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necessary for our agriculture to grow, it is sufficiently high to match the growth in labour and maintain the level of farm production. The latter is borne out by the fact that the capital/output ratio has remained more or less constant between 1920 and 1960. According to our calculations this has varied between 100.00 to 103.26 during the period.

These constant ratios—constancy between capital/labour and capital/output—probably provide a major explanation for the level of investment that obtains in Indian agriculture. Constant capital/labour and capital/output ratios will give constant labour/output ratio. Now if labour changes exogenously and technological change is absent, output would change in the same proportion and so also capital. The equilibrium is maintained at a lower level.

CAPITAL GROWTH IN INDIAN AGRICULTURE

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The purpose of this study is to indicate the inter-relationship between farm capital, labour and output and changes in the capital structure of Indian agriculture during the years 1949-50 to 1960-61. India is taken as a typical under-developed agricultural society. Generally for such a society with its problems of increasing population growth and the consequent demographic pressure, uneconomic land utilisation, static and undeveloped technologies, falling agricultural productivities and farm incomes, relatively small saving ratio, and virtual social and economic stagnation, the problem of agricultural development directed towards a long run objective of self-sustained growth can very largely be viewed as a problem of farm investment and capital formation. The process of agricultural development in India viewed in this way is subject to many inherent obstacles.

OBSTACLES TO AGRICULTURAL DEVELOPMENT

Structural Obstacles

Firstly, the small size of land holdings, poor soil, inadequate rainfall, adverse land-man ratio, and surplus, but unproductive, animal stock act as structural obstacles to this development. Their solution may be assumed to be a function of additional farm investments, because any expenditure incurred for consolidation of land holdings, constitution of optimum and co-operative farms, supply of natural and organic fertilizers and farm machinery, the construction of irrigation works and distributory canals and the improvement of animal stock, involves mobilization of monetary and real resources and ultimately improves the agricultural structure by creating permanent farm assets.

Technological Obstacles

Secondly, there are technological obstacles. They cover such problems as land utilisation, scientific farm practices, use of fertilizers and agricultural implements and machinery. Agriculture in India, viewed as a way of life, is not considered as a productive proposition by a socially, economically and technologically backward population. The inter-sectoral mobility of personnel, resources and technology is very limited and it creates a vicious circle of technological isolation of the agricultural sector. Within the agricultural sector itself, there does exist the phenomenon of technological dualism. There are farmers who use advanced technology and farm practices and they exist along with a group of farmers who are completely ignorant of these developments. The inter-group flow of technology is limited by the total absence of technical dynamism, low degree of demonstration effect, social and caste barriers, illiteracy and ignorance, Production-oriented extension works which call for some overheads may succeed in solving them.

The Price Factor

Thirdly, obstacles are created by adverse movements of farm prices. Relative stable prices are essential for capital formation and for agricultural development at a constant or increasing marginal rate. Agricultural prices would include prices of farm equipments and currently required variable resource inputs as well as the prices of end products. The prices may relate to different time periods and they will have varying degrees of impact on the farmers' calculation. The farmers' calculation will fluctuate according to the oscillation of these expected and actual prices.

In India the indices of wholesale prices (base year 1952-1953=100) of rice and wheat and of cereals as a whole, moved adversely to the farmer during 1951-52 to 1960-61. If prices are really determinants of farm behaviour, at least during the years 1954-55 to 1956-57 which witnessed the lowest marks in the indices (82, 78 and 97) capital formation must have declined, causing a relative decline in agricultural production in the years ahead. During the First Plan, the index of agricultural production (all crops) rose by 21 points, but during the Second Plan, it moved only by 18 points.[1] The changes in the index of food crops alone were 24 and 17 respectively during the two Plan periods.

Disposable Income

Fourthly, there are financial obstacles to capital formation in agriculture which originate in the form of deplorably low-saving ratio, falling productivities and incomes and a dangerous growth of rural debts coupled with inadequate sources of institutional credit. The task of overcoming them is not simple as it involves the problem of ploughing back into agriculture a sizable amount of all increments in agricultural output through an elaborate institutional machinery. The Reserve Bank of India (RBI) has calculated the average saving-income ratio, as percentages, for the Rural Household Sector (RHS) as 2.6 for the period 1950-51 to 1958-59. Table I shows the relative pattern of savings as percentages to total

1. Report on the Third Five-Year Plan, Planning Commission, Government of India, 1961, p. 35.

savings and national income for both RHS and Urban Household Sector (UHS). The aggregate savings ratio for the whole economy for 1950-51 to 1958-59 was 7.1, for the UHS 14.1 and for the RHS only 2.6. Savings ratio almost remained more or less steady for the RHS. If the RHS's savings is taken as a measure of disposable income available for capital formation in Indian agriculture it has only fared badly relatively to the whole economy.

TABLE I—PATTERN OF SAVINGS IN INDIA (1950-51 TO 1960-61)

Sector	As proportion (per cent) of		Saving-income ratio
	Total savings	National income	
Rural household sector	26.5	1.9	2.6
Urban household sector	54.9	3.9	14.1

Source : *Reserve Bank of India Bulletin*, Vol. XV, No. 8, August, 1961. p. 1208.

CAPITAL FORMATION

The Concept

Before suggesting some strategic indicators of capital growth, the concept itself has to be discussed. According to Tostlebe who made a pioneering study of capital formation in U. S. agriculture, capital formation must be viewed "not as an automatic process but a response to investment of money, effort and time in new resources or facilities of production."[2] It is defined as "the growth of inputs" and is indicated by the growth of "reproducible wealth" which helps larger production in future.[3] The "reproducible wealth" includes all possible resource inputs. Capital assumes a greater proportion of the resource inputs and takes the form of goods or tangible assets. Capital formation may, therefore, be indicated by the growth of reproducible tangible wealth. (RTW). It is usually computed on a net basis for the purpose of analysis.[4]

As technical progress also makes a substantial contribution to output without becoming directly a part of input in the traditional analysis, though not directly measurable, it may be indicated by the shifts in capital-output ratios over a period. To assess the rate of capital formation therefore, the estimates of the growth in RTW and shifts in the capital-output ratio will be useful. The ratio of RTW to net output will give the average capital-output coefficient and the ratio of incremental capital stock to incremental net output, the marginal capital-output coefficient.

There are differences of opinion with regard to the composition of capital for the purposes of estimates. Colin Clark excludes residential buildings in the

2. A. S. Tostlebe : Capital in Agriculture : Its Formation and Financing since 1870, National Bureau of Economic Research, Princeton University Press, 1957, p. 6.

3. J. R. Hicks : Value and Capital, Oxford, 1950, p. 284.
The concept of capital cannot, however, be identified with that of RTW, because capital is a multi-dimensional concept involving many micro and macro approaches to its measurement. See Tibor Barna, "On Measuring Capital," in Theory of Capital, Edited by F. A. Lutz, and D.C. Hague, Macmillan, London, 1961, p. 76.

4. S. Kuznets : Capital in the American Economy, Its Formation and Financing, National Bureau of Economic Research, Princeton, 1961, pp. 15-16.

computation of capital.[5] Kuznets, however, prefers to include them.[6] Domar suggests the inclusion of all "productivity-sustaining outlays, such as necessary food and shelter and minimum of education."[7] Most of these outlays are evidently in the nature of current consumption and do not directly constitute savings which form the basis for capital creation. The position of Domar is justified only if one follows Kuznets and defines capital as what capital does and assumes that the outlays raise the capacity for economic production. Kuznets has even included outlays on such current consumption as education, recreation and material luxuries that increase health and productivity of individuals. But that only adds to the difficulties of computation.[8]

Estimates in India

The estimates of RTW in Indian agriculture made so far do not include the much confusing "productivity-sustaining outlays." Studies at estimating RTW in India were pioneered by Uma Datta and Vinod Prakash and later by Mukherjee and Sastry.[9] Recently, the Reserve Bank of India also made an estimate of RTW for the year 1960-61 and compared it with that of the earlier studies.[10] With the purpose of "re-examining the estimates of capital formation and RTW more carefully so that they can be used for analytical studies of the capital structure of the economy and changes in it," Uma Datta brought out still another brilliant study which helped to throw more light into the estimation problem.[11] A summary of the last two mentioned estimates relating to agriculture is given in Tables II and III.

For all sectors the percentage growth during the period stood at 88.1 and 55.9 while for agriculture it stood at 67.3 and 49.6 respectively under the two estimates. The rate of growth in RTW in agriculture was thus relatively slower than in the whole economy. Defining the rate of capital formation as the proportion of net national product used as additions to the stock of capital, Uma Datta showed that the average capital-output ratio for agriculture increased from 1.19 in 1949-50 to 1.31 in 1960-61 and the incremental capital-output ratio stood at 1.66. The percentage increases in capital stock and net output in agriculture were 49.66 and 35.8 respectively. The percentage distribution of capital stock in agriculture was 29.4 in 1949-50, but it declined to 28.2 in 1960-61, indicating a relatively slower growth of capital formation in agriculture. The addition to

5. Colin Clark : Conditions of Economic Progress, Third Edition, Macmillan, 1957, pp. 565-581.

6. S. Kuznets, "International Differences in Capital Formation and Financing," in Capital Formation and Economic Growth, National Bureau of Economic Research, Princeton, 1955, pp. 20-25.

7. *Ibid.*, pp. 107-111.

8. If productivity outlays are also included in the estimates of capital, agricultural wages and subsidized government outlays on rural housing, sanitation and education (only to mention a few) would become part of RTW.

9. Uma Datta and Vinod Prakash, "An Estimate of the Reproducible Tangible Wealth in India, 1949-50," Papers on National Income and Allied Topics, Vol. I, Indian Conference on Research in National Income, 1960, p. 70.

M. Mukherjee and N. S. R. Sastry, "An Estimate of the Tangible Wealth in India," Income and Wealth Series VIII, The Measurement of National Wealth—International Association for Research in Income and Wealth, 1959.

10. "Estimates of Tangible Wealth in India," *Reserve Bank of India Bulletin*, Vol. XVII, No. 1, January, 1963, pp. 8-19.

11. Uma Datta, "The Capital Structure of the Economy's Changes over the Two Plan Periods," *The Economic Weekly*, Vol. XVI, Nos. 5, 6 & 7, February, 1964, pp. 301-310.

TABLE II—ESTIMATES OF CAPITAL FORMATION IN INDIAN AGRICULTURE (1949-50 TO 1960-61)

(Rs. crores at 1960-61 prices)

	Item	1949-50	1960-61	Percentage increase
1.	RTW All Sectors (I)	170,90	321,60	88.1
2.	RTW All Sectors (II)	206,22	321,64	55.9
3.	RTW Agriculture (I)	52,04	87,08	67.3
4.	RTW Agriculture (II)	60,57	96,05	49.6
5.	Agricultural implements including tractors	3,63	8,60	136.8
6.	Livestock used in farms	24,28	27,02	11.3
7.	Sheds, barns, etc.	8,80	13,66	55.2
8.	Improvement of land and irrigation works (private) ..	13,04	24,15	85.2
9.	Improvement of land and irrigation works (public) ..	2,29	13,65	500.4
10.	Distribution of capital stock (percentage)	29.4	28.2	—
11.	Net farm output	50,93	69,00	35.3
12.	Average capital-output ratio.	1.19	1.31	—

Source : *Reserve Bank of India Bulletin*, January, 1963, pp. 8-10 ; Uma Datta, *The Economic Weekly*, February, 1964.

Estimates (I) relate to RBI and (II) to Uma Datta. Items 5 to 9 relate to RBI and 10 to 12 to Uma Datta.

capital stock in the form of improvement of land and irrigation works (public) was the highest but it was the lowest for livestock.

Analysis of capital growth in agriculture centres on the inter-relationships of three variables—farm capital (RTW), farm labour and output.[12] Here an attempt is made to present these interesting inter-relationships in Indian agriculture based on the above data.

TABLE III—ADDITION TO CAPITAL STOCK (1949-50 TO 1960-61)

(at 1960-61 prices)

	Item	Additions during 1949-50 to 1960-61
1.	Capital stock in agriculture (Rs. crores)	30,08
2.	Net farm output (Rs. crores)	18,07
3.	Incremental capital-output ratio	1.66
4.	Percentage increase in capital stock	49.66
5.	Percentage increase in net farm output	35.48

Source : Uma Datta, *The Ecomonic Weekly*, February, 1964, p. 307.

12. Tostlebe : *Op. cit.*, p. 3.

Changing Composition

The growth of agricultural capital has also changed its basic composition (Table IV). The increase in land improvement and irrigation works (public) is spectacular. The importance of farm machinery increased, while that of livestock and farm buildings declined relatively to other items in the stock of capital.

TABLE IV—CHANGING COMPOSITION OF RTW IN INDIAN AGRICULTURE

(in per cent)

Item	1949-50	1960-61
1. Machinery power	6.97	9.87
2. Livestock	46.56	31.04
3. Farm buildings	16.91	15.68
4. Land improvement and irrigation works (private)	24.96	27.74
5. Land improvement and irrigation works (public)	4.60	15.67
6. Total	100.00	100.00

Farm Assets per Person

The growth in RTW has also led to a change in the relation of physical assets per person depending on agriculture (Table V).

TABLE V—AGRICULTURAL CAPITAL PER FARM PERSON

(Rupees at 1960-61 prices)

Item	1949-50	1960-61
1. Machinery power	14.58	28.21
2. Livestock	97.51	88.32
3. Farm buildings	35.34	44.65
4. Land improvement and irrigation works (private)	52.37	78.94
5. Land improvement and irrigation works (public)	9.19	44.62
6. Total	208.99	284.74

The number of persons depending on agriculture was roughly assumed as 24.90 crores in 1949-50 and 30.59 crores in 1960-61. The total value of farm assets per person in 1949-50 was found to be Rs. 208.99 and it increased to Rs. 284.74 in 1960-61, showing an increase of 36.3 per cent over the period. The annual addition to farm assets per person was thus less than Rs. 7. The value of livestock per farm person declined. The value of land improvements and irrigation works (public) showed the highest increase. Regarding composition of farm assets per person, livestock stood prominent, though its relative importance declined.

Capital-Product Ratio

The quantum of agricultural capital used during 1949-50—1960-61 to supply a unit of agricultural output is indicated by the capital-product ratio which is the same as the capital-output ratio. According to Uma Datta's estimates the ratio showed a movement from 1.19 to 1.31 indicating a rise in unit requirement of capital per unit output. The ratio worked out from the Reserve Bank of India data moved from 1.02 to 1.26. Assuming the ratio to remain at 1.31 or 1.26 in 1969-70, the total requirements of farm capital (RTW) to give current rate of output (that of 1960-61) would roughly range from Rs. 135,98 crores to Rs. 146,29 crores. The stupendous task before India is, therefore, obvious.

Land-Product Ratio

The capital-product ratio is a general or all-embracing ratio. The ratio may be computed for each item of physical capital to show individual movements. Before we proceed to do that let us calculate the land-product ratio. The RTW shown in earlier tables excluded the value of land. The Reserve Bank of India has calculated the value of land by assuming that land values change in proportion to changes in the price level of agricultural commodities.[13] Mukherjee and Sastry estimated the value of land for 1949-50 at Rs. 178,54 crores. On the basis of these data the land-product ratio is worked out (Table VI). The decline in land-product ratio is significant because it indicates higher average quality and productivity of land during the period. It must have been due to technological advances in farming, increased crop yields per acre and generally improved farm performance.

TABLE VI—RELEVANT CAPITAL-PRODUCT RATIOS

Item	1949-50	1960-61
1. Capital-product ratio (RBI)	1.02	1.26
2. Capital-product ratio (Uma Datta)	1.19	1.31
3. Land-product ratio	3.30	2.93
4. Machinery power-product ratio	0.07	0.12
5. Building-product ratio	0.17	0.19
6. Livestock-product ratio	0.48	0.39
7. Irrigation-product ratio	0.30	0.54

Other Ratios

The farm buildings (sheds and barns) and farm machinery constitute durable types of reproducible capital. Given the net farm output at 1960-61 prices for 1949-50 and 1960-61 the machinery-product ratio is worked out. It moved from 0.07 to 0.12 showing an increase of 72 per cent over the period. This is significant because it also shows the purchase of new machinery and prospective uses of them

13. *Reserve Bank of India Bulletin*, January, 1963, p. 17.

in farms and must have been accompanied by technological improvements since 1950. The building-product ratio moved from 0.17 to 0.19. It indicates rising farm prosperity inducing additional investments in farm buildings (sheds and barns). It is substantially lower than the machinery power-product ratio. The livestock-product ratio moved from 0.48 to 0.39. This decline is inconsistent with the movements in other ratios. A substitution of machinery for animal power must have taken place in Indian agriculture during 1949-50 to 1960-61. The irrigation-product ratio moved from 0.30 to 0.54 during the period. It shows an increase in unit capital expenditure on irrigation to produce an unit of output in Indian farms. The net product per farm person moved from Rs. 204.53 in 1949-50 to Rs.225.62 in 1960-61, showing an increase of only Rs. 21.09 over the period. In other words, the annual increase in net farm output person was less than Rs. 2.

CONCLUSIONS

The formulation of any policy for increasing capital formation in Indian agriculture must be based upon the following findings :—

(1) The study of the inter-relationship of RTW, farm labour and output indicated a basic change in the composition of farm capital.

(2) The increase of durable capital (machinery and farm buildings) in Indian agriculture was an encouraging phenomenon, which must be pursued in the future.

(3) While the value of physical farm assets per person shows an increase of of Rs. 7 per annum, the resultant increase in farm output per person was only Rs. 2. The implication of this aspect of capital growth needs further probe if it, in a sense, reflects uneconomic application or falling productivity of capital.

(4) As the addition to capital stock in the form of improvement of land and irrigation works (public) was the highest in relation to others, the capital growth in Indian agriculture may safely be described as "Government subsidized." The task before the country is therefore to evolve conditions for building up durable capital and for stimulating productive growth by effecting a smooth and speedy transition from "Government subsidized capital growth" to "self-financed capital growth." This transition holds the key to real economic progress.