but the lack of internally as well as externally available funds may act as barrier for them to escape the low-level equilibrium trap. The individual farmers are unable to incur the heavy capital outlay required for the purpose, and therefore require appropriate institutions to carry out the programmes. In the case of modern farms, evidences nevertheless indicate that the development and introduction of the new technology accompanied with capital investment by Government tended to induce capital expenditure by the farmers. The large as well as the small farmers not only positively responded to the new technology but also showed their readiness to invest on the requisite items such as irrigation works, purchase of costly machines, etc., to fit the current phase of agricultural innovations.

Availability of credit in adequate quantity at appropriate interest rates has also a bearing on the extent of capital investment by farmers. It should be pointed out that the rate of interest will come to play an important role in determining the volume of investment in the first phase of modernization.

Therefore, for the purpose of planning, studies on the input-output relationship of modern farms should be undertaken to determine the most profitable form of investment in the context of India's overall development. This is more urgent because such technology should not be introduced which will replace labour. On the other hand, the adoption of technology in the agrarian sector should be kept at a level which will stimulate industrial development. The creation of home market which is necessary for self-sustained economic growth will be difficult if closer relation between the two sectors is not maintained in the modernization process.

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CAPITAL FORMATION IN AGRICULTURE OF THE TARAI REGION OF UTTAR PRADESH

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At the foot hills of Uttar Pradesh, Himalayas is an agroclimatic belt called the Tarai. This stretches from West to East and comprises a part of the districts of Nainital, Rampur, Lakhimpur-Kheri, Pilibhit, Gorakhpur, Bahraich and Gonda. This region is agriculturally very rich. The annual rainfall is about 60″. The area has several rainfed streams. It has a high water table, good natural contours for drainage and the soil can hold water.

The new technology of agricultural production consisting of high-yielding varieties (HYV) of seeds, fertilizers, pesticides and irrigation has increased the incomes of the Tarai farmers. The growing incomes of the farmers are being invested back in agriculture in capital assets as farm machinery, irrigation equipment, farm buildings, drought and milch animals, etc. The agricultural working expenditures on seeds, chemical fertilizers, labour, pesticides, fuel and oils, etc., have considerably increased and are being met from the increase in agricultural incomes. The magnitude and patterns of these capital investments and working expenditure are quite different from those of the traditional farmers. A study was conducted in the Tarai region of district Nainital to find the extent of capital formation in Tarai agriculture. It is hypothesized that capital formation depends on the level of technology, the size of holdings and the cropping pattern.

The farmers are classified into two categories : progressive and less progressive. Progressive farmers are those who have their own private means of irrigation, have at least one agricultural machinery like a tractor, power thresher, paddy puddlers, etc., have at least 20 per cent of their cultivated area under high-yielding varieties and use chemical fertilizers. Cross-sectional data for the year 1967-68 (June 1, 1967 to May 31, 1968) are used. It is shown that there is significant difference in the incomes, and capital investments of the progressive and less progressive farmers in the different size-group of holdings.

Sample Design

The Tarai region of Nainital district was selected as this region had the highest agricultural performance in terms of area under high-yielding varieties, number of farm machinery and vehicles, use of chemical fertilizers, area irrigated with owned means of irrigation, etc. There are four blocks in the Tarai area of Nainital district. Out of these four, two blocks were selected, which were the most progressive according to the norms already stated. In each of these two blocks, 6 progressive *gaon sabhas* were selected randomly according to their agricultural performance and the net cultivated area in each *gaon sabha*. Both progressive and less progressive farmers were classified in three size-groups, small having a holding of less than 10 acres, medium with a holding between 10 and 20 acres and large with holding between 20-40 acres. All progressive farmers in these three size-groups and 10 per cent of the less progressive of the total lot with a minimum number of 4 were selected. All farmers owned the land, hence the tenurial system was the same for all the farmers. The cropping pattern for the year under study was sugarcane, paddy-wheat, maize-wheat for both progressive and less progressive farmers. But there was a significant difference between progressive and less progressive farmers in the cropping pattern as the area under HYV was different. The use of fertilizers, water management and use considerably varied and this was reflected in their agricultural incomes and investments.

Cropping Pattern

The intensity of cropping, the percentage of irrigated area and the proportion of area under major crops both *deshi* and HYV of the farmers selected in our study are shown in Table I.

TABLE I—CROPPING PATTERN, INTENSITY OF CROPPING AND IRRIGATED AREA

Category and number of farmers	Average operated area (acres)	Intensity of cropping	Percentage of cropped irrigated area	Proportion of area under major crops to total sown area							
				Maize		Paddy		Wheat		Sugar-cane	Millets, pulses, etc.
				Deshi	HYV	Deshi	HYV	Deshi	HYV		
PFS(13)	6·66	159	74·0	8·53	1·22	21·95	6·10	14·63	20·73	8·53	18·29
PFM(39)	15·07	167	75·0	5·62	1·05	24·82	7·29	13·22	15·72	11·00	21·20
PFL(43)	27·90	174	78·8	5·25	1·29	20·00	10·93	9·44	20·56	8·04	24·45
FS (17)	7·40	158	38·0	10·15	2·00	24·90	—	23·90	2·50	6·65	29·90
FM (34)	14·47	147	37·2	10·52	0·48	22·04	1·42	19·42	2·11	14·69	29·31
FL (10)	25·30	146	48·7	12·20	0·27	22·95	3·00	15·04	2·93	12·20	31·16

PFS = Progressive farmer small.   FS = Less progressive farmer small.
PFM = Progressive farmer medium.   FM = Less progressive farmer medium.
PFL = Progressive farmer large.   FL = Less progressive farmer large.

It is seen that the progressive farmers have higher intensity of cropping and this intensity increases as the size of farm increases. They have also a larger percentage of area under irrigation. The progressive farmers also have a larger proportion of their cropped area under HYV especially wheat, where there has been a real break-through in technology. The less progressive farmers have a higher proportion of their cropped area under the *deshi* varieties, millets and pulses.

Agricultural Incomes, Capital Investments and Working Expenditures

Agricultural incomes are mainly obtained from crops amongst which three cereal crops, maize, wheat and paddy are important. A substantial portion of the income is obtained from sugarcane cultivation. Non-crop agricultural incomes are obtained from the sale and rental value of irrigation equipment, machinery and vehicles, sale and renting out of land. The main sources of non-agricultural incomes are services, shop-keeping, rents and shares elsewhere. Non-agricultural incomes are insignificant as compared to the agricultural income.

The gross income is obtained by adding all the incomes, *viz.*, crop incomes, the non-crop incomes and the non-agricultural incomes. From this sum land revenue is deducted to get the disposable income per farm. The disposable income is used in consumption or in savings and investments. The consumption expenditure of the farmers consisted of non-durable expenditures as food, clothing, light, fuel, medical, education, travel, weddings, dowry, recreation, etc., and the durable expenditures included expenditures on non-farm buildings, household goods and vehicles, etc. After meeting their consumption expenditures the disposable income was invested in agriculture in two ways : firstly in working expenditures in agriculture as wages of labour, maintenance of animals, running irrigation costs, costs of pesticides used, running charges of machinery and vehicles and secondly, in capital investment on durable capital goods, as irrigation equipment like pump sets, tube-wells, farm machinery, tractors and power threshers.

The disposable income and its distribution in capital investments and working expenditures are given in Table II. Since our purpose here is limited to study the growth of capital, only capital investments are analysed.

(*in Rs.*)

Category and number of farmers	Capital investment				Working Expenditure							Dis-pos-able income
	Irri-gation equip-ments	Machi-nery and vehi-cles	Animals	Total	Irriga-tion	Machi-nery and vehi-cles	Animals	HYV seed	Ferti-lizers	Labour	Total	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
PFS (3)	418	71	398	887	263	33	389	145	199	803	1,832	405.00
PFM (39)	1,806	4,501	665	6,972	310	560	896	324	834	3,768	6,692	2,080.58
PFL (43)	2,836	9,038	680	12,554	539	2,489	1,475	666	2,266	5,573	13,008	3,412.86
FS (17)	149	26	290	465	93	31	295	90	114	388	1,011	268.05
FM (34)	227	110	569	906	76	360	495	207	169	1,972	3,279	996.70
FL (10)	571	2,910	1,872	5,353	71	671	1,461	151	511	2,501	5,366	1,521.00

A perusal of Table II shows the magnitudes of the investments in agriculture. The amount invested on capital assets depends on the level of technology and the size of holdings. As the size of farm is increasing the investment on irrigation, machinery and animals is increasing. This is true both for progressive and less progressive farmers. But the investments in these assets are significantly higher for progressive farms. The investments made on machinery and irrigation equipment is highest for large progressive farmers. Whereas the large progressive farmers invest more on mechanization, the medium farmers are investing more on irrigation. Capital investments of the less progressive farmers are insignificant and low as compared with the investments of progressive farmers, which shows that the technological level of the farmers is very decisive in determining capital formation. Capital investments and working expenditures are broken down to per acre basis in Table III.

TABLE III—CAPITAL INVESTMENT AND WORKING EXPENDITURE PER ACRE OF OPERATED HOLDINGS DURING THE YEAR 1967-68

(in Rs.)

Category and number of farmers	Capital investment				Working expenditure						
	Irriga-tion	Machi-nery and vehi-cles	Ani-mals	Total	Irriga-tion	Machi-nery and vehi-cles	Ani-mals	HYV seed	Ferti-lizers	La-bour	Total
PFS(13)	62·7	10·6	59·6	133·0	39·5	4·9	58·3	21·7	29·8	120·6	274·7
PFM(39)	119·8	298·6	44·1	462·5	20·6	37·1	59·6	21·5	55·3	250·0	444·1
PFL(43)	104·2	332·2	25·0	461·4	19·8	91·5	54·2	24·4	83·3	204·8	478·0
FS (17)	20·1	3·5	39·1	62·7	12·5	4·2	39·8	12·1	15·3	52·4	136·3
FM (34)	15·7	7·6	39·3	62·6	5·2	24·8	34·2	14·3	11·7	136·2	226·4
FL (10)	22·5	115·0	73·9	211·5	2·8	26·5	57·7	6·0	20·1	98·8	211·9

Table III reveals that capital growth per acre of operated holding is more pronounced in the form of irrigation and machinery on progressive medium and large farms. On small progressive farms also investment on irrigation equipment and animals is quite substantial. The large progressive farmers are spending the biggest sum on machinery and vehicles, the medium progressive farmers on irrigation equipment and the progressive small farmers on animals. In less progressive groups comparatively smaller sums have been invested on irrigation equipment. The large less progressive farmers are investing substantially on machinery and vehicles. Thus we see that capital growth is more pronounced on farms with higher size-group of holding coupled with higher level of technology.

Regression Analysis

To find the relationship between capital investments and disposable incomes a regression was run. The relationship is given by C = a + by where C is the

capital investment, b is the regression coefficient, y is the disposable income in units of Rs. 10 and a is the constant term.

The results are shown in Table IV.

TABLE IV—CAPITAL INVESTMENTS AND DISPOSABLE INCOME RELATIONSHIP

Category				Intercept	Coefficient	R²
PFS (13)	..	..	..	671·02	0·53450 (0·66419)	·02678
PFM (39)	..	..	..	—832·75	3·75133** (1·08087)	·24559
PFL (43)	..	..	..	4628·11	2·32246** (0·71321)	·20547
FS (17)	..	..	..	441·70	0·08807 (0·31254)	·00168
FM (34)	..	..	..	1077·40	—·17203 (·25209)	·01434
FL (10)	..	..	..	3505·81	1·21445 (2·47010)	·02930

** Significant at 1 per cent level.
Note : Figures in parenthesis denote standard errors.

A significant and positive relationship is found between capital investments and disposable income for progressive medium and progressive large farmers. For each Rs. 10 increase in disposable income the increase in capital investment is Rs. 3.75 for medium and Rs. 2.32 for large progressive farmers. The value of the intercept for medium progressive farmers is —832.75 and for large progressive farmers 4628.11 which shows that a substantial part of investment on large farmers are affected by factors other than disposable income such as the already existing level of capital stock, borrowing capacity, etc. The negative intercept value on progressive medium farms indicates that it is only after achieving Rs. 2,220 as disposable income, that disposable income starts affecting capital investment significantly with further rise in its level. No significant relationship between capital investment and disposable income exists for progressive small and all the three types of less progressive farmers. It is thus seen that capital investments are related to the level of technology and the size of holdings. The R² value is low. The reason for a low proportion of the variation in capital expenditure being explained by disposable income may be that current investment may be related to past years disposable income and the levels of previous years investments.

Conclusion

It is seen that considerable amount of capital formation is going on in the progressive farms of the Tarai area of Nainital district particularly in medium and large size-groups of farmers, mainly in owned means of irrigation equipment and machinery. This capital formation depends on the cropping pattern of the farmers, the level of technology and the size of holdings.