Vol XXIV
No. 4

ISSN 0019-5014

CONFERENCE
NUMBER

OCTOBER-
DECEMBER
1969

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

ROLE OF IRRIGATION AND FERTILIZERS IN CAPITAL FORMATION

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The concept of capital formation in the normal terminology comprises of investment in agriculture, land development, soil conservation, rural roads, agricultural machinery, storage and other items, the return from which is expected over a period. When considered broadly, investment made on research, education and technical training for the development of human capital should also be included since this increases efficiency of the operator leading to increase of output on the farm.

We have actually to go a step further to say that the efficiency of agricultural production is directly related to the increasing use of inputs like improved seeds, fertilizers, pesticides, etc, and consider that the amount spent on these items is a part of capital formation. This is based on the argument that if out of the current income of the agriculturists, a certain portion is set apart for expenditure of manures, fertilizers etc., this should be treated as a part of capital formation. For purposes of this paper we are restricting ourselves to irrigation and fertilizers alone and study their relation to total investment in agriculture.

Information on investment in agriculture is lacking for earlier periods. According to an available estimate (Table I) investment on implements, bullocks, irrigation and land on the eve of the First Five-Year Plan was of the order of Rs. 2,300 crores, of which bullocks alone accounted for more than Rs. 1,800 crores and irrigation for not more than Rs. 200 crores. The consumption of fertilizers was also quite negligible and a major portion of the small quantity consumed was actually being used on plantations alone.

TABLE I—GROSS CAPITAL FORMATION IN AGRICULTURE IN INDIA (1935-36 TO 1960-61)
(AT 1950-51 CONSTANT PRICES)

(*Rs. in crores*)

Year	Implements only	Implements, bullocks with appreciation	Implements, bullocks, and irrigation	Implements, bullocks, irrigation and land	Bullock as per cent of col. (5)	Irrigation as per cent of col. (5)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1935-36 to 1940-41	106	1,704	2,130	2,324	68·8	18·3
1940-41 to 1945-46 ..	99	1,661	1,801	1,944	80·3	7·2
1945-46 to 1950-51	171	1,888	2,216	2,321	74·0	14·1
1950-51 to 1955-56	159	2,053	2,655	3,087	61·4	19·5
1955-56 to 1960-61	239	2,319	3,279	3,704	56·2	25·9

Source : Tara Shukla: Capital Formation in Indian Agriculture, Vora & Co., Bombay, 1965, p. 151.

* The views expressed in this paper are the responsibility of the author.

Agriculture at that time was being run more or less on traditional patterns and irrespective of the importance attached to it under the Grow More Food Campaign started sometime in 1942, there was hardly any visible improvement in its development. It could at best be called a 'bullock economy' which accounted for more than 70 per cent of the total investment in agriculture. Concerted efforts were made during the planning era to raise agricultural production to higher levels through a system of planned investment pattern. This brought about a complete change in the traditional pattern of investment resulting in huge investment being made on irrigation and fertilizers—two important components of agricultural production.

Table II provides useful data about the total investment in agriculture both in the public and private sector and the share of irrigation and fertilizers in it. This depicts a complete break from the traditional pattern of agricultural development. Irrigation as well as fertilizers play a most important role. By the end of the Fourth Plan, these two important components of agricultural production are targeted to contribute over 60 per cent in the total agricultural investment in the country.

While this change may be accepted as a healthy sign for agricultural development, it becomes extremely necessary to probe into the matter further so as to find out the contribution of these two important elements of growth in the agricultural development of the country. Table III gives an idea of the sourcewise distribution of the irrigated area during the three Plans and Table IV gives irrigation targets, potential and utilization according to State progress reports.

This shows that total irrigated area in India increased from 55.7 million acres during 1950-51 to 76.6 million acres at the end of the Third Plan in 1965-66 representing an increase of about 40 per cent. A comparison with Table IV would show that while the potential created from major and medium irrigation projects during the three Plan periods was only 56 per cent of the targets, actual utilization of the potential created was not more than 77 per cent. Further when we add up actual utilization figures for total irrigation we find that there should have been an addition of more than 45 million acres to the irrigated area of the country while the actual area added during the three Plan periods is only 20.9 million acres.

With regard to fertilizers, there has been a remarkable improvement in their consumption during the planning era. The consumption of nitrogen increased from 57.8 thousand tonnes in 1952-53 to 582.3 thousand tonnes during 1965-66. Corresponding figures for phosphoric acid were 4.5 and 134.1 thousand tonnes respectively. In so far as potash is concerned, its application started only in 1959-60 when its consumption went up from 21.3 thousand tonnes to 89.6 thousand tonnes in 1965-66.

With the investment in agriculture having increased from Rs. 2,300 crores in 1950-51 to Rs. 6,580 crores by 1968-69 and estimated at Rs. 11,883 crores by the end of the Fourth Plan and the share of irrigation and fertilizers having gone up from about 14 per cent in the pre-Plan period to 47.6 per cent by 1968-69, one would have expected a spectacular improvement not only in agricultural

TABLE II—INVESTMENT IN AGRICULTURE DURING EACH PLAN PERIOD

(*Rs. in crores*)

Item	First Plan			Second Plan			Third Plan		
	Public sector	Private sector	Total	Public sector	Private sector	Total	Public sector	Private sector	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. Agriculture and C. D.	234	457·3	691·3	210	625	835	660	800	1,460
2. Major Irrigation	250	—	250	420	—	420	650	—	650
3. Fertilizers**	—	15·6	15·6	—	21·9	21·9	—	66·3	66·3
4. Total	484	472·9	956·9	630	646·9	1,276·9	1,310	866·3	2,176·3
5. Minor irrigation	46	13·8	59·8	94·9	37·5	132·4	270·2	114·4	384·6
6. Major and Minor irrigation	296	13·8	309·8	514·9	37·5	552·4	920·2	114·4	1,034·6
7. Irrigation as percentage of item 4 ..	61·2	2·9	32·4	81·7	5·8	43·3	70·2	13·2	47·5
8. Fertilizers as percentage of item 4 ..	—	3·5	1·6	—	3·4	1·7	—	7·7	3·0
9. Irrigation and fertilizers as percentage of item 4	61·2	6·2	34·0	81·7	9·2	45·0	70·2	20·9	50·5
10. Research			4·6 (0·5)			14·1 (1·1)			71·4 (3·3)

(*Contd.*)

TALEE II (*Concld.*)

(*Rs. in crores*)

Item	1966-69			Draft Fourth Plan			*Cumulative total Three Plans, 1966-69 and Fourth Plan*		
	Public sector	Private sector	Total	Public sector	Private sector	Total	Public sector	Private sector	Total
1	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
1. Agriculture and C. D.	723·3*	792·8	1,516·1	1 667	1,800	3,467	3,494·3	4,475·1	7,969·4
2. Major irrigation	414·1	—	414·1	857	—	857	2,591·1	—	2,591·1
3. Fertilizers**	—	240·2	240·2	—	979	979	—	1,323	1,323
4. Total	1,137·4	1,033·0	2,170·4	2,524	2,779	5,303	6,085·4	5,798·1	11,883·5
5. Minor irrigation	314·1	162·1	476·2	475·7	902·3	1,378	1,200·9	1,230·1	2,431
6. Major and Minor irrigation	728·2	162·1	890·3	1,332·7	902·3	2,235	3,792·0	1,230·1	5,022·1
7. Irrigation as percentage of item 4 ..	64·0	15·7	41·0	52·8	32·5	42·1	62·3	21·2	42·3
8. Fertilizers as percentage of item 4 ..	—	23·3	11·1	—	35·2	18·5	—	22·8	11·1
9. Irrigation and fertilizers as percentage of item 4	64·0	39·0	52·1	52·8	67·7	60·6	62·3	44·0	53·4
10. Research			51·1			93·0			234·2
			(2·4)			(1·8)			(2·0)

* 62 per cent of the outlay of Rs. 1,116·7 crores, on the basis of Third Plan ratio.

** Actual value of fertilizers consumed at the end of each Plan period beginning from First Plan is calculated as Rs. 20·6 crores, Rs. 42·5 crores Rs. 108·8 crores, Rs. 349 crores and Rs. 1,328 crores.

Notes : (1) Investment in agriculture for the public or private sector is not available for the First Plan. Sectoral distribution of outlay being known, public sector investment in agriculture has been calculated on the basis of the ratio between total outlay and total investment during the First Plan. Private sector investment has been calculated at 1·9 per cent of the total national income from agriculture for the five-year period on the basis of the Rural Credit Survey, 1954 estimates.

(2) For the three-year period 1966-69, we know only total outlay and its sectoral break-down. Agricultural investment for the three years has been calculated on the basis of the ratio between outlay and investment in agriculture for the Third Plan and private sector investment as 1·9 per cent of the total national income from agriculture for the three years.

(3) Investment on fertilizers is based on the value of additional fertilizers consumed during each Plan period.

(4) Public sector investment for minor irrigation during the First Plan has been assumed to be equal to the Central assistance for minor irrigation projects as given in the Report of the Working Group on Minor Irrigation for the earlier Fourth Five-Year Plan. For the other Plan periods, the public sector outlay on minor irrigation has been assumed as investment. With regard to minor irrigation investment in the private sector, the assumption made is that it is equal to one-third of the investment in the public sector plus institutional finance during the different periods.

Figures in brackets are percentages to total under item 4.

TABLE III—SOURCEWISE DISTRIBUTION OF THE IRRIGATED AREA : 1950-51 to 1965-66

(in thousand acres)

Year	Net area irrigated								Gross area		
	Canals			Tanks	Wells		Other sources	Total	Major and Medium	Minor	Total
	Government	Private	Total		Tube-wells	Wells					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1950-51	17,898	2,814	20,712	8,776	—	14,712	7,329	51,500	22,342	33,314	55,755
1955-56	19,832	3,561	23,193	10,929	—	16,651	5,464	56,257	25,472	37,892	83,364
1960-61	22,803	3,021	25,924	11,096	—	17,995	5,983	60,896	27,701	41,208	68,909
1963-64	24,339	2,824	27,163	11,362	2,540	16,698	6,131	63,892	29,476	43,348	73,324
1964-65	24,595	2,807	27,402	11,762	—	19,546	6,197	64,908	—	—	75,156
1965-66	24,283	2,800	27,083	10,974	4,843	16,025	6,412	65,338	—	—	76,584

TABLE IV—IRRIGATION TARGETS, POTENTIAL AND UTILIZATION ACCORDING TO STATE PROGRESS REPORTS

(in million acres)

	First Plan	Second Plan	Third Plan	Total Three Plans
(1)	(2)	(3)	(4)	(5)
Major and Medium				
Target	8·3	10·4	12·8	31·7
Potential	6·5	5·2	6·3	18·0
Utilization	3·1	5·2	5·5	13·8
Minor				
Target	11·2	9·0	12·8	33·0
Potential	9·5	9·0	12·8	31·3
Utilization	9·5	9·0	12·8	31·3

production but also in the utilization of capital. Capital-output ratios in agriculture and agricultural production index for all these periods (Table V), however, show that the results are not commensurate with the efforts made.

TABLE V—INCREMENTAL CAPITAL-OUTPUT RATIO IN INDIA

	Investment in agricultural sector (at 1948-49 prices) (Rs. crores)		Additional income in agricultural sector (at 1948-49 prices) (Rs. crores)	Capital-output ratio		Agricultural production index
	Total	Total (excluding fertilizer)	Trend values	Total	Total (excluding fertilizer)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
First Five-Year Plan ..	806·2	791·6	580	1·4 : 1	1·4 : 1	117
Second Five-Year Plan	1,065·9	1,047·6	590	1·8 : 1	1·8 : 1	142
Third Five-Year Plan ..	1,462·6	1,418·0	580	2·5 : 1	2·4 : 1	158
1966-69	1,002·5	891·5	350	2·9 : 1	2·5 : 1	162*
Draft Fourth Five-Year Plan	2,368·5	1,931·0	2,347	1·01 : 1	0·8 : 1	218*

* Estimated.

Notes : (1) Given total investment in agriculture at current prices under item 4 (Table II) for each Plan period, they were deflated by the average price increase during each Plan period to bring them to 1948-49 prices.

(2) With actual values of the share of agriculture and allied services in the total national income of the country at 1948-49 prices, a trend line was fitted so as to get assumed values of national income from agriculture for each year. The actual value of agricultural income for the year 1968-69 has been assumed as Rs. 6,900 crores against Rs. 6,880 crores for 1967-68.

(3) To arrive at the actual figures of 1969-70, the 1968-69 figures of national income from agriculture were raised by 5·1 per cent as assumed in the Draft Fourth Five-Year Plan.

(4) In order to work out the incremental output during each Plan period, it has been assumed that after having smoothened the effect of natural factors by fitting a trend line, there will be a time lag of at least one year to realize the effect of investment made during each Plan period. Incremental output for each Plan period has thus been calculated from the trend values as the difference between, say 1956-57 over 1951-52 for First Plan, 1961-62 over 1956-57 for the Second Plan, 1966-67 over 1961-62 for the Third Plan and so on.

The picture becomes much more alarming when we analyse the data for the period 1964-65 to 1968-69. Total consumption of NPK increased from about 6 lakh tonnes to about 20 lakh tonnes and area under irrigation is estimated to have increased from 76.6 to about 90 million acres, but all commodities agricultural production index has increased from 158.5 to only around 162. During this period, the country also witnessed the Green Revolution under which high-yielding varieties programme was introduced and the total area under this programme increased to as much as 21 million acres during 1968-69.

If the results thrown out above are any indicators, one would perforce conclude that there is a need to pause and think again about the future development of agriculture during the coming Fourth Plan when fertilizer consumption is targeted to increase to about 6.5 million tonnes of NPK from about 2 million tonnes as today and total irrigated area from the estimated 90 million acres to 108.5 million acres.

One of the obvious reasons for this state of affairs would appear to be that the returns from irrigation are not proportionate to the investment made. Investment programmes for irrigation being what it is, the actual area irrigated is hardly 40 per cent of the targets. There are innumerable problems of water management. The efficiency of water utilization in major projects is rather low.[1] Only a small percentage of water stored is actually utilized and large losses occur in transit, application and evaporation. It is assumed that by and large farmers have the technical know-how and the resources to develop their lands for receiving and applying irrigation water. But in actual fact, considerable guidance and help is necessary in transforming the dry land farmer to an irrigated one. An extension education programme is extremely necessary well ahead of time. There are also problems of bad soil management under irrigated conditions which has resulted in complete destruction of the soil in certain parts of the country. Steps are also required to be taken to prevent soil erosion at upper reaches by taking up afforestation and soil conservation measures in cultivated lands.

If one assumes that with the 'biological revolution' being an established fact and the cultivator having patronised the use of fertilizers as well as improved methods of cultivation, a mere increase in the availability of various inputs will solve the problem, we will be sadly mistaken. The record of our farmers in absorbing new inputs like fertilizers and insecticides and other plant protection chemical, mechanical power and implements and even developing private irrigation capacity has been extraordinary but research and extension do not seem to have received the required attention. In fact research and extension of new knowledge are two vital components of modern agriculture and the availability of modern inputs comes only next to them. Total investment in agricultural research has no doubt increased from 0.5 per cent during the First Plan to 2.4 per cent during 1966-69. But estimates for the Draft Fourth Plan have again reduced its share to 1.8 per cent. Not only the share of research has to be increased, it has also got to be more selective and purposive.

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1. Actual utilization is about 44 per cent of the target and 77 per cent of potential created.