AGRARIAN PRODUCTION RELATIONS
(A MICRO STUDY BASED ON COST OF CULTIVATION DATA)

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Introduction:

The main objective of this paper is to study the production relations on farms of different sizes. It is normally assumed that favorable production relations in crop production, if provided will definitely increase the value of output. To mention, the production factors - land use, labor use, and other intermediary/material inputs, such as, improved seeds, fertilizers, machinery, implements, water supply, etc, associated with new technology operate in combination across different farm size groups (the principal productive unit) in increasing the productivity.

In the economic literature, there are differences of opinion on the nature of the use of production factors across farm size groups and it is quite debated and empirically examined by many scholars. It is very often found, that smaller farm size groups are more efficient and also the levels of utilization of production factor inputs are higher in these farms in comparison to larger farm size groups [Sen (1962); Bharadwaj (1974); Reddy (1993); Sharma and Sharma (2000); etc]. On the other hand, some scholars raised doubts on the survival of above statement in the post green revolution period. With the advent of new technology no such differences are observed in the production relations [Ghose (1979); Hanumantha Rao (1975); Bardhan (1973); Chadha (1978); and others].

To mention at the outset, over a period of time many institutional, technological and policy changes have taken place and these factors might have influenced the correlation of farm size with productive units and facilities.

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Therefore, it is of our interest in this study to examine the differences in the use of major production factors, viz., land, labor, inputs and also other important variables in total crop production activity across farm size groups in the post economic reform period using the primary data samples collected from Cost of Cultivation studies for the state of Andhra Pradesh.

The data used in this present study is for the normal year, 1994-95. It represented a favorable year in post-liberalization phase- a period of strong recovery in agriculture following a run of poor monsoons, which retarded agricultural growth. Compared to the previous years, the country has had excellent rains and as a consequence food grain production had a record output up to the level of 191 million tones.

Section II

A brief description of some of the *concepts* presented and the *nature of hypothesis* being tested are discussed in this section.

***Farm size*:** One of the important production units in agriculture is 'land', that is the most commonly used classificatory basis, namely, the 'size of land holding' or 'farm size'. 'Farm size' is defined as the 'physical area of the cultivator', which is used wholly or partly for agricultural production[1]. Farm size being the principle productive resource and the level of utilization of this crucial resource is closely correlated with the ability to command other productive inputs and facilities. The pattern of land use over farm size groups would bring to light the extent of utilization of the available land resources in crop production and the prospects of expansion in employment in the new areas, etc.

[1] *'In the economic literature, most of the empirical research carried out by different scholars' defined 'Farm size' as Acreage (physical area), Gross Cropped Area, Net Sown Area, Operational Holding (land owned minus land leased out plus land leased in), etc. Some times, it is defined as 'Relative Farm Size' which is acreage divided by number of family members engaged in crop production. The use of different definition of size of holdings is likely to give different results.*

***Cropped Area*:** 'Cropped Area' is defined as the 'area under crop cultivation'. This area does not include the 'current fallows lands'; 'permanent fallows lands' and 'cultivable waste' lands[2]. Again Cropped Area is of two types – 'Gross Cropped Area' and 'Net Sown Area'. In our study, 'Gross Cropped Area' is defined as the 'net sown area plus area sown more than once'. 'Net Sown Area' is defined as 'operational holding minus uncultivated area'. The extent of factor inputs such as the human labour, animal labour, tractor hours and material inputs like seeds and chemical fertilizers, etc in the crop production are measured and analyzed as per both gross cropped area (GCA) and net sown area (NSA).

Plot size: The role of production relations, especially in Indian agriculture is associated with fragmentation of land holdings. That is, the more number of fragments/parcels and the distance between them will increase the total expenditure per hectare as well the labour requirements. It is of expectation that small farmers hold more number of fragments, which is associated with negative value of production. In our study, as the cost of cultivation data shows that fragmentation (parcels) is present in all size groups, we have tried to find the pattern of fragmentations with farm size groups. Since, we do not have data on distance between the parcels, as an alternative appropriate measure, we have used plot size. 'Plot size' is defined as 'the ratio of farm size to number of parcels'. It is of expectation that small farmers hold more number of fragments.

Value of Production: 'Value of Production' is defined as 'total yield or output of the crop production'. As there are limitations involved in measuring the quantities of different crop outputs, in the analysis we have considered the value measurement, which seems to be an appropriate measure in given context of study. Moreover, in the review of literature, most of the empirical research centered on issues relating the total crop output (production) with farm size and the relationship of these two variables still continues to be a moot question. In economic sense, there is positive correlation of value of production with size of farm [Bharadwaj (1974)].

[2] *The 'Current fallows' means the land that is cultivated but not cropped during the year for a variety of reasons like crop rotation, unfavorable weather conditions, etc. 'Permanent fallow' is the land once cultivated but left fallow for periods exceeding one year but not more five years in succession; 'Cultivable waste' is meant to include the land suitable for growing crops but not cultivated. Also in this category is included the land that is cultivated once but left fallow for more than five successive years.*

Cropping Intensity: Cropping Intensity' is defined/measured as a 'ratio of gross cropped area to land holding in percentages'. One of the important factor through which value of production and labour use, etc could be increased is the cropping intensity, and it depends on the amount of rainfall, soil type and the level of irrigation. In the economic literature, it is recognized that cropping intensity is higher on irrigated areas and varies with the level of irrigation depending on the type and source of irrigation [Motilal (1973); Chadha and Sharma (1982); etc]. We also find differences of opinion on the aspect of cropping intensity with farm size groups. According to some empirical evidences, intensity of cropping showed a tendency to vary inversely with the size of holding irrespective of level of irrigation [Sen (1962); Bardhan (1973); etc]. The possible explanations given are: small farms tend to use more family labour compared to large farms, soil characteristics, cropping pattern which is of short duration category, etc. Therefore, it is of our interest in this chapter to examine the differences in different farm size groups.

Proportion of Irrigated Area: Irrigation plays an important role in crop production, that is, it increases the labour input via an increase in cropping intensity. Irrigation improves the relative economic position of the farming community and generates dynamism of growth and productivity [Vaidyanathan (1987); Rao, S.K. (1979); etc]. This however, depends on the type or source of irrigation. Above all, the proportion of irrigated area has the potential for higher cropping intensity and an increase in total value of production. It is of expectation that large farmers hold more proportion of irrigated area. To examine the effects of irrigation by combining all sources of irrigation under one heading is likely to give misleading results because they have a varying degree of importance. To quote, the major sources of irrigation are canals, tanks, wells and tube wells. The most dependable source is canal and tube well irrigation because tank and well irrigation is extremely sensitive to rainfall conditions (being essential rain fed). Even within one type of irrigation there are wide differences in quality. As such, in the analysis of cost of cultivation studies, we have computed 'Proportion of Irrigated Area'. It is defined as 'the ratio of gross irrigated area to gross cropped area' separately to avoid the misleading results, irrespective of the type of irrigation used.

Proportion of High Yield Variety Area: The pattern of land use is reflected in a significant growth in agricultural production, and with the high yield variety innovations (such as, high yield variety seeds, chemical fertilizers, pesticides, etc) tremendous changes in crop production is witnessed in India. In general, as per the economic theory, it is assumed that high yield varieties are positively related with principal production unit, that is, the farm size (because of better purchasing power of large farmers), but evidences show an inverse relationship of farm size and high yield variety innovations [Schluter and Mellor (1972); Hanumantha Rao (1975); Reddy (1993), etc]. This trend is also observed to be stronger in recent studies [Sharma and Sharma (2000); etc]. In order to examine such differences, we have computed Proportion of High Yield Variety (HYV) Area in the analysis. It is defined as the 'ratio of high yield variety area to gross cropped area'.

Labour Productivity: 'Labour productivity' is defined in the analysis as 'the ratio of total value of production to total labour hours'. Labour Productivity is closely associated with Land Productivity. Labour productivity in agriculture is determined by the use of capital inputs on one-hand and output-augmenting modern biological inputs on the other. Whereas, in Indian agriculture, investment in modern equipment like tractors and tube-wells are quite limited and even the working capital requirements are quite low. In these conditions, labour productivity depends more on fluctuating output determined by vagaries of monsoons than on the quantum of fixed and variable capital [Bhalla and Alagh (1983); Dev (1986); etc]. As such, it will be of our interest to observe labour productivity pattern along with the labour intensity (defined as total labour hours per unit of gross cropped area as well as net sown area) in different farm size groups as per the farm-level data.

Different Constituents of Labour: In the crop production process, involvement of labour is of different categories. Here in the analysis, as per the available statistics, we tried to consider only the pattern of family labour, casual labour, attached farm servants and exchange labour.

The family members of owner cultivation provide *family labour*. Generally, we expect family labour to be *inversely* related to farm size. Small farms tend to use more family labour compared to large farms. We can advance two main reasons for such pattern: one, the opportunity cost of

family labour is less than the market wage rate due to prevalence of mass unemployment and surplus labour in agriculture and as a consequence, small farms will employ family labour more profusely; second reason is of sociological in nature. Large farms due to prestige considerations do not use family labour for manual work. They confine themselves only to supervision work. Thus, one can expect family labour to be inversely associated with farm size.

Casual labour is usually hired on day-to-day basis. They are also called as seasonal labour. In a peak season, certain critical operations have to be performed in a limited period of time and therefore, even small farmers might have to hire in labour. The component of casual/hired labour in total labour is higher than for any other kind of labour, except the family labour. We expect casual labour to have *positive* association with farm size groups. As said earlier, large farms for various reasons will use less of family labour and substitute it with casual or attached labour.

Among the different types of labour, servant labour or *attached farm servants* are of permanent labour or hired on contract basis. In fact, Attached labour a substitute for family labour, in the sense, that supply of attached labour is almost as certain as that of family labour. Farmers try to make a trade off between insuring the risk of not getting an assured labour supply during busy seasons and minimizing the cost of labour use by striking a balance between the uses of attached and casual labour. We expect attached labour to be *positively* associated with farm size.

Exchange labour is a system of hiring of labour services for smoothing labour supply (especially, small farmers hire out their services). In this system no payment is involved (the work is done on mutual basis) for hiring labour but the farmer has to work for an equivalent number of hours on the farms of those whose services he had hired. Labour is exchanged partly to over come credit constraints. There fore, we expect exchange labour to *decline* with increase in farm size.

Hypotheses:

The following hypotheses that are being tested are:

1. To examine whether farm size effect on production factors is negative. The current literature on agricultural affairs is replete with studies on the effect of farm size and of production relations/factors. Many researchers found the negative size effect on land productivity is due mainly to the existence of negative relations of production factors.
2. The higher cropping intensity (measured as the ratio of gross cropped area to land holding in percentages) on small farms is considered to be an important factor in explaining the inverse relationship between farm size and productivity. Positive association with proportion of irrigated area, intermediary/material inputs, total labour hours, labour productivity and value of production, etc follows the higher cropping intensity.
3. It is expected in our study the number of fragments/parcels has a negative association with farm size and a positive association with the total labour requirements. That is, the plot size (a proxy taken for fragmentation of land holdings and it is measured as a ratio of farm size to number of fragments) will increase with the size of farm.
4. As far as differences in different types of labour hours are concerned, it is expected that family labour, exchange labour, animal labour to be negatively associated with farm size and on the other hand, casual labour and attached labour is expected to be positive with farm size groups.
5. No hypotheses are being made regarding the relationship between soil quality and farm size. With the dynamics of new technology and high yield variety innovations; it is assumed soil quality differences are no longer considered as a hindrance factor in crop production. However, in the sample analysis, we have taken the 'rental value per hectare' as a proxy measurement, as it is not possible to measure the quality of soil. It is assumed fertile land fetches a better price.

Section III

Methodology

The sample study undertaken using the cost of cultivation scheme data is Andhra Pradesh state for the year 1994-95 (a normal year after introduction of economic reforms). The sample size covered under the scheme in Andhra Pradesh is 600 households, distributed among 120 villages from 60 tehsils/clusters, belonging to five zones or regions.

As per Cost of Cultivation studies 'FARMSIZE' is defined as 'Acreage or Physical Area of the cultivator'. Average farm size in Farm size group one is 0 to 1 hectares; farm size group two is 1 to 2 hectares; farm size group three is 2 to 4 hectares; farm size group four is 4 to 6 hectares; and farm size group five is 6 hectares and above.

In order to examine the differences across farm size groups both parametric and non-parametric tests are used. Analysis of Variance (ANOVA) is used as a parametric test and the Kruskal-Wallis test as a non-parametric test. The Kruskal-Wallis test has a power efficiency of 95.5 % when compared with ANOVA, under conditions where the assumptions associated with ANOVA is used when more than two sample means are to be compared for differences, and F value determines the ratio of the variability occurring between the sample groups and the variability occurring within each of the sample groups. When the F value is higher, there is a greater possibility that the sample represent different populations. A high F ratio indicates that there is a great deal of between-group variability and little within-group variability. This would also mean that the small distributions show little or no overlap. A low F ratio shows that there is little between-group variability compared to the amount of within-group variability. The Kruskal-Wallis test is the extension of Mann-Whitney test. It is used when testing differences are more than two groups and it is an extremely useful test for deciding whether K independent samples are from different populations. We can say that whether the differences among the sample signify genuine population differences or whether they represent merely chance variations. The Kruskal-Wallis technique tests the null hypothesis that the K samples come from the same population or from identical populations with respect to averages. The procedure for computing the Kruskal-Wallis test is similar to that is used in the Mann-Whitney test. All cases from the groups are combined and ranked. Average ranks are assigned in the case of ties. For

each group, the ranks are summed, and Kruskal-Wallis (chi-square in our analysis) statistic is computed from these sums.

Section IV

Empirical Analysis

In the following section, we analyze the empirical evidence of the above said hypothesis under two headings:

1. Farm size with land use factors; and
2. Farm size with labour use factor.

The results for the total crop production are presented in Table 1 (ANOVA) and Table 2 (Kruskal-Wallis test).

1. *Farm size with land use factors*: As per the sample study, even after the introduction of economic reforms, the differences exist in the use of production factors across different farm size groups which corroborate the empirical evidences as discussed earlier[3].

To begin with, the *cropping intensity* findings have a consistent and systematic inverse pattern with farm size groups, which support our hypotheses as well as corroborate the literature reviewed. It is observed the cropping intensity declines from 143 percent to 95 percent as size class increase from one to five; and the intensity of cropping is 19 percent high in smaller farms when compared with total samples average and 50 percent higher than the larger size groups. Both the parametric (means) and non-parametric (mean ranks) tests results are statistically significant and robust. One among the reasons put forward is in the economic literature is the labour intensity differences, soil quality differences (an exogenous factor), fragmentation of land holdings, etc for such inverse pattern in farm size groups.

In our analysis, we observe labour intensity differences in next section. Where as, to notice the association of soil quality differences in different farm size groups, *rental value per hectare* (a

[3] *We can observe such differences in production factors in Sen (1962); Bharadwaj (1974); Bardhan (1973); etc.*

proxy measurement taken for soil quality) is taken into consideration, even though no assumption is made in our hypotheses regarding the association of soil quality with farm size[4]. In fact, our samples do not show systematic association for explaining the soil quality differences.

One of the explanations put forwarded for higher cropping intensity in smaller farms is reflected in *plot size* (a proxy taken for fragmentation of land holdings). That is, the more number of fragments and the distance between them will increase the total expenditure per hectare (multiple cropping) as well the labour requirements. Here we find a systematic and significant pattern of plot size with farm size groups. The average plot size increases as the size class increases from one to five [On the average small size groups hold 0.60 hectares of the plot size and on the other end, farm size group five has nearly 2.58 hectares of the plot size]. Larger size group cultivators hold less number of fragments or parcels when compared with smaller size group cultivators. Therefore, we expect small farmers keep more parcels of land that can have varying soil characteristics and this also makes possible to cultivate more number of crops (higher cropping intensity).

Higher cropping intensity contributes to the relative higher *value of production per net sown area* on smaller farms, but our data do not support this argument. The variations across farm size groups are random and statistically insignificant for total crop production. It may also be noted, that the findings on the value of production per net sown area neither supports the hypotheses of *positive* association with farm size. On the other end, value of production per unit of gross cropped area is higher on large farms and it is statistically insignificant according to ANOVA test. But, the chi-square value of Kruskal-Wallis test is significant. Both the tests are having conflicting results.

Further more, the pattern relating *proportion of irrigated area* (the ratio of gross irrigated area to gross cropped area) and cropping intensity with farm size appears to be somewhat different. The cropping intensity does not show a positive association with proportion of irrigated area (both the findings are statistically significant and robust). In fact, we observe a significant *positive* association of proportion of irrigated area with farm size. Larger farm size groups are observed

[4] *With the dynamics of new technology and high yield variety innovations; it is assumed soil quality differences are no longer considered as a hindrance factor in crop production.*

to have more proportion of irrigated area compared to smaller farm size groups. Farm size group five has 94 percent of irrigated land in comparison with farm size group one (69 percent). Considering the scope of study and other constraints, it is difficult to further probe into the matter. However, there is a possibility that large farms size groups favor long duration/high value crops with better quality inputs, mechanization, etc associated with high yield variety innovations [Ranade (1980); Vaidyanathan (1987); etc].

We also tried to examine the *material inputs* (such as seeds, chemical fertilizers –NPK, etc) and *tractor hours* per unit of gross cropped area and net sown area with different farm size groups[5].

In the observation there is no systematic or consistent pattern of different intermediary/material inputs such as total value of seeds, total value of chemical fertilizers (NPK), total tractor hours measured per unit of both gross cropped area and net sown area with different farm size groups. The variations across farm size groups are random and statistically insignificant in both the parametric and non-parametric tests undertaken.

The *proportion of High Yield Variety area* (computed as the ratio of high yield variety area to gross cropped area) also does vary systematically with different farm size groups. The variations are random and statistically insignificant.

When one looks at the dynamics of crop production conditions, as per the statistics available from the data set, it is of our interest to witness the influence of credit availability and the level of education in different farm size groups[6]. Some of the studies found that these factors have the ability to quickly establish/access to newly available economically useful information, choose optimum crop combination, new inputs and agricultural practices, etc among farmers. [Chaudhuri (1973); Acharya (1973); Baker and Bhargava (1974); Bardhan and Rudra (1978), Hanumantha Rao (1975); etc]. Therefore, it is expected both these factors will have *positive* impact on production units.

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[5] *As far as total seeds and chemical fertilizers are concerned, we have taken the total value measurement in taken into consideration. Generally, quantity is a better measure than its value, measuring in terms of quantity poses some problem particularly, for example, when seeding is done by transplantation or when seeds are measured in terms of bundles. Similarly, there exist quantity measurement problem in chemical fertilizers. Therefore, total value is taken instead of quantity measurement, which is considered to be a better measure.*

[6] *Credit and education is considered in our study is due to the fact that, material/cash inputs being credit intensive cannot be afforded by the small farms, and the ability to quickly establish/access to newly available economically useful information is possible only when one is basically educated.*

As expected, we observe a systematic and significant pattern in the *level of education* (irrespective of primary, secondary or higher education) with different farm size groups. The educated mean *increases* as the size class increases from one to five. It is 1.9 in farm size group one and 3.2 in farm size group five. Both the parametric (means) and non-parametric (mean ranks) tests results are statistically significant and robust.

As far as *credit availability* (it has to be noted here, as per the statistics available from cost of cultivation data, we have taken the original principal loan amount borrowed irrespective of the sources of credit in the analysis) is concerned, we do not get satisfactory results as expected. The variations across farm size groups are random and statistically insignificant.

2. Farm size with labour use factor: Pattern of labour use and its association with farm size is crucial for studying the issue of labour absorption in agriculture. The issue on the relationship between farm size and labour use is being debated for long. It is expected, in Indian agriculture there is *inverse* association of total labour hours with farm size groups, and that is, labour absorption is higher on smaller farms when compared with larger farms[7].

As per the findings, it reveals a systematic inverse pattern in the use of total labour hours (both per gross cropped area and net sown area) and farm size groups. When labour intensity is defined as the total labour hours used per unit of net sown area, the pattern is clearer, that is, statistically significant and robust. There is nothing surprising in these findings, when cropping intensity is also found to have a systematic inverse pattern with farm size. Small farms use 28 percent more of total labour hours per unit of gross cropped area when compared with larger size group and 14 percent more than the total samples average. This implies labour productivity (measured as total value of production by total labour hours) to also have a systematic *positive* pattern with farm size groups. This observation is as expected; both the parametric (means) and non-parametric (mean ranks) tests results are statistically significant and robust. Yield per labour hour increases from 11.11 Kilograms in farm size one to 15.04 Kilograms in farm size five as the farm size increases from one to five. Use of mechanical power is considered to have favorable impact on labour productivity, but our data do not support this argument. Differences in the use of tractor

[7] *Total labour hours is calculated as the total of family labour hours, casual labour hours, attached labour hours and exchange labour hours irrespective of labourer's age and sex in consideration.*

across different farm size groups are not significant. Some other factors might be important in explaining higher productivity of labour on larger farms. Considering the scope of study and other constraints, it is difficult to further probe into the matter. It has to be noted here, that one of the explanations put forwarded for more number of total labour hours in smaller farms is reflected in plot size (a proxy taken for fragmentation of land holdings). The average plot size increases as the size class increases from one to five. This implies the more number of fragments and the distance between them will increase the total expenditure per hectare as well the labour requirements (multiple cropping).

As far as total labour hours employed and proportion of irrigated area is concerned, it is expected positive association between both of them. Irrigation (that is, the proportion of irrigated area) has the potential of cultivating more number of crops followed by more labour absorption. Ishikawa (1978) in identifying the factors on labour intensity quotes, "*Irrigation is the crucial element or the leading input called as land augmenting technical change is as much as it is a precondition for other land augmenting changes (such as higher cropping intensity and more intensive use of fertilizer) to take root*". But, as per our findings, it is noted that the pattern relating proportion of irrigated area and cropping intensity along with labour intensity (total labour hours per unit of net sown area) with farm size appears to be somewhat different. The cropping intensity and labour intensity has a negative and proportion of irrigated area a positive association with farm size groups. Both the parametric (means) and non-parametric (mean ranks) tests results are statistically significant and robust in these findings. This aspect needs to be further investigated. However, as said earlier, there is a possibility that large farms size groups favor long duration crops (which is of less labour-intensive category) with high yield variety innovations. Or in other words, another important reason for this could be the big farmers remaining engaged in a multiplicity of channels of profit making and the cultivation of land appears on their agenda only for a brief period; at other times of the year, their land remains fallow.

Most of the studies focus on the pattern of total labour use and its association with farm size groups. Here we have attempted to do some exploratory analysis to study the pattern of constituents of labour and its association with farm size from the samples.

Family labour: Family labour is provided by the family members of owner cultivation. Small farms tend to use more family labour compared to large farms. We have expressed some of the possible reasons for such differences between farms in earlier section. Therefore, one can expect family labour to be inversely associated with farm size.

From the data presented (Table 1 and 2), one finds that, as expected farm size and family labour are negatively associated. As farm size increases, use of family labour per unit of gross cropped area as well as net sown area declines gradually. Variations in the use of family labour across different size groups of farms are statistically significant, according to both parametric and non-parametric test. As per mean results, farms in the smallest size group use 878 hours of family labour, while farms in the largest group use 209 hours of family labour when measured per unit of net sown area. On the whole, the percentage share of family labour in total labour hours is 41 percent in smaller farms and only 18 percent in larger farms.

Casual labour: Casual labour is usually hired on day-to-day basis. The component of hired labour in total labour is higher than for any other kind of labour, except family labour (in a peak season, certain critical operations require more of hired/casual labour and this also provided by the small farmer). We expect hired labour to have *positive* association with farm size groups. As said earlier, large farms for various reasons will use less of family labour and substitute it with casual or attached labour.

When we look at the samples, the data do not support the hypotheses of positive association of casual labour hours intensity measured both per unit of gross cropped area as well as net sown area with different farm size groups in the argument. The variations across farm size groups are random and statistically insignificant for total crop production. However, we do find a significant and systematic pattern of increase in farm size and casual labour when percentage share casual labour hours in total labour hours are calculated. For example, in smaller farm size group (one), 56 percent of total labour hours are of casual labour and the same in larger farm size group (five) is 68 percent. There is nothing surprising in these findings, when share of family labour is found to have a systematic inverse pattern with farm size groups. This outcome

indicates the importance of cropping pattern and other factors in influencing the use of casual labour [8].

Attached labour: Among the different types of labour, servant labour or attached farm servants are of permanent labour or hired on contract basis. In fact, Attached labour a substitute for family labour, in the sense, that supply of attached labour is almost as certain as that of family labour. Farmers try to make a trade off between insuring the risk of not getting an assured labour supply during busy seasons and minimizing the cost of labour use by striking a balance between the uses of attached and casual labour. We expect attached labour to be *positively* associated with farm size.

As per the data presented, it is revealed that attached labour exhibits a similar pattern of relationship/association with farm size as that of casual labour. We find a statistically significant systematic pattern of attached farm servants and farm size groups, that is, as expected larger farm use more of attached farm servant hours in comparison with smaller farm size groups measured both per unit of gross cropped area as well as net sown area. Smaller farms use only 38 hours of attached labour per net sown area, whereas, on the other end, larger farms use on the average 177 hours of attached labour hours in the same per unit of net sown area measure, which is 46 percent more than the total sample average attached labour hours (120 hours). On the whole, the percentage share of attached labour in total labour hours is 11 percent in larger farms and only 1 percent in small farms. Both the parametric (means) and non-parametric (mean ranks) tests results are statistically significant and robust in these findings. Crop variation in the use of attached labour and its share in total labour hours across the farm size indicate that crop-mix could be one of the important factors in explaining the variation in the use of attached labour for aggregated production. Mechanization (such as tractors, etc) does not play a major role in explaining the variations in the use of attached labour as these are observed to be invariant with farm size groups.

[8] *Different combinations of crop varieties, seasons and specific farm operations require the need of hired labour [Ahmed (1981), etc].*

Exchange labour: Exchange labour is a system of hiring of labour services for smoothing labour supply (especially, small farmers hire out their services). Labour is also exchanged partly to over come credit constraints and as such no payment is involved in this system. There fore, we expect exchange labour to *decline* with increase in farm size.

Based on the statistics available in the sample study, we do not find any systematic nor significant observations for exchange labour hours used per unit of gross cropped area as well as net sown area with different farm size groups. Even the percentage share of exchange labour in total labour hours used is not consistent to explain the pattern with farm size. The parametric and non-parametric tests do not explain the variations. On the whole, the continuation of the system of exchange labour suggests that the labour is not fully marketized.

Farm size with animal Labour hours: In the economy of crop production animal labour plays an important role. Use of animal labour permits a farm operator to increase production to a higher level (for example, task operations such as hauling, ploughing, threshing, etc require a traditionally furnished draft power and as such animal/bullocks labour). In fact, animal labour is a multipurpose good for a farmer. Apart from crop production activity alone, it is also useful for transport operations, supply of manure to the farm and when used in breeding, it is a reproductive capital asset too.

Animal labour is expected to be *positively* associated with quantity of human labour. Since (as per our samples) quantity of human labour is inversely association with farm size, one may also expect a *negative* association between farm size groups and animal labour hours.

The findings presented in Table1 and 2 reveals a systematic pattern in the use of total animal labour hours (both per gross cropped area and net sown area) and farm size groups. When *animal labour intensity* is defined as the total animal labour hours used per unit of net sown area, the systematic pattern is more pronounced. The mean results show, farms in the smallest size group use 49 hours of animal labour, while farms in the largest group use only 10 hours of animal labour when measured per unit of net sown area. The *ratio of animal labour to human labour* hour increases by 4 percent in small farm size groups whereas in larger farm size it is only 1 percent. The findings of our study confirm the expectation, which can be found from statistically significant and large F Values and Chi-square values. There is nothing surprising in these

findings, when intensity of cropping and the number of parcels (plot size in hectares) is also found to have a systematic inverse pattern with farm size. Because of higher cropping intensity and complimentarily between human labour, the use of animal labour hours is found higher among smaller farms.

Section V

Summary and Conclusions

To sum up, we do find a substantial evidence of significant differences in the pattern of production factors such as the land use and labour use to exist in different farm size groups.

To begin with, the findings on the cropping intensity and labour intensity are both higher on smaller farms, but the results are mixed for land productivity. That is, value of production is observed to be invariant and statistically insignificant. One of the explanations put forwarded for higher cropping intensity in smaller farms is reflected in plot size (a proxy taken for fragmentation of land holdings), where we find a systematic and significant pattern of plot size with farm size groups.

The finding on the pattern relating proportion of irrigated area and cropping intensity with farm size appears to be somewhat different. The cropping intensity does not show a positive association with proportion of irrigated area (both the findings are statistically significant and robust). The same pattern is observed in proportion of irrigated area and labour intensity. The possible explanation put forwarded for such finding is: more than an improved irrigation, on smaller farms, an assured and flexible year round supply of their family labour appears to play a critical role in increasing cropping intensity. Or in other words, there is a possibility that large farms size groups favor long duration/high value crops which is of labour-saving technology with better quality inputs, mechanization, etc.

As far as the pattern of different intermediary/material inputs such as total value of seeds, total value of chemical fertilizers (NPK), total tractor hours per unit of gross cropped area and net sown area along with proportion of HYV area on farm size groups are concerned, there is no systematic or consistent pattern. Considering the scope of study and other constraints, it is difficult to further probe into the matter.

The issue of the use of different types of labour with farm size reveals a mixed pattern. Our analysis reveals a statistically significant pattern of family labour hours (a negative) and attached labour hours (a positive) with farm size, which is as per the expectations. Whereas, the association of casual labour hours and exchange labour hours is difficult to explain a priori. The findings do not show any uniform pattern in these categories of labour from the statistics available from the samples.

To sum up, there are some of the interesting aspects, which remain to be examined. A thorough understanding of the factors involved in individual crop data as well as total crop production is necessary before establishing any production relations.

TABLE 1.

DIFFERENT FARM SIZE GROUPS AND VARIABLES

(ANOVA Test)

VARIABLES	AVG	1	2	3	4	5	F	SIGF
Total.value.of prodn/GCA	16951	15272	15626	17712	17856	18287	1.77	.133
Total.value.of prodn/NSA	19939	21045	20397	20560	19366	18325	0.56	.689
Plot size (hectares)	1.50	0.60	1.04	1.33	1.91	2.58	67.2	.000
Cropping Intensity	119	143	132	118	108	95	9.37	.000
PIA (Irrigated area)	0.78	0.69	0.65	0.79	0.87	0.94	4.16	.002
PHA (HYV area)	0.65	0.64	0.60	0.65	0.68	0.65	0.61	.651
Rental value/hectare	591	604	578	610	587	575	0.12	.974
Labour Productivity	13	11	12	13	14	15	5.59	.000
Total.labourhours/GCA	1439	1646	1512	1391	1364	1282	2.27	.060
Total.labourhours/NSA	1653	2080	1774	1796	1352	1265	5.88	.000
Fam.labour hours/GCA	455	742	578	380	335	231	15.6	.000
Fam.labour hours/NSA	506	878	647	525	269	209	18.6	.000
Cas.labour hours/GCA	863	862	855	868	870	861	0.83	.937
Cas.labour hours/NSA	1010	1141	1054	1068	922	863	2.17	.070
Ser.labour hours/GCA	102	23	60	114	143	171	9.21	.000
Ser.labour hours/NSA	120	37	54	185	149	177	6.56	.000
Exc.labour hours/GCA	17	19	18	17	14	18	0.12	.974
Exc.labour hours/NSA	16	22	17	17	10	14	1.00	.405
Family labour *	29	41	37	28	24	18	31.3	.000
Casual labour *	62	56	58	63	65	68	9.74	.000
Servant labour *	6	1	2	7	8	11	22.8	.000
Exchange labour*	1	1	1	1	1	1	0.33	.855
Ani.labour hours/GCA	28	47	31	28	20	15	6.29	.000
Ani.labour hours/NSA	27	49	38	22	15	10	5.82	.000
Ratio of AL/HL**	0.02	0.04	0.03	0.01	0.01	0.01	7.86	.000
Tractor hours/GCA	5	5	6	4	5	4	0.32	.861
Tractor hours/NSA	7	7	11	7	4	4	0.77	.542
Total seeds/GCA	762	618	737	862	828	765	1.74	.139
Total seeds/NSA	842	756	910	943	862	739	1.60	.172
Total NPK/GCA	1284	1276	1189	1294	1319	1342	0.59	.669
Total NPK/NSA	1576	1822	1559	1641	1471	1386	1.66	.158
Illiteracy	1.84	2.05	2.17	1.97	1.87	1.17	5.15	.000
Educated	2.62	1.98	2.29	2.67	2.95	3.25	9.20	.000
Credit availability	2274	770	1593	3579	2464	2967	2.21	.066
N		**120**	**120**	**120**	**120**	**120**		

Note: *(*) refers to percentages. (**) refers to ratio of animal to human labour. (GCA) refers to Gross Cropped Area; (NSA) refers to Net Sown Area; (PIA) refers to Proportion of Irrigated Area; (PHA) refers to Proportion of High Yield Variety Area.*

TABLE 2.

DIFFERENT FARM SIZE GROUPS AND VARIABLES

(Kruskal-Wallis Test)

VARIABLES	1	2	3	4	5	CHI	SIG
Total.value.of prodn/GCA	269	281	302	321	327	9.91	.042
Total.value.of prodn/NSA	306	303	310	298	283	1.74	.783
Plot size (hectares)	113	242	296	396	454	284.3	.000
Cropping Intensity	350	333	311	271	235	35.1	.000
PIA (Irrigated area)	275	259	294	331	341	19.86	.001
PHA (HYV area)	302	281	302	316	300	2.74	.601
Rental value/hectare	298	294	310	304	294	.120	.949
Labour Productivity	238	275	299	327	351	33.72	.000
Total.labourhours/GCA	321	291	302	297	289	2.59	.628
Total.labourhours/NSA	355	319	305	272	249	27.12	.000
Fam.labour hours/GCA	390	352	294	259	205	86.77	.000
Fam.labour hours/NSA	412	368	296	238	186	135.4	.000
Cas.labour hours/GCA	289	281	302	310	318	3.50	.476
Cas.labour hours/NSA	327	305	308	288	272	7.00	.136
Ser.labour hours/GCA	213	239	310	351	387	109.5	.000
Ser.labour hours/NSA	217	243	315	343	382	96.65	.000
Exc.labour hours/GCA	299	295	295	286	321	3.05	.549
Exc.labour hours/NSA	306	302	299	288	306	1.09	.895
Family labour*	399	369	287	252	192	114.8	.000
Casual labour *	245	263	308	329	355	32.92	.000
Servant labour*	212	241	310	350	388	108.9	.000
Exchange labour*	297	294	296	289	323	3.70	.447
Ani.labour hours/GCA	363	317	282	269	269	27.9	.000
Ani.labour hours/NSA	371	331	278	265	255	42.28	.000
Ratio of AL/HL**	357	325	282	267	266	27.29	.000
Tractor hours/GCA	286	293	309	308	304	1.74	.783
Tractor hours/NSA	297	305	310	294	293	0.93	.920
Total seeds/GCA	238	305	321	328	309	20.71	.060
Total seeds/NSA	271	317	323	305	285	7.55	.109
Total NPK/GCA	298	278	304	307	313	2.79	.593
Total NPK/NSA	329	304	306	287	274	6.87	.143
Illiteracy	328	336	301	291	244	22.4	.000
Educated	239	270	310	339	342	32.8	.000
Credit availability	284	302	305	305	305	3.16	.530
N	**120**	**120**	**120**	**120**	**120**		

Note: *(*) refers to percentages. (**) refers to ratio of animal to human labour. (GCA) refers to Gross Cropped Area; (NSA) refers to Net Sown Area; (PIA) refers to Proportion of Irrigated Area; (PHA) refers to Proportion of High Yield Variety Area.*

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