Falling Agricultural Investment and Its Consequences

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Neglect of agriculture, an important sector of the Indian economy, is likely to have an adverse impact on the country. Such a neglect has been observed as a fall in agricultural investment during the 80s. Simulations using a computable general equilibrium model help in assessing the adverse impact of the fall in total agricultural investment on agriculture in particular and the economy in general. Though shifting investment resources away from agriculture to non-agriculture may result in a faster growth in total gross domestic product, the growth across sectors is likely to be uneven, with non-agriculture likely to show a far higher growth than agriculture. However, slowing down agricultural growth would lead to growing income inequality in rural areas. If the present trends of investment policy are continued large-scale cereal imports may become necessary and also despite such imports prices would go up substantially. Price increases of foodgrains are known to hit the poor most.

I
Introduction

AGRICULTURE being an important sector of the Indian economy, the impact of its performance (good/bad) is not confined to agriculture alone but is felt in all the sectors of the economy. Performance of agriculture is measured in terms of output of various crops. A major factor, amongst many, affecting crop output is the availability of water. Much of Indian agriculture is still largely unirrigated and dependent on rainfall. Though only about 30 per cent of cultivable land in the country is under irrigation, it has acquired a crucial role in determining the performance of Indian agriculture since use of high yielding variety (HYV) seeds require chemical fertilisers and irrigation as complementary inputs.

Development of irrigation requires massive investment in agriculture. Agricultural investment in India has grown, at 1980-81 prices (New series), from Rs 1,777 crore in 1960-61 to about Rs 4,864 crore in 1980-81. The share of agriculture in total investment has remained more or less constant but fluctuating between 15 per cent and 20 per cent over the same period (Table 1). However, since 1980-81, agricultural investment has shown a clear fall, both in level and also as a percentage of the total investment. It had fallen to Rs 4,360 crore (about 11 per cent of the total) in 1986-87. This fall in agricultural investment is reflected in slowing down the development of irrigation in the country. The annual compound rates of growth of gross irrigated area were 2.87 per cent, 2.46 per cent and 1.57 per cent in 1961-71, 1971-81, 1981-87, respectively.

The slow growth in gross irrigated area if continued in future also is likely to have an adverse effect on agricultural output in the long run. What are the consequences of such a resultant fall in growth in agricultural output within the agricultural sector and also on the rest of the economy? An attempt is made in this paper to study the long run impact of the fall in agricultural investment on agricultural sector and on the rest of the economy. Towards this a computable general equilibrium model is used since economy-wide consequences of policies are better captured in a general equilibrium framework.

The plan of this paper is as follows: In Section II the nature of the problem and some data problems are discussed. Section III discusses the methodology used. Section IV discusses the results of the computable general equilibrium analysis. Section V presents the conclusions of this study.

II
The Problem

Data on public, private and total agricultural investment (PBAI, PRAI, TAI respectively) and their shares as also the proportion of TAI in total gross domestic product (GDPT), and in agricultural gross domestic product (GDPA), are presented in Table 1. The figures in Table 1 are all based on the New Series of National Accounts Statistics (NAS) at 1980-81 prices, published by the Central Statistical Organisation (CSO). The data on total gross irrigated area (TGIA) as a proportion to total cultivated area are also presented in the same table.

From this table it can be observed that while TAI has grown by 2.74 times between 1960-61 to 1980-81, its share (SAGR) in total investment has been fluctuating between 15 per cent and 20 per cent approximately. Further, it can be noticed that agricultural investment fell in the 80s both in levels and also as a percentage in the total investment. The TAI as proportion in GDPT has also fallen in the 80s to levels below those prevailing in the 60s; i e, from a peak of 4.74 per cent in 1979-80 to 2.46 per cent in 1988-89. As a proportion to GDPA, TAI has shown a fall in the 80s from a high of 0.13 in 1979-80 to 0.075 in 1988-89.

From the same table it can also be seen that this fall in the TAI in the 80s has come about mainly due to a fall in public investment in agriculture. Public investment in agriculture fell from Rs 1,796 crore in 1980-81 to Rs 1,346 crore in 1988-89 whereas private agricultural investment during the same period has been fluctuating around Rs 3,000 crore without showing any clear trend. This is reflected in the falling share of public investment in total agricultural investment. In terms of proportion in public (private) GDPT, public (private) agricultural investment has shown a steep (marginal) fall in the 80s. The picture is similar with respect to proportion in public/private GDPA. Thus while private agricultural investment has been more or less stagnant public agricultural investment has been falling. A fall in public investment in agricultural sector reflects a bias in government policy in favour of non-agricultural sector over agricultural sector.

The fall in TAI seems to have resulted in a slowing of the development of irrigation.[1] Details of potential created and utilisation of irrigation facilities are given in Table 2. From this table it can be noticed that, by 1988-89, out of an ultimate potential of 113.5 million hectares (m ha) only 77.5 m ha (68.28 per cent) of irrigation potential had been created leaving still a great scope for irrigation development. Further, the pace of development of major and medium irrigation and minor irrigation has not been uniform. While minor irrigation has grown from 27.3 m ha (49.64 per cent of ultimate potential) to 45.2 m ha (82.2 per cent of ultimate potential) the development of major and medium irrigation, however, has been very slow. In terms of percentage in ultimate potential it has grown to 55.7 per cent in 1988-89 from 42.39 per cent in 1977-78. Further, since 1984-85 there seems to have been a slow down of the already slow pace of development of the major and medium irrigation. In the 5 years between 1983-84 and 1988-89 only 2.3 m ha of addi-

tional capacity was created in this segment

Turning to the utilisation of the irrigation potential, we find that the rate of utilisation of major and medium irrigation has remained more or less constant at around 85 per cent. Utilisation of minor irrigation, however, has not kept pace with the growth in its potential created, especially since 1983-84. This has resulted in a fall in rate of utilisation of total irrigation since 1983-84. As it is the utilisation of the irrigation which determines crop yields and output, in this study, therefore, we focus attention on the consequences of changes in gross irrigated area, thus taking into account the aspect of the utilisation rate also.

From Table 3 it can be seen that the addition to TGIA between 1961 and 1971 was 10,214 thousand hectares (t ha) which means on average 928.5 t ha was added every year in the 60s. Between 1971 and 1981, the addition to TGIA was 11,681 t ha implying an average of 1061.9 t ha per year of additional TGIA. In the 80s, however, irrigation development has slowed down considerably. Between 1981 and 1987 the addition to TGIA was only 5,761 t ha implying an yearly average addition of 823 t ha. In terms of annual compound growth rates, it was 2.87 per cent, 2.46 per cent and 1.57 per cent in 1961-71, 1971-81, 1981-87, respectively.

The slowing down of irrigation development during the 80s is also clear from the

TABLE 1: AGRICULTURAL INVESTMENT AND ITS SHARE AT 1980-81 PRICES (NEW SERIES)

Year	TAI	SAGR (Per Cent)	TAI/GDPT	TAI/GDPA	PBAI	Per Cent in TAI	PBAI/PBGDPT	PBAI/PBGDPA	PRAI	Per Cent in TAI	PRAI/PRGDPT	PRAI/PRGDPA	TGIA/GCA
1961	1777.0	15.091	0.0282	0.0555	589.0	33.146	0.1166	3.875	1188.0	66.854	0.0205	0.0373	0.1831
1962	1773.0	16.397	0.0273	0.0554	600.0	33.841	0.1062	2.941	1173.0	66.159	0.0198	0.0369	0.1822
1963	1928.0	15.191	0.0291	0.0614	694.0	35.996	0.1052	3.337	1234.0	64.004	0.0207	0.0396	0.1879
1964	2094.0	15.471	0.0301	0.0652	725.0	34.623	0.1001	2.832	1369.0	65.337	0.0220	0.0430	0.1893
1965	2262.0	15.904	0.0302	0.0645	765.0	33.820	0.0970	2.452	1497.0	66.180	0.0224	0.0431	0.1928
1966	2478.0	16.808	0.0344	0.0794	798.0	32.203	0.0924	2.117	1680.0	67.796	0.0265	0.0545	0.1990
1967	2486.0	16.085	0.0341	0.0808	696.0	27.997	0.0759	1.642	1790.0	72.003	0.0281	0.0590	0.2077
1968	2714.0	18.226	0.0344	0.0768	688.0	25.350	0.0704	1.543	2026.0	74.650	0.0294	0.0581	0.2028
1969	2838.0	21.421	0.0351	0.0804	775.0	27.308	0.0731	1.505	2063.0	72.692	0.0294	0.0593	0.2224
1970	3016.0	19.971	0.0350	0.0803	775.0	25.696	0.0677	1.556	2241.0	74.304	0.0300	0.0605	0.2278
1971	2884.0	17.426	0.0319	0.0717	789.0	27.358	0.0633	1.283	2095.0	72.642	0.0269	0.0529	0.2304
1972	3059.0	17.050	0.0335	0.0775	851.0	27.819	0.0644	1.344	2208.0	72.181	0.0283	0.0569	0.2326
1973	3317.0	18.808	0.0364	0.0885	1049.0	31.625	0.0746	1.631	2268.0	68.375	0.0295	0.0616	0.2409
1974	3352.0	16.754	0.0352	0.0834	993.0	29.624	0.0641	1.511	2359.0	70.376	0.0296	0.0597	0.2371
1975	3123.0	15.066	0.0324	0.0789	919.0	29.427	0.0580	1.336	2204.0	70.573	0.0274	0.0567	0.2542
1976	3556.0	15.523	0.0339	0.0796	1041.0	29.275	0.0604	1.442	2515.0	70.725	0.0287	0.0572	0.2536
1977	4457.0	19.811	0.0419	0.1059	1378.0	30.918	0.0724	1.842	3079.0	69.082	0.0353	0.0745	0.2604
1978	4281.0	19.099	0.0375	0.0924	1534.0	35.833	0.0766	1.937	2747.0	64.167	0.0292	0.0604	0.2671
1979	5447.0	19.354	0.0452	0.1150	1697.0	31.155	0.0790	1.982	3750.0	68.845	0.0379	0.0806	0.2764
1980	5414.0	19.807	0.0474	0.1310	1772.0	32.730	0.0791	2.058	3642.0	67.270	0.0397	0.0900	0.2899
1981	4864.0	18.857	0.0397	0.1043	1796.0	36.924	0.0743	1.948	3068.0	63.076	0.0312	0.0671	0.2881
1982	4741.0	13.856	0.0365	0.0960	1779.0	37.524	0.0710	1,913	2962.0	62.476	0.0283	0.0611	0.2912
1983	4865.0	14.613	0.0363	0.0997	1725.0	35.457	0.0624	1.767	3140.0	64.543	0.0295	0.0657	0.3006
1984	4406.0	14.070	0.0304	0.0815	1707.0	38.743	0.0580	1.675	2699.0	61.257	0.0234	0.0509	0.2994
1985	4888.0	14.801	0.0325	0.0904	1673.0	34.227	0.0526	1.590	3215.0	65.773	0.0271	0.0606	0.3066
1986	4641.0	12.131	0.0296	0.0855	1516.0	32.665	0.0435	1.419	3125.0	67.335	0.0257	0.0588	0.3056
1987	4360.0	11.344	0.0268	0.0817	1428.0	32.752	0.0374	1.302	2932.0	67.248	0.0235	0.0561	0.3145
1988	4486.0	11.754	0.0264	0.0838	1456:0	32.457	0.0354	1.292	3030.0	67.543	0.0235	0.0578	na
1989	4625.0	10.492	0.0246	0.0749	1346.0	29.103	0.0298	1.213	3279.0	70.897	0.0230	0.0540	na

Notes: 1961 refers to 1960-61 and so on. TAI—Agricultural investment (Rs crore); GDPA—Agricultural gross domestic product; PBAI—Public agricultural investment (Rs crore); PBGDPT—Public total gross domestic product; PRGDPA—Private agricultural gross domestic product; TGIA—Gross irrigated area under all crops; na—not available; SAGR—Share of agricultural investment in total investment; GDPT—Total gross domestic product; PBGDPA—Public agricultural gross domestic product; PRAI—Private agricultural investment (Rs crore); PRGDPT—Private total gross domestic product; GCA—Gross cultivated area under all crops.

TABLE 2: IRRIGATION POTENTIAL AND UTILISATION

(Million hectares)

	Ultimate Potential	1951	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Potential														
Major and medium	58.5	9.7	24.8	25.9	26.6	27.3	28.2	29.1	30.0	30.0	30.5	31.0	31.7	32.3
Minor	55.0	12.9	27.3	28.6	30.0	31.4	32.8	34.2	35.6	37.5	39.0	40.7	42.3	45.2
Total	113.5	22.6	52.1	54.5	56.6	58.7	61.0	63.3	65.6	67.5	69.5	71.7	74.0	77.5
Utilisation														
Major and medium	—	9.7	21.2	22.1	22.6	22.7	23.2	24.0	24.6	25.3	25.8	26.5	26.8	27.2
Minor	—	12.9	27.3	28.6	30.0	31.4	32.8	34.2	34.0	35.2	36.5	37.9	39.3	41.0
Total	—	22.6	48.5	50.7	52.6	54.1	56.0	58.1	58.6	60.5	62.3	64.4	66.1	68.2
Utilisation*														
Potential	—	100.0	93.1	93.0	92.9	92.2	91.8	91.8	89.3	89.6	89.6	89.8	89.3	88.0

Notes: 1951 refers to 1950-51 and so on.

* Total utilisation to total potential in per cent.

Source: *Economic Survey* various issues.

data on sourcewise net irrigated area (NIA) presented in Table 3. From this table it can be seen that the NIA by canals has shown a marginal increase of about 1.2 million hectares (m ha) between 1979-80 and 1986-87. This marginal increase has, however, been offset by a fall of about 1 m ha of NIA by tanks in the same period. As a result the NIA by surface water sources (canals and tanks) has been stagnating over this period. Note that these two sources are largely government controlled and their development is dependent on public investment. On the other hand the NIA by ground water (tubewells and other wells), to which private investment also contributes, has shown an increase of about 4.6 m ha over the same period. Thus it seems that the source of the problem seems to be the fall in public agricultural investment.

The slowing down of irrigation during the entire 80s obviously would affect the level of agricultural growth. Given the growing demand for food and other agricultural products due both to growing population and general economic growth, fall in agricultural growth is likely to result in imbalances between demand and supply. What are the consequences of such a fall on prices of agricultural commodities, consumption levels of food, income distribution effects and poverty in the country?

Before asserting that TAI indeed fell and hence analysing its short- and long-term consequences we must take note of differences in certain features of the CSO data on TAI between the 'old' (at 1970-71 prices) and the 'new' series (at 1980-81 prices). One can obtain the figures for TAI up to 1984-85 from the old series also. The figures at current and constant prices from the old and new series are given in Table 4.

The picture of TAI as obtained for the period 1980-81 to 1984-85 from the two series is somewhat different. While the new series presents a picture of falling TAI at 1980-81 prices with a lot of fluctuations in this period, according to the old series TAI at 1970-71 prices in this period showed a gradual fall initially but started growing again to a level marginally higher than in 1980-81. Further, quite frequently, the two series show a movement in TAI in the opposite directions. For example, according to the old series TAI in 1980-81 showed an increase over the previous year, whereas according to the new series TAI in 1980-81 shows a fall over the previous year. The reverse is also noticed in a few years, e g, in 1982-83.

This raises the question of not only comparability of the two series but also in some sense trust that one can have in the observed trends in either of the series. The comparability question has attracted the attention of other researchers too. For example, see Choudhury [1988].

Gross capital formation (GCF) consists of gross fixed capital formation (GFCF) and changes in stocks (CSTK). The difference between the two series in GCF is due to differences in the estimates of GFCF and CSTK. The NAS [1988, para 3.10, p 28] mentions that the new series uses latest data in estimating the GFCF and this would bring about some differences between the two series.

With respect to CSTK, two changes were made in the new series. First, the new series assumes the stocks with producers of agricultural commodities to be negligible. In the old series while foodgrains stocks with producers were taken to be negligible, stocks of agricultural commodities other than foodgrains were computed on the basis of data on bank advances [para 3.11 (i), page 28]. These advances, it notes, were meant for purchase of fixed assets and not for keeping stocks of these commodities. To that extent then, the old series would report a higher figure for CSTK.

The second change with respect to CSTK introduced in the new series is with respect to the stocks of cereals and cereal substitutes with the private traders. In the old series this was taken to be 25 per cent of marketable surplus less government procurement. In the new series a different procedure adopted by Dandekar has been used. According to this procedure, consumption of foodgrains has been subtracted from the net availability with the public to arrive at the estimates of stocks [para 3.11 (ii), page 30].

With respect to GCF in public, private and household sectors, Choudhury [1988] raises certain questions on methodology used in the new series. These relate to the way depreciation allowance has been treated in estimating the capital formation in public sector. With respect to the private sector also she questions the data used and some small methodological changes made in the new series. These questions are relevant for long-

TABLE 4: TAI AS PER NEW SERIES AND OLD SERIES

(Rs crore)

Year	New Series		Old Series	
	Current Prices	1980-81 Prices	Current Prices	1970-71 Prices
1960-61	448.0	1777.0	416.0	786.0
1965-66	720.0	2478.0	777.0	1200.0
1970-71	1214.0	2884.0	1365.0	1365.0
1975-76	2523.0	3556.0	2225.0	1278.0
1979-80	4976.0	5414.0	4900.0	2135.0
1980-81	4864.0	4864.0	6002.0	2364.0
1981-82	5385.0	4741.0	6224.0	2220.0
1982-83	6088.0	4865.0	6538.0	2156.0
1983-84	6055.0	4406.0	7855.0	2333.0
1984-85	7006.0	4888.0	8960.0	2472.0

Note: TAI—Total agricultural investment.

TABLE 3: GROSS AND NET IRRIGATED AREA, SOURCEWISE

(Thousand hectares)

Year	TGIA	Net Irrigated Area							
		Canals	Tanks	Surface Water[1]	Tubewells	Other Wells	Ground Water[2]	Other Sources	Total
1961	27980.0	10370	4561	14931	7290*	—	7290	2440	24661
1966	30901.0	10958	4258	15216	8653*	—	8653	2475	26344
1971	38194.0	12838	4112	16950	11887*	—	11887	2266	31103
1976	43363.0	13775	3986	17761	6769	7577	14346	2384	34491
1980	49178.0	15108	3918	19026	8180	8232	16412	2525	37963
1981	49875.0	15292	3198	18490	9527	8207	17734	2581	38805
1982	51554.0	15529	3511	19040	9898	8224	18122	2567	39729
1983	52121.0	15370	3112	18482	10684	8428	19112	2375	39969
1984	53937.0	16240	3783	20023	10973	8548	19521	2411	41955
1985	54083.0	15861	3330	19191	11265	8723	19988	2600	41779
1986	54652.0	15879	3070	18949	11544	8621	20165	2646	41760
1987	55636.0	16320	2983	19303	12211	8835	21046	2700	43049

Notes: 1980 refers to 1979-80 and so on, TGIA—Total gross irrigated area; * Pertains to total wells.
1 Surface water = canals + tanks; 2 Ground water = tubewells + other wells.

term comparability of the estimates. For further details see Choudhury [1988].

Thus while the new series seems to still have certain methodological shortcomings, the old series seems to overestimate GCF. These methodological issues while important are beyond the scope of this study. However, even with the old series data the picture of falling agricultural investment in the early 80s remains and the growth observed from 1983-84 has been only marginal.

III
Methodology

As mentioned earlier, to assess the consequences of a fall in TAI I use the 'Agriculture, Growth and Redistribution of Incomes Model (AGRIM)' a computable general equilibrium model of Narayana, Parikh and Srinivasan [1989] (NPS henceforth). Their model covers agricultural sector quite extensively. The salient features of this model are, in brief, as follows:[2]

The model considers the economy as made up of ten sectors—nine agricultural and one non-agricultural. The nine agricultural sectors are wheat, rice, coarse grains, bovine and ovine meats, dairy products, other animal products, protein feeds, other food agriculture and non-food agriculture. In the agricultural sector, 16 major and nine minor, i e, total 25 crops are considered separately. For each of these crops, the gross irrigated acreages, cropwise acreages and the yields are estimated separately. An important feature of the model is that the cropwise acreages, irrigation and yields are all econometrically estimated. The cropwise gross irrigated acreages are obtained from the total gross irrigated area which is a function of the agricultural investment. While acreage under a crop is determined by farmer's crop revenue expectations based on past prices, yields depend upon fertiliser used, HYV adoption rates and irrigation intensity. The output under each crop is then obtained and then aggregated over different crops to obtain the nine agricultural sectoral outputs and also to obtain the total GDPA. Along with the GDPN (non-agricultural gross domestic product) estimated as a function of non-agricultural investment and incremental capital output ratio, the GDPT is obtained. All these sectoral outputs are then distributed to different sections of the population in the country divided into 10 expenditure classes—five rural and give urban. This forms the aggregate supply component of the model.

On the demand side, for each of the 10 expenditure classes the demand is characterised by a linear expenditure system (LES) model and the classwise demands for various commodities are obtained. These classwise demands are then aggregated to obtain commoditywise the total household demands in the economy. The aggregate demand and the aggregate supply are then solved at national level to obtain the equilibrium prices that clear the markets under the influence of government policies on public distribution systems, procurement levels of foodgrains, targets on total and public investment, trade levels, taxes, domestic prices, etc.

The model is a dynamic simulation one. It is solved sequentially for year to year from 1971 to 2000. The percentage of balance of trade in total gross domestic product is exogenously fixed in this model. Given this, the exchange equilibrium of each year deter-

TABLE 5: RESULTS OF CGEM ANALYSIS

I) Specification of share (SAGR) of agriculture in total investment,
1) PV1 (Base scenario): $SAGR_t = 0.2$; 2) PV2: SAGR as per equation (1) (NPS specification);
3) PV3: SAGR as per equation (3); 4) PV4; SAGR = 0.1;
II) Simulation Results for years 1980 and 2000.

Variable	1980				2000			
	Base Scenario	Per Cent Change over Base Scenario			Base Scenario	Per Cent Change over Base Scenario		
		PV2	PV3	PV4		PV2	PV3	PV4
GDP agriculture[1]	221154.0	−0.37	−1.07	−2.06	351643.0	−0.82	−7.00	−5.96
GDP non-agriculture[1]	309313.0	0.11	0.32	0.61	1051200.0	1.87	5.03	8.33
GDP total[1]	530466.0	−0.10	−0.26	−0.51	1402844.0	1.19	2.01	4.74
Total investment[1]	110020.0	−0.07	−0.21	−0.48	483964.0	1.48	3.92	7.03
SAGR	0.2	−14.19	−23.18	−50.00	0.2	−9.14	−55.17	−50.00
Terms of trade	0.92573	−0.06	−0.09	0.98	0.90222	1.55	11.78	13.11
Rural income[6]	1177.4	−0.20	−0.55	−0.37	2560.7	1.39	4.44	7.35
Urban income[6]	2225.0	0.13	0.36	0.63	4789.0	1.84	5.03	8.27
Net sown area[2]	144779.0	0.00	0.00	0.00	152709.0	0.00	0.00	0.00
Gross cropped area[2]	172953.0	−0.25	−0.73	−1.38	203878.0	−0.69	−5.27	−4.70
Gross irrigated area[2]	46409.8	−1.71	−4.86	−9.25	87451.0	−2.90	−22.06	−19.66
Wheat								
Acreage[2]	21911.0	−1.20	3.41	−6.54	36698.0	−0.69	−13.99	−11.91
Yields[3]	1.64168	0.50	1.46	2.87	2.34326	−0.80	−3.58	−3.68
Production[4]	33812.0	−0.70	−2.00	−3.86	80834.0	−1.48	−17.07	−15.15
Net exports[4]	1973.0	−8.31	−24.01	−50.04	13252.0	−5.80	−81.94	−76.93
Irrigation[2]	12804.0	−1.11	−3.14	−5.98	27189.0	−3.29	−22.81	−21.15
Price[5]	1.37378	0.00	0.00	0.00	1.20797	2.98	12.29	12.29
Rice								
Acreage[2]	39241.0	−0.80	−2.29	−4.43	51888.0	−1.73	−11.80	−10.47
Yields[3]	1.26222	−0.07	−0.20	0.38	1.83120	−0.25	−2.53	−2.03
Production[4]	47054.0	−0.87	−2.49	−4.79	90267.0	−1.98	−14.03	−12.29
Net exports[4]	−1420.1	22.77	61.71	57.95	2116.0	−105.68	−286.13	−289.95
Irrigation[2]	16786.0	−2.08	−5.73	−10.67	28876.0	−2.68	−21.06	−18.26
Price[5]	1.98092	0.00	0.27	5.53	2.06582	0.00	24.53	21.73
Coarse grains								
Acreage[2]	42303.8	0.40	1.18	2.33	38373.8	0.24	4.93	4.09
Yields[3]	0.61942	−0.15	−0.44	−0.85	0.91417	−0.34	−4.21	−3.48
Production[4]	26204.0	0.25	0.73	1.47	35080.0	−0.11	0.51	0.47
Net exports[4]	−3837.2	−1.61	−4.61	−6.47	−5483.7	−0.13	−0.04	2.85
Irrigation[2]	4589.9	−2.30	−6.49	−12.19	9847.0	−3.33	−25.66	−22.58
Price[5]	1.05515	0.00	0.00	0.00	1.23058	1.44	11.40	11.72

Notes: 1—Rs million at 1970-71 prices; 2—000 hectares; 3—Tonnes per hectare; 4—000 tonnes; 5—Rs per kg; 6—Rs per capita per annum at 1970-71 prices; SAGR—Share of agricultural investment in total investment.

mines that year's domestic prices, values of classwise incomes and their commoditywise consumptions and hence household savings, tax levels, commoditywise net trade, public buffer stocks, tariffs and total investment. The realised total investment is then split into non-agricultural and agricultural investment. The latter determines the total gross irrigated area for the next year as follows:

$$TGIA = f(Rain_t, \text{Agricultural Investment}_{t-1}, Time_t)$$

In the AGRIM described above the share of agriculture (SAGR) in total investment is specified as a function of the terms of trade (TOT) between agricultural and non-agricultural sectors (agricultural price deflator over non-agriculture price deflator) as follows:

$$SAGR_t = \left[0.190879 - \frac{0.158848}{TIME_t}\right] * (TOT)^{0.25}_t \quad (1)$$

However, the elasticity of TOT, 0.25, was specified exogenously. In view of this, in this study, I propose to re-estimate the SAGR using the latest available data.

SAGR at constant prices is specified to be a function of TOT and the ratio of GDPA to GDPT at constant prices. The TOT is measured as the ratio of agricultural price deflator to non-agricultural price deflator. Agricultural (non-agricultural) price deflator is obtained as the ratio of GDPA (GDPN) at current prices to GDPA (GDPN) at constant prices.

$$SAGR_t = f\left[TOT_t, \frac{GDPA_t}{GDPT_t}\right] + U_t \quad (2)$$

A double logarithmic specification of SAGR, with a first order auto regressive scheme to correct for autocorrelation, was then estimated using the new series data, for the period 1951-52 to 1988-89, by the Hildreth-Lu procedure. The estimation result is as follows:

$$\ln(SAGR)_t = \underset{(-3.11)^+}{-0.952} + \underset{(1.90)^{+++}}{0.599} \times \ln(TOT)_{t-1} + \underset{(2.89)^+}{0.990} \times \ln\left[\frac{GDPA}{GDPT}\right]_{t-1} + \underset{(5.25)^+}{0.681} \times U_{t-1} \quad (3)$$

$R^2 = 0.7283 \quad \bar{R}^2 = 0.7123$

Notes: t-statistics are given in brackets. +/++/+++ indicates significance at 1 per cent, 5 per cent and 10 per cent confidence levels respectively.

From the above equation we notice that TOT and the ratio of GDPA to GDPT explain a major portion of the variation in SAGR as given by the high R^2 (0.7283). The t-statistics of these variables are also significant and have the expected signs. In the CGEM analysis later on equation (3) instead of equation (1) is considered as another variant.

IV
CGEM Analysis

In this section economywide consequences of falling TAI are analysed in comparison to maintaining it at pre-80s rate. Towards this four alternative policy variants (PV1 to PV4) are constructed with regard to agricultural sector's share in total investment as follows:

PV1: SAGR = 0.2
This implies a constant 20 per cent of the total investment goes to agricultural sector every year. In this variant, the SAGR is maintained at 20 per cent, which corresponds to the observed levels during late 70s. This variant is taken as the base scenario against which the other variants are to be compared.

PV2: SAGR is as given in equation (1) (NPS specification).
This variant is considered to compare the results of this study with those of NPS. Results reported here under this variant correspond to their reference run of AGRIM (see NPS [1991]).

PV3: SAGR is as given by the estimated equation (3) above.
The estimated SAGR equation represents the behaviour of the SAGR and hence the agricultural investment given the terms of trade between agricultural and non-agricultural sectors and also the weight of agriculture in the GDPT. This variant, based on econometric estimation using the latest available data reflects the current behavioural aspect of agricultural investment.

PV4: SAGR = 0.1
In this variant the SAGR is fixed at a constant 10 per cent. This variant for the SAGR is considered since in 1988-89 its realised value was indeed around 10 per cent. The performance of the economy if the SAGR continues to remain at this level is simulated under this variant.

These four variants of the SAGR are assessed in the light of comparative results obtained for the years 1971 to 2000 by simulating the computable general equilibrium model AGRIM. Each alternative variant is introduced to be effective from 1980. Specifically, the following variables are of interest for the analysis: GDPA, GDPN, GDPT, TINV, terms of trade, rural income, urban income, net sown area, gross cropped area, TGIA, cropwise acreage, yields, production, net exports, irrigation and price of

TABLE 6: EXPENDITURE CLASSWISE POPUALTION PROPORTIONS

Variable	1980				2000			
	Base Scenario	PV2	PV3	PV4	Base Scenario	PV2	PV3	PV4
(I) Rural (Rs per capita per annum)								
≤216	0.31459	0.31558	0.31747	0.32018	0.20646	0.20755	0.23211	0.22687
		(0.31)	(0.92)	(1.78)		(0.53)	(12.42)	(9.89)
>216≤336	0.17973	0.17975	0.17978	0.17982	0.15932	0.15960	0.16156	0.16145
		(0.01)	(0.03)	(0.05)		(0.18)	(1.41)	(1.34)
>336≤516	0.17903	0.17876	0.17824	0.17750	0.18971	0.18934	0.18101	0.18276
		(−0.15)	(−0.44)	(−0.85)		(−0.20)	(−4.59)	(−3.66)
>516≤900	0.18205	0.18160	0.18075	0.17953	0.21682	0.21538	0.20480	0.20583
		(−0.25)	(−0.71)	(−1.38)		(−0.66)	(−5.54)	(0.21)
>900	0.14460	0.14432	0.14377	0.14298	0.22769	0.22814	0.22052	0.22309
		(−0.19)	(−0.57)	(−1.12)		(0.20)	(−3.15)	(−2.02)
(II) Urban (Rs per capita per annum)								
≤216	0.01949	0.01949	0.01932	0.01910	0.00491	0.00473	0.00532	0.00490
		(−0.56)	(−1.43)	(−2.55)		(−3.67)	(8.35)	(−0.20)
>216≤336	0.07890	0.07870	0.07835	0.07788	0.03425	0.03331	0.03590	0.03398
		(−0.25)	(−0.70)	(−1.29)		(−2.74)	(4.82)	(−0.79)
>336≤516	0.18734	0.18713	0.18673	0.18618	0.12916	0.12691	0.12783	0.12434
		(−0.01)	(−0.01)	(−0.04)		(−1.74)	(−1.03)	(−3.73)
>516≤900	0.33970	0.33969	0.33965	0.33958	0.33308	0.33103	0.32402	0.32208
		(0.02)	(−0.05)	(−0.51)		(−0.62)	(−2.72)	(−3.30)
>900	0.37447	0.37499	0.37595	0.37726	0.49861	0.50402	0.50693	0.51470
		(0.14)	(0.40)	(0.75)		(1.09)	(1.67)	(3.23)

Note: Percentage change over base scenario is given in brackets.

wheat, rice and coarse grains, expenditure classwise population proportions. The results of the model simulations obtained under the above policy variants for the years 1980 and 2000 are given in Table 5. From this table we notice that the results of the simulation obtained for the year 1980 from the four scenarios are very close. However, by the year 2000, the differences between these scenarios are quite substantial thus indicating the long run impacts. The results of the simulations for the year 2000 are discussed below.

At the outset we notice that the results obtained from the base scenario (PV1) are very close to those of NPS (PV2). The differences between these two scenarios are marginal. The results of the scenarios PV3 and PV4 are, however, substantially different from the base scenario.

From Table 5 we notice that the lower TAI in PV3 and PV4 leads to much lower TGIA in these scenarios than in the base scenario. It is lower by about 22.06 per cent in PV3 and 19.66 per cent in PV4. The lower TGIA in the PV3 and PV4 scenarios results in lower cropwise irrigated acreages as in the case of wheat, rice, coarse grains. The cropwise irrigations are lower in PV3 by 22.81 per cent, 21.06 per cent and 25.66 per cent in the case of wheat, rice and coarse grains respectively. In PV4 these are lower by 21.15 per cent, 18.26 per cent and 22.58 per cent respectively.

The lower cropwise irrigations compared to the base scenario have an adverse effect on the crop yields which alongwith lower crop acreages result in lower output in the case of wheat and rice. In the case of wheat, yield is lower by 3.58 per cent and 3.68 per cent in PV3 and PV4 respectively while output is lower by 17.07 per cent and 15.15 per cent in the two scenarios respectively. These percentages of shortfall in the case of rice are somewhat less than that of wheat. In the case of coarse grains, however, the lower yield in PV3 and PV4 is compensated by higher acreage with the result that output is marginally higher in these scenarios than in the base scenario.

Though in the initial years cereal price differentials are only marginal between the scenarios, by 2000 they become quite substantial. The lower agricultural outputs in PV3 and PV4 result in higher prices for agricultural commodities than those in the base scenario. The price of wheat, rice and coarse grains are higher in PV3 by 12.29 per cent, 24.53 per cent and 11.40 per cent respectively while in PV4 they are higher by 12.29 per cent, 21.73 per cent and 11.72 per cent respectively. In both these scenarios the higher agricultural prices result in the terms of trade favourable to agricultural sector (greater than 1.0) against non-agricultural sector.

However, the favourable terms of trade for agriculture in the PV3 and PV4 scenarios do not result in higher GDPA over the base scenario. On the contrary GDPA is substantially lower in these scenarios than in base scenario. The GDPA is lower by 7.0 per cent and 5.96 per cent in these two scenarios. Note that total investment has been higher in these scenarios with a greater share going into non-agriculture. Thus GDPN is substantially higher in these scenarios and the increase here more than compensates the reduction in GDPA, resulting in higher GDPT than in the base scenario. GDPN and GDPT are higher by 5.03 per cent and 2.01 per cent respectively in PV3 while in PV4 these are higher by 8.33 per cent and 4.74 per cent respectively.

Thus it seems that shift of investment in favour of non-agriculture results in an accelerated growth in GDPT, brought about mainly through higher output of non-agricultural sector. This accelerated growth results in higher incomes in both rural and urban areas in PV3 by 4.44 per cent and 5.03 per cent respectively and PV4 by 7.35 per cent and 8.27 per cent respectively. Note, rural income consists of both agricultural income and rural non-agricultural income.

Before discussing the income distributional aspects, look at the net exports (exports-imports) of agricultural commodities. From Table 5 it is clear that the neglect of agricultural sector as in PV3 and PV4 has adverse impacts on net exports of agricultural commodities. In the case of wheat, the quantity available for exports is far less in the PV3 and PV4 scenarios than in the base scenario. While exports of wheat was about 13.3 million tonnes (mt) in the base scenario it is lower in the PV3 and PV4 scenarios by about 81.94 per cent and 76.93 per cent respectively; in quantity terms the exports fall down to 2.4 mt and 3.1 mt respectively. In the case of rice, the situation changes from one of exportable surplus of about 2.1 mt in the base scenario to a situation of importing about 4 mt in the PV3 and PV4 scenarios. In the case of coarse grains also imports are higher in these scenarios over the base scenario.

Turning now to the distributional aspects, Table 6 presents the population proportions of the 10 expenditure classes, for the years 1980 and 2000, under the four scenarios. The results show that compared to the base scenario the population proportions in the lowest two expenditure classes in rural areas are higher in PV3 and PV4 implying a worsening of the situation with respect to income distribution. By year 2000, percentages of the people in total rural population that would be more in the two poorest rural classes under PV3 and PV4 than under the base scenario come to 2.8 per cent and 2.3 per cent respectively. The changes in population proportions in the lowest two classes in urban areas are only marginal. These results imply that with investment shifting away from agriculture towards non-agriculture, while non-agricultural growth would hardly change the urban inequalities, the slow down in agricultural growth results in greater rural inequality with substantial increase in the number of rural poor. In the rural areas, agriculture being a dominant activity, the sharp fall in agricultural income is likely to be the factor behind the increase in income inequality. Thus we find that even though a faster growth in GDPT could be brought about by a bias towards non-agricultural sector, it could have serious distributional consequences.

V
Conclusions

Neglect of agriculture, an important sector of the Indian economy, is likely to have an adverse impact on the country. Such a neglect has been observed as a fall in agricultural investment during the 80s. Simulations using a CGE model help in assessing the adverse impact of the fall in TAI on agriculture in particular and the economy in general.

Though shifting investment resources away from agriculture to non-agriculture may result in a faster growth in GDPT, the growth across sectors is likely to be uneven, with non-agriculture likely to show a far higher growth than agriculture. However, slowing down agricultural growth would lead to growing income inequality in rural areas. Besides, though the country is right now deemed to be self sufficient in foodgrains, if the present trends of investment policy are continued, not only large-scale imports to meet the domestic demand may become necessary, but also despite such imports food prices would go up substantially. Price increases of foodgrains are known to hit the poor most.

This aspect of Indian agriculture has to be kept in mind in the formulation of the New Agricultural Policy which the government is keen about. Since the VIII Five-Year Plan, though officially launched on April 1, 1992, has not been finalised yet, perhaps, there is still some scope to take these issues into consideration.

Notes

[I thank N S S Narayana for his guidance throughout the completion of this paper. However, I alone am responsible for any remaining errors.]

1 Data on irrigation investment is not available.

2 For details see Narayana, Parikh and Srinivasan [1989].

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