The Pakistan Development Review
34 :3 (Autumn 1995) pp. 181–223

Growth and Distribution of Agrarian Assets in the Punjab

MOAZAM MAHMOOD

This is a micro study of the growth and distribution of the non-land agrarian assets in the Punjab between 1970 and 1984. This period of farm accumulation is interesting especially since it allows us to trace the agricultural productivity impact of the Green Revolution (introduced in the late 1960s) on the distribution of wealth. The Green Revolution was based on a wide spread adoption of inputs, HYV seed, and fertiliser, albeit with some evidence of time lags and differentials across farm size, and it generated a high rate of acquisition of agrarian assets, especially tubewells and mechanisation. The introduction of the HYV inputs definitely enhanced profitability, income, and wealth in the farm sector, but its impact on the distribution of agrarian assets across income classes was not so definite. This study focuses on this less well-researched aspect of the distribution of wealth generated by the Green Revolution.

To examine asset accumulation, we posit an analytical framework of exogenous and endogenous constraints on growth, which is useful in picking up both the common and contrasting patterns of growth and distribution across the two distinct regions of the Punjab, the canal colonies, and southern Punjab. The first exogenous constraint of an imperfect credit market is macro in nature, and is common to both regions, which strongly handicaps asset acquisition by small farmers. Further, there is evidence that, given the new technology, the ownership of assets is an important determinant of both growth and distribution. So this initial equity bias against small farmers in the first round of accumulation implies an even greater bias in the second round. The second endogenous constraint is regionally specific to the more land-concentrated southern region, which generates supervision costs for the largest operators, preventing them from expanding their operated area further through increased mechanisation. It also adds to the persistence in southern Punjab of the contractual form of sharecropping, in contrast to the proliferation of self-cultivation and use of wage-labour in the canal colonies.

1. INTRODUCTION

This is a micro study of the growth and distribution of the non-land agrarian assets in the Punjab between 1970 and 1984. This interesting initial period of farm accumulation especially allows us to trace the agricultural productivity impact of the Green Revolution (introduced in the late 60s) on the distribution of wealth. The Green Revolution was based on the widespread adoption of inputs, HYV seed, and fertiliser, albeit with some evidence of time lags and differentials across farm size, and it generated a high rate of acquisition of agrarian assets, especially tubewells

Moazam Mahmood is Senior Research Economist at the Pakistan Institute of Development Economics, Islamabad.

Author's Note: I wish to thank Michael Lipton and an anonymous referee of the *PDR* for valuable suggestions and comments. Any errors and omissions are of course mine.

and mechanisation. The introduction of the HYV inputs definitely enhanced profitability, income, and wealth in the farm sector, but its impact on the distribution of agrarian assets across income classes is not so definite. This study focuses on this less well-researched aspect of the distribution of wealth generated by the Green Revolution.

To examine asset accumulation, we posit an analytical framework of exogenous and endogenous constraints on growth, which is useful in picking up both the common and the contrasting patterns of growth and distribution across the two distinct regions of the Punjab, the canal colonies, and southern Punjab. The first exogenous constraint of an imperfect credit market is macro in nature, and is common to both regions–which strongly handicaps asset acquisition by small farmers. Further, there is evidence that given the new technology, the ownership of assets is an important determinant of both growth and distribution. So this initial equity bias against small farmers in the first round of accumulation implies an even greater bias in the second round.

The endogenous constraint is regionally specific to the more land-concentrated southern region, which generates supervision costs for the largest operators, preventing them from expanding their operated area further through increased mechanisation.[1] It also adds to the persistence of the contractual form of sharecropping in southern Punjab, in contrast to the proliferation of self-cultivation and use of wage-labour in the canal colonies.

2. MICRO THEORY ON THE ACCUMULATION OF AGRARIAN ASSETS

Agricultural investment theory uses three factors of production, land, capital and labour, as in Ricardo [Hicks (1932) or Sen (1968)]. Both land productivity and capital can be increased in two ways, commercially or by a greater application of labour. If the labour used for such activities is the family labour of small operators with a low opportunity cost in off-farm employment, then land productivity and non-land assets increase with a relatively low commercial input. Small operators with low purchasing power for large commercial assets can then at least increase their assets produced by family labour. Whereas larger operators with more purchasing power rely more on commercial assets [Booth and Sundrum (1985)]. The importance of family labour assets, however, has decreased considerably in subcontinental agriculture for two reasons. One, the spread of the HYV seed, commercial fertiliser, controlled irrigation, and the pesticide package have increased the use of both commercial variable inputs and fixed assets, which has decreased the importance of

[1]This constraint on the expansion of mechanisation on very large farms supports a constraint on the expansion of their area, which I have shown in an earlier study [Mahmood (1990)].

implements made by family labour [Chadha (1978) and Sen (1981)]. The second and major reason for the decreasing importance of family labour is the replacement of work animals by mechanisation. Animals have a high family labour component, but the increasing replacement of bullocks by tractors and tubewells has led to the growing predominance of mechanical assets.

Furthermore, mechanised assets have become dominant because of tractorisation, which has increased rapidly in Pakistan due to several incentives. These incentives have generated a large literature, with a major debate between the school of Technological Necessity and the school of Wrong Prices and Labour Displacement. Whereas the Technological School argues that tractors increase output by allowing deeper tilling, and their speed eases seasonal bottlenecks permitting multiple cropping [Singh (1971); Johl (1972); Sen (1981) and Salam (1981)]. The school of Wrong Prices and Labour Displacement maintains that tractors are not technically better than bullocks and their adoption is due to imperfections in the capital market. Tractors are subsidised and credit is allocated for their purchase, which makes them artificially cheaper than bullocks and labour [Bose and Clark (1969)].

Empirical Evidence Favours the Wrong Prices School

Binswanger (1978) finds that tractors are associated with a higher configuration of inputs and output because of a cross-sectional accident. The farms that are tractorised are already input-intensive. He also finds that tractors displace labour in that they allow cropped area to increase without a corresponding proportionate increase in hired labour. Binswanger's findings support Sen's (1981) theory that family labour needed for the supervision of wage labour constrains the expansion of the self-operated area of large farms.

However, tractorisation has allowed such farms to increase their cultivated area without making proportionate increases in hired wage labour and complementary family supervisory labour.

In Pakistan, this labour-saving nature of tractors has permitted landlords to resume the sharecropped-out area for self-cultivation. As mechanical assets predominate total non-land assets, and the share of animal assets declines, the share of family labour in total non-land assets also declines. Hence, all size classes of operators become more reliant on purchasing power to increase their non-land assets. However, the "stylised facts" for Pakistan are:

(a) credit allocation for the purchase of large tractors absorbed approximately 80 percent of the total credit in the Seventies;
(b) there was no credit to acquire assets for landowners under 12.5 acres or for tenants;
(c) obtaining agricultural credit depended on the farmer's provision of

collateral, and thus on his ownership of area.

These features show the credit market for agrarian assets to be imperfect on two counts: it allocates the larger proportion of credit to larger operators, and it does not meet the needs of smaller operators for smaller, more divisible assets.

3. PREDICTING CHANGES IN NON-LAND ASSETS

The Analytical Framework

Agrarian capital accumulation in a region can be seen to be determined by the interaction of a set of exogenous and endogenous factors. Within this interaction, exogenous factors like public policy, which is common across all regions in the agrarian sector, will exercise an equalising influence on the pattern of accumulation across regions. On the other hand, endogenous factors specific to a region, like the distribution of owned and operated area, irrigation endowments, some forms of land rental, and other market conditions, can vary between regions, and tend to de-equalise the pattern of regional accumulation.

Survey

The Punjab is a heterogeneous province, consisting of two distinct regions, the canal colonies and southwestern Punjab. The important characteristics of the canal colonies are a relatively less concentrated distribution of the operated area, a lower incidence of sharecropped area, an earlier-established canal irrigation system, higher growth, and therefore a network of more developed factor markets for land and labour. In contrast, southwestern Punjab has a relatively more concentrated distribution of operated area, a relatively higher incidence of sharecropping, a later-developed canal irrigation system, lower growth, and therefore less developed factor markets for land and labour. To capture both the common and the divergent trends between the two regions, one village from each region has been surveyed to typically represent its major characteristics: *Chak* 323 in the canal colonies and Rahimabad (Rahimabad+Mahmoodabad) in the south.[2] Asset data have been obtained for two points in time, 1970 and 1984, to allow estimation of the change over time and to analyse this change.

The Basic Propositions

We can now put forward a set of propositions about the expected nature and

[2]Each of the two villages has been chosen to typically represent the following variables for each region: the historical pattern of village settlement, the structure of land ownership and tenure, irrigation endowments, cropping patterns, and the distance from markets, roads, and *tehsil* headquarters. For quantitative detail, see Mahmood (1990).

determinants of change in non-land assets between 1970 and 1984 in the surveyed regions. And we can then test these propositions using the survey data.

We expect the changes in non-land assets between 1970 and 1984 in *Chak* 323 and Rahimabad to have been determined by two exogenous factors and one endogenous factor.

(i) One exogenous factor is expected to be the tendency towards labour-saving mechanisation.

(ii) The second exogenous factor is expected to be the imperfect credit market for non-land assets which is biased in favour of asset acquisition by larger owners and operators and against smaller owners and operators.

(iii) The endogenous factor is expected to be the concentrated distribution of the owned and operated area in Rahimabad in 1970, leading to an increased supervision constraint in the area of the largest size class of operators already above 200 acres.[3]

These exogenous and endogenous factors tend to interact and yield the following pattern of growth and distribution of agrarian assets between 1970 and 1984.

First, the tendency towards mechanisation increases the accumulation of mechanical assets, substituting for both human labour and animal farm power in both the villages, *Chak* 323 and Rahimabad, although at a relatively slower pace in Rahimabad, given its slower historical growth.

Second, there is a credit bias in favour of the larger operators which results in a relatively greater increase in the value of larger mechanical assets for the larger operators, rather than for the smaller operators, in both villages. The smaller operators in both villages exhibit some accumulation through their increase in the value of smaller mechanical assets, as well as an increase in animal assets as a substitute for mechanical farm power.

Third, there is a supervision constraint on the area expansion of the already large operators, which modifies the pattern of asset change in Rahimabad as compared to *Chak* 323. This supervision constraint has been noted in an earlier study of land distribution conducted for these two villages.[4] This study shows that a higher concentration of operated area in Rahimabad gave it a number of owners and operators already operating very large areas (well above 200 acres by 1970) and their accumulation behaviour between 1970 and 1984 has been different from that

[3]Seen in an earlier study by Mahmood (1990).

[4]Mahmood (1990), *op. cit.*

of the operators in *Chak* 323. All large operators in both the villages have increased their operated area between 1970 and 1984, except the operators already above 200 acres by 1970. This increase in the operated area is based primarily on the landowner's resumption of the sharecropped-out area for self-cultivation, using wage-labour supplemented by tractors. Clearly, then, the operators already above 200 acres in 1970 did not resume further sharecropped-out area because they already had optimal levels of self-cultivation. These very large operators above 200 acres only existed in Rahimabad. This constraint on the expansion of the already large farms above 200 acres in Rahimabad appears to be consistent with the supervision constraint seen in the literature cited above. What it implies for this study is that if the farms above 200 acres in 1970 were prevented from expanding further their operated area, then they would also be found not to have expanded their use of tractors, whose main function is that they allow an expansion in cultivated area without a proportional increase in labour use. This would have constrained the increase of the principal labour-saving technology, such as tractors, on these already large farms. In fact, if for some reason these operators above 200 acres decreased their operated area between 1970 and 1984, then their optimal levels of tractorisation by 1970 would imply a subsequent decrease in their value of tractors.

These basic propositions are specified in detail for each asset, and aggregates of assets, and then tested in the following empirical sections.

EMPIRICAL RESULTS

Tabular analysis tests whether a size class, say below 5 acres, has increased its assets between 1970 and 1984. This is a test for the size class because the size class remains constant over time while its assets change. The test is carried out in Section 4. Tabular analysis is less stringent statistically, but a useful first test for the size class. It can be converted, using regression analysis to a statistical probability of asset change over time for a size class. This is done in Section 5.1 by correlating asset change to current operated area. This assumes that the individual's operated area remains constant over time, much as the tabular test keeps the size class constant over time while their assets change.

But what the size class test misses is the transition between the size and tenure classes between 1970 and 1984. An operator of under-5 acres in 1970 could subsequently have bought a tubewell and also increased his operated area, thus adding his tubewell to another size class of above-5 acres by 1984. So the size class test needs to be supplemented by tests for the individual's probability of asset change. For this, regression equations are specified to correlate the increase in an individual's value of assets to his past operated area. This is carried out in Section 5.2.

4. ASSET CHANGE BETWEEN 1970 AND 1984 IN *CHAK* 323 AND RAHIMABAD

This first sub-section takes a perspective look at the changes in the value of assets for the entire village.[5] The second sub-section divides the village into size classes.[6]

4.1. Asset Change at the Village Level

The interesting aggregations of assets to examine at the village level are the non-land assets comprising farm, non-farm, and domestic assets. Change in these assets between 1970 and 1984 is expected to be determined by the factors given in Proposition 1:

P1. The process of accumulation comprises:

(a) mechanisation substituting for labour and animal power;
(b) animal acquisition for farmers not mechanising;
(c) diversification of farm assets into non-farm assets; and
(d) domestic asset acquisition.

P1.1. Increase in the value of farm assets is contingent on:

(a) being net positive-mechanisation overriding decrease in animals, or
(b) animals being net positive, and {(a + b) – (c)} being net positive-farm asset increase overriding non-farm asset diversification.

P1.2. Increase in the value of non-farm and domestic assets is simply contingent on (c) and (d), both being net positive.

P1.3. We expect farm, non-farm, and domestic assets to increase over time, which will increase the share of non-land assets and decrease the share of land in total assets.

Table 1 shows change in values between 1970 and 1984. Table 1A is for

[5]The procedure that has been used to estimate the value of fixed capital assets is given in the Appendix.

[6]These values are all estimates for the population rather than the sample, and are calculated according to the weighting procedure given in the Appendix. The standard error for the estimates is given for each size and tenure class in Table 3 in the Appendix. The standard errors for all the estimates barring one (tenants of between 5 and 12 acres in Rahimabad) are less than half the estimate. This shows that the value of these estimates is not zero with a 95 percent level of probability. All these values are in constant 1970 prices and, therefore, comparable between 1970 and 1984.

Chak 323. As expected, the share of land in the value of total assets dropped from 75 percent to 50 percent, while the share of non-land assets increased reciprocally between 1970 and 1984. This increase in non-land assets is not due largely to an increase in farm assets, but to an increase in non-farm assets. The table shows that the value of farm assets only increased by 8 percent between 1970 and 1984, while their share in total assets increased only marginally, from 12 percent to 14 percent. However, the most striking change seen in Table 1A is that the share of non-farm assets in the total value of assets increased from 2 percent to 33 percent. This increased preference for non-farm assets over farm assets reflects a higher rate of return in the non-farm sector. Table 1A also shows that between 1970 and 1984, the share of domestic assets in total assets rose from 0.3 percent to 3.6 percent.

Table 1A

Chak *323 Population: Value of Assets in 1970 Prices (000 Rupees)*

	Value of Assets 1970			Value of Assets 1984			Change from 70–84	
Assets	Total	Mean	%	Total	Mean	%	Total	%
Land	9600.4	75.0	85.0	5309.3	41.5	49.5	–4291.1	–44.7
Farm	1399.6	10.9	12.4	1512.7	11.8	14.1	+113.1	+8.0
Non-farm	256.8	2.0	2.3	3511.0	27.4	32.7	+3254.2	+1267.2
Domestic	38.8	0.3	0.3	389.6	3.0	3.6	+350.8	+904.1
Total	11295.5	88.2	100.0	10722.5	83.8	100.0	–57.3	–5.1

Table 1B for Rahimabad shows approximately the same pattern. The share of land in total assets dropped from 83 percent to 33 percent between 1970 and 1984, while the share of non-land assets increased reciprocally, as expected. This increase in non-land assets was not caused by farm assets but entirely by non-farm assets. Farm assets actually decreased in value by 39 percent while their share in total

Table 1B

Rahimabad+Population: Value of Assets in 1970 Prices (000 Rupees)

	Value of Assets 1970			Value of Assets 1984			Change from 70–84	
Assets	Total	Mean	%	Total	Mean	%	Total	%
Land	37822.9	121.6	82.7	25783.4	81.6	33.2	12039.5	–31.8
Farm	5267.5	16.9	11.5	3194.0	10.1	4.1	–2073.5	–39.4
Non-farm	2364.9	7.6	5.2	47058.8	148.9	60.6	+44693.9	+1889.9
Domestic	284.6	0.9	0.6	1614.5	5.1	2.1	+1329.9	+467.3
Total	45739.9	147.1	100.0	77650.7	245.7	100.0	+31910.8	+69.8

(Sample Survey, 1984).

assets dropped from 17 percent to 4 percent. However, the share of non-farm assets in total assets rose from 8 percent to 61 percent. This preference for non-farm assets over farm assets has been much greater in Rahimabad than in *Chak* 323. The share of domestic assets in the total assets rose from 1 percent to 2 percent.

So, between 1970 and 1984, the value and share of land assets decreased, and the value and share of non-farm and domestic assets increased in both villages. However, the value and share of farm assets increased marginally in *Chak* 323 but decreased significantly in Rahimabad.

4.2. Asset Change for the Size and Tenure Classes of Operators

We can now take a first look at the change in the value of assets across size and tenure classes using tabular analysis. These assets have been divided into the categories of mechanical, animal, and non-farm assets. We expect the change in the value of these assets between 1970 and 1984 to be determined by the following propositions:

(a) ***Mechanical Assets***

P2. On farms with operated area of <250 acres, tractors per farm increase (for *Chak* 323 all of whose operators <250 acres).

P3. On farms with operated area of >250 acres, tractors per acre, being optimal in 1970, remain constant by 1984. However, a decrease in the operated area of these large farms may decrease the tractors per farm (for Rahimabad some of whose operators are >250 acres).

P4. Non-tractor mechanical assets per farm increase on all farms.

P5.1. Given P2 and P4, in *Chak* 323, the increase in more expensive assets, tractors, and tubewells per farm, are positively correlated to the area operated in 1984–and to its components owned and leased in area, but not to the sharecropped-in-area, reflecting the share-tenants' lower incomes.

P5.2. Given P3 and P4, in Rahimabad, the increase in tractors per farm is negatively correlated to the area operated in 1984, and to its components owned and leased in area. However, in Rahimabad, the increase in tubewells per farm is positively correlated to the area operated, owned, and leased in 1984–although, again, not to the sharecropped-in area.

P5.3. The increase per acre is not correlated to operated area since this indicates economies of scale.

P6. The increase in the value of cheaper assets, such as drills, sprayers, and fodder-cutters, is more weakly correlated to the area operated in

1984.

P7. The increase in the total value of mechanical assets is be affected by tractors, as in P2-P3, and will behave according to P4–P6, being correlated to the operated area and its components.

P8. The increase in the value of labour-substituting assets, like tractors and tubewells, is negatively correlated to the available number of family males per operated acre in 1984, reflecting a supervision constraint.

P9. The increase in the value of more expensive assets like tractors and tubewells is positively correlated to any additional income in 1984.

(b) *The Accumulation of Animal Assets between 1970 and 1984 is Expected to be Determined by the Following Factors*

P10.1. On larger, richer farms, tractors substitute for bullocks, decreasing the value of bullocks per farm. On smaller, poorer farms, the value of bullocks per farm increases.

P10.2. Therefore, the increase in the value of bullocks per farm is negatively correlated to the area operated and owned in 1984.

(c) *The Accumulation of Non-farm Assets between 1970 and 1984 is Expected to be Determined by the Following Factors*

P11. Non-farm and domestic assets per farm increase on all farms. This increase is correlated to the area operated in 1984.

These propositions relating change in the value of assets between 1970 and 1984 to the size class and tenure structure in 1984 can now be tested using Graphs 1–3. These graphs show change in the value of mechanical, animal, and non-farm assets per farm between 1970 and 1984 respectively, for six size classes.[7]

Chak 323

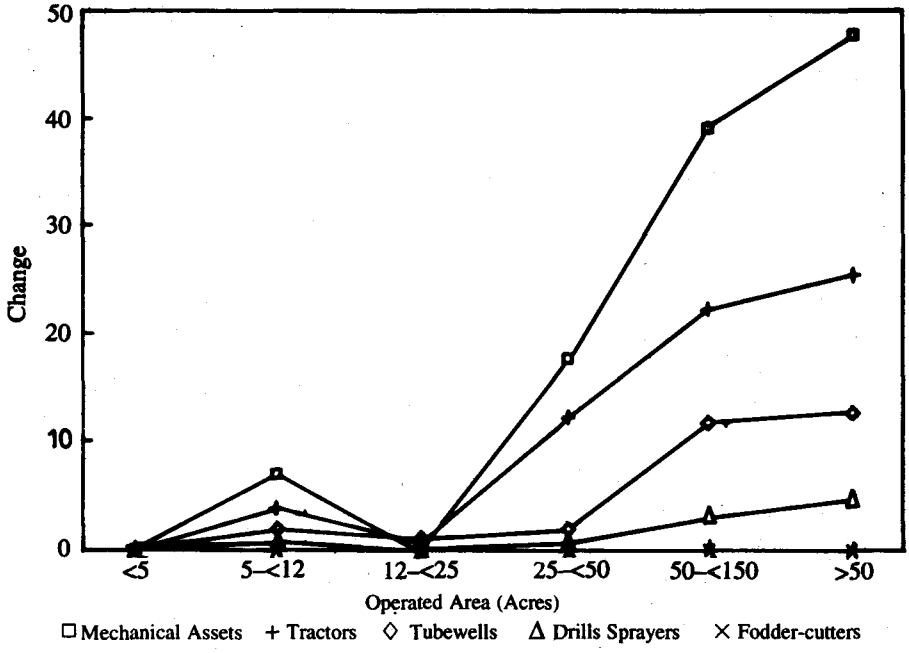
(a) *Mechanical Assets*

Propositions 2,4,5 and 7 for *Chak* 323 argue that mechanical assets per farm are expected to increase over time, and this increase is expected to be positively correlated to the operated area. This does not apply per acre to discount scale efficiencies. The correlation is also expected to be stronger for more expensive assets like tractors and tubewells than for cheaper assets like drills, sprayers, and fodder-cutters (P6).

[7]Detailed tables are given in the Appendix. Comparison of the percentage change is ruled out by infinite values for increases from zero. Percentages would also equate an increase from 1 spade to 2 with an increase from 1 tractor to 2, hiding the inequality in value terms.

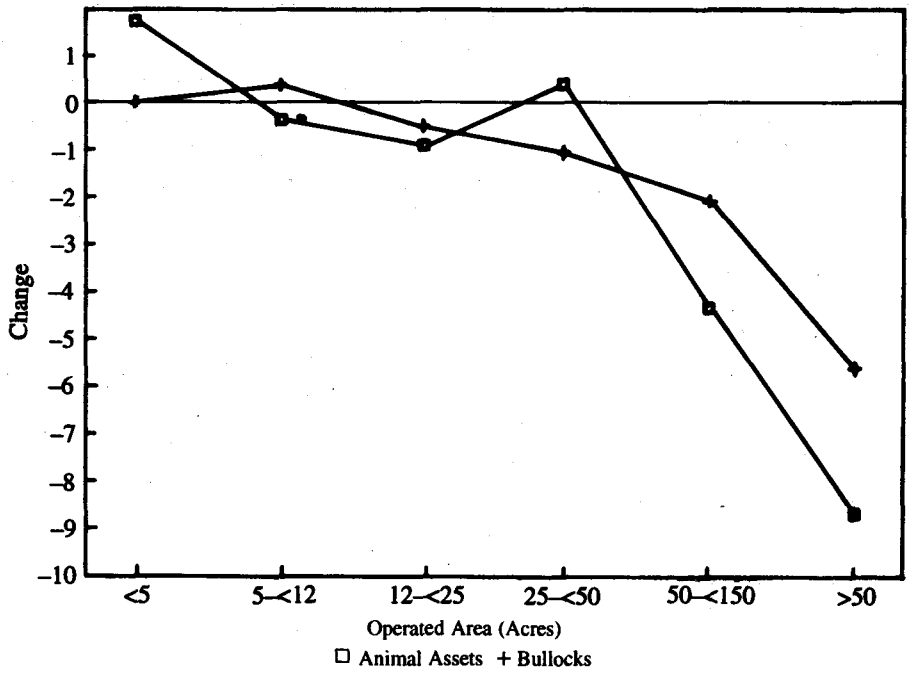
Graph 1A : Mechanical Assets

Chak 323 : Change in the Value of Assets per Farm, 1970–84 (1970 Prices–'000Rs)



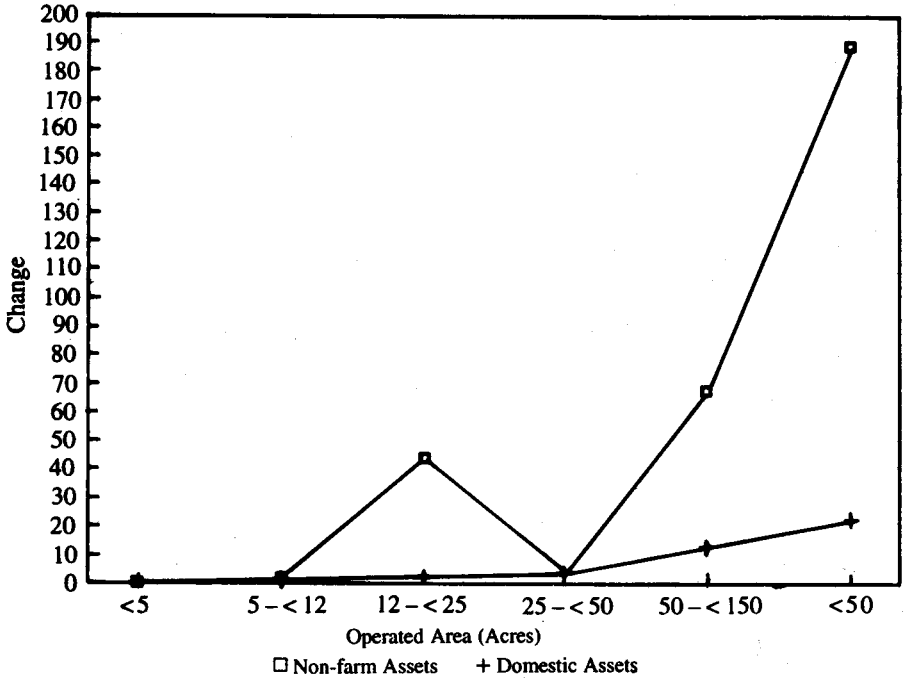
Graph 2A : Animal Assets

Chak 323 : Change in the Value of Assets per Farm, 1970–84 (1970 Prices–'000Rs)



Graph 3A : Non-farm Assets

Chak 323 : Change in the Value of Assets per Farm, 1970–84 (1970 Prices–'000Rs)



Graph 1A bears this out. It shows that between 1970 and 1984 the value of total mechanical assets increased per farm. More importantly, it shows that the increase in the value of individual mechanical assets per farm was also positively related to the operated area. This positive relationship was stronger for tractors and tubewells. But most important of all, these larger assets exhibited two break points; at 5 acres below which the increase was zero; and at 25 acres for tractors and 50 acres for tubewells, above which there was a quantum increase. These break points imply that there was an absolute resource-cum-credit constraint on the tractor and tubewell expansion for farmers below 5 acres, and another strong constraint for farmers below 50 acres.

As expected, increase in the value of smaller, more divisible assets like drills, sprayers, and fodder-cutters had a weaker positive relationship with the operated area. Drills and sprayers again exhibited break points at 5 and 50 acres. Fodder-cutters being the cheapest asset, Graph 1A shows that their increase had no relationship with the operated area.

Increase in the total value of mechanical assets per farm was positively related to the operated area. This value of mechanical assets exhibited 3 break points; at

5 acres, below which the increase is negligible; then at 25 acres, and at 50 acres.

So, for large, expensive, and relatively indivisible assets like tractors and tubewells, there was a resource-cum-credit constraint on their increase. The break point at 5 acres completely excluded 14 percent of the farms in *Chak* 323, while the break point at 50 acres especially privileged 12 percent of the farms.

This positive relationship for mechanical assets per farm did not hold per acre as the Appendix Table A2A shows.

(b) *Animal Assets*

Proposition 10 gives the expected behaviour of animal assets over time, which is essentially a contra trend to that of mechanisation. Small farms are expected to increase their value of bullocks per farm, while larger farms decrease them, giving a negative correlation between the increase in bullocks per farm and the operated area.

The Appendix Table A1A shows that the mean value of bullocks per farm decreased between 1970 and 1984. Graph 2A shows further that this decrease in the value of bullocks per farm was due to a turning-point at 12 acres, above which there was a decrease in each size class, and below which there was an increase, as expected. This implies that the farms under 12 acres, constrained by internal resources and credit from mechanising, instead increased their animal power; while the less constrained farms above 12 acres mechanised and decreased their animal power.

(c) *Non-farm and Domestic Assets*

Proposition 11 gives the expected behaviour of non-farm and domestic assets between 1970 and 1984, arguing that their increase per farm is again expected to be positively correlated to the operated area. Graph 3A, however, shows that the increase in non-farm assets was not very systematically related to the operated area except for farms above 50 acres. So the operators above 50 acres significantly diversified investment into non-farm assets between 1970 and 1984. And this increase in non-farm assets was not entirely dependent on the internal resources of the farm in *Chak* 323. The increase in the value of domestic assets per farm was, however, clearly related to the operated area, as expected, with a break point at 50 acres.

Rahimabad

(a) *Mechanical Assets*

Propositions 3–7 give the expected behaviour of mechanical assets in Rahimabad between 1970 and 1984. In this village, as in *Chak* 323, increase in mechanical assets per farm is expected to rise with the operated area. But there is one critical difference in the pattern of accumulation between the two villages.

Operators of above-250 acres in 1970 are expected to have an optimal value of tractors per acre, which they keep constant over time. Therefore, if their farm area drops over time, they are expected to decrease the value of their tractors per farm. In Rahimabad, the size class of above-150 acres in 1970 actually operated more than 250 acres. So the proposition applies to the size class above-150 acres.

Tractors and the Supervision Constraint

Graph 1B and Appendix Table A2B confirm the propositions about tractors. In Graph 1B, tractors per farm had a turning-point at 150 acres, so they increased in size classes of below-150 acres and decreased in the size class above. This implies that the size class of above-150 acres had a supervision constraint on increasing its already large self-operated area, and as an earlier study showed, in fact decreased it. Appendix Table A2B confirms that there was an optimal ratio of tractors per acre for this size class of above-150 acres. So, while other size classes of below-150 acres increased their value of tractors per operated acre, the size class of above-150 acres kept its value of tractors per acre constant between 1970 and 1984.

The existence of a supervision constraint on the expansion of the size class operating above-150 acres (actually 250 acres) is further supported by its increase in the value of other mechanical assets. Tractors are the most important substitute for labour and only the value of tractors has been constrained–to decrease per farm and remain constant per acre. Tubewells, drills, sprayers, and fodder-cutters are not the most important substitute for labour. And Graph 1B and Table A2B show that the values of these non-tractor mechanical assets increased per farm and per acre for this size class of above-150 acres.

The simultaneous proportional decrease in the operated area and value of tractors and the increase in the value of non-tractor mechanical assets show that these largest farms were concerned with labour power. Then, more detailed implications can be added to Proposition 3 about the supervision constraint.

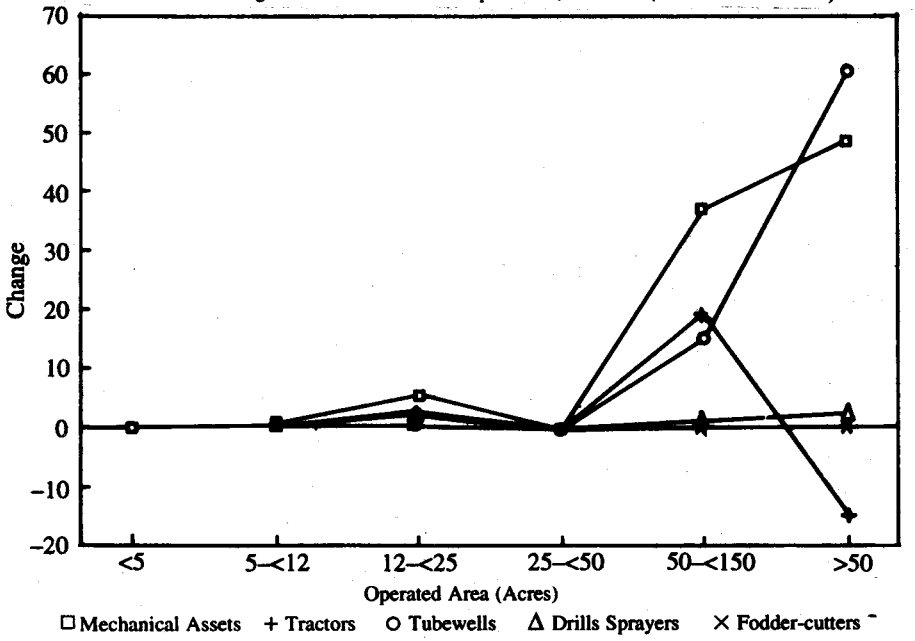
If L = Labour A = Acreage P = Power T = Tractors.

Initially excluding the possibility of tractorisation on operated area above 250 acres, the available number of male family labourers gives an optimal number of hired labourers who can be supervised, p. The desired output per acre gives the minimal labour per acre p/q. Dividing p by p/q gives an optimally supervisable area, q giving a minimum yield. Optimally:

$$L = p \quad \text{(i)}$$
$$A = q \quad \text{(ii)}$$
$$L/A = p/q \quad \text{(iii)}$$

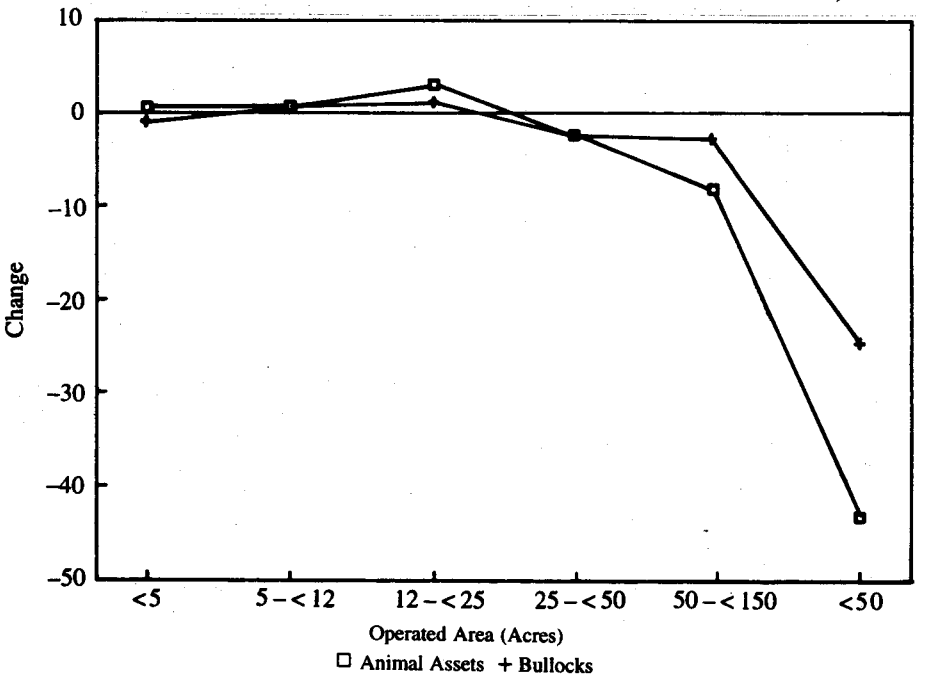
Graph 1B : Mechanical Assets

Rahimababd : Change in the Value of Assets per Farm, 1970–84 (1970 Prices–'000Rs)



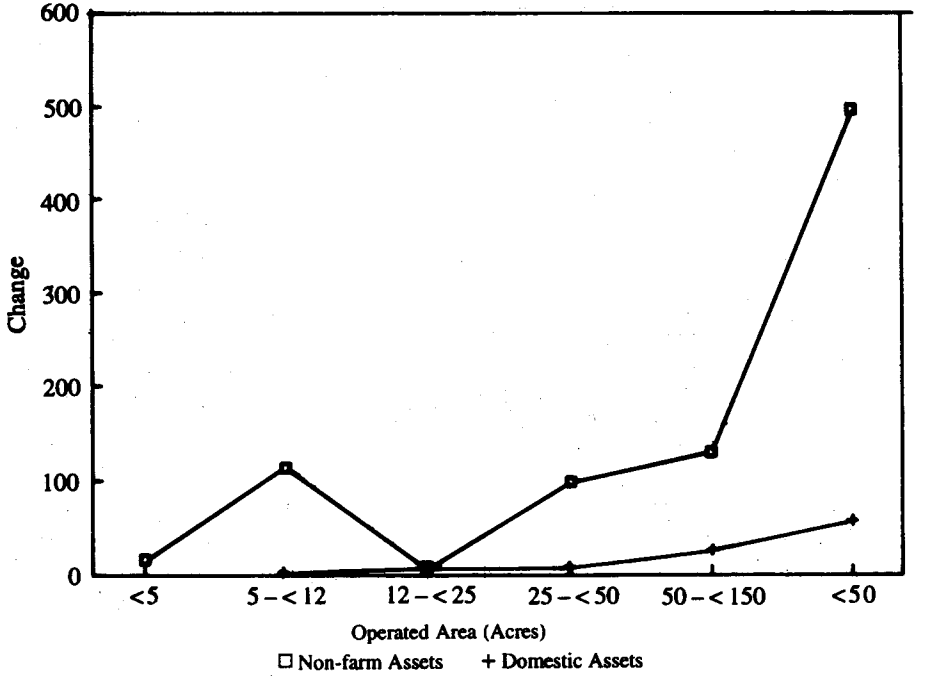
Graph 2B : Animal Assets

Rahimababd : Change in the Value of Assets per Farm, 1970–84 (1970 Prices–'000Rs)



Graph 3B : Non-farm Assets

Rahimababd : Change in the Value of Assets per Farm, 1970–84 (1970 Prices–'000Rs)



So supervision capacity is given by p/q. And if family labour is constant, p/q also remains constant, because:

1. If $A > q$ $L/A < p/q$ yield drops
2. If $L > p$ $L/A > p/q$ unsupervisable
3. If $A > q$ and $L > p$ to give $L/A = p/q$ unsupervisable
4. If $A < q$ $L/A > p/q$ possible
5. If $L < p$ $L/A < p/q$ yield drops
6. If $A < q$, $L < p$ to give $L/A = p/q$ possible

Now we assume that tractors can substitute for hired labour up to a point. This simply drives down the minimal labour per acre p/q and gives a minimal value of tractors per acre t/q, i.e., optimally

$$T/A = t/q \quad \text{(iv)}$$

An increase in t/q is useless because it does not reduce p/q. A decrease in t/q

increases p/q and so reduces q. Therefore, supervision capacity is also given by t/q, which remains constant if family labour is constant.

So (i)–(iv) are simultaneous conditions indicating the supervision constraint. Contravention of these conditions can have the six outcomes given above, of which only two are possible. The number of labourers cannot be expected to increase because the increased labour per acre is unsupervisable. The number of labourers cannot be expected to decrease because the decreased labour per acre lowers yields. The acreage cannot be expected to increase because the decreased labour per acre lowers yields. The acreage can be expected to decrease. The number of labourers and acreage cannot be expected to increase proportionally while keeping the labour per acre constant, because the increased labour is unsupervisable. A proportional decrease in both labour and acreage while keeping the labour per acre constant is also possible. A decrease in the tractors per acre will affect the labour per acre with these same outcomes. Either a labour shortage drops yields, or an increased labour per acre is unsupervisable, unless the acreage is decreased in proportion to the decrease in tractors, which makes the tractors per acre constant. Therefore, a supervision constraint prohibits all outcomes except an expected decrease in the acreage and an expected constant ratio of the tractors per acre over time. The observed constancy in the value of tractors per acre in Table A2B, the decrease in the value of tractors per farm in Graph 1B, and the decrease in the operated area for the size class of above-150 acres (250 acres) show the existence of this supervision constraint.

Non-tractor Mechanical Assets

Graph 1B shows that the increase in the value of individual mechanical assets was not systematically related to the operated area. Rahimabad, however, shared a break point with *Chak* 323 at 50 acres, for tubewells, drills, and sprayers. This implies that while the drive towards mechanisation was weaker in Rahimabad as compared to *Chak* 323, there was a credit constraint on the expansion of large assets for farms of under-50 acres. But increase in low-valued fodder-cutters per farm was widespread in Rahimabad, as expected.

As a result of the sketchy increases in individual assets below 50 acres, the increase in the total value of mechanical assets per farm was not very systematically related to the operated area except for a clear break point at 50 acres.

(b) *Animal Assets*

Proposition 10 gives the expected behaviour of animal assets over time in Rahimabad, which is common to *Chak* 323. They argue that small farms are expected to increase their bullocks while larger farms decrease them, giving an inverse

relation between the bullock increase per farm and the operated area.

Graph 2B shows that the 12-acre turning-point for bullocks, which held in *Chak* 323, is raised to 25 acres in Rahimabad. This implies that the resource-cum-credit constraint on small farms, combined with the weaker drive towards mechanisation in Rahimabad, pushed the farms under-25 acres which were unable to mechanise to increase their animal power instead.

Table 2B also shows that the increase in the value of bullocks broadly decreased with the operated area of the size class.

(c) *Non-farm and Domestic Assets*

Proposition 11 gives the expected behaviour of non-farm and domestic assets over time in Rahimabad, which is common to that in *Chak* 323. The propositions state that the increases in non-farm assets and domestic assets per farm are expected to be positively correlated to the operated area. Graph 3B shows that for Rahimabad, as for *Chak* 323, the increase in the value of non-farm assets per farm was not very systematically related to the operated area. However, again, there was a break point at 50 acres, above which the increase in non-farm assets rose sharply. So these largest size classes relied on diversifying investment into non-farm assets.

Unlike non-farm assets, Graph 3B shows that domestic assets per farm were more clearly positively related to the operated area.

5. THE PROBABILITY OF ASSET CHANGE, FOR A SIZE CLASS AND AN INDIVIDUAL

Tabular analysis has shown that operated area is a strong positive determinant of increase in mechanical, non-farm, and domestic assets, excluding tractors in Rahimabad. And it is a negative determinant of increase in animal power. This can now be converted into a determination of the statistical probability of asset change for a size class by correlating the increase in assets between 1970 and 1984 to the area operated in 1984. This regression equation is specified in Section 5.1.

The individual's transition between size classes, however, implies a separate test for the individual's probability of assets change. This requires correlating change in the individual's assets between 1970 and 1984 to his area operated in 1970. These regression equations are specified in Section 5.2. The test for individuals is more stringent than the test for size classes; so weaker results are expected for individuals.

5.1. The Probability of Asset Change for a Size Class

A multiple linear equation is specified. In Table 2 the dependent variable is the change in the value of mechanical assets, tractors, tubewells, drills, sprayers,

Table 2

The Relationship between Increase in Assets and Area

VIL	R2	Dependent Variable	Intercep Alpha (t) sig.	Independent Variables Beta (t) sig. Area Owned 84	Area Leased in 84	Area Sharcrop in 84	Area Sharcrop out 84	No. Family Males/ Acre 84	Value Remit-tance 84
A	.61	Increase	+3734.4	+288.1	+172.6	−327.9	+54.8	−2071.3	−0.01
		Mechanical	1.2 .22	4.6 .00	5.1 .00	0.9 .37	0.1 .89	0.2 .83	0.2 .85
B	.78	Assets	+4709.8	+117.9	+19.6	−385.6	−12.2	−8184.8	−0.3
		1970–84	1.4 .18	8.6 .00	0.3 .79	0.7 .49	0.6 .58	0.7 .87	0.2 .87
A	.44	Increase	+2401.4	+140.9	+84.0	−245.3	Drop	Drop	+0.03
		Value of	1.4 .16	3.4 .00	3.7 .00	1.0 .32			0.6 .56
B	.35	Tractors	+2446.7	−10.9	−51.0	−212.4	+64.3	−3553.9	−0.3
		1970–84	1.0 .32	1.1 .28	1.0 .59	0.5 .00	4.1 .59	0.4 .67	0.2 .81
A	.52	Increase	+584.3	+92.9	+54.4	−37.8	+41.6	−1413.1	−0.02
		Value of	0.5 .60	4.1 .00	4.4 .00	0.3 .77	0.4 .77	0.4 .70	0.8 .43
B	.90	Tubewell	+1813.5	+124.4	+75.9	−162.8	−85.5	−4054.0	Drop
		1970–84	1.0 .33	16.5 .00	1.9 .06	0.5 .59	7.1 .00	0.6 .53	
A	.62	Increase	+230.9	+18.8	+17.2	−24.0	−8.7	−310.2	−0.01
		Value Drills+	0.9 .35	3.7 .00	6.3 .00	0.8 .41	0.3 .78	0.4 .70	1.4 .18
B	.81	Sprayers	+38.0	+4.1	−3.3	Drop	+4.9	−145.3	Drop
		1970–84	0.3	6.3 .00	1.0 .34		4.7 .00	0.3 .80	
A	.22	Increase	−3.2	−0.1	+0.1	Drop	−3.6	−24.5	+0.0
		Value of	0.3 .80	0.4 .67	0.7 .52		1.8 .08	0.5 .62	1.4 .16
B	.19	Fodder-cutters	−8.3	−0.2	+0.2	−2.0	+0.1	+27.2	−0.0003
		1970–84	0.6 .57	2.6 .01	0.5 .61	0.9 .39	1.6 .58	0.6 .58	0.5 .64

Continued–

Table 2 –(*Continued*)

VIL	R2	Dependent Variable	Intercep Alpha (t) sig.	Independent Variables Beta (t) sig. Area Owned 84	Area Leased in 84	Area Sharcrop in 84	Area Sharcrop out 84	No. Family Males/ Acre 84	Value Remit-tance 84
A	.30	Increase	–60.2	–26.4	–10.6	+79.1	–17.3	+1242.4	+0.03
		Value of	1.1 .27	2.4 .02	1.7 .09	1.2 .22	0.3 .80	0.7 .48	2.2 .03
B	.59	Bullocks	+1183.1	–45.3	–77.7	Drop	+42.8	Drop	+0.2
		1970–84	1.1 .29	7.6 .00	2.4 .02		4.2 .00		0.3 .77
A	.08	Increase	–673.9	+17.7	+3.2	+131.7	–154.4	+2438.3	+0.02
		Value of	0.7 .49	0.9 .38	0.3 .77	1.1 .26	1.2 .22	0.8 .44	1.0 .31
B	.45	Milch Animals	–276.1	–15.8	–27.2	–36.5	+15.0	+916.39	+0.2
		1970–84	0.4 .75	5.0 .00	1.7 .10	0.3 .77	3.0 .00	0.3 .73	0.5 .61
A	.17	Increase	–11403.9	+662.5	+709.8	+11292.4	Drop	–20449.0	–0.32
		Value of Non-farm	0.3 .77	0.8 .40	1.7 .10	2.4 .02		0.2 .87	0.3 .74
B	.37	Assets	+57003.3	+617.8	–3306.2	Drop	+3585.3	–118202.7	Drop
		1970–84	0.4 .72	0.9 .38	0.9 .36		3.2 .00	0.2 .84	
A	.62	Increase	+2006.2	+72.1	+73.3	Drop	–89.6	–2225.0	–0.02
		Value Domestic	2.5 .02	3.8 .00	6.8 .00		0.7 .48	.7 .47	0.8 .43
B	.66	Assets	+10539.1	+68.4	–156.3	–656.4	+128.5	–22635.4	–0.6
		1970–84	1.9 .06	3.1 .00	1.4 .18	0.8 .46	3.7 .00	1.2 .23	0.2 .83

Note: VIL. A = *Chak* 323.
B = Rahimabad.

fodder-cutters, bullocks, milch animals, non-farm assets, and domestic assets between 1970 and 1984. The explanatory X variables are chosen on the basis of Propositions 5–11. Operated area is broken up into its owned and rented components. So the explanatory variables are 1984 values for: the area owned, leased-in, sharecropped-in, sharecropped-out, the number of family males per acre, and the value of remittances.[8]

(a) *Mechanical Assets*

Propositions 5–9 give the expected behaviour of mechanical assets. They state that increase in the value of mechanical assets per farm in both the villages is expected to be: positively correlated to the 1984 values for area owned or leased-in (Proposition 7), and to the value of remittances (Proposition 9), and negatively correlated to the 1984 values for sharecropped-in area (Proposition 5) and the number of family males per acre (Proposition 8). The essential difference lies in the behaviour of tractors in Rahimabad, whose increase is expected to be negatively correlated to owned area, reflecting the decrease in tractors at above-150 acres (Proposition 5.2). Also, the positive correlations are expected to weaken for cheaper, more divisible assets like drills, sprayers, and fodder-cutters (Proposition 6).

First, the results for *Chak* 323 are examined. Reading down Table 2, the increase in mechanical assets was well-correlated to the explanatory variables. The R2 shows that the variation in the explanatory variables explains 2/3rds of the increase in mechanical assets. Increase in the individual value of assets was also well-correlated to the explanatory variables. The R2 for larger assets like tractors, tubewells, drills, and sprayers was high while it dropped for smaller assets like fodder-cutters.

The most important result is that the area owned in 1984 was positively and significantly correlated to the increase in mechanical assets, tractors, tubewells, drills, and sprayers, as expected. The leased-in area in 1984 was also positively and significantly correlated to the increase in mechanical assets, tractors, tubewells, drills, and sprayers, but not to fodder-cutters as expected. This implies two things. One, the leased-in area was used to increase the operated area in keeping with the increase in mechanical assets. Two, the larger operated areas also reflected greater internal farm resources to increase mechanical assets.

The other explanatory variables, area sharecropped, the number of family males, and remittances, were insignificant.

What this result shows is that there was a 2/3rds probability that each incre-

[8]Individual farm data were used for these regressions, with 50 observations in *Chak* 323 and 48 observations in Rahimabad. The equations were run separately for each village.

mental acre owned added an approximate Rs 300 increase in mechanical assets over time, and each incremental acre leased added another Rs 175 increase to this. In Rahimabad, as Table 2 shows, the increases in mechanical assets, tubewells, drills, and sprayers were strongly correlated to the explanatory variables with very high R2s. The increase in tractors and fodder-cutters had lower R2s. The table shows that one important result is that the owned area in 1984 was positively and significantly correlated to the increase in mechanical assets, tubewells, drills, and sprayers, as expected.

Another important result is that the owned area in 1984 was negatively though insignificantly correlated to the increase in tractors. The decrease in tractors at above-150 acres (actually 250 acres), as observed in the last section, led to a negative correlation as expected. So, in Rahimabad, the supervision constraint on the operated area and tractors overrode the credit constraint. The leased-in area in 1984 was only significantly correlated to the increase tubewells. The low incidence of the leased-in area in Rahimabad accounted for its insignificant impact on other mechanical assets. The sharecropped-in area was not significant. The sharecropped-out area was significantly positively correlated to the increase in tractors, and significantly negatively correlated to the increase in tubewells. The other explanatory variables were insignificant.

These results show that in Rahimabad there was a stronger probability of about 80 percent than in *Chak* 323, that each incremental owned acre added a Rs 120 increase in mechanical assets over time. Tractors, however, were excluded from this by the supervision constraint on the very large farms in Rahimabad.

(b) *Animal Assets*

Proposition 10 gives the expected behaviour of animals over time in both the villages. It expects the increase in the value of bullocks per farm to be inversely correlated to owned area in 1984, and positively correlated to remittances in 1984. In *Chak* 323, as Table 2 shows, the increase in bullocks was not well-explained by variation in the explanatory variables. The R2 for bullocks was low. The most important result is that the area owned in 1984 was negatively and significantly correlated to the increase in bullocks, as expected. This shows a substitution of bullocks by tractors. The value of remittances in 1984 was positively and significantly correlated to the increase in bullocks. So in *Chak* 323 there was a 1/3rd probability that bullocks decreased by about Rs 25 per incremental owned acre and by another Rs 10 per incremental leased-in acre.

In Rahimabad, the increase in bullocks was relatively well-explained by variation in the explanatory variables, as compared to *Chak* 323. Here the R2 for bullocks was higher than in *Chak* 323. Again, the most important result is that owned area in 1984 was negatively and significantly correlated to the increase in

bullocks as expected.

These results show that in Rahimabad there was a stronger probability (of about 60 percent) than in *Chak* 323 that bullocks decreased per incremental owned acre.

(c) *Non-farm and Domestic Assets*

Proposition 11 gives the expected behaviour of non-farm and domestic assets over time. It expects the increase in both non-farm and domestic assets per farm between 1970 and 1984 to be positively correlated to the owned and leased area in 1984. However, our tabular results from Section 4 lead us to expect the non-farm asset relationship to the operated area to be weaker.

Table 2 shows that in *Chak* 323 the increase in non-farm assets was not well-explained by variation in the explanatory variables. But the increase in domestic assets was well-explained by variation in the explanatory variables, with an R2 of 0.62. Area owned in 1984 was positively but insignificantly correlated to the increase in non-farm assets. Area owned in 1984 was positively and significantly correlated to the increase in domestic assets. So, increase in non-farm assets did not depend upon the farm's internal resources entirely, while the increase in domestic assets did. Leased-in area in 1984 was positively and significantly correlated to the increase in non-farm assets and to the increase in domestic assets. This shows that investment in agriculture through leasing-in area competed with non-farm investment in *Chak* 323. A negative correlation would have shown them to be substitutes. So in *Chak* 323, there was a 2/3rds probability that domestic assets increased by Rs 70 per incremental owned acre and by another Rs 70 per incremental leased-in acre.

In Rahimabad, the increase in non-farm assets and domestic assets was better explained by variation in the explanatory variables than in *Chak* 323. Non-farm assets had an R2 of .37 and domestic assets had an R2 of .66. Area owned in 1984 was positively but insignificantly correlated to the increase in non-farm assets as expected. Area owned in 1984 was positively and significantly correlated to the increase in domestic assets. This shows that in Rahimabad, as in *Chak* 323, the increase in non-farm assets did not depend entirely on the farms internal resources, but the increase in domestic assets did. These results show that in Rahimabad, as in *Chak* 323, there was a 2/3rds probability that domestic assets increased by about Rs 70 per incremental owned acre.

These regression results in Table 2 have shown, with 60-80 percent levels of probability, that mechanical and domestic assets increased by between Rs 300 and Rs 100 per incremental owned acre, in both villages. In *Chak* 323 leased-in area was an additional determinant of asset increase. In Rahimabad the supervision constraint weakened the tractor correlation to owned area.

5.2. The Probability of Asset Change for an Individual

To determine the probability of an individual's increase in assets over time, asset increase has to be correlated to the operated area in 1970. We expect the following behaviour:

P12.1. The increase in mechanical, domestic, and non-farm assets per farm between 1970 and 1984 is more weakly correlated to the area owned in 1970 than the area owned in 1984. Currently (1984) large area owners are more likely to have accumulated greater assets. Past (1970) large area owners are less likely to have accumulated greater assets.

P12.2. Similarly, the decrease in bullocks per farm between 1970 and 1984 is more weakly correlated to the area owned in 1970 than the area owned in 1984.

P13.1. The increase in the value of mechanical, non-farm, and domestic assets between 1970 and 1984 is positively correlated to the value of farm assets in 1970.

P13.2. The increase in the value of bullocks between 1970 and 1984 is negatively correlated to the value of farm assets in 1970.

Proposition 12 states that increase in assets per farm is more weakly positively correlated to the operated area in 1970 than to the operated area in 1984. The argument is that currently (1984) large area operators are more likely to have accumulated more assets. Since the individual's operated area is assumed to remain constant over time (much like the tabular size class test) while his assets change, this gives a higher probability for the size class.

However, past (1970) large area operators are less likely to have accumulated more assets. Since the individual's operated area can now be allowed to change over time, along with his assets, this gives a lower probability for the individual. Allowing for this transition in operated area weakens the correlations obtained in Table 3. To improve the fit, another possibility is allowed for: that increase in non-land assets will be correlated to the value of farm assets in 1970. This adds Proposition 13, that the increase in the value of mechanical, non-farm, and domestic assets between 1970 and 1984 is positively correlated to the value of farm assets in 1970. The increase in the value of bullocks between 1970 and 1984 is negatively correlated to the value of farm assets in 1970.

In Table 3 the dependent variables are the same as in Table 2, that is, the increase in the values of non-land assets between 1970 and 1984. The explanatory variables are the area variables of Table 3, but for 1970 rather than for 1984. Table

Table 3

The Relationship between Increase in Assets and Area

VIL	R2	Dependent Variable	Intercep Alpha (t) sig.	Independent Variables Beta (t) sig. Area Owned 70	Area Leased in 70	Area Sharcrop in 70	Area Sharcrop out 70	Value Farm Assets 70
A	.32	Increase	+6691.6	+227.4	+360.4	−304.6	−136.7	−0.1
		Mechanical	2.2 .03	2.7 0.1	2.4 .02	1.2 .22	0.5 .61	0.8 .43
B	.72	Assets	+4219.9	+36.3	Drop	−239.3	−37.0	+0.1
		1970–84	1.2 .23	1.9 .07		1.0 .33	2.3 .02	4.0 .00
A	.26	Increase	+4460.0	+142.4	+217.0	−197.5	−41.1	−0.1
		Value of	2.3 .02	2.7 .01	2.2 .03	1.3 .21	.02 .81	1.8 .07
B	.32	Tractors	+3530.1	−39.2	−123.6	−187.9	+37.3	+0.1
		1970–84	1.5 .13	3.1 .00	0.2 .88	1.2 .24	3.6 .00	2.5 .02
A	.37	Increase	+1117.2	+60.0	+151.0	−70.6	−61.1	−0.001
		Value of	1.2 .25	2.2 .03	3.1 .00	0.9 .37	0.7 .48	0.2 .83
B	.85	Tubewell	+360.5	+71.9	Drop	−42.4	−73.7	+0.1
		1970–84	0.2 .86	6.2 .00		0.3 .77	7.8 .00	3.9 .00
A	.38	Increase	+415.2	Drop	−18.9	−18.8	+15.2	+0.04
		Value Drills+	1.9 .06		1.6 .11	1.0 .31	0.8 .44	4.3 .00
B	.84	Sprayers	−75.9	+2.6	Drop	+3.4	−0.5	+0.002
		1970–84	0.6 .58	3.5 .00		0.4 .73	0.8 .40	1.3 .21
A	.07	Increase	−11.9	−0.2	+0.5	−0.6	−1.5	0.0
		Value of	0.9 .37	0.5 .60	0.8 .44	0.6 .56	1.3 .20	0.2 .87
B	.27	Fodder-cutters	−8.5	+0.06	+1.0	Drop	+0.02	0.0
		1970–84	1.0 .33	0.9 .37	0.3 .82		0.3 .76	3.2 .00

Continued–

Table 3 –(*Continued*)

VIL	R2	Dependent Variable	Intercep Alpha (t) sig.	Area Owned 70
A	.40	Increase	+467.5	–17.8
		Value of	1.2 .22	1.7 .10
B	.73	Bullocks	+2311.2	–19.0
		1970–84	1.9 .06	2.8 .01
A	.08	Increase	+829.6	–24.9
		Value of	1.1 .26	1.3 .20
B	.52	Milch Animals	+805.4	–16.1
		1970–84	1.2 .24	4.3 .00
A	.11	Increase	+38464.5	–778.8
		Value of Non-farm	1.5 .15	1.0 .32
B	.41	Assets	–1441.7	–871.0
		1970–84	0.01 .90	1.0 .31
A	.53	Increase	+2812.7	–26.7
		Value Domestic	3.4 .00	1.1 .26
B	.85	Assets	+4341.3	+4.6
		1970–84	1.3 .19	0.3 .80

Note: VIL. A = *Chak* 323.
B = Rahimabad.

Independent Variables Beta (t) sig.			
Area Leased in 70	Area Sharcrop in 70	Area Sharcrop out 70	Value Farm Assets 70
−38.9	−52.4	+34.1	−2.02
2.0 .05	1.7 .09	1.0 .31	1.6 .12
−132.6	−93.7	+29.3	−0.1
0.3 .76	1.1 .27	5.3 .00	4.9 .00
−58.6	−10.2	Drop	+0.04
1.6 .12	0.2 .86		1.2 .23
+83.6	−74.3	+14.2	+0.0
0.3 .73	1.6 .11	4.7 .00	0.1 .90
−2816.1	Drop	Drop	+2.9
1.8 .07			2.3 .03
Drop	Drop	+1248.6	+3.5
		1.8 .08	2.2 .03
+51.1	−120.5	+168.0	+0.1
1.2 .24	1.8 .08	2.3 .03	3.6 .00
Drop	−229.0	+32.7	+0.1
	1.0 .32	2.2 .03	3.8 .00

3 shows that in *Chak* 323 the correlation coefficient dropped for all assets, as compared to Table 2. So, area transition weakened the correlation between the increase in assets and the explanatory variables. The area owned in 1970 was positively and significantly correlated to the increase in mechanical assets, tractors, and tubewells. The area owned was significantly negatively correlated to the increase in bullocks. And the area owned was insignificantly correlated to the increase in non-farm assets and domestic assets. So, the only change between Tables 2 and 3 was the insignificance of the area owned for drills, sprayers, and domestic assets. Leased-in area in 1970 was positively and significantly correlated to the increase in mechanical assets, tractors, and tubewells. The leased-in area was negatively significantly correlated to increase in bullocks and non-farm assets. Leased-in area was insignificantly correlated to domestic assets. The only change between Tables 2 and 3 was the insignificance of drills, sprayers, and domestic assets, and the negative correlation of non-farm assets. Farm assets in 1970 were only significantly positively correlated to the increase in non-farm assets.

These results actually predict the probability of increase in assets of the operators in 1970 in *Chak* 323. In 1970, there was a 1/3rd probability that an individual's mechanical assets would increase by Rs 225 per incremental owned acre, and by another Rs 350 per incremental leased-in acre. The probability for the individual drops by about 1/3rd from the probability for the size class. This is a very important result: that the size class was heavily constrained in its acquisition of assets over time, while the individual was less so.

In Rahimabad, the correlation coefficients did not drop between Tables 2 and 3. Owned area in 1970 was significantly positively correlated to the increase in mechanical assets, tubewells, drills, and sprayers. The area owned was significantly negatively correlated to the increase in tractors, bullocks, and milk animals. The area owned was insignificantly correlated to the increase in non-farm assets and domestic assets. The major change between Tables 2 and 3 was in the increased significance of the negative correlation between the owned area and the increase in tractors. This confirms the supervision constraint, in that large owners in 1970 definitely decreased their value of tractors between 1970 and 1984. The value of farm assets in 1970 was significantly positively correlated to the increase in mechanical assets, tractors, tubewells, non-farm assets, and domestic assets. The value of farm assets in 1970 was significantly negatively correlated to the increase in bullocks. So in Rahimabad, the probability of asset change for the individual remained as high as that for the size class. In 1970, there was a 3/4ths probability that mechanical assets would increase by about Rs 35 per incremental owned acre, and non-farm assets by about Rs 1300 per incremental sharecropped-out acre. The supervision constraint, however, gave a 1/3rd probability that tractors would not increase. Then, in Rahimabad, both the size class and the individual's assets change were highly

constrained; while in *Chak* 323 it was largely the size class.

6. CONCLUSIONS

Contrasting change in assets over time in the two villages of *Chak* 323 and Rahimabad has been explained well by some of the variables in the exogenous-endogenous model used. The posited variables of operated, owned, and leased area have usefully explained the trends in the accumulation of farm assets. The posited variables of remittances and the number of family males have not explained these trends in the accumulation of farm and non-farm assets very consistently. The increase in mechanical assets per farm over time was positively correlated to the operated area in both villages. In *Chak* 323 there were two break points, at 5 acres and 25 acres, above which the increase rose sharply. In Rahimabad the weaker drive towards mechanisation raised this break point to 50 acres. Bullocks per farm substituted for tractors, increasing below-12 acres and decreasing above this acreage in *Chak* 323. In Rahimabad this turning-point came higher up, at 25-acres.

This results in a very high statistical probability of 2/3rds; that growth of mechanical assets increased with the size class, in both villages. The probability of assets increase for an individual dropped by a 1/3rd from the probability for the size class in *Chak* 323. But in Rahimabad, the probability for the individual remained as high as for the size class. So, growth of assets remained bound to the size class in both villages, with better chances for the individual in the canal colony village, but fewer chances for the individual in the southern Punjab village.

The already high degree of land concentration in the southern Punjab village of Rahimabad was seen to inhibit the further area expansion of the largest operators already above-250 acres. These operators were seen to have fixed an optimal tractor per acre ratio by 1970. As a result, when supervision problems dictated a decrease in their operated area, their tractors per farm also fell, leaving this tractor per acre ratio constant. Any other outcome was seen to be sub-optimal in terms of productivity.

Therefore, growth and distribution of agrarian assets in the Punjab showed some common trends between its major regions of the canal colonies and southern Punjab in constraining the accumulation of small farmers. The phenomenon was also seen to follow some divergent regional trends, constraining further expansion of the already very large farms in the more concentrated south.

Table A1A

Chak *323: Value of Assets/Farm in 1970 Prices (000 Rupees)*

Operated Area (Acres)	Mechanical Assets			Tractors			Tubewells		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	NA	0.05	+0.05	NA	0.0	0.0	NA	0.0	0.0
5–<12	0.02	6.93	+6.91	0.0	3.68	+3.68	0.0	1.65	+1.65
12–<25	1.64	3.89	+2.25	1.6	2.36	+0.76	0.0	0.85	+0.85
25–<50	0.16	17.89	+17.73	0.0	12.34	+12.34	0.0	1.93	+1.93
50–<150	0.02	39.03	+39.01	0.0	22.4	+22.4	0.0	11.87	+11.87
>150	7.5	55.1	+47.6	7.5	33.0	+25.5	0.0	12.68	+12.68
Total	0.94	7.72	+6.78	0.88	4.57	+3.69	0.0	1.71	+1.71
Tenure									
Owners	0.68	6.09	+5.41	0.67	3.99	+3.32	0.0	0.85	+0.85
Own+Ten	0.0	18.35	+17.45	0.83	10.73	+9.9	0.0	4.42	+4.42
Tenants	0.11	3.55	+3.44	0.0	1.65	+1.65	0.0	1.26	+1.26
Non-ops	0.0	5.15	+5.15	0.0	3.33	+3.33	0.0	0.33	+0.33

Table A1A

Chak *323: Value of Assets/Farm in 1970 Prices (000 Rupees)*

Operated Area (Acres)	Drills+Sprayers			Fodder-cutters			Transport		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	NA	0.0	0.0	NA	0.04	+0.04	NA	0.0	0.0
5–<12	0.0	0.75	+0.75	0.0	0.14	+0.14	0.0	0.11	+0.11
12–<25	0.0	0.18	+0.18	0.02	0.12	+0.10	0.0	0.64	+0.64
25–<50	0.0	0.64	+0.64	0.01	0.39	+0.38	0.0	0.47	+0.47
50–<150	0.0	3.0	+3.0	0.02	0.4	+0.38	0.0	2.03	+2.03
>150	0.0	4.7	+4.7	0.0	0.35	+0.35	6.77	14.38	+7.61
Total	0.0	0.58	+0.58	0.02	0.15	+0.13	0.2	0.88	+0.68
Tenure									
Owners	0.0	0.71	+0.71	0.01	0.13	+0.12	0.0	0.41	+0.41
Own+Ten	0.0	1.16	+1.16	0.02	0.27	+0.25	0.75	3.23	+2.48
Tenants	0.0	0.06	+0.06	0.02	0.1	+0.08	0.0	0.09	+0.09
Non-ops	0.0	0.44	+0.44	0.0	0.24	+0.24	0.0	0.84	+0.84

Table A1A

Chak *323: Value of Assets/Farm in 1970 Prices (000 Rupees)*

Operated Area (Acres)	Animal Assets			Bullocks			Milch Animals		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	NA	1.72	+1.72	NA	0.0	0.0	NA	1.48	+1.48
5–<12	3.74	3.37	–0.37	0.88	1.26	+0.38	1.55	1.75	+0.20
12–<25	3.97	3.08	–0.89	1.47	0.9	–0.57	1.68	1.8	+0.12
25–<50	6.24	6.61	+0.37	2.54	1.49	–1.05	1.97	4.60	+2.63
50–<150	10.17	5.83	–4.34	2.3	0.23	–2.07	7.52	5.17	–2.35
>150	17.13	8.43	–8.7	7.2	1.55	–5.65	4.5	4.93	+0.43
Total	5.88	3.44	–2.44	1.82	0.92	–0.9	2.71	2.09	–0.62
Tenure									
Owners	2.24	3.51	+1.27	1.37	0.75	–0.62	2.06	2.39	+0.33
Own+Ten	8.11	5.05	–3.06	2.19	1.1	–1.09	4.87	3.3	–1.57
Tenants	4.36	2.36	–2.0	2.17	1.04	–1.13	1.01	1.0	–0.01
Non-ops	5.88	3.22	–2.66	0.0	0.85	0.85	1.85	2.03	+0.18

Table A1A

Chak *323: Value of Assets/Farm in 1970 Prices (000 Rupees)*

Operated Area (Acres)	Farm Assets			Non-farm Assets			Domestic Assets		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	NA	1.78	+1.78	NA	0.0	0.0	NA	1.49	+1.49
5–<12	4.35	10.41	+6.06	0.2	1.38	+1.18	0.49	2.35	+1.86
12–<25	10.87	7.61	–3.26	2.33	45.78	+43.45	0.26	2.06	+1.8
25–<50	7.24	24.96	+17.72	1.58	3.57	+1.99	0.22	3.23	+3.01
50–<150	10.81	46.90	+36.09	0.0	67.33	+67.33	0.09	13.0	+12.91
>150	92.3	77.93	–14.37	28.33	217.58	+189.1	0.37	22.73	+22.36
Total	11.54	12.04	+0.05	2.14	29.5	+27.36	0.3	3.11	+2.81
Tenure									
Owners	4.8	10.01	+5.21	1.07	9.48	+8.41	0.17	2.91	+2.74
Own+Ten	18.53	26.65	+8.12	2.96	122.29	+119.3	0.33	6.9	+6.57
Tenants	5.06	6.03	+1.03	1.11	0.85	–0.26	0.16	1.12	+0.96
Non-ops	1.85	9.2	+7.35	0.0	3.0	+3.0	0.35	2.26	+1.91

Table A1B

Rahimabad+: Value of Assets/Farm in 1970 Prices (000 Rupees)

Operated Area (Acres)	Mechanical Assets			Tractors			Tubewells		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	0.4	0.52	+0.12	0.0	0.0	0.0	0.0	0.32	+0.32
5–<12	0.0	0.42	+0.42	0.0	0.0	0.0	0.0	0.0	0.0
12–<25	0.04	5.41	+5.37	0.0	2.82	+2.82	0.0	2.15	+2.15
25–<50	0.24	0.32	+0.08	0.0	0.0	0.0	0.0	0.0	0.0
50–<150	2.72	39.93	+37.21	2.56	22.14	+19.58	0.0	15.06	+15.06
>150	35.06	84.08	+49.02	34.4	19.42	14.98	0.0	60.86	+60.86
Total	0.90	3.28	+2.38	0.83	1.14	+0.31	0.0	1.63	+1.63
Tenure									
Owners	5.42	9.62	+4.2	5.27	3.87	–1.4	0.0	5.06	+5.06
Own+Ten	0.08	8.92	+8.84	0.0	2.06	+2.06	0.0	6.21	+6.21
Tenants	0.05	0.43	+0.38	0.0	0.0	0.0	0.0	0.0	0.0
Non-ops	26.14	23.71	–2.43	26.1	14.2	–11.9	0.0	7.92	+7.92

Table A1B

Rahimabad+: Value of Assets/Farm in 1970 Prices (000 Rupees)

Operated Area (Acres)	Drills+Sprayers			Fodder-cutters			Transport		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	0.0	0.0	0.0	0.1	0.07	–0.03	0.0	0.0	0.0
5–<12	0.0	0.0	0.0	0.0	0.24	+0.24	0.0	0.0	0.0
12–<25	0.0	0.0	0.0	0.0	0.17	+0.17	0.0	0.19	+0.19
25–<50	0.03	0.03	0.0	0.0	0.1	+0.1	0.0	0.0	0.0
50–<150	0.0	1.29	+1.29	0.0	0.0	0.0	18.5	21.47	+2.97
>150	0.0	2.54	+2.54	0.06	0.28	+0.22	26.0	56.46	+30.46
Total	0.0	0.08	+0.08	0.0	0.21	+0.21	1.26	1.46	+0.2
Tenure									
Owners	0.0	0.24	+0.24	0.0	0.12	+0.12	8.01	4.67	–3.34
Own+Ten	0.0	0.26	+0.26	0.02	0.15	+0.13	0.0	4.66	+4.66
Tenants	0.0	0.0	0.0	0.0	0.24	+0.24	0.0	0.0	0.0
Non-ops	0.0	0.94	+0.94	0.0	0.05	+0.05	37.5	14.98	–22.52

Table A1B

Rahimabad+: Value of Assets/Farm in 1970 Prices (000 Rupees)

Operated Area (Acres)	Animal Assets			Bullocks			Milch Animals		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	2.35	2.98	+0.63	2.0	1.08	–0.92	0.25	1.86	+1.61
5–<12	2.66	3.37	+0.71	0.92	1.71	+0.79	1.71	1.50	–0.21
12–<25	2.39	5.33	+2.94	0.99	2.11	+1.12	1.17	2.84	+1.67
25–<50	7.99	5.62	–2.37	5.18	2.93	–2.25	1.6	2.68	+1.08
50–<150	11.46	3.27	–8.19	3.33	0.59	–2.74	8.0	2.4	–5.6
>150	52.34	9.04	–43.3	29.1	4.28	–24.82	17.7	4.14	–13.56
Total	4.6	3.7	–0.9	2.08	1.74	–0.34	2.11	1.79	–0.32
Tenure									
Owners	9.87	4.92	–4.95	4.41	2.09	–2.32	4.15	2.49	–1.66
Own+Ten	5.94	4.89	–1.05	2.26	1.83	–0.43	2.69	2.52	–0.17
Tenants	2.34	3.14	+0.8	1.15	1.59	+0.44	1.17	1.46	+0.29
Non-ops	7.73	2.5	–5.23	2.06	0.33	–1.73	4.8	1.93	–2.87

Table A1B

Rahimabad+: Value of Assets/Farm in 1970 Prices (000 Rupees)

Operated Area (Acres)	Farm Assets			Non-farm Assets			Domestic Assets		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	2.75	3.5	–0.75	0.0	15.15	+15.15	0.0	1.51	+1.51
5–<12	2.66	3.79	+1.13	0.0	114.64	+114.64	0.13	0.84	+0.71
12–<25	2.53	10.93	+8.4	0.05	5.51	+5.46	0.09	1.73	+1.64
25–<50	8.24	5.94	–2.3	0.0	100.0	+100.0	0.0	8.26	+8.26
50–<150	74.39	64.67	–9.72	16.67	147.86	+131.2	4.26	29.47	+25.21
>150	227.1	149.56	–77.54	140.0	638.0	+498.0	13.16	73.0	+59.84
Total	11.18	8.45	–2.73	4.25	101.11	+96.86	0.56	3.1	+2.54
Tenure									
Owners	48.81	19.21	–29.6	22.97	67.73	+44.76	2.97	8.79	+5.82
Own+Ten	6.58	18.48	–11.9	0.28	20.63	+20.35	0.11	3.61	+3.5
Tenants	2.39	3.56	+1.17	0.0	119.09	+119.1	0.06	0.81	+0.75
Non-ops	235.0	41.19	–193.8	134.64	1045.4	+910.7	14.36	42.78	+28.42

Table A2A

Chak *323: Value of Assets/Acre in 1970 Prices (000 Rupees)*

Operated Area (Acres)	Mechanical Assets			Tractors			Tubewells		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	NA	0.03	+0.03	NA	0.0	0.0	NA	0.0	0.0
5–<12	0.0	0.92	+0.92	0.0	0.49	+0.49	0.0	0.22	+0.22
12–<25	0.1	0.24	+0.14	0.1	0.15	+0.05	0.0	0.05	+0.05
25–<50	0.0	0.57	+0.57	0.0	0.39	+0.39	0.0	0.06	+0.06
50–<150	0.0	0.46	+0.46	0.06	0.26	+0.26	0.0	0.14	+0.14
>150	0.05	0.25	+0.2	0.05	0.15	+0.1	0.0	0.06	+0.06
Total	0.03	0.37	+0.34	0.03	0.22	+0.19	0.0	0.08	+0.08
Tenure									
Owners	0.06	0.64	+0.58	0.06	0.42	+0.36	0.0	0.01	+0.01
Own+Ten	0.03	0.39	+0.36	0.03	0.23	+0.2	0.0	0.01	+0.01
Tenants	0.0	0.17	+0.17	0.0	0.08	0.0	0.0	0.0	0.0
Non-ops	0.0	0.37	+0.37	0.0	0.24	+0.24	0.0	0.02	+0.02

Table A2A

Chak *323: Value of Assets/Acre in 1970 Prices (000 Rupees)*

Operated Area (Acres)	Drills+Sprayers			Fodder-cutters			Animal Assets		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	NA	0.0	0.0	NA	0.02	+0.02	NA	0.86	+0.86
5–<12	0.0	0.1	+0.1	0.0	0.02	+0.02	0.49	0.45	–0.04
12–<25	0.0	0.01	+0.01	0.0	0.01	+0.01	0.25	0.19	–0.06
25–<50	0.0	0.02	+0.02	0.0	0.01	+0.01	0.18	0.21	+0.03
50–<150	0.0	0.04	+0.04	0.0	0.0	0.0	0.15	0.07	–0.08
>150	0.0	0.02	+0.02	0.0	0.0	0.0	0.12	0.04	–0.08
Total	0.0	0.03	+0.03	0.0	0.01	+0.01	0.21	0.16	–0.05
Tenure									
Owners	0.0	0.08	+0.08	0.0	0.01	+0.01	0.21	0.37	+0.16
Own+Ten	0.0	0.02	+0.02	0.0	0.01	+0.01	0.23	0.11	–0.12
Tenants	0.0	0.0	0.0	0.0	0.0	0.0	0.15	0.11	–0.04
Non-ops	0.0	0.03	+0.03	0.0	0.02	+0.02	0.13	0.23	–0.10

Table A2A

Chak *323: Value of Assets/Acre in 1970 Prices (000 Rupees)*

Operated Area (Acres)	Bullocks			Milch Animals			Farm Assets		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	NA	0.0	0.0	NA	0.74	+0.74	NA	0.89	+0.89
5–<12	0.12	0.17	+0.05	0.2	0.23	+0.03	0.57	1.38	+0.81
12–<25	0.09	0.06	–0.03	0.11	0.11	0.0	0.69	0.48	–0.21
25–<50	0.07	0.05	–0.02	0.06	0.15	+0.09	0.21	0.80	+0.59
50–<150	0.03	0.0	–0.03	0.11	0.06	–0.05	0.16	0.55	+0.39
>150	0.05	0.01	–0.04	0.03	0.02	–0.01	0.64	0.35	–0.29
Total	0.07	0.04	–0.03	0.1	0.1	0.0	0.42	0.57	+0.15
Tenure									
Owners	0.06	0.08	–0.02	0.09	0.25	+0.16	0.46	1.05	+0.59
Own+Ten	0.06	0.02	–0.04	0.14	0.07	–0.07	0.53	0.574	+0.04
Tenants	0.07	0.05	–0.02	0.03	0.05	+0.02	0.17	0.28	+0.11
Non-ops	0.0	0.6	+0.6	0.13	0.15	+0.02	0.13	0.66	+0.53

(Sample Survey, 1984).

Note: Own+Ten = Owners + Tenants.
Non-ops = Non-operators.

Table A2B

Rahimabad+: Value of Assets/Acre in 1970 Prices (000 Rupees)

Operated Area (Acres)	Mechanical Assets			Tractors			Tubewells		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	0.01	0.2	+0.1	0.0	0.0	0.0	0.0	0.12	+0.12
5–<12	0.02	0.07	+0.07	0.0	0.0	0.0	0.0	0.0	0.0
12–<25	0.09	0.34	+0.34	0.0	0.18	+0.18	0.0	0.14	+0.14
25–<50	0.01	0.0	–0.01	0.0	0.0	0.0	0.0	0.0	0.0
50–<150	0.04	0.57	+0.53	0.04	0.32	+0.28	0.0	0.22	+0.22
>150	0.04	0.18	+0.14	0.04	0.04	0.0	0.0	0.13	+0.13
Total	0.03	0.2	+0.17	0.02	0.07	+0.05	0.0	0.1	+0.1
Tenure									
Owners	0.04	0.26	+0.22	0.04	0.11	+0.07	0.0	0.14	+0.14
Own+Ten	0.0	0.16	+0.16	0.0	0.04	+0.04	0.0	0.11	+0.11
Tenants	0.0	0.07	+0.07	0.0	0.0	0.0	0.0	0.0	0.0
Non-ops	0.03	0.23	+0.2	0.03	0.14	+0.11	0.0	0.08	+0.08

Table A2B

Rahimabad+: Value of Assets/Acre in 1970 Prices (000 Rupees)

Operated Area (Acres)	Drills+Sprayers			Fodder-Cutters			Animal Assets		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	0.0	0.0	0.0	0.03	0.03	0.0	0.59	1.14	0.55
5–<12	0.0	0.0	0.0	0.0	0.04	+0.04	0.33	0.59	+0.26
12–<25	0.0	0.0	0.0	0.0	0.01	+0.01	0.16	0.34	+0.18
25–<50	0.0	0.0	0.0	0.0	0.0	0.0	0.22	0.17	–0.05
50–<150	0.0	0.02	+0.02	0.0	0.0	0.0	0.16	0.05	–0.11
>150	0.0	0.0	0.0	0.0	0.0	0.0	0.06	0.02	–0.04
Total	0.0	0.0	0.0	0.0	0.01	+0.01	0.13	0.23	+0.1
Tenure									
Owners	0.0	0.0	0.0	0.0	0.0	0.0	0.07	0.13	+0.06
Own+Ten	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.09	–0.21
Tenants	0.0	0.0	0.0	0.0	0.04	+0.04	0.16	0.53	+0.37
Non-ops	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.02	+0.01

Table A2B

Rahimabad+: Value of Assets/Acre in 1970 Prices (000 Rupees)

Operated Area (Acres)	Bullocks			Milch Animals			Farm Assets		
	1970	1984	Change 70–84	1970	1984	Change 70–84	1970	1984	Change 70–84
<5	0.5	0.42	–0.08	0.06	0.71	+0.65	0.69	1.34	+0.65
5–<12	0.11	0.3	+0.19	0.21	0.26	+0.05	0.33	0.66	+0.33
12–<25	0.07	0.13	+0.06	0.08	0.18	+0.1	0.17	0.69	+0.52
25–<50	0.14	0.09	–0.05	0.04	0.08	+0.04	0.23	0.17	–0.06
50–<150	0.05	0.01	–0.04	0.11	0.03	–0.08	1.04	0.93	–0.11
>150	0.03	0.01	–0.02	0.02	0.01	–0.01	0.261	0.33	+0.07
Total	0.06	0.11	+0.05	0.06	0.11	+0.05	0.32	0.52	+0.2
Tenure									
Owners	0.03	0.06	+0.03	0.03	0.07	+0.04	0.35	0.52	+0.17
Own+Ten	0.11	0.03	–0.08	0.13	0.05	–0.08	0.33	0.34	+0.01
Tenants	0.08	0.27	+0.19	0.08	0.25	+0.17	0.16	0.6	+0.44
Non-ops	0.0	0.0	0.0	0.01	0.02	+0.01	0.24	0.40	+0.16

(Sample Survey, 1984).

Note: Own+Ten = Owners + Tenants.
Non-ops = Non-operators.

REFERENCES

Binswanger, H. P. (1978) *The Economics of Tractors: An Analytical Review Hyderabad: India.* New York: Agricultural Development Council.

Booth, A., and R. M. Sundrum (1985) *Labour Absorption in Agriculture.* Oxford: Oxford University Press.

Bose, S. R., and E. H. Clark (1969) Some Basic Conclusions on Agricultural Mechanisation in West Pakistan. *The Pakistan Development Review* 9:3 273–308.

Chadha, (1978) Farm Size and Productivity Revisited: Some Notes from Recent Experience of the Punjab. *Economic and Political Weekly* 13:39.

Hicks, J. R. (1932) *The Theory of Wages.* London: Macmillan.

Johl, S. S. (1972) Mechanisation, Labour Use, and Productivity in Indian Agriculture. Department of Agricultural Economics and Rural Sociology, Studies in Agricultural Capital and Technology. (Occasional Paper No. 23).

Mahmood, Moazam (1990) The Change in Land Distribution in the Punjab–Empirical Application of an Exogenous-endogenous Model for Agrarian Sector Analysis. *The Pakistan Development Review* 29: 3&4.

Salam, A., *et al.* (1981) Farm Mechanisation, Employment, and Productivity in Pakistan's Agriculture. *Pakistan Economic and Social Review* 19:2.

Sen, Abijit (1981) Market Failure and Control of Labour Power: Towards an Explanation of Structural Change in Indian Agriculture, Parts I and II. *Cambridge Journal of Economics* 5: 201.

Sen, A. K. (1968) *Choice of Techniques.* Oxford: Basil Blackwell.

Singh, I. J. (1971) A Recursive Model of Traditional Agricultural in Transition. Ph. D. Thesis, University of Michigan.