As suggested in the previous chapter, the purpose of the present study is to examine the relative crop production efficiency of small farms in the Punjab State at the 1969-70 level of technology. The crops studied are wheat, characterizing the modern level of crop technology, paddy, maize and cotton, representing semi-modern level of crop technology, and the aggregate of crop enterprises based on a hybrid of modern, semi-modern and traditional crop technologies in 1969-70. The idea is to see how well the small farms in comparison with medium/large farms convert inputs into output, at modern, semi-modern and hybrid levels of crop technology.

To a large extent, the study is inspired by the recent controversy on the differential economic impact of the new agricultural technology. As is well known, two diametrically opposite views have been expressed regarding this matter. One view asserts that the new technology has so shifted the production relationships that the small farmer's ability to produce has deteriorated relative to that of the large farmer. This is attributed to the fact that the smaller farms lack resources or are institutionally precluded from investing in indivisible inputs necessary for adoption of the new techniques.

The other view claims that the gains of the new technology are more pervasive and that the relative economic position of small farms has not deteriorated. The number of empirical studies on this controversial issue has swelled and different areas reveal different experiences. Studies on the Punjab show mixed findings but, by and large, the view that the small farmers are at a relative disadvantage seems to have been discredited. These studies, however, suffer from several handicaps. Ladejinsky and Frankel's pessimistic writings are no more than tourists' impressions hastily gathered via talks with a variety of politicians, officials and non-officials. While Sen makes inferences by proxy, Randhawa's optimistic statements are based on arbitrary generalisations. Falcon and others of his hue anticipate generations of problems, probably in the vein of historical consequences of all major technological changes taking place from time to time. Two recent studies on the Punjab, by Sidhu and Harrison, based on actual field data are probably the first systematic attempts to analyze the impact of technological change on income distribution among farms of


3 Some handy references are available in Indian Journal of Agricultural Economics, Vol.23, Oct. −Dec., 1968 and Comparative Experience of Agricultural Development... op.cit., 1972


different size. Sidhu's work is more elaborate in that a time series of cross section data is used though the propriety of his mixing data from one area for one year with data from another for the second year is certainly questionable. A more serious handicap relates to the assumptions upon which the variables and the production, the supply and the profit models are constructed. A farm is treated like a pure firm and the entire analysis is cast in the frame of an atomistic world.

Harrison's study is largely free from untenable assumptions but it has its own limitations. The data used are based on the 1967-68 farm management survey for 150 farms of the Ferozepur District of the Punjab. Since 1967-68 was practically the first year of the massive adoption of the new seed-fertilizer technology, his study essentially deals with problems that had yet to crystallize. Moreover, the earliest experience of technological change in one single district cannot typify the experience of the whole state. A still more serious limitation, common to both Sidhu and Harrison, is that the analysis is confined to wheat crop, understandably because the technology of this crop alone was the surrogate of agricultural modernization. The Punjab farms are typically multi-product farms, under one single unit of management. As said earlier, by the close of sixties, three distinct levels of crop technology operated simultaneously in the Punjab farms. It is easy to appreciate that on a single farm an advanced crop technology does affect decisions for crops with relatively less advanced technology. It is fascinating to see the farm size-wise impact of the advanced
crop technology. It is, however, no less essential to see the impact of the simultaneously operating less advanced level of crop technology because in the ultimate analysis statements about full impact of a technological change are meaningful only at the farm level.

The present study is more comprehensive at least in three respects. Firstly, it is based on the 1969-70 farm management data for 351 holdings of different size, drawn from all the three typical climate-soil-crop zones of the state. The year 1969-70 is typically the best for our study because the technological changes which started in 1966-67 (or later in 1967-68) had taken a concrete shape by this time and also because this was a year that was free of input bottlenecks that plagued the Indian agriculture ever since the turn of the 1970's. Secondly, it covers wheat, maize, paddy as well as the total crop mix. Thirdly, unlike Sidhu and Harrison, it splits the sample holdings generally into three size groups: small, medium and large. This in our opinion would lend more rigour and practical significance to the analysis. Moreover, an attempt has been made to compute the variables used as carefully as possible. All this, however, does not absolve the present study of its main limitation that stems from the use of just one year's data. One year data cannot obviously capture the whole profile of the technological gains of small farms. However, since the nature of later technological changes are not likely to be significantly different from those analyzed here with 1969-70 data, the empirical findings of this study should provide some idea of the things ahead.
Besides affecting the production structure, the new farm technology has added fresh dimensions to the problems of pricing and marketing, farm employment, income and investible surpluses, food imports, inter-industry terms of trade, and so on. The present study is confined to production for the reason that inadequate agricultural production has proved a major bottleneck to the fast growth of our economy in the past. As said earlier, ever since mid-fifties, inadequate domestic production was responsible for huge food imports making inroads into other priority investments, nearly stationary per capita availability of foodgrains, consistently rising prices and unsatisfactory working of public distribution system. Since the rate of increase in population is likely to remain high for quite a long time, the agricultural sector will be under great pressure to generate and transfer rising marketable surpluses of food and industrial raw materials for speeding up both the processes of industrialisation and labour transfer from agriculture. Agricultural production will, therefore, continue to be the most baffling problem of the country for many years to come.

In this connection the production performance, problems and prospects of all categories of agricultural producers are a matter of great national importance. The class of small farmers


7 Falcon, op.cit., 1972, pp.295-317

8 Michael Lipton, "India's Agricultural Performance: Achievements, Distortions and Ideologies", in Comparative Experience ......, op.cit., 1972, pp.106-121.

as such is quite important, *inter alia*, because they are numerically preponderant and because their output is the source of income and farm family welfare for an overwhelming majority of rural households in India. It is, therefore, quite natural to look into the relative production performance of this class of farms which it is felt are doing relatively worse under the new technology. The basic question investigated in this dissertation is: *has the small farmers' relative ability to convert inputs into output deteriorated as a result of shift in technology?* The empirical answer to this question should have considerable bearing on production, marketing and price policies in India.

The data used in this study are the 1969-70 farm management data in respect of 351 farms of different size taken from all over the state. The farms coming as they do from different parts of the state cannot be studied in one single block since the natural conditions of cultivation such as soil types, terrain, rainfall and temperature, differ from area to area. Using the technique of 'Cluster Analysis', three homogenous farming regions have been formulated in the hope that all farms in each farming region have, more or less, the same climate-soil-crop complex.

The minimum size of the sample farm included in the present study is 3.00 acres since the 1969-70 farm management data contain no farm below that size. Further, none of the sample farms reports off-farm wage employment by any member of the cultivating households for any part of the year.

10 In the farm management data, only one farm of 2.00 acres was available. This was not included by the author.
By implication, production decisions of small farmers in our sample represent the effect of their entrepreneurial ability alone and are thus comparable with those of large ones. On the other hand, if some of the small farmers had reported off-farm wage employment, their resource use decisions would be governed not only by production possibilities on the farm itself but also by wage earning opportunities elsewhere. The production decisions of this farmer-cum-labourer class would not be comparable with those of such farmers as work whole time on their own farms. In our opinion, therefore, the exclusion of farms below 3.00 acres in the present case sets the sample data more in tune with the theme of the study.

Defining Production Efficiency

Efficiency is a complex notion. Problems involving ideas of efficiency are so many and so intimately inter-related that an unambiguous notion of efficiency may not be identified in all situations. It is useful to remember that the precise definition adopted should be based on the purpose for which efficiency is sought to be measured. The definition in our case stems directly from specifying the objective function at the farm level. The present study stipulates that every farmer aims at producing maximum possible output corresponding to the resources in use. In other words, the relative efficiency of each farming unit is sought to be judged with reference to realized current output.

output and resource inputs currently in use. A farming unit showing relatively larger output per unit of different resource inputs will be taken to represent higher production efficiency. The definition is analogous to Hall and Winston's concept of 'efficiency in present use'.

To operationalize the above definition of efficiency, the many standard tools of production economics can be drawn upon. At the simplest level, comparison of average magnitudes such as output per acre, input cost per acre or cost per unit of output can give some idea of efficiency. Such comparisons cannot, however, be conclusive, especially because many resource inputs are simultaneously involved in the production process. Questions on resource use efficiency can be answered in any degree of severity in terms of the well-known factor-product, factor-factor, or product-product relationships.

Consider a technical unit of production comprising some fixed resource inputs, a single variable input and a single product. The factor-product relationship will point out that the production is inefficiently organized when the single variable input can be recombined with the fixed resources to give more output from the same resources or the same output from fewer resources. Likewise, the factor-factor relationship can be

16 E.O. Heady, Economics of Agricultural Production and Resource Use (New Delhi: Prentice Hall, 1968), Chap(s) 4, 5, 8.
understood easily in terms of two variable inputs, say, $X_1$ and $X_2$ and a single product. Production is inefficiently organised if the same amount of output can be obtained by lesser quantity of $X_1$ and the same quantity of $X_2$ or the same quantity of $X_2$ and lesser of $X_1$ or lesser both of $X_1$ and $X_2$. The last situation also implies that larger output can be obtained from the given combination of $X_1$ and $X_2$. Conceptually, the factor-factor relationship is, mutatis mutandis, an extension of the factor-product relationship. In fact, both can be described under the general title of production function. The product-product relationship, however, answers different type of questions. Here issues such as 'how much of what to produce' or 'what combination of crops should be produced' are answered.

This study does not deal with the efficiency of product combinations which are assumed by us as given for farms of different size. The analysis in Chapter I shows clearly that the cropping patterns emerging in recent years were largely in due response to changes in agricultural technology. Moreover, there are no empirical indications that changes in cropping pattern at one farm size is significantly different than that at the other. Given the technologically determined cropping pattern, the more interesting question is to examine how far

18 Robertson, op.cit., 1971, pp.123-134.
19 Johl & Kapur, op.cit., 1973, p.143
effectively the inputs are being converted into output, at the three levels of crop technology that existed in 1969-70.

To expound and illustrate the concept of production efficiency further, product-product relationship is dropped and the factor-factor relationship is elaborated below. A simple graphic exposition is quite rewarding. Let there be two inputs only: labour and capital. Each point in the xy-plane denotes a farm with its own combination of labour and capital and the same level of output. In other words, it is assumed that the level of technology is the same for all farms but the technique of resource combination varies from farm to farm. Some farms are using more capital relative to labour (possibly large farms operating nearer to y-axis) and some are using more labour relative to capital (possibly small farms operating nearer to x-axis). Locus of lower most points is the curve SS'. It is the boundary line isoquant. Points M,M',N,N',O,Q' lie on the curve SS' and represent input combinations below which the specified output cannot be produced. All cross-points above SS' are reminiscent of inefficient techniques of production since the specified output can be obtained by less of either labour or capital or both. Consider point P. A farm with input combination P could have produced the same output with the same amount of labour (Oc) but less of capital (Om'/Oa') or with less of labour (Om/Oc) and the same amount of capital (Oa') or with less of capital (Ob'/Oa') as well as labour (Ob/Oc). All

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20 With the input of one factor given, it defines the minimum quantity of other factor which will yield the specified output e.g. Om units of labour corresponding to Oa' of capital in the diagram.

21 Heady, op.cit., 1968, p.168
Diagram 1
points such as M, M', N, M' lying on the boundary line SS' are 100 percent technically efficient. To every farm on the curve SS', only substitution between labour and capital is available without saving of either of the inputs. The nearer a farm is to the boundary line, the lesser is the extent of technical inefficiency. In terms of this simple exposition, the present study seeks to locate the average position of small farms relative to that of other farms in the xy-plane.

A concept allied to 'technical efficiency' is 'price efficiency'. A price efficient producer maximizes profits, equating marginal value products of the inputs to their respective market prices. The 'technical efficiency' relates to a physical relationship between resource inputs and output; is essentially an offshoot of technology and is free from considerations of factor or product pricing except that every factor/product has a positive price. On the other hand, the 'price efficiency' puts the production unit in the frame of a pure firm; shifts the focus of analysis from technology to factor/product markets and speaks of profit or loss. The difference between the two concepts can be explained easily again on the diagram. Every point on SS' denotes the success of the farm to attain maximum output with a given set of inputs. As before, consider a typical cross point, say, P, above SS' and two points M' and Q on SS' itself. Both M' and

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22 The term 'technical efficiency' (instead of a more general term 'production efficiency') is used by many economists, e.g. Heady, Farrell, Robertson, and so on, probably because it sounds quite distinct from 'price efficiency', both being examined simultaneously for determining 'economic efficiency'. Inasmuch as the present study examines only one type of efficiency, the term 'production efficiency' may be taken synonymous with 'technical efficiency'.
Q are 100 per cent technically efficient but Q is price inefficient. AA' is an isocost curve and represents the ratio of input prices. Evidently, the cost of combination M' is only a fraction \(=\frac{OR}{OQ}\) of that at Q. This is the price efficiency of Q as well as P. The technical efficiency of P is \(\frac{OQ}{OP}\). The overall efficiency of P is defined as

\[
\frac{OR}{OP} = \left(\frac{OR}{OQ}\right) \cdot \left(\frac{OQ}{OP}\right) = \text{(Price Efficiency)} \cdot \text{(Technical Efficiency)}.
\]

Since \(\frac{OR}{OQ}\) and \(\frac{OQ}{OP}\) will both be unity for a point like M on the isoquant and the price line, a technically as well as price efficient farm will have unit value for the coefficient of overall economic efficiency.

This study, however, does not deal with price efficiency both for theoretical considerations as well as practical difficulties. The price efficiency is more sensitive to sample size than technical efficiency. Reverting to diagram, price efficiency \(\frac{OR}{OQ}\) of P depends on the slope of AA', the slope of SS' at Q and its curvature between Q and M'. Any addition to the sample is likely, if it affects part M'Q' of SS' at all, to affect both the slope and the curvature, in either direction and perhaps quite substantially. Price efficiency of P will readily get upset. Also, even a slight change in the isocost line AA' would affect price efficiency. Clearly, therefore,

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24 Theoretical arguments against price efficiency are drawn mostly from Farrell's article.
even minor errors in estimating input prices are likely to affect price efficiency. Moreover, a firm may very well adjust input use not to current but expected future prices or a combination of past, current and expected price ratios. Measuring price efficiency with respect to current set of prices is good only in a completely static sense. "Thus price efficiency is a measure that is both unstable and dubious of interpretation; its virtue lies in leaving technical efficiency free of these faults, rather than in any intrinsic usefulness". Further on the strength of numerous empirical studies, Leibenstein confirms that in a great many instances, the amount to be gained by increasing X-efficiency (i.e. production efficiency) is frequently significant." Harberger also suggests that in a competitive setting allocative inefficiencies, if any, have small welfare impact because the losses are only marginal rather than total. Yet another author expresses his scepticism as under:

Prices perform a very useful role in allocating resources between closely competing farm products, but they are much less powerful in inducing a rational allocation of capital and labour either within agriculture or between agriculture and other industries. The pressing economic problems in production in this generation are associated with and grow out of the social process of incorporating the continuing stream of new technologies into the farm production process.

The practical difficulties of determining price efficiency in Indian Agriculture are far more serious. Achieving price efficiency implies that the farm is a pure firm whose objective is to maximize profits. Indian farms include farm business and family household in combination. For studying the behavioural aspect of such farm families, the economic models imposing profit maximisation as the end objective may not adequately serve such a purpose. Desai rightly asserts that the resource use pattern which seems irrational from the viewpoint of pure firm may be quite rational from the point of view of family farm.

The most baffling practical problem is pricing of the variable input(s) with respect to which price efficiency is determined. Labour is a typical variable input. A feature common to all Indian farms is that the input human labour consists of both family and hired labour. The cost of this input is accordingly made up of cost of hired labour plus cost of family labour. Since no payment is actually made to family labour, its cost is to be imputed on certain basis. It is this problem of imputing a certain wage rate to family labour that defies readily acceptable solution. Theoretically,

30 idem
31 It could be argued that imputation problem rests not only with family labour but other family owned resources as well, such as own land, farm raised seed and manure, and so on. "Such of those other factors, which the farmer owns and uses, like land, obviously have established market values and (Contd....)
cost arises out of use of resource(s) that involves some sacrifice on the part of the owner/user, and the valid principle in cost measurement is to take the opportunity cost of the resource. Usually the market price serves satisfactorily as the opportunity cost of a family owned resource. Since, however, a very large part of the input human labour does not pass through the market, it is conceptually absurd to think of a genuine market price of labour and hence the opportunity cost of family labour.

All attempts made to impute wage rates to family labour, most commonly the average wage paid to farm servants, are based on unrealistic and arbitrary generalisations, possibly unrelated to socio-cultural milieu in the rural Punjab. Considering the opportunity cost of family labour synonymous with any form of market wage rate, the subtle yet substantial difference between the 'existing' and the 'would-be' wage rates is lost. To say the least, the opportunity cost of family labour on small farms is just not the same as on large farms. A uniform rate imputed for all farm sizes does over-


Other wage rates could be (a) those paid on an average to casually hired labour and (b) equivalent to minimum
estimate the cost component on small farms. Rao, therefore, rightly warns that insofar as the ruling wage rates cannot approximate the true opportunity cost of family labour, the estimates of total costs, based on the imputed value, would give an unrealistic and even misleading picture regarding the profitability of farm business. In a similar vein, Sen asserts that the surplus of output over all costs, including the imputed wage of family labour, is worth very little, as an indicator of efficiency. To him the profit function is in fact a barren economic concept in the Indian system of farming. Precisely for these reasons, a strong plea is often made to adopt 'Farm Business Income' as an indicator of economic returns.

In spite of these very severe conceptual problems, several analysts earlier undertook studies on relative price efficiency at farm level. Their results did not indicate lower efficiency for small farms. There is little to suspect that the recent technological innovations have changed the

33 (Contd....)

consumption requirements of an average farm worker. For arguments in favour and against see (a) Agra-wal (pp.124-26), Pande (p.137) and Rao (p.45) all in Cost Studies in Agriculture, op.cit., 1961.


the relative economic acumen of small farms. Some latest empirical evidence does vouchsafe this contention.

Identifying Determinants of Production Efficiency

Factors which determine the relative production efficiency of a farm group are the very same that influence the farm production directly or indirectly. It is very difficult, however, to identify all the factors that determine agricultural production. On one extreme, there are such uncontrolled (or extraneous) factors as air, sunlight and rainfall, and on the other, such controlled factors as seed, fertilizers and pesticides. Since the uncontrolled factors apply equally intensely to every farm in a given region, their direct impact on output is, ceteris paribus, expected to be equi-proportional to farm size. However, their indirect effect is not necessarily equi-proportional since the series of resource use adjustments in response to these extraneous factors may differ among farms, especially at the later stage of flowering and grain formation. But then in cross section production studies it is nearly impossible to disentangle these indirect effects from the direct effects associated with resource use. In a relative study such as the present one, it is operationally more meaningful to say that output per unit of

38 Harrison, op.cit., 1972,p.35.
39 Sidhu, op.cit., 1972,p.169
a resource at farm level is the combined outcome of both the level of resource use itself as well as the adjustments, if any, made in response to the extraneous factors.

On the strength of whatever best could be fished out of the \textit{ex post} single year cross section data, this study hypothesizes that the production potential of farms in a homogenous farming region depends broadly upon:

(i) the quality and the quantity of both fixed farm resources such as implements/machinery, irrigation equipment and draught cattle as well as current inputs such as seed, water, fertilizers, pesticides and human labour;

(ii) the manner in which the flow of services from fixed farm assets are combined with current inputs;

(iii) the effect of institutional factors such as extension and credit facilities, input and product marketing/pricing and tenancy systems.

In practice the above factors operate not singly but in combination with each other. For example, the percentage of farms using improved inputs depends very largely on the efficacy of extension, credit and marketing agencies. Further the planning horizon of a tenant cultivator as also his willingness to use improved inputs depend directly upon the terms of tenancy. In what follows, the exogenous factors are taken up first.

It is generally stated that the benefits of rural credit and extension agencies accrue relatively more to large farms.


Further large farms are said to enjoy relative commercial advantages in sale of output and purchase of inputs. This helps them adopt agricultural innovations at an early stage. Some of these notions may be true. For example, the large farms do generally adopt the technological innovations first, due possibly to easy extension, credit and marketing facilities. But this may be due also to a better resource base and capacity to make lumpy investment and undertake risks. This does not preclude the fact that many of the large farms are tradition bound and conservative in their management approach. Also many small farmers do not wish to avail of the extension and credit facilities at the early stage of technological diffusion, due largely to their limited risk bearing capacity. As a matter of fact, credit and uncertainty are not entirely separable.

As outlined earlier, the world history of technological transformation is generally punctuated by lead-lag relationships. In the Punjab case, opines Yudelman, there appears to be no significant difference in the rate of adoption of new wheats by size of farm other than that large farmers were the initial innovators. Some intuitive evidence, based on the sample data used in this study, is adduced in Chapter V below to reinforce Yudelman's contention.

46 Yudelman, op. cit., 1972, p. 239.
It has been asserted time and again that the tenant operated farms produce less per acre and that ownership has its own incentive for higher production. Most writings and official thinking on land reforms in India and abroad point to lack of security, absence of incentives for investment and hence poorer resource base of tenant farms. Possibly with stray exceptions, the great majority of tenant farmers have been found among small farms. The tenancy problem in the Punjab is, however, on a different footing. Here both the fixed rent tenancy as well as the share-crop tenancy are common among farms of all sizes, and the class of pure tenant cultivators is nearly conspicuous by its absence. The tenancy debate as such is not the main pre-occupation of this thesis. The relevant problem for us is to examine whether the nature and the terms of tenancy on small farms are different and make a differential impact on output than on large farms. Details regarding adverse impact of tenancy systems on farm output as also the terms and conditions under which land is leased in by small and large farms, again based on sample data, are sorted out in Chapter V below.

Although external factors are important in their own right yet the main thrust of explanation for efficiency differentials between small and large farms emerges essentially from the qualitative and the quantitative differences in resources as also the manner of resource combination. In a

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cross section of farms, size-wise differences in the quality of inputs used are quite possible, especially at the early stage of technological transformation. For example, quality differences are discernible between farm yard manure and chemical fertilizers, irrigation through wells and canals and irrigation through tubewells, ploughing, harvesting and threshing manually and through machines, and so on. In particular, the qualitative differences in the stock (and hence the service flow) of capital assets are reported to have become sharper in recent years inasmuch as some type of capital investment coming up in the past few years is biased to farm size. Such differences must be fully recognized for cautious interpretation of empirical results based on cross section data. The quantity, the composition and the crop-wise flow of services of fixed capital assets, followed by per acre use of current inputs, are compared between small and medium/large farms in a good part of Chapter V below.

Given the type and the quantity of resource inputs on farms of different size, the volume of actual output depends upon how production is organized, i.e. how effectively the various factors of production are combined with one another. In a broad sense, the organizing efficiency of a producer depends upon his technical knowledge, age, experience and farming skill and problem handling ability - an epitome for all

is managerial ability. As a general rule, the quality of inputs goes hand in hand with the quality of management, yet in the Punjab case, better quality inputs (especially of size-neutral type) may not be synonymous with better management. This study contends that widespread use of improved inputs in the Punjab Agriculture reflects the success of the extension/research agencies more than the quality of management input itself. Better management input may be treated synonymous with better use of the given resources rather than the use of better resources. This distinction does not rule out the possibility that 'better use of the given resources' is also partially a function of extension contact. It follows immediately that greater output per unit of resource input(s) is an indicator of higher managerial ability, if significant differences in the composition of inputs do not exist among farms of different size.

There are reasons to believe that small farms enjoy higher managerial ability. A small farm has greater interest in and incentive for maximizing his farm output. Inasmuch as the small farmer (i.e. each family farm worker on small farms) has to look after a comparatively much smaller acreage, he can devote the best of his knowledge, attention and care to every minor detail of field crop operations. As long as 'eye of the...

50 Since in the Indian system of farming, the farm operator acts both as an entrepreneur as well as the manager, in this study the term entrepreneurial ability means the same thing as managerial ability.

52 Thomas, op. cit., 1949, p. 140
master's matters in agricultural management, a small farm does enjoy an edge over large farms. No wonder, therefore, family farm workers may be doing certain operations far more thoroughly, naturally devoting more man hours, and yet in comparison with large farms, the small farms are maligned for making a mess of their manpower resources. Larger labour input on small farms is attributed generally to the preponderance of labour intensive techniques but the subtle distinction between labour use under technological compulsions and labour use under better perception is hardly recognized. Further, because the entire man hours are provided by the family itself (except at peak intervals for which incidentally the bargaining power of the employer declines as farm size increases), the small farms are very largely free from the problems of labour management. On the other hand, a large farm spreads its managerial ability thinly over the expanse of cropped area, besides being over burdened with difficult problems of managing and motivating a hired labour force.

A partial off-shoot of managerial ability is the timely observance of field crop operations. Preparation of seed bed and ploughing to a prescribed schedule, time and manner of seeding, watering and fertilizing, composition of fertilizers used, time and manner of harvesting, threshing and storing and so on are examples of exacting, time-bound field crop operations.

under the new technology. Needless to emphasize that correct
and timely observance of such field crop operations is a
sine qua non for higher yields. While tractor use may ensure
strictly timely observance of some operations, such as ploughing
and threshing, for most others, the crucial ingredients are the
technical knowledge, willingness and the organisational skill
of the farm operator. Whatever evidence is available from our
secondary data does support the thinking that these ingredients
are not essentially skewed against small farms. On the one
hand, a big percentage of small farms is hiring in tractor
services at least for the vital operations of ploughing and
threshing, on the other hand, significant differences between
small and large farms as regards the time and manner of seeding,
watering and fertilizing, especially for the new wheats, have
not been observed. There is thus little empirical evidence to
suggest that small farms are at a disadvantage due to the
timeliness of field crop operations.

The Summing Up

The foregoing discussion raises several issues that
bear directly or indirectly upon the relative production
efficiency of small farms. For convenience of exposition, a
set of questions is proposed below answers to which will
decide the debate whether the relative production efficiency
of small farms has deteriorated as a result of the introduction

54 Punjab Agricultural University, Package Practices for
Kharif/Rabi Crops of Punjab, 1969(Ludhiana: Punjab
Agricultural University, September 1969).
of the new farm technology:

In each of the three homogenous farming regions:

1. Do the extension/credit agencies and input/product markets operate to the relative disadvantage of small farms?
2. Do the small farms obtain lease area under more severe terms of tenancy?
3. Does the quality of fixed capital assets as also of current inputs differ between small and medium/large farms?
4. Does the quantity of input use per acre of cropped area differ between small and medium/large farms?
5. Do the small farms produce relatively less output per unit of each resource input, at each of the three levels of crop technology? or do the small farms convert inputs into output less effectively than the medium/large farms?
6. Has the shift to modern wheat technology resulted in widening the differentials in the input-output coefficients between small and medium/large farms?
7. Do factors such as land tenure system, tractor use and education create a differential impact on output of small and medium/large farms, at the three levels of crop technology?

Answers to the first four questions are attempted in Chapter V by using arithmetic averages or standard regression techniques. The last three questions are answered in Chapters VI through VIII using elaborate production models the methodology for which has been explained in detail in Chapter III. The related problems of using secondary sample data, formulating homogenous farming regions therefrom and the procedural explanation for computing the variables used in production models are handled in Chapter IV.