it being 6.71 per cent for inland fisheries and 6.18 per cent for marine fisheries (Dehadrai 1997).

Second strength of agriculture is that its value added in 1970-71 prices increased by over three times from Rs.10,300 crores in 1950-51 to Rs.31,600 crores in 1996-97 though its relative share in national income as expected declined from 61 to 30 per cent during this period. This is because of the increases in agricultural productivity and demand for farm products being income-elastic and price-inelastic. But this increase in real value added in per capita terms is quite unsatisfactory as agriculture has been neglected under "Machines First" strategy of industrialization (Oza 1997).

Third strength of agriculture is that it is diversified due to its varied agro-climatic conditions ranging from tropical but highly humid and sub-humid to tropical semi-arid and arid in nature. Farmers diversify to minimise risks which are more in agriculture compared to industry on account of weather dependency. Moreover, diversification is found in both crop-farming and allied sub-sectors of livestock and fisheries. This diversification is, indeed, more often a "complementary" process that is consistent with agriculture's resource endowments.

Fourth strength of agriculture is that its production process being "complementary" in nature is a common knowledge among the farming community. When such is the case, farmers output response is larger than the sum of effects of each input used singly (Ishikawa 1967 and Mellor 1966). This then facilitates achieving not only the higher growth of agricultural output but also that of employment. Both agricultural output growth and farm employment elasticity were much higher in post-Green Revolution period since mid 1960s; it being 3.41 vs 2.05 per cent for the former, and 1.37 vs 0.52 per cent for the latter (Desai 1997, and Desai and Namboodiri 1998a).[1]

Fifthly, agriculture has become more commercialized over time. The share of market-purchased inputs in major intermediate inputs increased from 3.7 per cent in early 1950s to 34 per cent in early 1990s. Farming for market rather than home consumption of even subsistence crops like paddy and wheat is now more common (NABARD 1995 and Satyasai and Vishwanathan 1997). The ratio of marketed surplus of foodgrains which used to be around 20 per cent in early 1950s increased to 40 to 50 per cent in 1980s. Even in perishables like milk and fisheries this commercialization process has become more common and even increased.

Agriculture in India like in Japan, Taiwan and South Korea, is small in size. Smaller farmers have higher land productivity and efficiency in general (see, for example, Chattopadhyay and Sengupta 1997). Moreover, land ownership inequality is neither very high nor much increasing. Average farm size in 1992 was little over 1 hectare. Over 80 per cent of the farmers have less than 2 hectares with over 35 per cent of land. Another

---

1. Lower employment elasticity shown by Bhalla 1993 has a weakness in that it relates employment to value added which excludes intermediate inputs like seeds, fertilizer, irrigation, etc. which are all labour augmenting.

15 per cent have 2 to 10 hectares with close to 50 per cent of land. Thus small and medium size peasantry dominates the land ownership distribution.

To conclude, agriculture in post-Independent India has demonstrated long-term growth rates and resilience that are not much heard of by international and historical standards.[2] And harnessing potential of its strengths requires overcoming six weaknesses that are discussed next.

Weaknesses: The reliance of macro reforms to reduce protection to trade and industry[3] for improving relative farm prices for technical change[4] and growth in agriculture is a contemporary weakness and misplaced. In post-reform period despite improvement in already favourable relative prices, growth in most of the non-price factors like use of fertilisers, pesticides, electricity, gross irrigated area, and plan expenditure on agriculture, etc. and hence in agricultural production and productivity was much lower than in the six years preceding reforms.[5] Such a performance is despite more favourable weather in post-reform period. Moreover, rural poverty ratio has also increased. As discussed earlier, aggregate agricultural supply response to relative farm prices is indeterminate **a priori** as its substitution, income and wealth effects work in opposite directions (Desai and D'Souza 1999, Desai 1999a, and Desai and Namboodiri 1999a). Desai and Namboodiri 1999a shows that "net" impact of these three factors for foodgrains which occupy two third of cropped land unlike other crops is negative for their output as well as marketed surplus. In other words, as relative farm prices for foodgrains increase their output and marketed surplus decline. Moreover, aggregate supply response is also long known to be price-inelastic because of three factors that are unique to agriculture. These are: (1) land supply being fixed, (2) resource specificity which makes crop-pattern being governed by agro-climatic factors in addition to demand conditions, and (3) initial lower input intensity. Even the enterprise/crop-mix has not much shifted from low-yield/value

---

2. Some literature considers past performance as weak on the ground that inter-regional and interpersonal inequity may have increased. But in more recent times agricultural growth has become broad-based. Similarly, Lorenz ratio of distribution of consumption expenditure in rural areas has declined. As regards employment growth it is the industrial sector rather than agriculture which has faltered perhaps because of the choice of "Machines-First" strategy of industrialization that has low labour-intensity since the Second Five Year Plan. And lastly, some inter-regional inequity in agriculture is inherent due to differences in agro-climatic conditions and (natural) resources endowments.
3. It is contended that such protection has led to implicit taxes for agriculture based largely on negative NPC (i.e. domestic prices being lower than border prices). But lower domestic prices is because of labour-intensive resource endowments and technology being less capital intensive compared to that in developed agriculture.
4. But, Desai and Namboodiri 1998b shows that a priori total factor productivity (i.e. technical change) and relative prices have no uni-directional positive association. This is because when these prices improve farmers income increases with the consequent rise in consumption and hence decline in saving and investment for technical change. Thus, this negative impact could off-set the positive incentive effect of relative prices on saving and hence on technical change. They also show an empirical evidence on this considering the 25 years of post-Green Revolution period.
5. Similar empirical evidence also holds for a state-level analysis for the Gujarat State (Desai and Namboodiri 1997c). Despite this reducing protection to trade and industry is a right reform for it would improve market structure.

to high-yield/value enterprises in post-reform period as it is also "relatively more" governed by non-price factors rather than relative prices.[6] But, the overall supply elasticity for non-price factors is over three times larger than for the relative prices (Krishna 1982). And the growth of non-price factors is largely determined by the public goods that constitute basic infrastructure related to production and R&D for agriculture.

Agriculture's weather-dependency is a self-explanatory weakness. However, that is not unique to India. What is interesting, if not unique, is that Indian agriculture has become weather-resilient over time (Dev 1987, and Ray 1998). This has largely resulted from two major sources. One of these is farmers improved knowledge to deal with vagaries of weather. And second is increase in irrigated farming. Such farming now accounts for over one-third of cultivated land. And this ranges from over 60 to 90 per cent in Northern States of Punjab, Haryana and Uttar Pradesh; over 15 to 40 per cent in Southern States of Goa, Karnataka, Andhra Pradesh, Kerala, and Tamil Nadu; over 8 to 43 per cent in such Eastern States as Assam, Mizoram, Himachal Pradesh, Orissa, West Bengal, Jammu & Kashmir and Bihar; and over 15 to 29 per cent in Western States of Maharashtra, Madhya Pradesh, Gujarat and Rajasthan. Despite these inter-state differences in irrigated farming they have over time reduced locational-differences in agricultural productivity and production in various states (Desai and Namboodiri 1997a, and Ray 1998). Both government investment and farmers' investment facilitated by rural credit for crop production, irrigation and electricity have contributed to improving weather resilience, besides higher and broad-based agricultural growth.

Thirdly, agriculture has less developed markets and institutions for modern farm inputs, extension services, credit, and perishables like horticulture, fisheries and to an extent milk. But this weakness is being reduced through government policies such as for rural credit, extension, opening the farm input distribution business to the private sector, and encouraging commodity-based co-operatives and private sector in agro-processing.

Agriculture being geographically dispersed and isolated is its fourth weakness. Roads, transportation and communication infrastructure development is still not as broad-based.

Though on Independence India abolished the absentee landlord (Zamindari) system in agriculture, the land tenure structure is inimical to technical change and capital formation especially in Eastern and Central India, besides some pockets in rest of India. Furthermore, concealed tenancy is quite common wherever it is legally prohibited. This has endangered farmers' incentives. Fragmentation of land is on the rise due to sub-division in family and population pressure in general. These problems are being tackled with the implementation of tenancy reforms, consolidation of land fragments, and ceiling on surplus land and its redistribution.

---

6. In post-reform period some shift in favour of high value enterprises has occurred and yet the growth rates have deteriorated. Moreover, such shift got initiated much before the reforms when agricultural growth was also better.

Last but not the least important weakness of agriculture in India as anywhere in the world is that it unlike industry and service sectors is subject to Ricardo's Law of Diminishing Returns. Overcoming this weakness requires shifting production function upward and to the right through technological innovations. Such a technical change has occurred in India. But in more recent times both land productivity and total factor productivity growth have receded (Sidhu et al 1992, Rosegrant et al 1994, Kumar et al 1994, Desai 1994, and Desai and Namboodiri 1997a); the relative share of technical change in agricultural growth which was 43 per cent in post-GR period reduced to about 30 per cent in second half of eighties. Similarly, absolute contribution of technical change in agricultural growth in post-GR which was 1.45 per cent per annum receded to 1.33 per cent per annum in second-half of 1980s. Further, yield per hectare as a source of growth in more recent times is unsatisfactory for major crops (see, for example, Sawant et al 1995 and Ray 1998). Thus, another round of technical change that is broad-based as well as seed and resource centered is urgently needed.

IV. Impact on Political Will of India to Develop Agriculture More Rapidly

The discussion in preceeding section (i.e. III) should inspire confidence to attempt more rapid development of agriculture considering the strengths of its past achievements. It should also do so based on the need to overcome many of its vexed problems discussed as a part of its weaknesses. Both of these in turn justify aggressively stepping up of government expenditure "on" and "for" agriculture since its development requires different types of agriculture and general infrastructures in which private sector may not invest due to long gestation period, externalities and returns that cannot be fully internalized (Desai 2000). But resource crunch is the constraint. So also is the failure of implementation as suggested by the past experience (see, for example, Dantwala 1996).

But a pre-condition for overcoming these problems is a strong and sustained political will to develop agriculture more rapidly than in the past. Where there is a will there is a way out. Past, however, suggests this has always been a rhetoric rather than reality. For example, none of the last six plans allocated more than 23 to 28 per cent of public outlay on agriculture. More disappointing is that the Planning Commission of the former government officially declared that Ninth Plan will give highest priority to agriculture with 4.5 per cent target of rate of growth in its value added and yet it allocated barely 18/19 per cent of total public outlay on agriculture. However, what research on agricultural economics has shown and what agriculture has achieved in a short span of five decades given its highly unfavourable initial conditions, agricultural development certainly deserves a better deal.

Several reasons may be responsible for wavering political will. One, the initial conditions inherited may not have been considered conducive to the process of rapid implementation. Two, the choice of "Machines-First" strategy of industrialization may have lead to neglect of agriculture and industries related to them. And three, there may be a genuine communication gap between researchers in agricultural economics and those who make policies. While last two could be overcome, the first one cannot be nor

should one try to cry over a spilt milk. Once conviction along these lines is commonly shared within the country first task of taking along the international community would be hopefully less difficult. In order to achieve this I for one is in favour of maximum generation of domestic resources (see, for example, Desai and Namboodiri 1997d and 1999a, Desai 1997 and 2000, and Rao 1997). This is because it will establish our credibility and thereby have a better leverage with the outside world to attract resources of appropriate nature and size.

V. Changes Required in Research in and Policies for Sustainable Agricultural Development and Those in Other Major Branches of Economics

These changes are required for three broad reasons. One of these is that in the past we have pursued too many objectives with too little visible impacts. Two, while resources available to achieve all these objectives are getting thinner, the objectives are increasing. There is thus a curious mix of wants being increased from growth and absolute poverty removal to achieving better and rapid Human Development Index (HDI), better income equality and higher rate of growth with the assistance of shrinkage in resources. **This is far from what economics is all about.** And three, in this new formula of mix of objectives, the crucial question of composition of growth is not even raised. This will compound the self-defeating process in a geometric proportion, besides perhaps creating social and political instability.

We thus propose that

- Objectives of economic growth and absolute poverty alleviation are "prioritized",
- Agricultural growth as a composition of growth is also "prioritized",
- Seed plus resource centred technical change as a "strategy" for its rapid growth is "prioritized",
- Behavioural instead of technocratic/price fundamentalism-oriented approach to incorporate all three "instruments" of institutional, technological and economic factors that consider both embodied and disembodied agricultural R&D and production-cum-market and banking infrastructure, besides land reforms are"prioritized", and
- Price support (procurement) policy should follow rather than precede technical change as prevailing price-environment would by and large provide incentives though minimum support price based on variable cost (i.e. cost A2) may be fixed to ensure some stability and sustenance of agriculture, besides emphasizing neutral barter terms of trade.

These "priorities" are imperative to make impact on the chosen objectives visible, loud and clear. And the change required in research in agricultural economics and policies is to multiply the earlier discussed their strengths and overcome their weaknesses on a god-speed basis.

Other major branches of economics, if I may say so, should try to emulate what good quality research on agricultural economics attempted. They should in specific terms attempt to study the experiences with Mahalanobis strategy, besides examining the potential to shift to "Textiles-First" strategy of industrialization (Karnik 1997) in a sequential manner in which two keep alternating periodically to achieve high rate of growth in employment and consumption that is broad and mass-based and that in saving and investment for future such growth. Public finance, trade and monetary policies may be dovetailed such that these two broad strategies of industrialization and their associated real goods sectors, R&D and other infrastructure financing is substantially met from domestic sources and relatively marginally from foreign sources without causing runaway inflation or recession.

VI. Epilogue

It has been a long journey to review what agricultural economics has accomplished through its conceptual contributions and practice in policy making. While this journey in itself has made me feel contented given a short history of five decades of Independent India, it has left me with a feeling that the full potential of agriculture and its research being not realized because of the choice of Mahalanobis strategy that the Second Plan made, implementation of agricultural change being not of high quality and self-owned in its tenor, and misplaced emphasis on better barter terms of trade/price supports as a source of growth since around early 1980s and post-reform years of 1990s in particular.

Select Bibliography

1. Acharya S.S. (1997), Agricultural Price Policy and Development: Some Facts and Emerging Issues, Indian Journal of Agricultural Economics, 52.1, January-March.

2. Ahluwalia Montek S. (1986), "Rural Poverty, Agricultural Production and Prices: A Reexamination," in Agricultural Change and Rural Poverty (eds), John W. Mellor and Gunvant M. Desai, Oxford University Press, Bombay.

3. Ahluwalia Montek S. (1996), "New Economic Policy and Agriculture: Some Reflections," Indian Journal of Agricultural Economics, 51, 3, July-September.

4. Anderson Per Pin-Strup and Rajul Pandya-Lorch (1994), "Acreviating Poverty, Intensifying Agriculture and Efficiently Managing Natural Resources," Paper 1, International Food Policy Research Institute, Washington, D.C., August.

5. Asian Development Bank (ADB) (1976), Rural Asia: Challenges and Opportunities, Asian Development Bank, Manila.

6. Ball Eldon (1985), "Output, Input, and Productivity Measurement in U.S. Agriculture: 1948-79," American Journal of Agricultural Economics, 67, 3, August.

7. Bapna S.L. (1997), "Role of Public Distribution System in Food Security". in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

8. Bardhan Pranab (1984), Land, Labour and Rural Poverty: Essays in Development Economics, Oxford University Press, Delhi,

9. Barker Randolph and Yujiro Hayami (1976), "Price Support vs Input Subsidy for Food Self-sufficiency in Developing Countries, American Journal of Agricultural Economics, 58, 4, November.

10. Benor Daniel, James Q. Harrison and Michael Berxter (1984), Agricultural Extension, The World Bank, Washington, D.C., U.S.A.

11. Bhalla G.S. and Alagh Y.K. (1979), Performance of Indian Agriculture: A District-wise Study, Sterling Publishers, Delhi.

12. Bhalla G.S. and Vasant P. Gandhi (1997), "Proceedings on Agriculture in Future: Demand-Supply Analysis". In Agricultural Development Paradigm for the Ninth Plan under New Economic Environment (ed.), Bhupat M. Desai, Oxford & IBH Publishing Company Private Limited, New Delhi.

13. Bhalla G.S., Chadha G.K., Kashyap S.P., and Sharma R.K. (1990), Agricultural Growth and Structural Changes in the Punjab Economy: An Input-Output Analysis, Research Report No.82, International Food Policy Research Institute, Washington, D.C.

14. Bhalla Sheila (1993), "Pattern of Employment Generation in India," Keynote Paper, Indian Journal of Labour Economics, 36, 4, October-December.

15. Bhattacharjee Sourindra, Bhupat M. Desai and Gopal Naik (1997), "Profitability Analysis of Rural Banking by Nationalized Commercial Banks," in Agricultural Finance: Problems and Potential, (ed.) D.B. Kuchhadiya, Gujarat Agricultural University, Junagadh.

16. Bhattacharjee Sourindra, Bhupat M. Desai, and Gopal Naik (1999). "Viability of Rural Banking by the Nationalized Commercial Banks in India," Indian Economic Journal, September-November.

17. Blyn George (1966), Agricultural Trends in India: 1891-1947: Output, Availability and Productivity, University of Pennsylvania Press, Philadelphia.

18. Brahmanand P.R. (1954), "The Theory of Underdevelopment and Agricultural Backwardness". Indian Journal of Agricultural Economics, 9,2.

19. Brewer J., S. Kolavalli, A.H. Kalro, G. Naik, S. Ramnarayan, K.V. Raju and R. Shaktivadivel (1999), Irrigation Management Transfer in India: Policies, Processes and Performance, Oxford & IBH Publishing Company Private Limited, New Delhi.

20. Chakravarthy Sukhomoy (1987), Development Planning - The Indian Experience, Oxford.

21. Cummings Ralph Jr. (1967), Pricing Efficiency in the Indian Wheat Market, IMPEX India, New Delhi.

22. Dandekar V.M. (1959), "Price Response of Foodgrains Production and Marketed Surplus Being Zero/Inverse," Indian Journal of Agricultural Economics, 14,3&4.

23. Dandekar V.M. (1970), "Agricultural Growth With Special Justice in Overpopulated Countries". Economic and Political Weekly, 5, 29 to 31, Special No., July.

24. Dandekar V.M. (1993), "Limits of Credit, Not Credit Limits," Economic and Political Weekly, 38, 39, September 25.

25. Dandekar V.M. and Nilakanth Rath (1971), Poverty in India, Indian School of Political Economy, Pune.

26. Dantwala M.L. (1951), "Land Reforms in India," International Labour Review, 66, 5&6, November-December.

27. Dantwala M.L. (1961), "Trends in Yield Per Acre of Crops". In Changing India: Essays in Honour of D.R. Gadgil, (ed.), V.M. Dandekar, and N.V. Sovani, Asia Publishing House, Bombay.

28. Dantwala M.L. (1962) "The Two Worlds of Food and Agriculture." The Economic Weekly, 15, 4, October-December.

29. Dantwala M.L. (1967), "Incentives and Disincentives in Indian Agriculture". in Indian Journal of Agricultural Economics. 22, 2, April-June.

30. Dantwala M.L. (1970), "From Stagnation to Growth." Indian Economic Journal, 19, 2, October-December.

31. Dantwala M.L. (1973), Poverty in India: Then and Now 1870-1970, Macmillan India, Delhi.

32. Dantwala M.L. (1985) "Garibi Hatao: Strategy Options," Economic and Political Weekly, March 6, 1985.

33. Dantwala M.L. (1986). "Technology, growth and equity in agriculture. In: Agricultural Change and Rural Poverty," op.cit.

34. Dantwala M.L. and Others (1986), Indian Agricultural Development Since Independence (eds.), Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.

35. Dantwala, M.L. (1996), "Strategy of Agricultural Development Since Independence". In Dilemmas of Growth: The Indian Experience: M.L. Dantwala, (eds.) Pravin Visaria, N.A. Mujumdar and T.R. Sundaram, Sage Publications, New Delhi.

36. Dantwala, M.L. and Pravin Visaria (1976) "Rural Labour Force and Employment Policy," In Economic Theory and Planning: Essays in Honour of A.K. Dasgupta,(ed) Ashok Mitra, Oxford University Press, Bombay.

37. Datta Samar K. and Bhupat M. Desai (1999), "Status and Impact of Land Reforms and New Technology on Agricultural Development in Land Reforms in Western India, (ed), Ghanshyam Shah, Sage Publications, New Delhi (forthcoming).

38. Desai B.M. (1972), "Analysis of consumption expenditure patterns in India". Occasional Paper No.54. AID Employment and Income Distribution Project. Department of Agricultural Economics, Cornell University, Ithaca:, New York.

39. Desai B.M. and M.D. Desai (1969), The New Strategy of Agricultural Development in Operation, Thacker & Co. Ltd., Bombay.

40. Desai Bhupat M. (1994), "Contributions of Institutional Credit, Self-finance and Technological Change in Indian Agriculture". in Indian Journal of Agricultural Economics. 49, 3, July-September.

41. Desai Bhupat M. (1997). Agricultural paradigm: A synthesis. In Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

28. Dantwala M.L. (1962) "The Two Worlds of Food and Agriculture." The Economic Weekly, 15, 4, October-December.

29. Dantwala M.L. (1967), "Incentives and Disincentives in Indian Agriculture". in Indian Journal of Agricultural Economics. 22, 2, April-June.

30. Dantwala M.L. (1970), "From Stagnation to Growth." Indian Economic Journal, 19, 2, October-December.

31. Dantwala M.L. (1973), Poverty in India: Then and Now 1870-1970, Macmillan India, Delhi.

32. Dantwala M.L. (1985) "Garibi Hatao: Strategy Options," Economic and Political Weekly, March 6, 1985.

33. Dantwala M.L. (1986). "Technology, growth and equity in agriculture. In: Agricultural Change and Rural Poverty," op.cit.

34. Dantwala M.L. and Others (1986), Indian Agricultural Development Since Independence (eds.), Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.

35. Dantwala, M.L. (1996), "Strategy of Agricultural Development Since Independence". In Dilemmas of Growth: The Indian Experience: M.L. Dantwala, (eds.) Pravin Visaria, N.A. Mujumdar and T.R. Sundaram, Sage Publications, New Delhi.

36. Dantwala, M.L. and Pravin Visaria (1976) "Rural Labour Force and Employment Policy," In Economic Theory and Planning: Essays in Honour of A.K. Dasgupta,(ed) Ashok Mitra, Oxford University Press, Bombay.

37. Datta Samar K. and Bhupat M. Desai (1999), "Status and Impact of Land Reforms and New Technology on Agricultural Development in Land Reforms in Western India, (ed), Ghanshyam Shah, Sage Publications, New Delhi (forthcoming).

38. Desai B.M. (1972), "Analysis of consumption expenditure patterns in India". Occasional Paper No.54. AID Employment and Income Distribution Project. Department of Agricultural Economics, Cornell University, Ithaca:, New York.

39. Desai B.M. and M.D. Desai (1969), The New Strategy of Agricultural Development in Operation, Thacker & Co. Ltd., Bombay.

40. Desai Bhupat M. (1994), "Contributions of Institutional Credit, Self-finance and Technological Change in Indian Agriculture". in Indian Journal of Agricultural Economics. 49, 3, July-September.

41. Desai Bhupat M. (1997). Agricultural paradigm: A synthesis. In Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

42. Desai Bhupat M. (1999a), "WTO and Indian Agriculture: Beyond Trade Related Public Policies," in Agriculture and the WTO: Perspectives from France and India, (eds.), G.S. Bhalla and Jean-Lue Ravine, ICSSR-MSDH Seminar Papers and Proceedings, India-France, 1999 (forthcoming).

43. Desai Bhupat M. (1999b), "Strategies for Development of Agriculture in the New Millennium." Financing Agriculture, Special Mellennium Issue, 31, 3&4, July-September and October-December.

44. Desai Bhupat M.(1999c), "Agriculture and Agri-business Issues under Economic Liberalization," in Contemporary India in Transition: Papers and Proceedings of India-Portugal Co-sponsored Conference, (ed), Peter DeSouza, Sage Publications, New Delhi, (forthcoming).

45. Desai Bhupat M. (2000), "Infrastructure for Developing Agriculture: Its Needs and Financing Strategy," in Rural Credit: Papers and Proceedings of the Seminar organized by NABARD on April 29-30, NABARD, Bombay (unpublished).

46. Desai Bhupat M. and Errol D'Souza (1999), "Economic Reforms, Terms of Trade, Aggregate Supply and Private Investment in Agriculture - A Discussion," Economic and Political Weekly, 34, 20, May 15.

47. Desai Bhupat M. and N.V. Namboodiri (1996), "Whither Rural Financial Institutions ?", Economic and Political Weekly, 31, 31, August 3.

48. Desai Bhupat M. and N.V. Namboodiri (1997) "Pesticides Industry and Policies for Technical Change in Agriculture," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

49. Desai Bhupat M. and N.V. Namboodiri (1997a), "Strategy and Sources of Growth in Crop-agriculture". in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit

50. Desai Bhupat M. and N.V. Namboodiri (1997b), :Price and Non-price Determinants of Aggregate Agricultural Supply," Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

51. Desai Bhupat M. and N.V. Namboodiri (1997d), "Government Expenditure in Agriculture Under Planning Era," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

52. Desai Bhupat M. and N.V. Namboodiri (1997f), "Developing Agriculture in Gujarat: A Strategic Perspective for the Ninth Plan," Economic and Political Weekly, 32, 13, March 29-April 4..

53. Desai Bhupat M. and N.V. Namboodiri (1998a). "Policy Strategy and Instruments for Alleviating Rural Poverty". Economic and Political Weekly, 27, 51 & 52, December 19-26.

54. Desai Bhupat M. and N.V. Namboodiri (1998b), "Determinants of Total Factor Productivity in Indian Agriculture". Economic and Political Weekly, 32:52, Dec. 27, 1997-January 2.

55. Desai Bhupat M. and N.V. Namboodiri (1999a), "Farmers' Response, Prices and Government Expenditure Analysis under WTO Framework for Developing Agriculture," in WTO and Agriculture in India (eds.), Samar K. Datta and Satish K. Deodhar, Oxford & IBH Publishing Co. Private Ltd., New Delhi (forthcoming).

56. Desai Bhupat M. and N.V. Namboodiri (2000), Organization and Management of Rural Financial Sector: Text, Cases and Exercises, Oxford & IBH Publishing Company Private Ltd., New Delhi (forthcoming).

57. Desai Bhupat M., V.K. Gupta and N.V. Namboodiri (1991), Food-Processing Industries: Development and Financial Performance, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

58. Desai D.K. and D.A. Patel, (1967), Planning and Implementation in Agriculture: Studies in High Yielding Varieties Programme, Vol.IV, Hybrid Bajra in Gujarat, Indian Institute of Management, Ahmedabad.

59. Desai D.K. and Narayanan A.V.S. (1967), Planning and Implementation in Agriculture: Studies in High Yielding Varieties Programme, Vol.III, Hybrid Maize in Madhya Pradesh, Indian Institute of Management, Ahmedabad.

60. Desai D.K. and V.M. Rao (1997), Proceedings on Strategy and Sources of Agricultural Growth". In Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

61. Desai Gunvant (1997), Fertilizer Policy Reforms and Agricultural Growth, in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

62. Desai Gunvant M. and A. Vaidyanathan (eds.) (1995), Strategic Issues in Future Growth of Fertilizer Use in India, Macmillan India Ltd.

63. Dev Mahendra (1987), "Growth and Instability in Foodgrains Production: An Inter-State Analysis," Economic and Political Weekly, 52, 3, July-September.

64. Dev Mahendra, Kirit S. Parikh and H. Suryanarayana (1991), "Rural Poverty in India: Incidence, Issues and Policies," Discussion Paper No.55, Indira Gandhi Institute of Development Research, Bombay.

65. Dhawan, B.D. (1997) "Latent Threats to Irrigated Agriculture," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

66. Dholakia Bakul H. and Ravindra H. Dholakia (1997), "Growth of Total Factor Productivity in Indian Agriculture," Indian Economic Review, 28, 1, January-June.

67. Dreze Jean and Amartya Sen (eds.) (1995), Indian Development: Selected Regional Perspectives, Oxford University Press, Delhi.

68. Dubey Daya Shanker (1920/21), "A Study of the Indian Food Problem," Indian Journal of Economics, 3, 1&2.

69. Ensminger Douglas (1962), "Overcoming the Obstacles to Farm Economic Development in the Less Developed Countries". Journal of Farm Economics, 44, 5, December.

70. Falcon Walter (1970), "The Green Revolution," American Journal of Agricultural Economics, 52, 5, December.

71. Gadgil D.R. (1955), "Organization of Agricultural Production: Structure and Size of the Unit," in Selected Readings: Indian Journal of Agricultural Economics, 1940-64, Indian Society of Agricultural Economics, Bombay.

72. Gandhi Vasant P. and N.T. Patel (1997), "Are Tractors Rising in Importance? An Examination of the Growth of Tractor Demand and Industry in India," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

73. Government of India - GOI (1959), Report on the Food Crisis and Steps to Meet It, The Agricultural Production Team Sponsored by the Food Foundation, Ministry of Agriculture, New Delhi.

74. Government of India-GOI (1969), "Modernising Indian Agriculture," Report on the Intensive Agricultural District Planning (1960-68), Vol.I, Expert Committee on Assessment and Evaluation, Ministry of Food, Agriculture, Community Development and Cooperation, New Delhi.

75. Gulati Ashok and Anil Sharma (1994), "Agriculture under GATT: What it Holds for India," Economic and Political Weekly, July 16.

76. Gulati Ashok and Pradeep K. Sharma (1991), "Government Intervention in Agricultural Markets: Nature, Impact and Implications," in Journal of Indian School of Political Economy, April-June.

77. Gupta Anand P. (1986) "Taxation and Subsidies," Indian Agricultural Development since Independence, op.cit.

78. Gupta V.K. and Kothari K.B. (1967), Planning and Implementation in Agriculture: Studies in High Yielding Varieties Programme, Vol.II, Mexican Wheat in Punjab State, Indian Institute of Management, Ahmedabad.

79. Haggablade S., Hanover J. and Hazell P. (1991), "Modelling Agricultural Growth Multipliers." American Journal of Agricultural Economics, 73, 2.

80. Hazell Peter and Steven Haggablade (1990), "Rural-Urban Growth Linkages in India". Working Paper Series 430, The World Bank, May.

81. Heady Earl O. (1968), Economics of Agricultural Production and Resource Use. Prentice-Hall of India Private Ltd., New Delhi.

82. Herdt Robert W. (1971). "A Disaggregate Approach to Aggregate Supply," American Journal of Agricultural Economics, 52, 4, November.

83. Hirway Indira (1997) "Issues in Special Employment Programmes and Agricultural Development: Perspective," in Agricultural Development Paradigm for the Ninth Plan Under New Economic Environment, op.cit.

84. Hopper David (1962), "The Economics of Fertilizer Use - A Case Study in Production Economics". Indian Journal of Agricultural Economics. 17, 4.

85. Hunter, W.W. (1868), The Annals of Rural Bengal, Smith, Eldor & Co., London.

86. Ishikawa Shigeru (1967), Economic Development in Asian Perspective, Kinokumye Bookstore Co. Ltd. Tokyo, Japan.

87. Jairath Jasreen (1999), "Participatory Irrigation Management: Experiments in Andhra Pradesh," Economic and Political Weekly, 34, 40, October 2.

88. Jasdanwala Z.Y. (1996), Marketing Efficiency in Indian Agriculture, Allied Publishers Private Ltd., Bombay.

89. Jha Dayanath and Robert Evenson (1973), "The Contribution of Agricultural Research System to Agricultural Production in India". Indian Journal of Agricultural Economics, 28, 4, October-December.

90. Johnston Bruce F. and John W. Mellor (1961) "The Role of Agriculture in Economic Development." American Economic Review, September.

91. Joshi P.K. (1997), "Rapporteur's Report on Technology and Environmental Management in Agriculture," Indian Journal of Agricultural Economics, 52, 3, July-September.

92. Kahlon A.S. and D.S. Tyagi (1983), Agricultural Price Policy in India, Allied Publishers, New Delhi.

93. Karnik Ajit (1997), "Look Back in Anguish," Journal of Indian School of Political Economy, January-March.

94. Khusro A.M. (1973), The Economics of Land Reforms and Farm Size in India, Macmillan India, Delhi.

95. Krishna Daya and M.S. Swaminathan (1971), The New Agricultural Strategy, New Heights, Delhi.

96. Krishna Raj (1963), "Farm Supply Response in India-Pakistan: A Case Study of the Punjab Region," Economic Journal, 73, 291, September.

97. Krishna Raj (1964), "Some Production Functions for the Punjab". Indian Journal of Agricultural Economics. 19, 3&4.

98. Krishna Raj (1967), "Agriculture Price Policy and Economic Development" in Agricultural Development and Economic Growth, (eds). Southworth H.M. and B.F. Johnston, Cornell University Press, Ithaca, New York.

99. Krishna Raj (1982), Some Aspects of Agricultural Growth, Price Policy and Equity in Developing Countries," Food Policy Research Institute Studies, 18, 3.

100Krishnan T.N. (1965), "The Marketed Surplus of Foodgrains: Is it Inversely Related to Price?" The Economic Weekly, 17, 5-7, February.

101Kumar Praduman and Mark R. Rosegrant (1994), "Productivity and Sources of Growth for Rice in India, Economic and Political Weekly, 19,53, December 31.

102Kumar Praduman and Mruthyunjaya (1972), "Measurement and Analysis of Total Factor Productivity Growth in Wheat". Indian Journal of Agricultural Economics, 47, 3, July-September.

103Kumar Praduman and V.C. Mathur (1997), "Agriculture in Future: Demand-Supply Perspective Analysis," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

104Kuznets Simon (1957), "Quantitative Aspects of Economic Growth of Nations," Economic Development and Cultural Change, July.

105Kuznets Simon (1965), Economic Growth and Structure, New York.

106Ladejinsky Wolfe (1969a), "The Green Revolution in the Punjab: A Field Trip". Economic and Political Weekly, 4, June 28.

107Ladejinsky Wolfe (1969b), "Green Revolution in Bihar: The Kosi Area: A Field Trip," Economic and Political Weekly, 4, September 27.

108Ladejinsky Wolfe (1970), "Ironies of India's Green Revolution," Foreign Affairs, 48, 4, July.

109Ladejinsky Wolfe (1972), "Land Ceiling and Land Reform," Economic and Political Weekly, 7, 5, 7 February.

110Leather J.W. (1894) "Notes on the Value of Indian Cattle Dung". Agricultural Ledger, No.3, 1994.

111Lele Uma J. (1967), "Market Integration: A Study of Soughum Prices in Western India, Journal of Farm Economics, 49, 1, Part I, May.

112Lele Uma J. (1972), Foodgrain Marketing in India: Private Performance and Public Policy, Cornell University Press, Ithaca, New York.

113Lewis John P. (1986), "Overview: Development Promotion: A Time for Regrouping" in Development Strategies Reconsidered (eds), John P. Lewis and Valerriana Kallab, Transaction Books, New Brunswick, New York.

114Lipton Michael (1969), "Agriculture: Urban Bias and Rural Planning," In Crisis of Indian Planning, (eds.), P. Streeton and Michael Lipton, Oxford University Press, London.

115Lipton Michael (1975), "Urban Bias and Food Policy in Poor Countries," Food Policy, November.

116Malaya Meenakshi M. and Madappa P.P. (1967), Planning and Implementation in Agriculture: Studies in High Yielding Varieties Programme, Vol.I, Paddy (ADT 27) in Madras State, Indian Institute of Management, Ahmedabad.

117Manage (1997), Farmers Participation in Agricultural Research and Extension Systems, Concept Publishing Co., New Delhi.

118Mason Edward (1966), Economic Development of India and Pakistan, Harvard University Press, Cambridge.

119Mathur P.N. and Hannan Ezekil (1961), "Marketable Surplus of Food and Price Fluctuations in a Developing Economy," Kyklos, 14.

120Mellor John W. (1962), "Increasing Agricultural Production in Early Stages of Economic Development". Indian Journal of Agricultural Economics. 17,4, .

121Mellor John W. (1966), The Economics of Agricultural Development, Cornell University Press, Ithaca, New York, U.S.A.

122Mellor John W. (1976), The New Economics of Growth, Cornell University Press, Ithala and London.

123Mellor John W. (1986), "Agriculture on the Road to Industrialization". In Development Strategies Reconsidered (eds), John P. Lewis and Valerriana Kallab, Transaction Books, New Brunswick, New York.

124Mellor John W. and Gunvant M. Desai (1986). "Agricultural change and rural poverty: A synthesis". In Agricultural Change and Rural Poverty, op.cit.

125Mellor John W. and Uma J. Lele (1975) "The Interaction of Growth Strategy, Agriculture and Foreign Trade - The Case of India," in Trade, Agriculture and Development, George Ley S. and Petakzadrozmy (eds), Ballinger Publishing Co., Cambridge, Massachussets, U.S.A.

126Minhas B.S., "Rural Poverty, Land Redistribution and Development Strategy Facts and Policy," Indian Economic Review, 5, 1, April.

127Mishra S.N. (1997), "Agricultural Liberalization and Development Strategy in Ninth Plan," Economic and Political Weekly, 32, 13, March 29.

128Misra V.N. (1998), "Economic Reforms, Terms of Trade, Aggregate Supply and Private Investment in Agriculture," Economic and Political Weekly, 33, 31,August 1-7.

129Mungekar B.L. (1992), The Political Economy of Terms of Trade, Himalaya Publishing House, Bombay.

130Mungerkar B.L., "Terms of Trade, Technology and Agricultural Development," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

131NABARD (1995), Watershed Development in Ralegaon Siddhi: A Special Study, Special Studies Series No.1, Pune.

132Naik Gopal and S.K. Jain (1997), "Demand-Supply Analysis and Projections for Major Agricultural Commodities," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

133Namboodiri N.V. (2000), "Economics of Scale and Scope: District Central Cooperative Banks," Working Paper No.2000-03-03, Indian Institute of Management, Ahmedabad, March.

134Nanavati Manilal B. and J.J. Anjaria (1947), The Indian Rural Problem, The Indian Society of Agricultural Economics, Bombay.

135 Narain Dharm (1965), The Impact of Price Movements in Areas Under Selected Crops in India, 1990-39, Cambridge University Press, Cambridge.

136Narain Dharm (1977), "Growth of Productivity in Indian Agriculture," , Indian Journal of Agricultural Economics, 32.1, January-March.

137Narayan Pratap and Uttam Gupta (1997), "Emerging Perspectives in the Fertilizer Sector," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

138Nayyar Deepak (1976), India's Exports and Export Policies in the 1960s, Cambridge University Press, London.

139Nayyar Deepak and Abhijit Sen (1994), International Trade and the Agricultural Sector in India," Economic and Political Weekly, 29, 20, May 14.

140Ninan K.N. (1994), Poverty and Income Distribution in India, " Economic and Political Weekly, 29-25, June 18.

141O'Molley, L.S.S. (1912), Bengal District Gazeters, Murshidabad, Calcutta, 1994, Jessore.

142O'Molley, L.S.S. (1917), Bengal, Bihar and Orissa , Sikkim, University Press, Cambridge

143Oza Ajay N. (1997). "Role of Agriculture in Industrialization". In: Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

144Pal Suresh, Alka Singh and Dayanath Jha (1997), "Levels of Agricultural Research Investment: Lessons for the Future," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

145Panchmukhi V.R. (1986) "Trade in Agricultural Commodities - A Profile of Two Decades: 1960-1980," in Indian Agricultural Development Since Independence (eds.), M.L. Dantwala and Others, Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.

146Panse V.G. (1959), "Recent Trends in the Yield of Rice and Wheat in India". in Selected Readings: Indian Journal of Agricultural Economics: 1940-64, Indian Society of Agricultural Economics, Bombay.

147Panse V.G. and V.S. Menon (1961), "Index Numbers of Agricultural Production in India". in Indian Journal of Agricultural Economics. 16, 2.

148Parthasarathy G. (1991), "Lease Market, Poverty Alleviation and Policy Options, Economic and Political Weekly, 26, 13, March 30.

149Patel S.M. , P.P. Madappa and B.M. Desai (1969), Management of Lift Irrigation, Faculty of Management in Agriculture and Cooperatives, Indian Institute of Management, Ahmedabad.

150Patnaik Gokul (1997), "Adding Value to Agriculture Through Marketing and Processing," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

151Radhakrishna R. and C. Ravi (1990), Food Demand Projections for India, Centre for Economic and Social Studies, Hyderabad.

152Raj K.N. (1969), "Some Questions Concerning Growth, Transformation and Planning of Agriculture in the Light of Experience in Mexico, Taiwan and India". Journal of Development Planning, 1.

153Raj K.N. (1983), "Agricultural Growth in China and India: Role of Price and Non-Price Factors". ". Economic and Political Weekly, 18,3, January 15.

154Rangarajan C.R. (1982), Agricultural Growth and Industrial Performance in India, International Food Policy Research Institute, 33, October.

155Ranjhan S.K. (1997), "Livestock Industry Perspective: Issues and Policies," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

156Rao C.H. Hanumantha (1994) Agricultural Growth, Rural Poverty and Environmental Degradation in India, Oxford & IBH Publishing Company Private Limited.

157Rao C.H. Hanumantha (1994), "Policy Issues Relating to Irrigation and Rural Credit in India," in Economic Liberalization and Indian Agriculture, (ed), G.S. Bhalla, Institute for Studies in Industrial Development, New Delhi.

158Rao C.H. Hanumantha (1997) "Inaugural Address," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

159Rao V.K.R.V. (1962), "Changes in Agricultural Productivity and Crop Pattern and Their Determinants". Indian Journal of Agricultural Economics. 17, 1.

160Rath Nilkantha (1985), "Garibi Hatao: Can IRDP do it ?" Economic and Political Weekly, February.

161Rath Nilkantha (1985), "Prices, Costs of Production and Terms of Trade of Indian Agriculture," Indian Journal of Agricultural Economics, 52.1, April-June.

162Ravallion M. and G. Dutt (1995). "Growth and poverty in rural India". Working Paper 1405, The World Bank, Washington D.C.

163Rawal Vikas and Madhura Swaminath (1998), "Agricultural Growth in West Bengal: 1950 to 1996," Economic and Political Weekly, October 3.

164Ray S.K. (1998), Sources of Change in Crop Output. Institute of Economic Growth, University Enclave, New Delhi, March (unpublished).

165Reserve Bank of India - RBI (1984), Report of the Committee on Agricultural Productivity in Eastern India, Bombay.

166Reserve Bank of India-RBI (1989), A Review of the Agricultural Credit System in India, Report of the Agricultural Credit Review Committee, Bombay.

167Robert E. Evenson, Carl E. Pray and Rosegrant Mark W. (undated) Agricultural Research and Productivity Growth in India, International Food Policy Research Institute, Research Report 109, Washington, D.C.

168Rosegrant Mark W. and Robert E Evenson (1994), "Total Factor Productivity and Sources of Long-term Growth in Indian Agriculture". Paper prepared for IFPRI/IARI Workshop on Agricultural Growth in India, May 1-6, New Delhi. (unpublished).

169Ruttan Vernon (1984), "The Green Revolution: Seven Generalizations," in Leading Issues in Economic Development, Fourth Edition (ed) Gerald M. Meier, Oxford University Press, New York and Oxford.

170Sankhyan P.L. (1988), Introduction to the Economic of Agricultural Production,. Prentice Hall of India Private Limited, New Delhi.

171 Satyasai K.J.S. and K.U. Viswanathan (1997), Commercialization and Diversification of Indian Agriculture, Occasional Paper 5, National Bank for Agriculture and Rural Development, Mumbai, October.

172 Sawant S.D. (1997), "Foodgrains Output Growth: Emerging Constraints and Perspectives for Technology Development Policies," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

173 Sawant S.D. and Achutan C.V. (1995), "Agricultural Growth Across Crops and Regions: Emerging Trends and Patterns". Economic and Political Weekly, 30, 12, March 25.

174 Schultze Theodore (1966), Transforming Traditional Agriculture, Chicago University Press, Chicago.

175 Sen A.K. (1985), Poverty and Famines, Clearndon Press, Oxford.

176 Sen Abhijit (1996). "Economic reforms, employment and poverty: Trends and options". Economic and Political Weekly, Special Number, September-November.

177 Shidhu, D.S. and Derek Byerlee (1992), Technical Change and Wheat Productivity in the Indian Punjab in the Post-Green Revolution Period," CIMMYT Economics Working Paper 92-02, CIMMYT, Mexico.

178 Singh Gurdev and S.R. Asokan (1997), "Seed Industry: Problems and Prospects," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

179 Singh Manmohan (1994), "Inaugural Address," Indian Journal of Agricultural Economics, 50, 1, January-March.

180 Singh, R.P., Suresh Pal and Michael Morris (1995), Maize Research Development and Seed Production in India: Contribution of the Public and Private Sectors, CIMMYT Economics Working Paper 95-03, CIMMYT, Mexico D.F.

181 Subbarao K. (1978a), Rice Marketing System and Compulsory Levies in Andhra Pradesh: A Study of Public Intervention in Foodgrain Marketing, Allied Publishers (P) Ltd., New Delhi.

182 Subbarao K. (1978b), "Rice Price Behaviour and Public Procurement: An Analysis of the Experience of Andhra Pradesh," Indian Journal of Agricultural Economics, 3, 3, July-September.

183 Subbarao K. (1986a), "Agricultural Marketing" in Indian Agricultural Development Since Independence, (eds), M.L. Dantwala and Others, op.cit.

184 Subbarao K. (1986b), "Farm Prices: A Survey of the Debate," in Indian Agricultural Development Since Independence, (eds.), M.L. Dantwala and Others, op.cit

185Sukhatme P.V. (1957), "The Food and Nutrition Situation in India". Indian Journal of Agricultural Economics, 12, 2&3.

186Thamarajkshy R. (1977), "Role of Price Incentives in Stimulating Agricultural Production in a Developing Economy," in Food Enough or Starvation for Million ,(ed.) Douglas Ensninger, Tata McGraw Hill, New Delhi.

187Thorner, Daniel and Alice (1962), Land and Labour in India, Asia Publishing House, Bombay.

188Lele Uma J. and Mellor John, W. (1981), "Technological Change and Distributive Bias and Labour Transfers in Two Sector Economy". Oxford Economic Papers, 33, 3, November.

189Unni K. (1997), "Role of Agro-Chemical Industry," in Agricultural Development Paradigm for the Ninth Plan under New Economic Environment, op.cit.

190Vaidyanathan A. (1977), "Performance and Prospects of Crop Production in India," Economic and Political Weekly, 12,33.

191Vaidyanathan A. (1987), "Indian Agricultural Development in Regional Perspective". R.L. Dutt Memorial Lecture (unpublished).

192Vaidyanathan A. (1999), Water Resource Management, Oxford University Press, Delhi.

193Vakil C.N. and Brahmanand, P.R. (1956), Planning for an Expanding Economy, Vora & Co., Bombay.

194Vivekananda M. (1999), Problems and Prospects of Agricultural Development in Karnataka, Occasional Paper 9, NABARD, Mumbai.

195Vyas V.S., D.S. Tyagi and V.N. Misra (1969), Significance of New Strategy of Agricultural Development for Small Farmers, Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar.

196Warriner Doreen (1984), "Land Reform" in Leading Issues in Economic Development, Fourth Edition, Gerald M. Meier, , Oxford University Press, New York.