CONFERENCE NUMBER

JULY - SEPTEMBER 1994

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF AGRICULTURAL ECONOMICS, BOMBAY
SUBJECT III
AGRICULTURAL FINANCE IN THE CONTEXT
OF TECHNOLOGY-LED DEVELOPMENT OF AGRICULTURE

Contributions of Institutional Credit, Self-Finance and
Technological Change to Agricultural Growth in India

Bhupat M. Desai†

I
INTRODUCTION

Both early and recent macro finance theories reach a common conclusion that finance
influences not only prices but also employment and output growth. This would largely result
from growth in investment including working capital and financial deepening. These
theories, therefore, emphasise the development of institutional finance although they differ
in their advocacy of policies (Desai and Mellor, 1993). Institutional credit for agriculture
would also facilitate growth in employment and output. This would, however, require rapid
and broad-based land- and labour- augmenting technological change in agriculture. This is
because under such conditions institutional credit would have far more favourable impact
on employment and output growth while at the same time containing its adverse implications
to prices. This would benefit the borrowers, lenders and the nation alike. This sets a con-
ceptual backdrop to the theme of this paper.

We lay down a conceptual framework, methodology and data base in Section II. The
results of application of this framework are analysed in Section III. Based on these, sug-
gestions are offered to enhance the contribution of institutional credit to agricultural growth
in Section IV. These suggestions emphasise the nature of change required in policies for
this credit, public investment and research and development (R & D) in the context of new
technologies. Customary concluding section follows this.

II
CONCEPTUAL FRAMEWORK, METHODOLOGY AND DATA BASE

Institutional credit per se does not influence agricultural growth because it is merely a
means to an end (Dantwala, 1966; Dandekar, 1993). But when it results in investment in
real resources including human labour, it influences output growth in agriculture. New
agricultural technology that has emerged in the mid-1960s is both land- and human labour-
(hereafter referred as labour-) augmenting. For example, use of high-yielding varieties
(HYVs) not only improves land productivity but also enables higher cropping intensity

---

* Keynote paper.
† Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad.
I had an opportunity to discuss some initial ideas of this paper with V.M. Dandekar, B.H. Dholakia, R.H. Dholakia,
Vasant Gandhi and Ajay N. Oza. I am grateful to them for their contributions. I am particularly thankful to B.H. Dholakia,
Vasant Gandhi, Paul Jacob, Jemol Unni, National Bank for Agriculture and Rural Development and Reserve Bank of
India for providing me some very valuable data without which this paper would not have been possible. I owe a deep
debt of gratitude to N.V. Nambodiri for his invaluable assistance in the preparation of this paper. I alone, however, am
responsible for the paper.
because they mature earlier. It is in both these senses they are land-augmenting. Such new technology encourages larger labour demand and thereby becomes labour-augmenting. Similar is the case with fertilisers, pesticides and mechanical devices for ploughing, irrigation, threshing and other farming operations. But, new technology embodied in such inputs as weedicides and harvest combines does not augment employment. However, inasmuch as such inputs have not become common we may assume that the new technology during the study period (1950-51 to 1989-90) is both land- and labour-augmenting. This assumption has been validated (see, for example, Mellor, 1966; Ishikawa, 1967; Binswanger, 1978; Sidhu and Singh, 1986; Binswanger and Donovan, 1987). This particular nature of new technology results from the fundamental characteristic of complementarity in the production process so unique to agriculture (Mellor, 1966; Ishikawa, 1967; Reynolds, 1977). And it is embodied in new intermediate inputs like HYVs, fertilisers, pesticides, diesel, electricity, etc., and private and public capital inputs like modern farm implements, equipments, certain machineries and well, tank and canal irrigation.

Institutional credit that encourages investment in these new inputs and capital makes larger contribution to growth in their use and hence in employment and output in agriculture. Four types of institutional credit are considered. These are (1) ‘cash’ and ‘kind’ components of short-term crop loans to the farmers, (2) term loans to the farmers for irrigation, land improvements, agricultural implements and machinery, farm structures and allied agriculture, (3) loans to private farm input dealers and other agencies marketing inputs, and (4) loans to rural electricity agencies for decentralised transmission lines. The first two are ‘direct’ agricultural credit and encourage demand for real resources. The last two are termed as ‘indirect’ agricultural credit. And they lead to increase in the supply of real resources which also facilitate their use at the farm level and thereby directly contribute to growth in agricultural output. A part of the ‘cash’ component is considered for growth in employment (including family labour). This part is assumed to have a share equivalent to labour cost in cost $A_2$ (out of pocket) plus family labour cost. The rest together with ‘kind’ component of crop loans plus credit for inputs marketing business is considered to finance expenditure on intermediate inputs. Similarly, term loans to the farmers finance private capital stock (PRK), while such loans to rural electricity agencies finance public capital stock (PBK). Since all this credit is purpose-oriented and since borrowers are rational, we consider that a part of human labour (N), intermediate inputs (MI), private capital (PRK) and public capital (PBK) are financed through this credit. Thus this component of institutional credit is considered as a contribution of this credit to growth in agricultural output. The remaining component of these four resources is treated as self-financed. This self-finance for labour, intermediate inputs and private capital is from the farmers’ and input agencies’ (financial) savings and to some extent capital subsidy from the government mainly for Integrated Rural Development Programme (IRDP). Against this, self-finance for public capital is from government’s tax revenues, other surpluses and deficit finance which is forced saving by the society. Thus institutional credit and self-finance together with land represent basic factors for the growth in agricultural production. In other words, there are nine sources of growth in agricultural production. These are land (L) and four each credit (NCF, MICF, PRKCF, and PBKCF) and self-financed (NSF, MISF, PRKSF and PBKSF) labour, intermediate inputs, private capital stock and public capital stock including government owned and managed like canal irrigation and rural electricity.
We further consider that growth in aggregate agricultural output that is not accounted for by the growth in these resources is a contribution of technological change. In other words, residual productivity growth is termed as technological change. This is also known as total factor productivity growth (TFP) since it postulates increases in total (aggregate) output less increases in total (aggregate) inputs (see, for example, Abramovitz, 1956; Denison, 1962; Hayami et al., 1979). In terms of production/cost function framework this implies an upward/downward shift in this function and hence it represents efficiency growth. This results from growth in basic agricultural knowledge of farmers and institutions including rural financial agencies (RFIs) serving them. Such knowledge improves synergy in input and product combinations, techniques of production, degree of utilisation of resources as well as efficiency of institutions for agricultural development. To the extent to which RFIs make this contribution through technical services it is not captured in the four credit-financed inputs. But, inasmuch as this service influences only the type of loans they make it is embodied in them.

Earlier literature assumed perfectly competitive product and factor markets as well as Hicks-neutral (i.e., unbiased factor shares) disembodied technological change for TFP growth framework (see, for example, Solow, 1957; Jha and Evenson, 1974; Evenson and Kislev, 1975; Dholakia and Dholakia, 1993). More recent literature makes this framework general. Following Christenson (1975) and Diewert (1976), we adopt this framework. Underlying this approach is a translog production function that allows for non-constant as well as constant returns to scale, complementarity in agricultural production process and operation of imperfect markets. It also permits neutral as well as non-neutral and embodied technological change. These are all, indeed, far more consistent with the realities of agricultural sector world over and developing countries in particular.

From this translog production function, Diewert (1976) derives what he calls an exact and superlative Tornquist-Theil Index\(^4\) of TFP. This index is computed as the ratio of an index of aggregate output to an index of aggregate inputs. In logarithmic form this index is:

\[
\ln \left( \frac{\text{TFP}_{t+1}}{\text{TFP}_{t}} \right) = \frac{1}{2} \sum_{j} \left( R_{j} + R_{j+1} \right) \ln \left( \frac{Q_{j}}{Q_{j+1}} \right) - \frac{1}{2} \sum_{i} \left( C_{i} + C_{i+1} \right) \ln \left( \frac{X_{i}}{X_{i+1}} \right)
\]

where \(R_{i}\) is the share of output ‘\(j\)’ in total revenue, \(Q_{j}\) is output ‘\(j\)’, \(C_{i}\) is the share of input ‘\(i\)’ in total cost, and \(X_{i}\) is input ‘\(i\)’, all in period ‘\(t\)’. \(R_{j}\) and \(C_{i}\) are in current prices, while \(Q_{j}\) and \(X_{i}\) (which are in monetary values) are in 1980-81 prices. In our case ‘\(j\)’ is eighteen. These are superior cereals, coarse cereals, gram, tur, moong and maseor, other cereals and pulses, groundnut and rapeseed and mustard, other oilseeds, sugarcane, cotton, jute, condiments and spices, coffee, fruits and vegetables, other crops, milk and milk products, meat and meat products, other livestock and poultry products, inland fish and marine fish. Crop by-products are excluded because feed to the livestock is not considered in intermediate inputs. Forest products are excluded because there is neither much institutional credit nor much intermediate and capital inputs used for them. The eighteen products account for about 92 per cent of agricultural output. And ‘\(i\)’ is nine resources mentioned earlier. Land is defined as gross sown area (GSA) to capture land-augmenting character of new technology. Labour is defined as annual employment days in agriculture. Intermediate inputs include seeds, organic manure, fertilisers, pesticides, diesel, electricity and irrigation charges. Capital is
inclusive of net value of land improvements, farm equipments and tools, public and private irrigation, agricultural machinery, farm houses, livestock and inventories.

We compute Tomquist-Theil index for eighteen agricultural products, nine inputs and 'residual' productivity by specifying this index to equal 100 in a particular year and accumulating the measures based on equation (1). This index-based methodology permits identifying various sources of growth in output without estimating production function. This advantage is particularly important because of severe econometric problems in estimating this function from time-series data. A further advantage of Tomquist-Theil index is that it accounts for changes in quality of inputs and products since current prices are used in constructing the weights for this index. Figure 1 picturises our framework for the contributions of land, four each credit and self-financed inputs and technological change to aggregate agricultural production.

Farm harvest prices are used to aggregate revenues from eighteen agricultural products reported in National Income Accounts of Central Statistical Organisation. Data on agricultural work force, wage rate and capital stock (new series) are from Dholakia and Dholakia (1993), while data on employment are from Unni (1988) and National Sample Surveys on Employment and Unemployment. Capital stock was decomposed into private (PRK) and public (PBK) by considering Gandhi's (1990) estimates of these two types of capital (old series) for 1950-51 to 1980-81. For the decade of the 1980s these two types of capital was estimated by using their shares in capital formation during this period from Ram (1993). This was necessary because separate data on public and private capital stock was not readily available.

The costs of intermediate inputs are the same as those reported in National Income Accounts which consider market prices to value these inputs. The costs of labour, land and capital are derived from Dholakia and Dholakia (1993) by considering their estimates of share of payments to these three factors in agricultural net domestic product (NDP) which includes mixed property income of self-employed agriculture and that of organised agriculture. This payment to labour is evaluated at the same market wage rate at which casual agricultural labour is paid. This when excluded from mixed property income of self-employed reported in National Income Accounts provides payment to land and capital. This is divided between these two by considering the share of value of land in total assets of rural households as the cost of land, which are all valued at market prices. Data for this are derived from the All-India Surveys of Rural Debt and Investment by the Reserve Bank of India (RBI). The remaining agricultural payment is considered as the cost of capital. Capital cost so derived was allocated between private and public capital by considering weighted average interest rates on these two types of capital. The weights are the shares of these two types of capital. For private capital average interest rates on medium- and long-term institutional loans were considered, while for public capital average interest rates on long-term government securities were used. Data for these rates were collated from RBI and National Bank for Agriculture and Rural Development (NABARD) publications. The cost of private and public capital that are credit and self-financed was subdivided for these two on the basis of their shares in the total for these two types of capital. This methodology of measuring costs of capital and land was followed due to non-availability of data separately for different types of capital, their prices and land prices.
Implicit in the foregoing methodology of costing labour, intermediate inputs and capital is the assumption that rental prices of these inputs are the same for the two components of credit and self-financed investment in these resources. This suggests that the self-financed investments have also an opportunity cost. And that the farmers and public agencies borrow institutional credit for these investments mainly because of liquidity constraint. Such constraint arises from seasonal, short and small surpluses as well as imperfect nature of factor markets so characteristic of agriculture (Desai and Mellor, 1993; Desai, 1975).

Data on land is drawn from the publications of the Ministry of Agriculture, Government of India. Data on intermediate inputs are from the National Income Accounts. Data for labour cost share in cost A2 plus family labour are drawn from Farm Management Surveys and Cost of Cultivation Surveys of the Ministry of Agriculture, Government of India. And data
on institutional credit from Primary Agricultural Co-operative Credit Societies (PACS), State Co-operative Land Development banks (CLDBs), Public Sector Commercial Banks (NCBs) and Regional Rural Banks (RRBs) are from RBI/NABARD publications and those supplied by them. 'Kind' component of crop loans from NCBs and RRBs is assumed to be the same as that from PACS. This component for 1950-51 to 1972-73 was assumed to be the same as the share of fertilisers, pesticides, electricity, diesel and irrigation charges in total intermediate inputs. These were necessary because data on this component were not separately available. Crop loans and input dealers credit are measured in flow terms since these are for wages and intermediate inputs. Term loans and credit to rural electricity corporations are in stock form as they are for capital stock.

The unaccumulated Tornquist-Theil index for each agricultural product and input categories was normalised to adjust for abnormal weather in some years. Normalisation was done for severe droughts of 1957-58, 1965-66, 1966-67, 1972-73, 1974-75, 1979-80 and 1987-88 by interpolating this index for the year preceding and following these years. This was necessary because this index is highly sensitive to abnormal adverse changes in production and inputs use. Growth rates in Tornquist-Theil index so derived were estimated by estimating regression equation, \( \ln Y_t = a + b + u \). These growth rates would give absolute contributions of each of the nine resources and technological change to agricultural production growth. They also provide a basis to determine the relative contributions of these sources of growth to increase in agricultural output. Both absolute and relative contributions are computed for (1) pre-Green Revolution phase of 1950-51 to 1965-66, (2) post-Green Revolution phase of 1966-67 to 1973-74: Period I, (3) post-Green Revolution phase of 1974-75 to 1979-80: Period II, (4) post-Green Revolution phase of 1980-81 to 1984-85: Period III, (5) post-Green Revolution phase of 1985-86 to 1989-90: Period IV, (6) Entire post-Green Revolution phase of 1966-67 to 1989-90 and (7) Entire period of 1950-51 to 1989-90. Before analysing application of our framework let us note some major findings on what proportions of labour, intermediate inputs, private and public capital stock were financed by the institutional credit during the study period (see Table I).

In the pre-Green Revolution phase institutional credit financed only about 3 per cent of expenditure on these resources. The corresponding figure in the post-Green Revolution phase was over 11 per cent. Secondly, over time institutional credit has financed increasing proportion of the four inputs; this amounted to a little over 14 per cent in the second half of the 1980s. Thirdly, institutional credit has financed larger and increasing proportions of intermediate inputs and fixed capital. This is because of growing demand for these inputs in the wake of the Green Revolution (GR). Moreover, such demand for fixed capital is also because such investment is lumpy and has long gestation period. Lastly, the proportion of intermediate inputs financed by institutional credit increased less rapidly. And this proportion for wages was not only stagnant but extremely low. Both these are because the scale of finance for crop loans and unit cost of investment do not cover much the cost of labour including family labour nor adequately cover intermediate inputs. This policy bias needs correction because of four reasons: first, income in agriculture arises at the end of a production cycle, while consumption (including inputs use) cycle is more continuous which together with the farmers' legitimate higher preference for physical forms of saving results in temporary deficits for which they need institutional credit (Desai and Mellor, 1993); second, technological change in vogue being material inputs and labour-augmenting
TABLE I. SHARE OF INSTITUTIONAL CREDIT IN TOTAL WAGES, INTERMEDIATE INPUTS* AND PRIVATE AND PUBLIC CAPITAL STOCK DURING PRE- AND POST-LGREEN REVOLUTION (GR) PHASES

<table>
<thead>
<tr>
<th>Phases</th>
<th>Pre-GR 1950-51</th>
<th>Post-GR</th>
<th>Both phases 1950-51</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Labour (N)</td>
<td>1.40</td>
<td>2.02</td>
<td>2.18</td>
</tr>
<tr>
<td>2. Intermediate inputs (MI)**</td>
<td>12.27</td>
<td>29.07</td>
<td>23.67</td>
</tr>
<tr>
<td>4. Public capital stock (PBK)</td>
<td>0</td>
<td>5.22</td>
<td>2.16</td>
</tr>
<tr>
<td>Four resources</td>
<td>2.70</td>
<td>11.37</td>
<td>8.60</td>
</tr>
</tbody>
</table>

* Excluding feed to livestock, market charges, and minor repairs.

** Institutional credit for MI includes crop loans and credit for inputs marketing business, while this for PRK includes term loans to farmers and for PBK it is term loans to rural electricity agencies.

Figures in brackets are percentages of farmer-level crop loans to total intermediate inputs (MI).

Institutional credit must facilitate exploiting this potential; third, credit-financed intermediate inputs and labour including family labour would lead to higher employment and hence output growth without much adversely affecting price environment; and the fourth being that the credit that even finances family labour would implicitly satisfy the much needed consumption needs. Indeed, the distinction between production and consumption loans in the case of farm households is artificial and inappropriate since they are both producers and consumers. All this is also because of the earlier discussed complementarity in various inputs. Specific policy suggestions would be discussed subsequently.

III

ANALYSIS OF RESULTS

Before discussing the detailed findings, the main conclusions may be stated. One, the post-GR phase has witnessed not only higher total factor productivity (TFP) but also higher contributions of institutional credit (CFI) as well as self-finance (SFI) as sources of growth. Secondly, the recent tendency of some slide back in TFP could be due to inadequate public investment for agriculture and rural infrastructure, inappropriate mix of this investment and other policies, besides inefficiency of institutions for agricultural growth with equity. Thirdly, between credit- and self-financed inputs (i.e., CFI and SFI), the latter was invariably more important. Fourthly, over time though land (L) as a source of growth turned less important it was more important than capital. Fifthly, among the four credit-financed inputs intermediate inputs (MICF) were more important as a source of growth, while private capital (PRKCF) was the least important. The preference for institutional credit and self-finance labour and intermediate inputs as compared to capital is consistent with the agriculture’s resource endowments and the land- and labour-augmenting character of new technology in
vogue. Sixthly, this is also the case for various self-financed inputs. However, unlike the pre-GR, in the post-GR self-financed private capital (PRKSF) was more important than self-financed public capital (PBKSF). And lastly, while the efficiency of all the four types of institutional credit improved significantly in most of the post-GR periods except to some extent for capital (KCF) in the latter half of the 1980s, the same cannot be said for self-financed capital (KSF). This inefficiency could be due to inadequate and untimely availability of financial savings, inadequate increases in institutional credit to finance complementary labour and intermediate inputs and inefficiency of publicly owned and managed irrigation systems.

Agricultural output increased by 2.97 per cent per annum during 1950-51 to 1989-90. Self-finance (SFI) was the most important source of growth closely followed by technological change (TFP) (see Table II). TFP increased at the rate of 1.12 per cent per year which is two-thirds of such growth in the post-war U.S. agriculture. Indeed, this was the single largest source of growth among the ten sources of growth. Institutional credit (CFI) was the least important as a source of growth for the four decades together.

In the post-GR phase agricultural production increased by 3.41 per cent per annum compared to 2.05 per cent per year in the pre-GR phase. Prior to the Green Revolution self-financed inputs (SFI) was the most important source of growth, while technological change (TFP) claimed this position in the post-GR phase (see Table II). TFP growth in this phase was more than two and a half times larger (i.e., 1.45 per cent) than in the pre-GR era (i.e., 0.56 per cent) of post-independent India. Credit-financed inputs (CFI) was the least important source of growth in both the pre- and post-GR phases (see Table II).

However, between credit- (CFI) and self-financed inputs (SFI), the effectiveness of the former improved significantly in the post-GR phase compared to the pre-GR phase (compare rows 3.1 versus 3.2 and 3.3, and rows 4.1 versus 4.2 and 4.3 for columns 2 and 3 in Table II). Thus institutional credit in real terms increased by only 7 per cent per annum and had an absolute contribution of 0.306 per cent point per annum which accounted for 9 per cent in the growth of agricultural output in the post-GR phase. The corresponding figures in pre-GR phase were 21 per cent, 0.248 per cent point and 12 per cent.

Agricultural production growth rate in each of the four periods except the immediate period of 1966-67 to 1973-74 of the post-GR phase was higher than in the pre-GR phase (see Table II). Even in the third period of 1980-81 to 1983-84 when this growth rate marginally declined, it was significantly higher than the growth rate in the pre-GR phase. Agricultural production growth in the second half of the 1980s was as high as 4.49 per cent per annum. This is to some extent due to agricultural policy shift in favour of Eastern India where there is considerable untapped potential and where agricultural growth accelerated.

During the four different periods of the post-GR phase, technological change (TFP) was the most important source of growth in the first two periods. In the subsequent two periods self-finance (SFI) claimed this (see Table II). This self-finance for public capital and to some extent private capital may have been for poverty alleviation programmes which were much emphasised in these periods. Both agricultural growth and poverty alleviation were much better achieved during these periods (see Table II and Ninan, 1994). This complementarity between these two objectives was, however, achieved less efficiently since TFP
TABLE II. ANNUAL COMPOUND GROWTH RATES OF TORNQUIST-THEIL INDEX OF AGRICULTURAL PRODUCTION, TOTAL FACTOR PRODUCTIVITY, LAND, SELF-FINANCED INPUTS, AND CREDIT-FINANCED INPUTS IN PRE- AND POST-GREEN REVOLUTION (GR) PHASES

<table>
<thead>
<tr>
<th>Details</th>
<th>Phases</th>
<th>Both phases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-GR 1950-51 to</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1965-66</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Entire post-GR 1966-67 to 1989-90</td>
<td></td>
</tr>
<tr>
<td></td>
<td>II 1974-75 to 1979-80</td>
<td>II 1974-75 to 1979-80</td>
</tr>
<tr>
<td></td>
<td>IV 1985-86 to 1989-90</td>
<td>IV 1985-86 to 1989-90</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td></td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td></td>
<td>(7)</td>
<td>(8)</td>
</tr>
</tbody>
</table>

1. Agricultural output growth (per cent point) 2.0486 3.4142 1.9847 4.2539 3.6778 4.4872 2.9658
2. Total factor productivity growth (TFP) 2.1 Absolute contribution (per cent point) 0.5575 1.4516 0.8360 1.7119 1.3826 1.3293 1.1167
2.2 Relative contribution (per cent) 27.21 42.52 42.12 40.24 37.60 29.63 37.65
2. Land (GSA) growth (L) 2.1 Amount (per cent) 1.17 0.48 0.93 0.54 0.56 0.02 0.70
2.2 Absolute contribution (per cent point) 0.3684 0.3625 0.4024 0.3972 0.4161 0.1622 0.3618
2.3 Relative contribution (per cent) 17.98 10.62 20.28 9.34 11.31 3.61 12.21
3. Credit-financed inputs growth (CFI) 3.1 Amount (per cent) 21.32 6.97 11.52 11.92 6.46 4.09 11.65
3.2 Absolute contribution (per cent point) 0.2478 0.3063 0.1382 0.4038 0.2829 0.1971 0.2516
3.3 Relative contribution (per cent) 12.10 8.97 6.96 9.49 7.69 4.39 8.48
4. Self-financed inputs growth (SFI) 4.1 Amount (per cent) 2.21 2.97 2.41 4.40 2.37 1.89 2.66
4.2 Absolute contribution (per cent point) 0.8749 1.2938 0.6081 1.7410 1.5962 2.7986 1.2357
4.3 Relative contribution (per cent) 42.71 37.89 30.64 40.93 43.40 62.37 41.66

In these periods receded. Indeed, in the 1980s (i.e., Periods III and IV) absolute contribution of TFP receded from what it was in the second period. This is so also for the relative contribution of this source (TFP) in these periods compared to the first two periods (see Table II). Inefficient growth and receding TFP could be due to inadequate public investment in agricultural research and extension, irrigation and other rural production infrastructure, and diffused and inappropriate policies such as inadequate development of suitable short duration HYVs, inadequate availability of seeds of such and other better varieties and breed that are already evolved, diversion of extension services to IRDP beneficiary identification task, excessive reliance on input subsidies and injudicious increases in procurement prices of innumerable crops. It could also be because of indiscriminate emphasis on and inefficiency of poverty alleviation programmes like Jawahar Rozgar Yojana (JRY) and IRDP. Non-price policy changes required for achieving more efficient complementarity between agricultural growth and equity would be discussed later. Suffice it to say here that the procurement price policy must take a back and selective seat for its indiscriminate use can hurt the poor without much agricultural growth, since it is the inappropriate technology which is the binding...
constraint (Vyas, 1994).

Credit-financed inputs (CFI) was more important as a source of growth than even land in the second and fourth periods of the post-GR phase (see Table II). Indeed in the latter half of the 1970s TFP growth was the highest, i.e., 1.71 per cent. However, between the credit- (CFI) and self- (SFI) financed inputs, the latter was more important in all the four periods of the post-GR phase. Both these sources of growth improved significantly in all the four except one period each during this phase (compare rows 3.1 versus 3.2 and 3.3 and rows 4.1 versus 4.2 and 4.3 for columns 4 and 7 in Table II). This period for institutional credit (CFI) was the second half of the 1980s, while for self-finance (SFI) it was the first period. Indeed, the efficiency of institutional credit (CFI) declined significantly in the latter half of the 1980s as 4 per cent growth in this credit accounted for just the equivalent relative share in agricultural production growth (see Table II).

Let us now discuss the role played by the earlier discussed four each inputs which are credit- and self-financed. Considering the entire four decades since 1950-51, institutional credit for intermediate inputs (MICF) was the most important source [after TFP, self-financed labour (NSF), land (L) and self-financed intermediate inputs (MISF) in that order]. This is followed by this credit for labour (NCF) [after self-financed private (PRKSF) and public (PBKSF) capital in that order] (see Table III). Interestingly, between credit-financed private and public capital, the former was the least important as a source of growth not only during both the pre- and post-GR phases but even during the four individual periods since 1966-67. Thus institutional credit was not unduly biased in favour of capital. Indeed, it was more in favour of land- and labour-augmenting intermediate inputs (MICF) and labour proper (NCF). Lastly, the efficiency of the four credit-financed inputs was higher in the post-GR phase (compare rows 1.1 versus 1.2 and 1.3, 2.1 versus 2.2 and 2.3, 3.1 versus 3.2 and 3.3, and 4.1 versus 4.2 and 4.3 for columns 2 and 3 in Table III). Moreover, this remained high throughout the post-GR phase except to some extent for credit-financed capital in the second half of the 1980s (see Table III). This type of credit in this period may have been promoted more for IRDP whose inefficiency is quite well recognised now.

Self-financed labour (NSF) was the most important source of growth (after technological change) during the four decades since 1950-51 (see Tables II and III). Among self-financed private (PRKSF) and public (PBKSF) capital and intermediate inputs (MISF), the last one was more important in this period as well as in the post-GR phase. But in the pre-GR phase these inputs were less important than either public or private capital self-financed (see Table III). Moreover, between private and public capital self-financed, the latter was more important in the pre-GR, while the former was more important in the post-GR phase (see Table III).

During the four individual periods of the post-GR phase, self-financed labour (NSF) was more important compared to the other three self-financed inputs (see Table III). Next important was the self-financed intermediate inputs (MISF). Between the self-financed private and public capital, the former was more important throughout the four periods (see Table III). Finally, over the entire post-GR phase, the efficiency of self-financed private (PRKSF) and public (PBKSF) capital was inferior compared to the self-financed material inputs (MISF) and labour (NSF) (compare rows 7.1 versus 7.2 and 7.3, and 8.1 versus 8.2 and 8.3 with rows 5.1 versus 5.2 and 5.3, and 6.1 versus 6.2 and 6.3 in Table III).
<table>
<thead>
<tr>
<th>Details</th>
<th>Pre-GR</th>
<th>Post-GR</th>
<th>Both phases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1950-51 to 1965-66</td>
<td>Entire post-GR</td>
<td>I</td>
</tr>
<tr>
<td>1. Credit-financed labour growth (NCF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Amount (per cent)</td>
<td>19.91</td>
<td>3.83</td>
<td>4.02</td>
</tr>
<tr>
<td>1.2 Absolute contribution (per cent point)</td>
<td>0.0811</td>
<td>0.0411</td>
<td>0.0337</td>
</tr>
<tr>
<td>1.3 Relative contribution (per cent)</td>
<td>3.96</td>
<td>1.21</td>
<td>1.70</td>
</tr>
<tr>
<td>2. Credit-financed intermediate inputs growth (MICF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Amount (per cent)</td>
<td>22.29</td>
<td>5.80</td>
<td>6.08</td>
</tr>
<tr>
<td>2.2 Absolute contribution (per cent point)</td>
<td>0.1667</td>
<td>0.2541</td>
<td>0.0990</td>
</tr>
<tr>
<td>3. Credit-financed private capital growth (PRKCF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Amount (per cent)</td>
<td>21.01</td>
<td>6.57</td>
<td>13.30</td>
</tr>
<tr>
<td>3.2 Absolute contribution (per cent point)</td>
<td>0.0002</td>
<td>0.0017</td>
<td>0.0005</td>
</tr>
<tr>
<td>3.3 Relative contribution (per cent)</td>
<td>neg.</td>
<td>0.05</td>
<td>0.02</td>
</tr>
<tr>
<td>4. Credit-financed public capital growth (PBKCF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1 Amount (per cent)</td>
<td>0</td>
<td>9.62</td>
<td>34.81</td>
</tr>
<tr>
<td>4.2 Absolute contribution (per cent point)</td>
<td>0</td>
<td>0.0093</td>
<td>0.0050</td>
</tr>
<tr>
<td>5. Self-financed labour growth (NSF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1 Amount (per cent)</td>
<td>1.21</td>
<td>3.77</td>
<td>0.46</td>
</tr>
<tr>
<td>5.2 Absolute contribution (per cent point)</td>
<td>0.6213</td>
<td>0.8936</td>
<td>0.2297</td>
</tr>
<tr>
<td>5.3 Relative contribution (per cent)</td>
<td>30.33</td>
<td>26.17</td>
<td>11.58</td>
</tr>
<tr>
<td>6. Self-financed intermediate inputs growth (MISF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1 Amount (per cent)</td>
<td>0.40</td>
<td>2.00</td>
<td>1.19</td>
</tr>
<tr>
<td>6.2 Absolute contribution (per cent point)</td>
<td>0.0391</td>
<td>0.1482</td>
<td>0.1527</td>
</tr>
<tr>
<td>6.3 Relative contribution (per cent)</td>
<td>1.91</td>
<td>4.34</td>
<td>7.70</td>
</tr>
<tr>
<td>7. Self-financed private capital growth (PRKSF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.1 Amount (per cent)</td>
<td>0.98</td>
<td>2.13</td>
<td>1.46</td>
</tr>
<tr>
<td>7.2 Absolute contribution (per cent point)</td>
<td>0.0990</td>
<td>0.1631</td>
<td>0.1309</td>
</tr>
<tr>
<td>7.3 Relative contribution (per cent)</td>
<td>4.83</td>
<td>4.78</td>
<td>6.61</td>
</tr>
<tr>
<td>8. Self-financed public capital growth (PBKSF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.1 Amount (per cent)</td>
<td>17.06</td>
<td>4.66</td>
<td>5.81</td>
</tr>
<tr>
<td>8.2 Absolute contribution (per cent point)</td>
<td>0.1155</td>
<td>0.0888</td>
<td>0.0948</td>
</tr>
<tr>
<td>8.3 Relative contribution (per cent)</td>
<td>5.64</td>
<td>2.60</td>
<td>4.75</td>
</tr>
</tbody>
</table>
IV

POLICY IMPLICATIONS

From the foregoing analysis the implications for policies for institutional credit, the pattern of public investment and research and development (R&D) for agricultural development may be discussed. These policies should be oriented to the basic nature of technological change that India requires. This change must still remain land- and labour-augmenting with the emphasis on complementarity in agricultural production process. Such a change requires appropriate laws, public investment and institutions serving agriculture. This is because it results from the growth in basic knowledge in agricultural sciences and its transfer in the form of new inputs and services by these institutions. For analytical convenience we discuss the three policy areas separately. We, however, strongly emphasise that a synergy in these policies is absolutely necessary because it has a larger impact than the sum of effects of individual policies on agricultural growth.

Institutional Credit

Our findings suggest that this credit should be more for labour and intermediate inputs, besides that for term loans that complement these resources. This is because financial savings in agriculture are seasonal, short and small, which result in temporary periods of deficits even within one single season. Hence working capital loans must be promoted to meet the expenses on labour (including family labour) and intermediate inputs on a continuous basis to the farmers just as it is the case for industries. Specific modifications required include: (1) scale of finance for crop loans and unit cost of investment must account for labour and intermediate inputs more fully, (2) working capital loan (including crop loans) must be combined with term loan whenever the latter is extended (including for IRDP), (3) term loans to the farmers need not be just for avowed purposes but also for repair to old wells and tanks, modern hand and bullock-drawn farm implements like seed-cum-fertiliser drill, simple soil turning operations which the farmers periodically undertake even in a bad weather and for soil and moisture conservation on watershed basis, and (4) increase in credit for inputs marketing business of both private dealers and PACS must be accelerated (i.e., indirect agricultural credit).

Even technical services by RFI could emphasise new irrigation, farm implements and resource as well as seed-centered (instead of just resource-centred) technologies. At present RFIs like public sector commercial banks (NCBs) and RRBs hesitate undertaking such services since they perceive high costs. But such costs can be contained by organising these services on a peripatetic basis and better co-ordination with government extension service, NABARD, Agricultural Universities and input industries. Moreover, such services have implicit returns in the form of better loan efficiency and hence recovery, and more durable relationship with the borrowers. Similarly, NCBs and RRBs tend to neglect working capital loans to the farmers (i.e., ‘direct’ credit to agricultural production sub-system - APS), and inputs marketing credit (i.e., ‘indirect’ credit for agricultural inputs distribution sub-system - AIS) (Desai, 1994 a). Even District Central Co-operative Banks tend to do the same for the latter (Desai and Namboodiri, 1994). Balanced development of the four credit portfolios mentioned above is desirable for it would encourage backward (BWL) and forward (FWL) linkages between APS and AIS, as shown diagrammatically below:
These linkages directly improve agricultural productivity, production, value added and incomes of farmers. Such improvements make them better loan repayers and also potential future borrowers and depositors. RFIs will also have two benefits. One of these is better recycling of their loans and larger loans and other businesses. And the other is an opportunity to combine APS loans with AIS loans which carry higher interest rates and are easily recoverable. Both of these would eventually lead to scale and scope economies in their costs that would improve their viability. Before we turn to the discussion on the pattern of public investment, current concerns for the viability of all the four RFIs may be briefly commented.

Elsewhere we have shown that their low viability is due to inefficiencies (Desai, 1994 a; Desai and Mellor, 1993). Indeed, all the four RFIs have either scale economies and/or constant returns to scale in their transaction, financial and total costs. This implies that their average cost curve is, respectively, downward sloping and/or horizontal for these costs. Hence, interest rates and gross margins should be reduced or kept constant so that business volume would expand through improved resource productivities and efficiencies. Thus RFIs can improve their viability by fully reaping scale economies rather than by increasing their lending rates and margins at present. We have also shown that restructuring of the type proposed by Khusro and Narasimham Committees is also not required (Desai, 1994 b). What is required is more decentralised, debureaucratised and depoliticised but accountable loan management decisions. Since RFIs’ scale economies in lending are the largest/second largest compared to other operations, it is this operation which they must expand more now. But this expansion has to be quality-oriented lest the problem of overdues would multiply. Both loan appraisal and monitoring including loan recovery need to be more rigorous and serious than has been the case. Finally, institutional credit need not be promoted merely to the large farmers nor to the smaller farmers. But it should also be for the medium size farmers (2 to 10 ha) who account for 22 per cent of the total and cultivate as much as 51 per cent of the land, besides the smaller farmers who constitute 76 per cent of the total and operate 29 per cent of the land in the mid-1980s.

**Pattern of Public Investment**

Both public and private investments in agriculture have a declining trend in the 1980s (Rath, 1989; Ram, 1993). This even corroborates the hypothesis that these two investments in agriculture are complementary rather than substitutes. Indeed public investment in agriculture and rural areas crowds-in rather than crowds-out private investment. But a moot question is what type of public investment may be accelerated.

In more recent years not only government investment in irrigation has declined but even the investment in agricultural research and education, area development including soil and moisture conservation and that for institutions that provide backward linkage such as the co-operatives, RFIs, local panchayats and land reforms has also declined either in absolute amount or in both absolute magnitude and in relation to total for agriculture and allied
sectors. What has gained most prominence is the wage-paid employment programmes, IRDP, certain commodity-based agricultural production programmes and input subsidies. We need to contain the latter and accelerate the former in the interest of not only agricultural growth but also equity objective. Most of the latter except IRDP merely facilitates current production growth rather than the development of production potential in these sectors. Input subsidies may be contained by regularly revising prices of such inputs as fertilisers, electricity, diesel and canal irrigation water lest the farmers get used to the cushion they provide. Any adverse impact on the use of these inputs must be averted by more pro-active non-price policies for institutional credit, minor irrigation, extension and spread of better varieties through private dealers and PACS.

As regards wage-paid employment programmes like JRY, they should be prioritised for those that directly contribute to agricultural production potential rather than community buildings and such other social infrastructure. On IRDP four types of changes may be considered. One, credit-based IRDP for the landless that solely depend on wage-paid employment may paradoxically be viewed with some detachment but not indifference. Two, such schemes for them and marginal and small farmers may be more carefully designed, besides being more selective and location-specific. Three, capital subsidy may be adjusted with loan repayment after the borrowers make consistent repayment instead of initially in loan cycle. And four, District Rural Development Agencies may be revamped by providing some technical staff who would organise backward and forward linkage related services. Between IRDP and JRY, the former together with the above-mentioned modification in the latter is preferable. This is because it would not only create asset base among the poor but would also simultaneously increase agricultural production and thereby relax wage goods constraint. Indeed, all these changes would further strengthen not only the complementarity between agricultural growth and equity objectives that has been experienced but would make the whole process more efficient. Resources saved from programmes like JRY, input subsidies and more selective IRDP may then be invested in agricultural research and education, irrigation and development of institutions that provide real resources for backward linkage.

In the context of new economic policies similar changes should be made for the government resources saved due to privatisation and foreign inflows for the non-agricultural sectors. Except for power, no other such changes that have emerged so far would benefit agriculture. Hence, whatever resources that the government would save should be deployed for the above discussed basic agricultural programmes including IRDP. They may also be utilised for policy-induced decentralised location of agro-processing industries for basic food. Such rural industries being labour intensive would provide employment opportunities to the rural poor. We recognise that this may not reduce the percentage of budget deficit to national income to the level insisted upon by International Monetary Fund and the World Bank. But our endeavour should be to convince them that such a shortfall as well as the concomitant increase in public investment is for agricultural infrastructure and agro-processing industries that would improve agricultural growth and economic growth in general.
Research and Development (R&D)

R&D policies are the cornerstones of land- and labour-augmenting technical change. They should be in relation to appropriate laws, hardware and software as it relates to agricultural research and education, seeds and modern small hand and bullock-drawn farm implements. Six specific suggestions are offered.

Our first suggestion stems from the fact that the spread of HYV technology is likely to be adversely affected under the sui generis system\(^8\) that India has to adopt as a part of Trade Related Intellectual Property Rights (TRIPS) agreement under the General Agreement on Tariffs and Trade (GATT). Since we do not have this system now, this obligation when fulfilled will create patenting of seeds, plant varieties and other agricultural inventions which will push the costs of new seed varieties and technology upwards for the farmers. This is because the seed and other producers will have to pay royalty to the plant breeders and inventors, the cost of which these producers will shift to the farmers. Both seeds and other resources production and their commercial use by general farmers would be adversely affected. Since new technology in crop and allied agriculture is scale-neutral and land- and labour-augmenting, these adverse implications must be averted by the government, bearing the royalty and the associated costs. This must be done to meet both agricultural growth and equity objectives. Appropriate provisions in Indian Patent Law and Seeds Act must hence be made.

Secondly, public investment in agricultural research and education needs to be stepped up not only for the above provisions but also to meet increased fixed capital requirements for evolving bio-technology as well as for the operation and maintenance budget. This public investment never formed even one-quarter of a per cent of agricultural production in the past seven plans. And it compares very poorly with one per cent that developed countries have consistently invested for three to four decades. Thirdly, there is a need to capitalise the decentralised agricultural research and education system that the Indian Council of Agricultural Research and various Agricultural Universities have built. Learning from this is very valuable to evolve location-specific biological and chemical innovations without which total factor productivity can neither be rapid nor broad-based. Such innovations must even be generated by any private seeds or other inputs industries that intend to create. Fourthly, modern designs for small hand and bullock-drawn implements like seed-cum-fertiliser drill, wheeled-tool-carrier, etc., which are now available must reach innumerable small farmers. What seems to be constraining is their availability and/or costs. The availability of these implements could be increased by the government initially manufacturing these to play a catalytic role that it played for seeds production. Alternatively, it could be that the government supports the existing public and/or private seeds, fertilisers and tractor producers to make these implements. Five, new technology evolution and transfer for the semi-arid and arid rainfed areas should be resource- and seeds-centred rather than merely resource-centred. And six, basic agricultural research in both public and private domain must interact with the extension (i.e., technology transfer process) so that suitable innovations are continuously generated.
CONCLUSIONS

The application of our conceptual and methodological framework reveals the following. One, institutional credit, self-finance and technological change have all made better contributions to agricultural growth under land- and labour-augmenting new technologies which emerged in the mid-1960s. Two, under such technologies institutional credit as a source of growth became more important than even land in the second-half of the 1970s and the 1980s. Consequently, land as a collateral may be given less importance than the criterion of technical and economic feasibility. Three, between credit- and self-financed investments the latter invariably contributed more to agricultural growth. This suggests that the farmers and input marketing agencies have invested their savings in utilising new technological opportunities. The government behaviour was not always so. This also follows from larger contribution of private compared to public capital to agricultural growth. Four, among the four inputs that were credit-financed, namely, labour, material inputs, private capital and public capital, the first two were far more important sources of growth in the four decades since the 1950s. This suggests that the response of institutional lenders, farmer-borrowers and input agencies was consistent with the nature of technological change and the resource endowments of the country. Institutional lenders must therefore make fuller allowance for these inputs in crop loans and unit cost of investment for term loans. This is also because the farmers’ credit demand arises from seasonal deficits in their cash inflows. Even farm input dealers have this. Hence, their credit needs must also be met so that they can promote timely and adequate supply of inputs. Five, over time even private capital that was credit-financed gained importance. This together with the preceding finding implies that term loan and working capital loan are complementary. Hence, whenever the former is promoted the latter must be combined so that investment efficiency and hence loan repayment ability improve. Moreover, term loans that are complementary to land, labour and material inputs should be preferred. Six, better performance of institutional credit in post-GR phase also suggests that the policies pursued for this credit have made a desirable impact. The only unsatisfactory feature is high and persistent loan overdues with the farmers though these are significantly lower in Northern and Southern India where technological change is more rapid. These high overdues nonetheless should be reduced by a moratorium on loan waivers and loan melas, perfecting loan appraisal and monitoring and inculcating more discipline among both borrowers and lenders. Seven, public capital that was self-financed by the government made declining contributions to agricultural growth in the 1980s. This is consistent with the declining trend in public investment in agriculture. Such a trend may have caused a receding tendency in technological change in this period. This must be reversed. Not only the investment levels should increase but the pattern of government investment must be changed. It may be restructured from current production growth through input subsidies and some crop-based programmes to efficient production potential generation by appropriate agricultural research and education (including royalty for inventors), irrigation, watershed-based farming and institutions that directly facilitate backward linkage. Similarly, rural development programmes like JRY, Minimum Needs Programme and Integrated Rural Energy Programme may be more for economic rather than social overheads, and IRDP may be more selective, efficient and location-specific. Eight, technological change was the single most important contributor to agricultural growth during 1966 to 1989. The government
must, therefore, urgently restructure its investments as just suggested. In addition, it should adopt appropriate Patent Laws and Seeds Act for sui generis system and encourage decentralised organisational changes to spur biological, chemical and mechanical (not necessarily automotive) innovations by both public and private R&D agencies. Institutional lenders must complement these by offering technical services to identify better loan portfolios for both themselves and farmers as they do for industrial borrowers. Finally, there must be synergy in policies for institutional credit, public investment and basic agricultural research to facilitate more rapid and broad-based scale-neutral technological change which has a potential to provide more efficient complementarity between agricultural growth and equity.

NOTES

1. While early monetary and finance literature recommended pro-active role of the government and guided market interest rates for the development of the institutional finance sector, more recent literature emphasises such a role for the market for financial services. Since financial market is inherently imperfect, government intervention in this market has a sound economic rationale. And hence the advocacy of the earlier literature is more relevant. This is so also for the rural financial market. Perhaps for this reason, among others, countries like South Korea and Taiwan have continued with such a strategy for critical sectors like agriculture, exports, and infrastructure even in the wake of financial liberalisation at their advanced stage of development. Even China has continued this. For a critique of the new literature see, for example, Desai and Mellor (1993).

2. Tractorisation in developing countries was in a way misinterpreted as farm mechanisation of the type that spread through agriculture in Western countries. That tractorisation does not lead to displacement of human labour is well documented now. This is because it facilitates higher cropping intensity, changes in cropping pattern and also higher intensities of other complementary inputs. These changes augment employment. Studies which have reported decline in employment show this for some individual crops. It would be more appropriate to study the impact on a farm as a whole.

3. It is in respect of factor and input complementarities that agricultural production process is distinctly different from the industrial production. For some discussion and empirical realities on this, see, for example, Mellor (1966), Ishikawa (1967), Reynolds (1977) and Subramaniam (1993).

4. For the application of Tomquist-Theil index of total factor productivity to Indian agriculture, see Sidhu and Byerlee (1992) and Rosegrant and Evenson (1994), and to the U.S. agriculture, see Ball (1985).

5. Our estimates of TFP growth (0.56 to 1.71 per cent) are quite closely comparable to the similar estimates by Jha and Evenson (1973) (which found it to be 0.33 to 0.81 per cent for 1953-1958 and 1958-1961, and 2.31 per cent for 1963 to 1969) and by Rosegrant and Evenson (1994) (which found it to be 1.10 per cent for 1957-1967 and 1.05 to 1.39 per cent respectively for 1967-1976 and 1976-1986). Considering that these authors' estimates are for crop-agriculture, consider fewer inputs and use somewhat different years for the two phases. While Jha and Evenson base their estimates on a framework that assumes perfect competition and neutral and disembodied technical change, Rosegrant and Evenson estimates are based on a framework similar to ours. These latter authors use disaggregated district-level data for 271 districts covering 13 states. Incidentally, our estimate of TFP of 1.12 per cent for 1950-1989 is almost the same as Rosegrant and Evenson's estimate of 1.13 per cent for 1957-1987. But our TFP estimate of 1.45 per cent for 1966-1989 is significantly lower than Sidhu and Byerlee's estimate of 2 per cent for wheat in Punjab during 1972-1989. This is not surprising because Punjab wheat revolution is a landmark in Indian agriculture. We have not compared our estimate of TFP growth with that of Dholakia and Dholakia (1993) because they estimate this for agricultural NDP.

6. Desai and Mellor (1993) found that demand for rural credit is influenced more by non-price factors like timely and adequate availability of credit, branch density, availability of new technology/economic opportunity and other services institutional lenders provide. But they also found that this demand has over time become interest rate-elastic. A higher importance of non-price factors need not be interpreted as interest rate-inelastic nature of rural loan demand. The two can and do co-exist. Moreover, interest rate-elastic nature of this demand is because interest cost share could be significant in total cost of production.

7. For comprehensive discussion on restructuring rural financial institutions, see Desai (1994 b).

8. Sui generis means a system which covers a unique class of inventions/discoveries which are not classifiable with other patentable inventions such as industrial products and process. For comprehensive discussion of Indian Patent Law and TRIPS under GATT, see Oza (1994).
REFERENCES


Desai, Bhupat M. (1975), Relationship of Consumption and Production in Changing Agriculture: A Study in Surat District, India, Occasional Paper No. 80, Technological Change in Agriculture Project, Department of Agricultural Economics, Cornell University, Ithaca, New York, U.S.A.


Gandhi, Vasant P. (1990), "Investment Behaviour in Developing Countries: The Case of Agriculture in India", Food Research Institute Studies, Vol. 22, No. 1.

Hayami, Yujiro; Vernon W. Ruttan and Herman M. Southworth (Eds.) (1979), Agricultural Growth in Japan, Taiwan, Korea, and the Philippines, The University Press of Hawaii, Honolulu.


