THE DEVELOPMENT OF SMALL-SCALE ENTERPRISES: A STUDY OF THE AGRICULTURE-RELATED ENGINEERING INDUSTRY IN PAKISTAN PUNJAB

BY

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ABSTRACT

This study seeks to explain the emergence, survival and growth (or decline) of the small-scale sector of the Agriculture-Related Engineering Industry (producing irrigation and cultivation products) in Pakistan Punjab during 1950-83. The two sectors of the industry (viz., the irrigation and cultivation) are separately studied.

We have identified four factors to explain the emergence, survival and growth (or decline) of small firms. These are: historical, technological, demand and economic policy. The first factor relates to a reservoir of labour with metal working experience in the Punjab, and the second to the technical possibility of separation of various processes in the manufacturing of agricultural engineering products, particularly tubewells. The other two factors, expansion of demand for agricultural engineering products and public policy, offered investment opportunities to small enterprises, and created a favourable environment which permitted diffusion of skills and technical know-how. An expanding market and the emergence of extensive vertical specialisation among small firms combined to help the enterprises overcome barriers to entry presented by integrated production. The survival of the small-scale firms among the large firms was possible because of the segmentation of the private tubewell market: the former operated in the lower end, while the later dominated the

upper end. The decline of the irrigation sector small-scale enterprises in the 1970s is attributable to (1) sudden fall in demand for private tubewells and (2) the inability of small enterprises to diversify into technically superior or similar products.

The cultivation sector comprised of three segments: (1) the lower segment (made up of traditional simple products) into which small-scale firms could easily enter because of the low level of technology required; (2) the middle segment which was occupied by a limited number of medium-sized firms produced simpler modern cultivation equipment; and (3) the upper segment dominated by a few large firms which produced sophisticated products. This resulted in the emergence of a pyramid like structure of the cultivation sector which was determined by the nature of the market and the technological requirements of production for different products.

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Part I

CHAPTER ONE

INTRODUCTION

1.1 The role of small-scale[1/] industry in the economic development of the less developed countries (LDCs) has been extensively discussed by economists. The promotion of small-scale production units has been advocated as either complementary or an alternative to large-scale enterprises. /Aubrey (1951), Dhar (1958), Hoselitz (1959, 1968), Dhar and Lydall (1960), U.N. (1969), UNIDO (1969)/.

Hoselitz (1959) produced historical data on employment to show the importance of the mmall-scale industry (1-14 workers) in Europe and Japan. With respect to the European industry his two important findings were (1) small-scale industries[2/] employed 40-50 per cent of the workers in the post-war years, and (2) while the handi craft and cottage industries (1-5 workers) declined gradually, the small-scale industry (6-49 workers) showed at first a rise in relative importance and later stabilized. However, in Japan during 1950-55 period, employment in small-scale firms (4-49 workers) increased faster than in large-scale enterprises (over 200 workers).

More recently, there has been a strong revival of interest in the small-scale industrial sector. This has been the result of certain perceived limitations of large-scale industrialization in the LDCs /World Bank (1979), (1980), and (1982)/. The major limitations of large-scale industrialization have been its failure to create sufficient employment and promote regional development. By contrast, small-scale industry is thought to have made significant contributions to employment generation, diffusion of skills and regional development. Perhaps the single most important contribution of the small-scale industries has been employment creation. Thus, according to one international cross-section study, small-scale units (1-49 workers) contributed 52 per cent of the total factory employment in low income countries /Banerji, 1978/.

An important line of thought on the role of small-scale industry is represented in the report of the ILO Mission to Kenya[3/] (1972). It emphasises the role of the urban informal sector in economic development. This sector is defined to include activities which are characterized by ease of entry, use of indigenous resources, family ownership, small-scale production, labour intensive technology, informal acquisition of skills and unregulated markets. It is maintained that despite its importance and contribution, this sector has suffered neglect. It is discriminated against by the economic policies which favour the modern sector through concessional rates of interest, import licenses, access to foreign exchange at official rates, etc. A number of areas where government help is considered desirable are: trade and commercial licensing, establishient of technical linkages (sub-contracting) between large and small firms, the setting up of institutions to provide assistance with respect to finance, technical and managerial training, etc. The ILO Mission to Kenya believes that, given government support, the small-scale sector is capable of playing an important role in the economic development of LDCs.

1.2 Despite official acknowledgement of the importance of small-scale enterprises, very few LDCs[4/] have assigned sufficient weight to the development of this sector. In Pakistan, for example, the growth of the small-scale sector was largely achieved under an economic policy which was almost wholly tailored to suit the requirements of large-scale industrialization. Pakistan's industrialization policy has been extensively discussed over the years. /Papanek (1967), Lewis (1969, 1970), White (1974), Naseem (1981), Amjad (1982)/. During the first phase of its industrialization (1950-70) Pakistan, in common with other LDCs, followed the course of industrial development via import substitution. This policy favoured large-scale industry, with little direct and explicit role given to the small-scale sector. Large firms were not only protected against foreign competition through high tariffs and direct controls, they also had access to essential inputs and finance at highly concessional rates. The preferential support to the large over the small-scale was based on (1) an investment licensing system to control foreign exchange allocations for machinery import which was geared largely to the needs of large-scale firms; (2) an import licensing and foreign exchange control system which directly influenced industrial investment in the country, and granted privileged status to large firms; (3) financial assistance to large firms that was ensured by close link existing between financial institutions and relatively small number of 'monopoly houses' in the country. The sheltered markets and access to resources guaranteed high profits to large firms. As a consequence, the large-scale manufacturing sector experienced a high growth rate: the annual average of 15.4 per cent in 1950-60 and 13.4 per cent during 1960-70.

Even though economic policy did not explicitly favour it, the small-scale sector also found room for growth in this period. This sector was able to expand by taking advantage of the favourable economic conditions characterized by strong industrial activity and business confidence, and the availability of essential raw materials, machinery and skills. The small-scale sector maintained a steady growth of 2.3 per cent per annum during 1950-60 and nearly 3.0 per cent in 1960-70.

One of the major developments within the small-scale sector, during the decade of 1960s, was the emergence of a large number of small enterprises in the Agriculture-Related Engineering Industry (hereafter called 'ARE'). This industry produced machinery for use in agriculture[5/]: in particular, such products as diesel engine and centrifugal water pump for irrigation purposes, and various kinds of cultivation equipment for tillage, harvesting, threshing, etc. An important aspect of this development was the suddenness of the emergence of the small-scale sector, producing irrigation equipment, over a short span of about five years (1960-65). This was in a situation when a number of medium-sized and a few large firms already existed in this industry. This raises a fundamental question: what were the factors which encouraged the emergence and growth of the small-scale sector in this industry?

1.3 A Micro View of Industrial Development

This study is aimed at identifying the factors that were responsible for the emergence of a small-scale sector. It was thought that the nature of the issue dictated a detailed study of the industry in question. There have been very few micro level studies in Pakistan - most of the existing studies on Pakistan's industrialization relate to the performance of the industrial sector as a whole. In addition to identifying the mechanism of the emergence and growth of firms in a particular industry, the present study, it is hoped, will also throw some light, albeit indirectly, on the process of industrialization in Pakistan. It is, however, important to emphasise that the main objective of the study is to discuss the emergence of the small-scale sector in a particular industry.

The selection of the ARE industry for this study is based on the following considerations. First, the ARE industry is part of the modern sector and produces technically advanced products such as diesel engines, turbine pumps, centrifugal water pumps, harvester, etc. Manufacturing of these products is a major industrial activity.

The second reason to choose this industry relates to the development of the small-scale firms amidst large and medium-sized enterprises. The sudden emergence of a large number of small enterprises producing sophisticated products is, to say the least, an unusual phenomenon in the LDCs. Third, the emergence of the ARE industry was a phenomena of the 1960s - a period of rapid industrial and economic growth in Pakistan, While various other aspects of the economic growth of the 1960s have been extensively studied, no attempt has ever been made to review the micro level changes taking place in a particular industry during this period. This is the first study to look at this aspect of the industrial growth of the 1960s. Fourth, the ARE industry is a good example of agriculture-industry linkages in a dynamic setting. Though various aspects of the "Green Revolution" have been widely studied,[6/] its impact on the development of industries which provide essential inputs through 'backward linkages' has been wholly neglected.[7/] This study is aimed at establishing the link between increased demand for durable agricultural inputs (e.g. tubewells, cultivation equipment, etc.) and the growth of the ARE industry.

1.4 The Objectives of Study

More specifically, this study deals with the following issues: the emergence of the small firms; the survival of these firms; and the growth/decline of these enterprises.

These questions are separately discussed with reference to the irrigation and cultivation sectors of the ARE industry. The decision to treat the two sectors independently is based on the following considerations: (1) a large majority of the firms producing irrigation (tubewells) and cultivation equipment constitute quite distinct groups and (2) the growth of the two sectors took place in different periods.

(1) Origin of Resources, Emergence and Survival of Firms

The rapid growth of the irrigation sector of the ARE industry in the 1960s was reported by Falcon (1967) and Child and Kaneda (1974-75). This was attributed to the development of agriculture in Pakistan. [Throughout this study 'Pakistan" refers to the existing country or the 'West Pakistan' of pre-1972. We shall use the term 'United Pakistan' to refer to the country as it was before 1972]. Falcon emphasised the 'dynamic interaction' between industry and agriculture, and noted the role of 'small shops' which according to him, supplied "virtually all the diesel engines and pumps used in private agriculture. The small town of Daska, for example, had only a few machine shops as late as 1961; but in 1965, over 120 shops were engaged in diesel engine production" [1967, p. 1151]. Child and Kaneda's survey (conducted in 1968-69) supported this observation and reported an estimated total of 533 small sized manufacturing units in the Punjab which employed 7,550 workers, of which 6,000 were engaged by the diesel engine and pump manufacturing firms /1974-75, p. 265/. They also reported that of the 130 irrigation firms in this sample, 87 per cent employed less than 30 workers and 66 per cent employed less than 10.

The first question that the development of this industry raises relates to the <u>origin</u> of the resources that within a relatively short period of four to five years came forth to constitute a dynamic small-scale sector. This issue is wholly ignored in the study of Child and Kaneda. (Falcon's paper, being a study of the interrelationship between agriculture and industry, was not aimed at examining the development of the small-scale sector in any detail.) Our first objective is to review and record the historical development of the ARE industry, with particular reference to the origin and development of certain resources, market expansion and diffusion of technology and skills. The purpose of this review is to identify the process of development of the manufacturing capability in the ARE industry and the role of large enterprises in the diffusion of tubewell-making technology.

The second question relates to the apparent ease with which small firms were able to enter an industry that was dominated by a small number of large enterprises. The explanation contained in the Child and Kaneda study rests on the assumptions of products homogeneity and constant returns to scale. The first assumption conflicts with the facts of the situation: different types of firms produce a wide variety of products and the large and medium-sized enterprises extensively advertise their products. On the second point, it needs to be noted that Child and Kaneda did not include large firms in their sample; there is thus no empirical basis for their assumption of constant returns to scale beyond the small-scale enterprises.

Our explanation of this phenomenon rests largely on the following two considerations. First, private agricultural market for tubewells was divided into two broad segments: the high-quality / high-price products supplied by the large firms, and the low-quality / low-price segment where the small enterprises operated. Second, from a technological point of view there was considerable scope for vertical specialisation in tubewell production and thus for the emergence of a large number of small units performing complementary activities. This meant that small firms were able to avoid the entry barriers in terms of financial, technological and organizational requirements normally associated with integrated (large-scale) production. The economies of specialization within the small-scale sector, and also obtained from outside this sector, thus compensated to a certain degree the loss of economies of scale associated with large-scale integrated production.

Another question dealt with in this study is the survival of small production units amidst large and medium-sized firms for a fairly long period (1960-73).

According to one view /Sylos-Labini, 1962/ we would expect small firms to occupy no more than the 'fringe' of an oligopolistic market. However, in the case of the Punjab's ARE industry (irrigation sector) we observe that small firms occupied a substantial segment (nearly 40 per cent)[8/] of the private agriculture market over a fairly long period (1960-73). We have attempted to explain the continued coexistence of small and large firms in terms of market segmentation and rapid expansion of the private agriculture and related markets in which large firms could expand.

(2) Long Term Growth of Small-Scale Firms

The last important issue to be discussed relates to the long term growth (or decline) of the small-scale sector. The growth of the irrigation sector suddenly ended around 1973 and the decline in the production of diesel engine continued till 1983. The contraction in the private agriculture market resulted in a substantial reduction in the number of irrigation firms. Most of the firms to decline in this period were small-scale and medium-sized. Our explanation of this sudden decline of the irrigation sector rests on two sets of factors - fall in demand and barriers to diversification and growth encountered by small firms.

1.5 Data Base:

The Field Survey

The survey of the ARE industry in the Punjab was conducted by the author during 1981-82 and 1983. The first step in this direction was the preparation of an appropriate questionnaire. In keeping with the objectives of the study, a detailed questionnaire (consisting of 24 foolscap pages) was designed for the field survey. The questionnaire was divided into 10 parts each covering different aspects of the study. Each of these sections was further divided into sub-sections consisting of detailed questions. The questionnaire sought information on the following important aspects of the firms:

(1) Factory/firm: business details;

(2) Personal information on owner/manager;

(3) The nature of the business organization;

(4) Management structure;

(5) Nature of products (i.e. product characteristics, prices, sales, new products, subcontracting, etc.)

(6) Size of the firm (employees, fixed assets etc.)

(7) Sources of finance;

(8) Technology (equipment, origin of equipment, further equipment requirements, etc.);

(9) Market conditions (nature of product and input markets),

(10) Labour (labour types, training/skills, hours of work, labour and rural links, labour shortages, trade unions, etc.)

While designing the questionnaire particular care was taken in framing questions in a manner that would help obtain maximum information without alarming the interviewees. It may be emphasised that the Pakistani owners/managers, especially of small firms, are extremely reluctant to disclose statistics on their assets, sources of finance, sales, growth/decline, etc. This is mainly attributable to two factors (1) apprehensions about tax liability, and (2) absence of legal obligation to disclose information for research purposes.

Selection of Firms

The selection of firms for the field survey was guided by the desire to make it a 'representative' sample. The following steps were taken. First, firms of all sizes (large, medium and small) were included in the sample and effort was made to accommodate as many firms from each group as possible, but without sacrificing the balance between different groups of firms. The total number of firms included in our sample is 102; of which 68 are small-scale 31 medium-sized and 3 large-scale. Though a complete list of the Punjab's ARE firms did not exist and therefore strictly a random sample could not be drawn yet our sample could be taken as representative as it included many units from each group of firms.

We base this study on the primary data collected through an extensive field survey. The need for this survey arose because of the non-availability of any published data on those aspects of the industry which constitute the subject matter of this study - the origin, emergence and growth of the ARE firms during 1950-83. A systematic explanation of these aspects of the ARE industry required detailed information of the historical development of the industry, mobilisation of resources, technological diffusion, etc. This information could only be obtained through extensive interviews with owners/ managers of firms and others associated with the industry in various capacities.

Second, effort was made to include firms from the two sectors as well as different major centres of the industry. The Punjabs' ARE firms are located around 5 major industrial centres - Lahore, Faisalabad, Daska, Gujranwala and Sargodha. Of these, Lahore and Daska are the main centres of irrigation firms, while Faisalabad, Gujranwala and Sargodha are important centres of cultivation firms. Our sample consisted of 62 irrigation firms (all located in Lahore and Daska) and 42 cultivation firms situated in Faisalabad, Gujranwala and Lahore.

Among a total of 102 firms, 54 were located in Lahore, 30 in Faisalabad, 13 in Daska and 5 in Gujranwala. Thus, our sample included irrigation and cultivation firms from different major centres of the industry.

Third, since (as noted) there did not exist a complete list of the ARE firms and their location, we relied on every available published and non-published source of information to locate firms for purposes of the field survey. The published sources used for this purpose included the following:

(1) Directory of Engineering Units, Publishers International, Karachi, 1980.

(2) A List of Suppliers of Diesel Engines and Allied Equipment Under State Subsidized Installation of Diesel Engines in the Punjab, Directorate of Agricultural Engineering, Faisalabad, 1981.

(3) A Handbook of Agricultural Machinery Manufacturers in Pakistan, Farm Machinery Institute, Islamabad, 1982.

Among the unpublished sources, the official record of the Directorate of labour, Lahore, proved extremely useful for identifying the location of the ARE firms.

Administration of the field survey too required special care. The first hurdle here was the selection of firms which would agree to be interviewed. As a first step, we approached firms for a preliminary interview to assess their willingness for a subsequent detailed interview (based on the questionnaire), and to record brief history of the firm. In most of the cases, the detailed questionnaire-based interview was conducted in a second meeting. Though the actual number of firms included in the sample was 102, the total was 104 (62 irrigation-sector and 42 cultivation-sector) because 2 large-scale firms in our sample produced both irrigation and cultivation products, and, hence, counted twice. Among the 62 irrigation sector firms, 3 were large-scale, 16 medium-sized, and 43 small-scale. Of the 42 cultivation sector firms, 2 were large-scale, 15 medium-sized and 25 small-scale.

It may be noted that classification of firms into large, medium and small is based on a particular criteria of their "resource characteristics". The point worth noting is that different ARE firms or, rather groups of firms, have different characteristics which refer to the type of 'resources' they own. For example, large-scale firms have access to institutional finance, foreign technology and government help i.e. licenses, subsidies, etc., which are not accessible to small firms. It is believed that firms' place in an industry and ability to grow depend on their overall resources. Hence, this criteria would be more suitable for assessing the role of small, medium and large enterprises in the development of ARE industry.

It may be emphasised that our large will be large by any standard (e.g. employment, value added, etc.) For example, each of the large-scale firms in our sample employed workers considerably above the level of 300. Similarly, our small will be small by other standards. None of the small-scale firms when interviewed employed more than 25 workers. (All the small-scale firms in our sample were in the 6-25 workers category.)

Duration of Field Survey

The survey of the ARE industry was conducted by the author in two phases. Most of the field work was completed during the first phase spread over 7 months in 1981-82. In the second phase, which lasted one month in 1983, further information was collected on the growth of firms.

As noted above, the field survey included detailed interviews with, and administration of questionnaire to 102 owners/managers of the ARE firms in four cities of the Punjab. It involved considerable travelling between different cities in which the firms were located. It is believed that detailed interviews with a large number of owners/managers have added a degree of reliability to our findings which is often found lacking in studies based on secondary sources.

However, this study does not lend itself to statistical analysis. This is due to the objectives of the study which deal with the 'growth' of the ARE industry rather than the 'static' issues such as factor proportions, productivity or profitability of firms. Thus we take a dynamic view of the development of the ARE industry; looking at the way the composition of output and methods of production gradually changed over time.

1.6 The Structure of the Study

This study is divided into three parts. Part I sets the scene for an examination of the emergence of the ARE industry. It consists of two chapters. Chapter 2, 'Technological Change in Pakistan Agriculture' traces the events taking place behind the increasing demand for the products of the ARE industry. It brings together available evidence on the changes in demand for the irrigation-related (tubewells) and cultivation-related (cultivation implements and machinery) products during 1950-82, which provide the background to the developments in the ARE industry.

Chapter 3 reviews the 'Industrialization Policy in Pakistan' during 1950-80. It identifies two phases of industrial development, and traces the impact of economic policies on the growth of large-scale and small-scale sectors.

Part II is devoted to a discussion of the emergence and growth of the ARE industry in the Punjab. It consists of the following chapters. Chapter 4 'Agriculture-Related Engineering Industry in the Punjab: Present State', deals with (1) definition of the 'ARE' industry, (2) assesses the size of the industry, (3) identifies its structure, and (4) determines the geographical location of the ARE firms in the Punjab. Chapter 5, 'Historical Development of Punjab's Agriculture-Related Engineering Industry: Development of Resources, Market Expansion and Technological Diffusion', reviews the development of the industry in three stages: (1) historical perspective (pre-1947); (2) rehabilitation of the engineering industry (1947-50); and the (3) emergence of the ARE industry (1950-60). Chapter 6 'Choice of Technique in the Irrigation Sector of the ARE Industry', is aimed at establishing (1) the possibilities of choosing alternative techniques at different stages of tubewell production, and (2) a definite link between technology and product characteristics. This provides the setting for our explanation, in the following chapter, of the growth of the irrigation sector of the ARE industry. In Chapter 7, 'Burgeoning of the Irrigation Sector of the Agriculture-Related Engineering Industry: 1960-73', an attempt is made to explain the sudden emergence of the irrigation-sector small-scale firms during the 1960s in the light of the framework set out in the preceding chapter. The explanation is divided into two parts: the first deals with the question of entry of firms; and the second with the survival of the firms over a long period of time (1960-73). Chapter 8, 'The Decline of the Irrigation Sector (1973-83)', reviews and analyses the development taking place in the irrigation sector in the post-burgeoning period and compares it with the sector's growth over 1960-73.

Part III consists of three chapters. In chapter 9, 'The Emergence and Growth of the Cultivation Sector (1950-83), we attempt to explain the emergence and growth of the sector till 1983. Chapter 10, 'The Structure of the Cultivation Sector', identifies (1) the factors that led to the emergence of a pyramid-like structure of the cultivation sector and (2) the differences in the growth of firms in the cultivation and irrigation sector. In Chapter 11, we conclude our findings on the development of ARE industry and identify some policy implications.

FOOTNOTES

CHAPTER ONE

1/ In this study, 'small' refers to the enterprises which are defined as having only limited resources including access to technology, finance, labour and management skills, import licences, government sponsored advisory services, etc. But our 'small' is small by any other standard, namely, number of workers or capital assets, etc.

2/ Small-scale "industries" always stand for industries in which small enterprises predominate.

3/ Another view expressed by Merhav (1969) emphasises the technological basis for the emergence of oligopolistic industry structure and, therefore, limited or no role for the small-scale firms. The viewpoint of 'technological determinism' emphasises the dependence of LDCs on foreign technology and, thus, little scope for the real development of domestic industrial sector. According to this view, foreign technology is unsuitable for LDCs (in terms of factor requirements, production scales and employment generation). Therefore, it is likely to result in economic stagnation. The industries of LDCs are generally considered incapable of producing capital goods, and unable to diversify into new product lines. So, economic stagnation of LDCs is taken as inevitable.

4/ Two countries which adopted positive policies for promoting small-scale sector are India and Peoples Republic of China. In India, for example, the licensing authorities have reserved over 800 products for production solely by the small-scale sector. /Lall, 1984/.

5/ Some of the ARE products are also used outside agriculture sector.

6/ The economic impact of the 'Green Revolution' has been studied in a number of ways, viz., (1) on agricultural productivity and output, (2) on growth of the economy, (3) on employment, and (4) on foreign aid and trade.

7/ Hirschman has emphasised the importance of backward linkages between agriculture and industry in LDCs in the following words:

"....... the introduction of modern (agricultural) methods does bring with it considerable outside purchases of seeds, fertilizers, insecticides, and other current inputs, not to speak of (machines) and vehicles" /1958, p. 109/.

8/ We have reason to disagree with Falcon (1967) who asserts, and Child and Kaneda (1974-75) who convey the impression, that most if not all of the diesel engine-powered tubewells installed in private agriculture were supplied by small firms. Between 1953 and 1972, when it was nationalized, Beco, the largest diesel engine producer in the Punjab, produced 10,000 slow speed diesel engines (Beco 1973). This was the type of machine extensively used in private agriculture. On our estimate, based on Ghulam Mohammad (1965) and Government of Pakistan (1981), over the same period, approximately 63 to 65 per cent of the tubewells installed in private agriculture were powered by diesel engines. If it is assumed that all of Beco's slow speed diesel engine were supplied to private agriculture this firm's share of the market over the period 1953-72 would come to 10-12 per cent. (Information on Beco's production of electric motors and water pumps is not available.) Another large firm in the industry, KSB-AG, according to figures supplied to the authors by its management, produced 24,000 low pressure centrifugal water pumps over the period 1960-73. Again, if it is assumed that all these pumps were supplied to private agriculture, this would give KSB a market share of more than 20 per cent over the period. (KSB, which specialises in water pumps, coupled its pumps with electric motors supplied by Siemens (Pakistan). Most of the industrialists with whom the authors had discussions during the summer of 1981 appeared to agree that the small firms, in the late 1960s, held a share that approximated 40 per cent of the private agriculture market, the rest being divided among the three large firms and about seven medium-sized enterprises.

CHAPTER TWO

TECHNOLOGICAL CHANGE IN PAKISTAN AGRICULTURE

The purpose of this chapter is to trace out the development taking place behind increasing demand for agricultural machinery in Pakistan since the sixties. It is intended to show that the sudden increase in demand for tubewells (for irrigation) in the 1960s, and later, for agricultural implements (for cultivation) was the result of the introduction of the new agricultural technology in the country under Green Revolution programme. The following analysis aims at identifying those demand side factors which led to the emergence of a large domestic market for agricultural machinery.

2.1 Background: the Land and People

In 1947, the year of Pakistan's emergence as a sovereign state, the country had two parts: the West and East Pakistan, divided by vast Indian territory. Both the wings of United Pakistan had agrarian economies, characterized by traditional agriculture, with predominant feudal structure. After the separation of the Eastern wing and formation of independent Bangladesh in December 1971, the present Pakistan (the Western province) was left with a population of 64.9 million living over an area of 55.09 million hectares. According to the 1981 Census, the total population of Pakistan stood at 83.78 million, which was later estimated to have gone up to 88.22 million in January, 1983 /Government of Pakistan, 1983, p. 169, and Table 2.1/.

Pakistan is divided into four provinces, viz., Punjab, Sind, N.W.F.P. and Baluchistan. In terms of population, the Punjab is the largest province, followed by Sind, N.W.F.P., and Baluchistan. The Punjab also occupies an important place in Pakistan's agriculture: it has 56.5 per cent of the total cultivated area, 69.12 per cent of the irrigated area, and 63.0 per cent of the total farm area. /Tables 2.2 and 2.3/. Moreover, it accounts for nearly 60.00 per cent of the country's agricultural labour force /Appendix Table A.2.1/.

In 1980, only 20.30 million hectares of the country's total area of 55.09 million hectares was cultivated, while 11.93 million hectares were classified as culturable waste mainly on account of water non-availability. The irrigated area totalled only 14.29 million hectares. /Table 2.2/. Thus about 60.0% of the country's cultivated area was irrigated although the inclusion of culturable waste land would further lower the share of irrigated area in the total land available for cultivation purposes. Moreover, the water availability to the presently cultivated land is considered quite insufficient.

With the purpose of providing irrigation water to this vast land, a network of canals was laid more than a century ago. Today the irrigation system of the Indus Basis[1/] Region serves 13.6 million hectares of land through its vast system

Table 2.1

Land and People in Pakistan

Year	Area Million Sq. Km.		Population Million		Density Per Sq. Km.	
	Pakistan	Punjab	Pakistan	Punjab	Pakistan	Punjab
(a) 1951	766,095	205,346	33.74	N.A.	42	N.A.
(b) 1961	do	do	42.88	25.48	54	124
(c) 1972	do	do	65.31	37.61	82	183
(d) 1981	do	do	83.78	47.29	105	229

Notes: (1) Pakistan refers to the West Pakistan.
(2) N.A. means not available.

Sources: Calculated from:
(1) Pakistan Economic Survey: 1982-83, p. 169, Government of Pakistan, 1983.
(2) Economy of Pakistan: 1948-68; p. 19, Government of Pakistan, 1968.
(3) Development Statistics of the Punjab: 1979, pp. 5 and 12, Government of the Punjab, 1980.
(4) Pakistan Basic Facts: 1980-81, p. 5, Government of Pakistan, 1982.

Table 2.2

Land Utilization Statistics of Pakistan (1979-80)

(Million Hectares)

Province	Total Area	Cultivated Area		Culturable Waste		Cropped Area		Irrigated Area	
Punjab	16.94	11.47	(56.5)	2.18	(18.3)	12.61	(67.7)	9.88	(69.12)
Sind	13.75	5.47	(26.9)	2.20	(18.4)	3.79	(20.2)	3.18	(22.2)
NWFP	5.36	1.96	(9.6)	1.15	(9.6)	1.98	(10.5)	0.70	(4.9)
Baluchistan	19.04	1.40	(6.8)	5.40	(45.3)	0.42	(2.2)	0.34	(2.4)
Total (for Pakistan	55.09	20.30		11.93		18.80		14.29	

Notes: Figures in parentheses are percentages of column totals.

Sources: Calculated from Agricultural Statistics of Pakistan: 1980, pp. 94-96, Government of Pakistan 1981.

Table 2.3

Number of Farms and Farm Area by Provinces, Pakistan (1980)

Administrative Unit	Number of Farms (Million)	Percent	Farm Area (Million) Acres	Percent	Average Size of	
					Farm Area (Acres)	Cultivated Area (Acres)
1	2	3	4	5	6	7
Pakistan	4.070	100	47.218	100	11.6	9.6
NWFP	0.528	13	4.107	9	7.8	5.0
Punjab	2.545	63	29.975	63	11.8	10.3
Sind	0.795	19	9.218	20	11.6	9.8
Baluchistan	0.202	5	3.918	8	19.2	12.1

Source: Pakistan Census of Agriculture, 1980, Table 1.

of perennial and non-perennial canals. Inspite of being served by a large canal network the crop output in these areas has been low because of water shortage. For example, water application in Pakistan in the 1960s was, on average, 1/3 - 1/2 of that found in comparable areas in California [Falcon and Gotsch, 1971].

Another problem is the irregular supply of canalwater resulting in sharp fluctuations in crop output. Thus, because of erratic supplies of canalwater this input remains a critical but uncertain factor in large areas of Pakistan. One observer summarised the agricultural scene in Pakistan in the mid-1960s in these words:

> 'Since nearly half the cultivated land in the canal commanded area lies fallow in each growing season, land is virtually a free good once water supply is relaxed'. [Nulty, 1972, p. 23].

The problem of underwatering of crops in canal areas could be remedied in two ways: (1) through increased irrigation intensity by reducing cultivated area; or (2) by finding alternative sources of additional water. The first option remained essentially a short term measure, while the real long term solution lay in finding supplementary sources of irrigation water. It was against this background that Pakistani farmers initiated large scale drive to instal private tubewells for additional water in the early 1960s, leading to introduction of new agricultural technology in the country.

2.2 The New Agricultural Technology

The new agricultural technology is a combination of a number of inputs, viz., HYV seeds, fertilizer-insecticide and water, of which water forms the critical part. Introduction of this technology in Pakistan resulted in dramatic improvements in agricultrual output in the 1960s, leading to increased demand for the new inputs. And because additional water was a pre-requisite for taking full advantage of the inputs package, it became a priority for public agencies as well as private farmers to increase water supply. Since most of the additional irrigation water was supplied by tubewells, it resulted in intensification of demand for them.

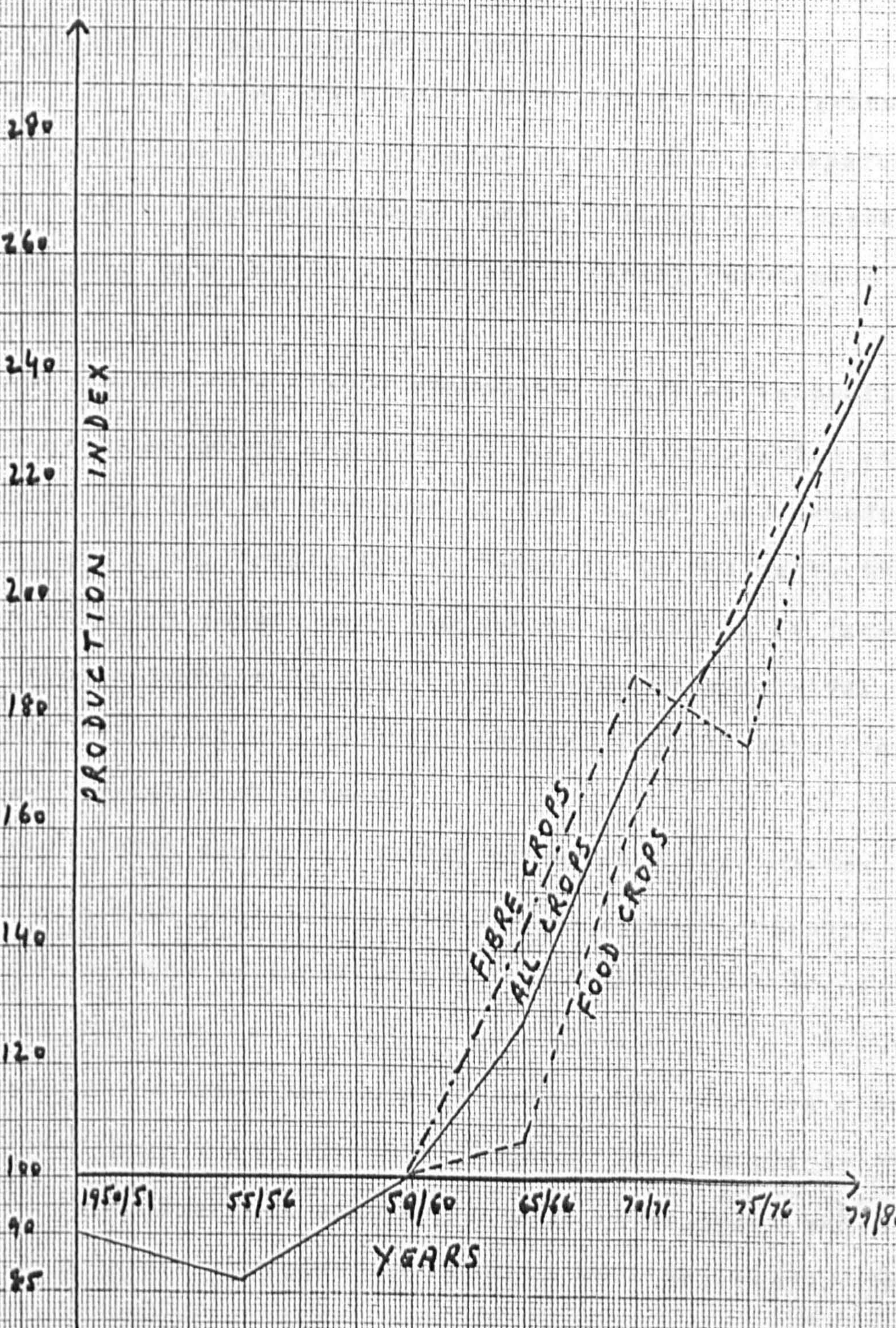
The overall impact of the new technology on agricultural output was enormous. It raised the agricultural production index from 100 in 1959-60 to 127 in 1965-66, almost doubled it by 1975-76, which stood at 239 in 1979-80. In particular, food and fibre crops benefited more than the others as the new HYV seeds of these crops proved very successful in Pakistani conditions. The index of food production gained 77 points between 1959/60 and 1969/70, and additional 68 points during 1969/70 - 1979/80. The fibre crops too registered 71 and 79 percentage points in the two phases, respectively. /Figure 2.1/.

The gains of agricultural production in the 1960's over the 1950's were largely attributable to exceptionally high growth in a relatively few districts of the Punjab, which could adopt the new technology sooner than the others.[2/]

Figure 2.1

Production Index of Major Crops

Selected Years (1959-60 = 100)



Source: Based on Appendix Table A.2.2.

/Gotsch, 1979(b)/. However, the overall impact of the new agricultural technology on sectoral growth was substantial: raising it from an annual average rate of 1.7% during 1950-60 to 5.0% in 1960-70 /Table 3.2 Chapter 3/.

2.3 Irrigation Water: The Key Input

The importance of additional water for raising agricultural output in Pakistan has been stressed by a number of experts /Revelle (1964), Ghulam Mohammad (1965), Falcon and Gotsch (1968), Ghaffar and Kaneda (1970) and Planning Commission (1970)/.

Ghulam Mohammad's (1965) pioneering study of tubewells in Pakistan highlighted the critical role of irrigation water by pointing out that an increase in its' supply had immediately raised agricultural production in Pakistan in the early 1960s i.e. before other inputs were abundantly available to farmers. He also drew attention to the role of water as a catalyst as it led to greater use of other inputs, finally resulting in higher agricultural output.

Nulty (1972) supported Ghulam Mohammad's conclusions by observing that this effect had worked through improved cropping intensity on farms that had access to additional water. Ghaffar and Kaneda /1970/ and Wizzarat /1981/ relied on production function analysis to assess the relative shares of different inputs in Pakistans' agricultural output in the 1960s and arrived at the conclusion that water input was the single most important factor to explain the increase in the use of other inputs as well as in the total output.

The importance of water supply for agricultural breakthrough was known to the government as well as the farmers of Pakistan, both of whom made concerted effort to build up irrigation resources. These efforts intensified in the 1960's with a view to breaking the existing barrier on intensive methods of cultivation. The development of extensive water resources in the country was possible due to official recognition of the fact that the private response to agricultrual prices and their ability to adopt new technology depended upon the availability of water [Gotsch, 1979 (a)]. The Government had drawn up ambitious water resource development plans during the First, Second and Third Plans. The public sector water resource development programmes were of two types: (1) surface water schemes; and (2) ground water schemes. A number of major projects completed under public sector surface water schemes included construction of: (1) dams, viz. Warsak, Mangla and Tarbela; (2) barrages, namely, Ghulam Mohammad, Taunsa, Guddu, and others; and (3) an extensive network of canals in the Indus Basin which is now spread over 38,000 miles.[3/] Following these schemes, the total canal irrigated area in the country steadily increased from 8.20 million hectares in 1950/51 to 9.70 million hectares in 1960/61 to 9.47 million hectares in 1970, finally reaching 10.10 million hectares in 1980-81. [Government of Pakistan, 1980, p. 101, and 1972, p. 102].

2.3.1 Tubewells: The Main Source of Additional Water Supplies

The other important public sector programme for additional water supplies comprised of tubewell installation.

These deepwell turbine type units were sunk under a multi-purpose scheme of soil reclamation and salinity control in the old irrigated areas of Pakistan. As a result of these schemes tubewell water supplies in the country increased from 1.7 million acre feet (MAF) in 1959/60 to 15.99 MAF in 1969/70, to 22.2 MAF in 1973/74 and went further up to 31.00 MAF in 1979/80. In other words, between 1959/60 - 1969/70, the tubewell supplies increased by 817 per cent and again by almost 100 per cent during 1969/70 to 1979/80. [Table 2.4]. The increasing significance of tubewell water for agriculture can be judged by the fact that it's share in the total water availability jumped from 0.03% in 1959/60 to 20.65% in 1969/70 and stood at 25.46% in 1979/80. Meanwhile the share of canal water in the total has been gradually falling: from 97.1% in 1959/60 to 78.4% in 1969/70, and finally 67.1% in 1979/80. Tubewells, thus, emerged as the main source of additional water supply between 1960 to 1980.

The earliest government initiative to popularise power tubewells in the Punjab was launched in the 1930s when the Punjab government installed 20 tubewell sets between 1938 and 1940. The main objective of this scheme was to provide supplementary water to farmers so that their cropping pattern and yield could improve. This scheme was enlarged after 1947 and another 1,500 tubewells were sunk under Rasul Project by the end of 1953. [Mohammad, 1965]. Since then a number of public sector tubewell installation schemes have been carried out, the most important of which is the Salinity Control and Reclamation Project[4] (SCARP) of Water and Power Development Authority [WAPDA] initiated in 1959.

TABLE 2.4

Availability of Irrigation Water By Source, Pakistan[1]

(Selected Years)

(Million Acre Feet)

Years	Canal Water at Farm gate (1)	Groundwater (Tubewells) Public (2)	Groundwater (Tubewells) Private (3)	Total Ground Water (4)	Total[2] Water Availability (5)
1959-60	50.0	0.90	0.80	1.7	57.20
1966-67	57.57	1.73	8.24	9.97	67.54
1969-70	59.91	3.54	12.05	15.59	75.50
1970-71	52.42	4.33	13.20	17.53	69.95
1973-74	57.64	5.40	17.02	22.42	80.06
1975-76	59.35	6.16	19.43	25.59	85.94
1979-80	63.14	7.03	23.97	31.00	94.14

Notes: (1) This data is for West Pakistan only.

(2) The total refers to water supplies to two major crops viz., Kharif (summer) and Rabi (winter), and also from traditional sources, viz., persian wells, tanks and others.

Sources: (1) First row calculated from Nulty, 1972; table 9, p. 55.

(2) For others, see Government of Pakistan, 1980, p. 103.

By 1981, WAPDA had sunk 13,099 deep turbine tubewells with an average output capacity of 3 cusecs. Of this total, WAPDA had dug in 2,069 deepwell turbines in the Punjab alone by 1963. Since then more projects have been completed and the total number of tubewells sunk in the province under various schemes had risen to 9858 by mid-1980. This development has brought 2.75 million hectares of culturable land under cultivation. As shown in Table 2.5 WAPDA installed 13,099 tubewells in the four provinces between 1959 and 1980 which commanded 6.26 million hectares of land.

Simultaneously, other government departments also carried out schemes of water resource development. By 1965, the Irrigation Department of Pakistan completed a number of surface drainage schemes for land reclamation. These included a few major schemes like the Bukkurawa, the Pandoki, the Jaranwala, the Satiana-Sumundri and the Chatkhadi drainage systems. These projects involved deep-well sinking for draining excess water in different areas. Prior to 1971, government efforts to improve irrigation and drainage facilities also covered East Pakistan. These included supply of pumping sets for low-lift irrigation schemes and also tubewell installation. For irrigation purposes government planned installation of 20,110 water pumping sets and sunk 715 tubewells between 1955 and 1970. /Table 2.6/. Consequently, the total area under pump irrigation scheme in East Pakistan increased from 19,021 hectares in 1960 to 161,880 hectares in 1968. /Government of Pakistan, 1968,(a) p. 64/. In the same period, the average

Table 2.5

Tubewell Installation Under Salinity Control and Reclamation Projects of WAPDA: 1959-80

Total No of Projects (Completed and On-Going)		Commanded Area (Million Hectares)	Tubewells Installed (as on 30-6-1980)
Punjab	14	2.75	9,858
Sind	16	3.28	2,786
NWFP	8	0.21	455
Baluchistan	1	0.02	-
Total (Pakistan)	39	6.26	13,099

Source: WAPDA, n.d. Annexure I.

Table 2.6

Pumping Sets and Tubewells Installed by East Pakistan Authorities for Irrigation Purposes

Period	No. of Pumping Sets (PS) and Tubewells (TW)	
1955-60	1,030	(PS)
	50	(TW)
1960-65	80	(PS)
	300	(TW)
1965-70	19,000	(PS)
	365	(TW)
Total number of pumping sets:	20,110	
Total number of tubewells:	715	

Source: (1) The First Plan, Government of Pakistan, 1957, p. 363.
(2) The Second Plan, Government of Pakistan, 1960, pp. 206-210.
(3) The Third Plan, Government of Pakistan, 1965, pp. 347-352.

annual number of public tubewell installed in West Pakistan gradually increased from 280 in 1947/48-1953/54 to 398 in 1954/55-1959/60, and to 2,141 in 1960/61-1964/65, and finally to a rate of 3,702 in 1964/65-1969/70. /Table 2.7/.

However, the average annual rate of public sector tubewell installation fell sharply to 1,504 in the following decade (1969/70-79/80) as many SCARP projects were nearing completion while the new phase of this scheme could not be started until 1974/75. Thus, the annual average of tubewell installation in the first half of the seventies remained particularly low, which also effected the decade's average. In the year 1974/75, WAPDA - the most important public sector agency to use tubewells - drew up an 'Accelerated Programme' for the 1974/75-1984/85 period with a view to increasing the speed of tubewell sinking and drain construction. The currently operative 'Accelerated Programme' is actually a part of the long term plan for the future, extending to 1995/96, which envisages installation of 59,011 tubewells /WAPDA, n.d./ Public sector irrigation and reclamation schemes, thus, formed an important part of the growing domestic market for tubewells in Pakistan, especially since the 1960s.

2.3.2 The Pattern and Scale of Private Tubewell Installation[5/]

The real qualitative changes in Pakistan's irrigation system occured with widespread private tubewell installation /Nulty, 1972/. Since access to private water facilitated use of other inputs, helped increase cropping intensity, average yield per acre and the farm income, tubewell procurement became a priority for the farmers. The decade of 1960s

Table 2.7

Tubewells, including deep turbine tubewells, installed for irrigation purposes by Public Authorities in West Pakistan: 1947-80

Period	Tubewells Installed (Average Annual)
1947/48 - 53/54	280
1954/55 - 59/60	398
1960/61 - 64/65	2,141
1965/66 - 69/70	3,703
1969/70 - 79/80	1,504

Total No. installed (1947-80); 42,089; of these WAPDA's deep turbine tubewells, submersible pumps, non-clogging pumps etc.: over 13,099.

Sources: (1) Water and Power Development Authority, n.d., annexture I.

(2) Government of Pakistan, 1970, p. 363.

(3) West Pakistan University of Engineering and Technology, 1970, p. 40.

witnessed a very high rate of tubewell installation in the private agriculture, which continued until the mid 1970s.

Three distinct phases of private tubewell installation in Pakistan can be identified:

PHASE I: 1953/54 - 1963/64: Steady growth

PHASE II: 1963/64 - 1974/75: Rapid growth

PHASE III: 1974/75 - 1979/80: Slowing down of growth

The celebrated study of Ghulam Mohammad /1965/ identified two main trends of private tubewell installation in Pakistan up to 1963/64 viz., (1) this activity took place in non-saline areas of Pakistan, especially in the Punjab; and (2) it was concentrated in areas where electricity supply was available. According to him, there were just under 1,000 private tubewells existing in the Punjab in 1953/54, which were located in areas with access to electricity including Lahore, Lyllpur, Gujranwala, Jhang and the Sahiwal districts. Since electric tubewells are cheaper to instal as well as to run than the diesel tubewells, private tubewells were concentrated mostly in Gujranwala and Sialkot districts which had extensively benefited from electric supply until 1959/60. /Table 2.8/.

It is possible that some other factors too favoured tubewell installation in this area. For instance, groundwater irrigation methods (wells) have long been used in these districts, and the farmers are fully familiar with the operational routines. Moreover, farmers have easy access to installation and maintenance services which are locally available. So what actually happened in many cases was that

Table 2.8

Total Number of Private Tubewells in Each District According to Revenue Department

1953/54 to 1963/64

	1953/54	1954/55	1955/56	1956/57	1957/58	1958/59	1959/60	1960/61	1961/62	1962/63	1963/64
1. D.I. Khan	n.a.	n.a.	10	10	52	105	124	131	131	140	149
2. Bannu	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
3. Mardan	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
4. Hazara	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
5. Peshawar	n.a.	n.a.	6	6	6	6	6	6	7	7	8
6. Kohat	n.a.	n.a.	2	2	2	nil	nil	nil	nil	nil	nil
7. Campbellpur	11	2	1	1	1	1	1	1	1	nil	nil
8. Rawalpindi	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
9. Jhelum	5	3	3	3	3	3	5	3	4	7	8
10. Gujrat	8	9	22	69	102	102	112	159	177	198	250
11. Mianwali	17	19	19	19	19	19	20	28	28	37	72
12. Sargodha	57	77	77	77	105	106	106	85	89	157	156
13. Lyallpur	209	210	239	426	389	387	347	474	492	732	599
14. Jhang	105	135	180	178	192	256	403	648	671	738	770
15. Lahore	177	177	177	188	188	201	205	220	301	305	427
16. Gujranwala	96	119	130	143	183	550	1,027	1,437	1,441	2,222	2,224
17. Sheikhupura	38	38	43	56	56	85	85	174	221	323	455
18. Sialkot	16	49	96	98	129	573	625	853	1,215	1,413	1,422
19. D.G. Khan	13	39	32	37	45	51	58	82	86	93	93
20. Muzaffar Garh	7	9	9	10	47	47	48	50	60	60	118
21. Multan	50	50	87	234	221	261	289	1,313	2,150	2,859	3,415
22. Montgomery	181	280	339	339	392	493	700	1,027	2,194	2,494	2,598
23. Bahawalpur	n.a.	n.a.	n.a.	n.a.	11	24	38	94	188	198	154
24. Bahawalnagar	n.a.	n.a.	7	7	7	7	7	16	59	115	126
25. Rahimyarkhan	n.a.	n.a.	16	18	18	18	18	103	233	279	302
Total	990	1,216	1,495	1,911	2,168	3,295	4,214	6,904	9,757	12,404	13,646

Source: (i) 1953/54 to 1959/60 from Season and Crop Reports.
(ii) 1960/61 to 1963/64 Information supplied by Director, Land Records, Lahore with his letters of 15 March 1965 and 9 April 1965, as reported by Ghulam Mohammad, 1965, p. 49.

farmers of Sialkot and Gujranwala got electric motors installed in old wells to convert them into tubewells. In this way they managed to get more water at small additional cost. These factors helped in early diffusion of tubewell technology in this area.

Two additional factors to cause private tubewell concentration in these districts were: (1) abundance of groundwater; and (2) comparatively low cost of tubewell installation in this area due to favourable soil conditions. /Ghaffar and Clark 1968/. Thus a number of factors seem to have helped rapid diffusion of tubewell technology in these districts in the early period. By 1960/61, private tubewell sinking spread to two other districts of the Punjab viz., Sahiwal and Multan as they too got electricity supply. This happened inspite of relatively higher cost of tubewell drilling in these districts. The data set out in Table 2.9 shows that by 1963/64 Gujranwala, Sialkot, Sahiwal and Multan districts together had more than 75 per cent of the total private tubewells in Pakistan. These sets were drilled with the help of irrigation department in the beginning but, since 1958/59, private drilling services were also available and, by 1963/64, the public sector's share in total private drilling had been reduced to 22% only.

Despite existing discrepancies between different estimates, there is sufficient evidence showing high rate of growth of private tubewell installation during the 1960s. Nulty's (1972) improved version of the World Bank data of tubewells shows that between 1963 to 1969 their total number, had sharply increased from 16,280 to 73,205. /Table 2.9/. Our

Table 2.9

Geographical Distribution of Private Tubewells in West Pakistan[a] at End of June in Each Year, 1963-69, Adjusted[b]

Location	1963	1964	1965	1966	1967	1968	1969
Peshawar Region	180	300	430	560	650	810	960
Lahore Region(Punjab)							
Rawalpindi Division	455	770	1,100	1,300	1,540	2,155	2,570
Gujrat District	360	630	915	1,095	1,260	1,830	2,180
Sargodha	200	310	440	530	700	970	1,280
Lyallpur	650	980	1,420	2,100	2,900	3,560	3,980
Jhang	1,120	1,420	1,800	2,460	3,300	4,060	4,780
Mianwali	130	200	330	470	630	820	1,000
Sialkot	1,790	2,310	3,140	3,830	4,450	5,790	7,460
Gujranwala	2,670	3,800	5,030	6,050	7,010	9,150	11,090
Shelkupura	280	400	670	950	1,250	1,610	2,000
Lahore	960	1,450	1,960	2,600	3,320	4,060	4,780
Sahiwal	2,680	3,830	5,350	7,200	9,020	10,260	11,270
Multan	3,370	4,700	6,340	7,880	9,410	10,350	11,010
Mazaffargarh	290	410	620	860	1,155	1,320	1,415
D.G. Khan	160	210	315	400	600	745	900
Bahawalpur	235	355	505	606	1,130	1,480	1,845
Bahwalnagar	155	245	210	365	495	755	1,060
Rahlymar Khan	210	380	590	840	1,075	1,365	1,635
Total	13,335	21,770	29,940	38,725	47,985	58,450	68,075
Hyderabad Region(Sind)							
Khalrpur District	55	60	85	115	180	260	295
Jacobabad	25	50	80	110	135	150	165
Sukkur	125	215	310	405	500	595	700
Nawabahah	75	90	125	1185	265	365	435
Larkana	25	30	40	60	90	130	150
Sanghar	15	20	25	35	50	60	70
Dadu	30	45	65	90	115	140	170
Hyderabad	20	30	45	60	80	135	160
Tharparkar	-	-	-	-	-	-	5
Thatta	-	-	5	5	5	5	5
Quetta Division	170	230	340	480	650	795	945
Kalat	80	100	130	170	220	280	340
Karachi	145	200	280	370	480	600	
Total	765	1,070	1,530	2,085	2,770	3,505	4,710
West Pakistan	16,280	23,140	31,900	41,370	51,405	62,765	73,205

Notes: (a) This refers to present Pakistan.

(b) IBRM-IBRD, Report, Vol. VI (London and Arnhem: Sir Alexander Gibb and Partners, International Land Development Consultants, N.V. Hunting Technical Services Ltd., 1966), Appendices, Table B.13. By 1970, there were several agencies collecting data on private tubewells. Between 1963 and 1967, the PIDE carried out a series of sample surveys. From 1966/67 to 1968/69 data were collected by the Statistics Branch of the Agricultural Department, Government of West Pakistan, and, in 1968, the Agricultural Census Organisation carried out a survey on behalf of the Farm Mechanization Survey. Since all these surveys were carried out at different times of the year, and presumably based on different samples, it is not surprising to find that there are discrepancies in the estimate for overlap years. The actual data for each source is given in IBRM, op. cit. Vol. 6, Appendices, Table B.12) This table reproduces the series produced by the IBRM, adjusted for differences in coverage, etc. which puts all the data on a comparable basis.

Source: Nulty, 1972, p. 61.

estimates of the annual average private tubewell installation for the entire period, i.e. 1949/50-1979/80 lend support to the results of earlier studies and shows that: (1) private tubewell installation was increasing in the 1950s, and the number of annual average tubewells installed in the second half of this decade was significantly higher than in the first half; (2) a real sharp increase took place in the 1960s when the annual average figure was around 10,000 tubewells for the entire decade; (3) private tubewell installation kept rising in the first half of 1970s when it reached the highest ever level of 14,700 tubewells per annum; and (4) thereafter, it declined sharply, making the annual average figure for 1974/75 - 1979/80 almost half of the average of the first half of the 1970s /Table 2.10/.

The fall in the annual rate of private tubewells installation after 1974/75 was attributable to a number of factors: (1) an increase in the canal irrigated area covered by SCARP projects i.e. additional water supply from the public sources; (2) near saturation of demand in some areas; (3) difficulty in getting new electric connections in certain areas; (4) higher electric tariffs and diesel oil prices; (5) substantially increased cost of imported new materials and parts of tubewells[6/] following 131% currency devaluation in 1972. However, the total number of private tubewells had risen to 175,125 by 1979/80 of which 63.5% were diesel engine operated sets.

Throughout this period most of the private tubewells were installed in the Punjab: its share in the total tubewells was 93.8 per cent in 1965, 92.3 per cent in 1970/71, and 88.7 per cent in 1979/80. /Tables 2.9 and 2.11/. Next in

Table 2.10

Tubewells Installed in West Pakistan[a] Private Agriculture (Average Annual) 1948-80

Period	Tubewells Installed (Average Annual)
1948/49 - 53/54	330
1954/55 - 59/60	975
1960/61 - 64/65	8,000
1965/66 - 69/70	12,050
1970/71 - 74/75	14,700
1975/76 - 79/80	7,400

Total No. installed (1948-80) West Pakistan: 175,125.[b]

Total No. installed (1948-80) Punjab: 154,468.

Notes: a/ This refers to present Pakistan.

b/ The figures for West Pakistan includes tubewells installed by public authorities in the Sind province.

Sources:
(1) Ghulam Mohammad, 1965, p. 4.
(2) Government of Pakistan, 1970, p. 64.
(3) West Pakistan University of Engineering and Technology, 1970, p. 34.
(4) Government of Pakistan, 1980, p. 103.

Table 2.11

Number of Tubewells in Pakistan

Year	Electric/ Diesel		Punjab			Sind(b)	N.W.F.P.			Baluchistan			Pakistan
			Public	Private	Total		Public	Private	Total	Public	Private	Total	Total
1	2		3	4	5	6	7	8	9	10	11	12	13
1970-71	Elect.		7,295	24,995	32,290	2,082	224	1,407	1,631	17	726	743	36,746
	Diesel		430	56,819	57,249	1,989	1	76	77	23	1,552	1,575	60,890
		Total	7,725	81,814	89,539	4,071	225	1,483	1,708	40	2,278	2,318	97,636
1971-72	Elect.		7,301	27,588	34,889	N.A.	226	1,569	1,795	20	777	797	N.A.
	Diesel		264	63,256	63,520	N.A.	1	76	77	24	1,744	1,768	N.A.
		Total	7,565	90,844	98,409	N.A.	227	1,645	1,872	44	2,511	2,565	N.A.
1972-73	Elect.		8,392	30,120	38,512	3,808	273	1,618	1,891	21	884	905	45,116
	Diesel		323	69,554	9,877	2,024	1	77	78	34	2,156	2,190	74,199
		Total	8,715	99,674	108,389	5,832	274	1,695	1,969	55	3,040	3,095	119,285
1973-74	Elect.		8,831	33,012	41,843	4,574	290	1,591	1,881	25	1,164	1,189	49,487
	Diesel		298	76,281	76,579	2,083	-	118	118	46	2,482	2,528	81,308
		Total	9,129	109,293	118,422	6,657	290	1,709	1,999	71	3,646	3,717	130,795
1974-75	Elect.		8,532	39,667	48,199	5,083	337	2,485	2,822	25	1,454	1,479	57,583
	Diesel		227	90,786	91,013	2,580	7	251	258	48	2,808	2,856	96,707
		Total	8,759	130,453	139,212	7,663	344	2,736	3,080	73	4,262	4,335	154,290

Table 2.11 (Cont'd.)

Year	Electric/ Diesel		Punjab			Sind(b)	N.W.F.P.			Baluchistan			Pakistan
			Public	Private	Total		Public	Private	Total	Public	Private	Total	Total
1	2		3	4	5	6	7	8	9	10	11	12	13
1975-76	Elect.		8,584	40,971	49,555	5,747	422	2,999	3,421	25	1,638	1,663	60,386
	Diesel		809	93,811	94,620	2,624	27	255	282	50	2,993	3,043	100,569
		Total	9,393	134,782	144,175	8,371	449	3,254	3,703	75	4,631	4,706	160,955
1976-77	Elect.		8,838	43,534	52,372	6,150	426	3,037	3,453	25	1,783	1,808	63,793
	Diesel		189	97,190	97,379	2,626	31	275	306	50	3,080	3,130	103,441
		Total	9,027	140,724	149,751	8,776R	457	3,312	3,769	75	4,863	4,938	167,234
1977-78	Elect.		9,448	45,542	54,990	6,645	439	3,407	3,846	25	1,889	1,914	67,395
	Diesel		205	98,579	98,784	2,026	33	239	252	50	3,254	1,304	104,966
		Total	9,653	144,121	153,774	9,271	472	3,626	4,098	75	5,143	5,218	172,361
1978-79	Elect.		9,956	47,508	57,104	7,283	452	3,681	4,133	76	2,490	2,557	71,077
	Diesel		160	100,487	100,647	2,627	33	571	604	64	3,464	3,528	107,406
		Total	9,756	147,995	157,751	9,910	485	4,252	4,737	131	5,954	6,085	178,483
1979-80	Elect.		9,889	50,034	59,923	8,004	539	3,711	4,250	70	2,840	2,910	75,087
	Diesel		163	104,434	104,597	2,627	38	581	619	61	3,613	3,674	111,517
		Total	10,052	154,468	164,520	10,631	577	4,292	4,869	131	6,453	6,584	186,604

NOTES: R = Revised (b) Break-up not available.

SOURCE: Agriculture Census of Pakistan, 1981, table 82.

rank order, though with a much smaller share, was the Sind, followed by the N.W.F.P. and the Baluchistan.

Another notable feature of the private tubewell installation in Pakistan is that the majority of these are diesel engine operated. Though tubewell sinking was in the beginning accelerated by electricity supply to the villages, a very large number of these run on diesel oil. Relying on a number of sources, we have estimated the number of diesel tubewells existing in various years and then plotted them against the total number of private tubewells in the country. Column (4) of table 2.12 shows fluctuating but high percentage share of the private diesel tubewells in the total over the years: it fell from 75.2% in 1964 to 61.2% in 1969, again rose to 68.5% in 1971-72, but again declined slowly till 1979-80, though it still claimed 63.4% share in the total.

The significance of diesel engines in Pakistan's agriculture cannot be over-emphasised. Most of rural Pakistan is still without electricity supply. By 1981, only 11,342 out of a total of about 38,000 Pakistani villages were electrified. [Government of Pakistan, 1982, p. 71]. Thus a large number of the villages still have to rely on diesel engines as a generator in case they choose to use it on jobs like tubewell running. Other uses of diesel engines include running of agro-industries like flour milling, cotton ginning, oil expelling, cotton baling in the rural areas.

Table 2.12

Private Diesel and Total Tubewells Installed at the End of Selected Years[1/]: Pakistan

Year (1)	Diesel Private Tubewells[2/] (2)	Total Private Tubewells[3/] (3)	% Share of the Diesel Tubewell (4)
1964	18,800	25,000	75.2
1969	48,520	79,233	61.2
1970-71	60,890	89,646	67.9
1971-72	65,076	95,000	68.5
1972-73	74,199	110,241	67.3
1973-74	81,308	121,305	67.0
1974-75	96,707	145,114	66.4
1975-76	100,955	151,038	66.8
1976-77	103,441	157,675	65.6
1977-78	104,966	162,161	64.7
1978-79	107,406	168,111	63.8
1979-80	111,628	175,844	63.4

Notes: 1. These include public sector electric tubewells in the Sind province.

2. These figures have been estimated from a number of sources, so there might appear a discrepancy between these and the data included in some other tables.

3. Total tubewells include diesel and electric.

Sources: 1. Ghulam Mohammad, 1965, P. 7.
2. Report of the Farm Mechanization Committee, Ministry of Agriculture Government of Pakistan, 1970, p. 64.
3. A Study of Contribution of the Private Tubewells in the Development of Water Potential in Pakistan, West Pakistan University of Engineering and Technology, 1970, p. 43.
4. Agricultural Statistics of Pakistan: 1980, pp. 141-143, Government of Pakistan, 1981.

2.3.3 Economic Rationale of Private Tubewells

Rapid growth in private tubewells during 1960/61 to 74/75 was not just the result of demonstration effect; this happened on the basis of pure and rational economic calculations.

First, as noted above, the returns on tubewell investment in the 1960s were very high. According to Ghulam Mohammad /1965/, in the rice growing area of the Punjab, an electric tubewell on 100-acre farm could recover its cost in one year, while the diesel engine powered tubewell made full cost recovery in two years. Despite higher initial and maintenance cost of diesel tubewell than that of the electric tubewell, the net return on the former was still very high to attract investment by farmers who did not have access to electricity.

Second, a combination of additional water and other inputs of the new technology worked itself out in three significant ways in Pakistan: (1) improved utilization of cultivated area by increasing cropping intensity; (2) increased agricultural yield; and (3) increased use of labour and machine power on farms. /Ghulam Mohammad (1965), Ghaffar and Kaneda (1970)/. The net result of these changes were shown in higher farm incomes.

Two important points must be noted about the beneficial effects of tubewell installation in Pakistan: (1) tubewell investment yielded high return, and (2) the large sized farms did not enjoy extraordinary advantage over the smaller farms, though the two may not have had uniform access to water. A small farmer could either sink his own tubewellor keep one in joint ownership and, thus, benefit from private water supply. Alternatively, a farmer could purchase water from neighbouring tubewell owners with surplus supply. Data presented in Table 2.13 shows that tubewells were spread out on private farms of all sizes in different years. To put it differently, whenever possible, tubewell water was being used as a supplementary irrigation source by farms of all sizes.

2.4 Mechanisation of Farms

Another notable feature of Pakistan agriculture since the mid-1960s is a gradual increase in the use of modern cultivation implements. Traditionally, the farmers of Pakistan have relied on domestically produced (Desi) simple agricultural implements and bullock power for farming purposes. But the situation radically changed with the introduction of new agricultural technology which led to higher cropping intensity. Since increased cropping intensity depended on timely land preparation, weeding, harvesting, threshing, etc. - which required greater use of machine power on farms - there arose the need for mechanised farming in Pakistan.

Farm mechanisation in Pakistan is closely associated with tractorization. The role of tractors in Pakistan agriculture has been extensively debated and there is a common view that tractor is a useful, multipurpose machine needed for various farm and off-farm jobs. [Lawrence (1970) Government of Pakistan (1970), Khan (1975), Ahmad (1976) and Munir (1979)] . On the farms, tractors are used for land

Table 2.13

Private Tubewell Distribution According to Size of Holding in Various Years

Source of Data	Number of Tubewell Surveyed	Less than 25 Acres %	25-50 Acres %	Over 50 Acres %
(1) PIDE Survey (1964)	13,646	23	32	45
(2) PIDE Survey (1966)	19,750	26.6	30.7[a]	42.7[b]
(3) Farm Survey (1968)	75,720	31.0	24.0	45.0
(4) Planning Commission Survey (1969)	79,233	28.54[c]	26.5	45.1

Notes:
(a) This refers to the farm size of 25-49.9 acres.
(b) This refers to farm size of 50 acres and above.
(c) This refers to farm size of up to 25 acres.

Sources:
(1) Mohammad, 1965, p. 21.
(2) Ghaffar and Clark, 1968, p. 17.
(3) Planning Commission, 1970, p. 53.
(4) A Report on Farm Mechanization Survey, Ministry of Agriculture and Works, Islamabad, 1970, p. 63.

preparation, weeding, sowing, fertilizer distribution, cropping, threshing and many other purposes. These jobs require use of different attachments (implements/machines) to go with tractors. The most important off-farm use of tractors in Pakistan is to serve as a transport vehicle for passengers and goods in rural as well as urban areas.

Over the years, tractor use has become widespread in Pakistan and its demand is still increasing. [Government of Pakistan, 1983]. Tractor imports have also kept increasing to meet this demand: the average annual number of imported tractors has risen from 3,657 in 1965/66-1970/71 to 5,857 in 1971/72-1975/76 and to 16,157 in 1976/77-1981/82. The cumulative number of tractors in Pakistan, thus, sharply increased from 13,276 in 1965/66 to 156,947 in 1981/82. [Table 2.14].

A number of factors have been instrumental in popularising tractors in Pakistan. First, introduction of new agricultural technology raised farm power requirements and, because tractors offered a more efficient alternative than farm labour, its demand consistently increased over the years since the mid-1960's. Second, there also appears to be some link between water availability and tractor use in Pakistan. [Table 2.14]. The Farm Mechanisation Committee (1970) reported that almost 97 per cent of the total tractors in Pakistan were operated on irrigated land and 62 per cent were used on land where canal water was supplemented with tubewells. The World Bank sample survey of 1975 further identified that almost 45 per cent of Pakistani farmers actually owned tubewells before buying tractors.

Table 2.14

Water Availability at Farm Gate (MAF) and Tractors in Pakistan

	Water Availability (MAF)	Tractors Imported[a]	Cumulative No. of Tractors
1965-66	63.87	1,665	13,276
1966-67	67.54	4,113	14,941
1967-68	68.54	2,182	17,123
1968-69	72.79	4,411	21,534
1969-70	75.50	5,696	27,230
1970-71	69.95	3,879	31,109
1971-72	71.10	4,224	35,333
1972-73	81.17	1,847	37,180
1973-74	80.06	5,216	42,396
1974-75	77.02	7,190	49,586
1975-76	85.94	10,809	60,395
1976-77	84.57	15,554	75,949
1977-78	89.44	11,902	87,851
1978-79	87.39	15,178	103,029
1979-80	94.14	19,313	121,952
1980-81	97.79	16,137	138,089
1981-82	96.45	18,858	156,947

Note: (a) The share of tractors used in agriculture is about 98%. This is calculated from Pakistan Census of Agriculture, 1975.

Source: (1) Pakistan Economic Survey, 1982-83, table 8.

(2) Agricultural Statistics of Pakistan, 1980, table 94.

One possible link between the two could be that tubewell installation increased the farmer's income and, thus, provided the means to purchase tractors that he would have liked to buy. So demand for tractors could have increased along with tubewell diffusion in Pakistan. Third, government policy also played an important role in promoting tractor use in Pakistan agriculture. Among the incentives given to encourage farm mechanisation were: (1) import of agricultural machinery at official exchange rate; (2) liberal import of tractors/implements; (3) availability of cheap agriculture credit; (4) tax-free agricultural income; and (5) State sponsored training and workshop facilities for tractor owners. /Ahmad, 1976/. Finally, emergence of tractor-hire market for farm and off-farm duties also added to its demand.

Put together, these factors led to large-scale use of tractors in Pakistan agriculture. Consequently, the tractor operated area in the country increased from 3.28 million acres (1.32 million hectares) in 1968 to 5.90 million acres (2.38 million hectares) in 1980. If the area using both tractors and bullocks were to be included then the total area would jump further up to 13.51 million acres (5.46 million hectares) 1980. /Government of Pakistan, 1970(b), p. 59, and Table 2.15/. Of the total farms in Pakistan, 15 per cent relied completely on tractors and 22 per cent used both tractors and bullocks. The share of the Punjab (in terms of area) in tractor use and tractor/bullock use was the maximum (77.15 per cent and 69.8 per cent, respectively) indicating higher degree of farm mechanization in the province. /Table 2.15/.

To make effective use of tractors on farms it is also necessary to select appropriate agricultural implements

Table 2.15

Private Farms Reporting Use of Tractors and Draught Animals for Cultivation of Land: (1980)

Administrative Unit	All Farms		Farms Reporting Use of					
			Tractor only		Both Tractor and Bullock/ Other Animals		Bullock/Other Animals	
	Number[1]	Area[2]	Number	Area	Number	Area	Number	Area
1	2	3	4	5	6	7	8	9
Pakistan	4.069	47.095	0.611	5.909	0.880	13.510	2.489	26.460
NWFP	0.528	4.099	0.093	0.381	0.117	1.083	0.310	2.529
Punjab	2.544	29.897	0.437	4.556	0.582	9.430	1.489	15.584
Sind	0.795	9.207	0.067	0.688	0.160	2.469	0.549	5.702
Baluchistan	0.202	3.892	0.014	0.284	0.021	0.528	0.141	2.645

Notes: (1) Number refer to millions.
(2) Area refer to million acres.

Source: Pakistan Census of Agriculture, 1980, table 10, Government of Pakistan, 1981.

and machinery. So an important decision for a tractor owner to make is what tractor-driven implements to buy and in which order. For example, an average Pakistani farmer uses tractors for a number of farm jobs like ploughing, clodding, crushing, levelling, channel preparation, sowing, spraying, harvesting and threshing. For each of these tasks he needs one or more implements/ machinery to be used with the tractor. According to one source, a typical progressive tractor-owner Punjabi farmer in the irrigated area wishes to purchase a set of implements including cultivator, leveller, seed drills, rotavator traditional plough and a ridger [Munir, 1979]. This shows that each Pakistani tractor owner requires a number of implements to take full advantage of it.

Till 1960, the tractor population in Pakistan was small and the use of modern agricultural implements also remained limited, but it became more common during 1960-70. The real big increase in tractors/implements took place in the 1970s, which was recorded by the Census of Agriculture (1980). Another important trend noted by the Agricultural Census of 1972, and still persisting in the 1980s, was that many farmers switched over to modern agricultural implements while still using bullock power. In this way, they managed to increase farm output without incurring tractor cost [Khan, 1975]. So use of modern agricultural implements in Pakistan agriculture was not tied up with tractors alone; farmers could in some cases match them with bullocks too. It all added up to the demand for modern agricultural implements in the country.

The rate of growth of demand for cultivation machinery attained still higher levels in the 1970s and in the following years. The data set out in Table 2.16 shows the new trends of ownership and use of agricultural machinery emerging in the 1970s. It indicates that: (i) there was an absolute increase in the number of agricultural machines owned and used by the farms during 1972-80; (ii) all sizes of farm households owned greater number of tractors and tractor-driven implements in 1980 than in 1972; (iii) although threshers/shellers ownership registered exceptionally high growth of almost 500 per cent, the increase in the case of other products was also very fast; (iv) in each farm size group, households reported much more intensive use of agricultural machines in 1980 compared to 1972, showing that: (a) the machines were used more than once on the same farm; and (b) the owners also leased them out on rental basis, thus, allowing intensive use of machines by more farms.

The picture that emerges from the above given data is that the farm mechanisation trend in the country has gained significantly since the early 1970s as shown by the increase in ownership and use of agricultural machinery. Over the years, this has led to the emergence of a fairly large domestic market for cultivation machinery.

Summary

In this chapter we set out to identify what lies behind the demand for irrigation and cultivation products in

Table 2.16

Number and Use of Selected Agricultural Machines, 1972 and 1980

SIZE OF FARM (ACRES)	FARM HOUSEHOLDS REPORTING USE AND OWNERSHIP OF											
	TUBEWELLS						TRACTORS					
	(OWNED)		%	(USED)		%	(OWNED)		%	(USED)		%
	1972	1980	Increase	1972	1980	Increase	1972	1980	Increase	1972	1980	Increase
	1	2	(2/1)	3	4	(4/3)	5	6	(6/5)	7	8	(8/7)
Total Farm[(a)] Households	125582	173933	38.50%	927771	1319680	42.24%	28937	90682	213.39%	664113	1455275	119.13%
Less than 1-12.5	34443	60015	74.24	612577	947590	54.68	2795	16392	486.47	398810	1048434	162.89
12.5-50	62110	77748	25.17	283340	334372	18.01	11424	43497	280.75	219205	349826	59.58
Over 50	29006	36170	24.69	31854	37718	18.40	15895	30791	93.71	46095	56954	23.55

SIZE OF FARM (ACRES)	FARM HOUSEHOLDS REPORTING USE AND OWNERSHIP OF											
	THRESHER/SHELLER						POWER DRIVEN BLADE					
	(OWNED)		%	(USED)		%	(OWNED)		%	(USED)		%
	1972	1980	Increase	1972	1980	Increase	1972	1980	Increase	1972	1980	Increase
	9	10	(10/9)	11	12	(12/11)	13	14	(14/13)	15	16	(16/15)
Total Farm Households	5679[(b)]	33933	498.57	N.A.	651020	-	12550	38572	207.34%	34634	97333	181.03%
Less than 1-12.5	N.A.	4798	-	N.A.	479309	-	816	5124	527.94	9214	43819	375.56
12.5-50	N.A.	15763	-	N.A.	148946	-	4406	16351	271.10	14322	37080	158.90
Over 50	N.A.	13432	-	N.A.	22765	-	7323	17095	133.44	11098	16434	48.08

Table 2.16 (Cont'd.)

SIZE OF FARM (ACRES)	FARM HOUSEHOLDS REPORTING USE AND OWNERSHIP OF											
	TRACTOR DRIVEN DRILLS						SPRAYER/DUSTER					
	(OWNED)		%	(USED)		%	(OWNED)		%	(USED)		%
	1972	1980	Increase	1972	1980	Increase	1972	1980	Increase	1972	1980	Increase
	17	18	(18/17)	19	20	(20/19)	21	22	(22/21)	23	24	(24/23)
Total Farm Households	4143	15937	284.67%	17955	82084	357.16%	1385	7081	411.26%	9943	20343	104.59%
Less than -12.5	361	2438	575.34%	7449	59987	638.17	357	608	70.30	3683	5966	61.98
12.5–50	1137	5047	343.88	5576	17637	216.30	485	2199	353.40	3867	8601	122.42
Over 50	3811	8452	121.77	5201	9460	81.88	541	4274	690.01	2538	5776	127.58

NOTES: (a) These figures have been calculated from Pakistan Census of Agriculture, 1972 and 1980.

(b) This figure refers to tractors/sheller ownership by tractor owners in 1975.

Source: (1) Pakistan Census of Agriculture, 1972, Province Report, Agricultural Census Organisation, Government of Pakistan, Lahore.

(2) Pakistan Census of Agriculutre, 1980, All Pakistan Report, Agricultural Census Organization, Statistics Division, Government of Pakistan, Lahore.

(3) Agricultural Statistics of Pakistan, 1980, p. 153.

Pakistan. We noted that demand for tubewells came from a number of sources, the most significant being private agriculture. This market expanded rapidly till 1973/74, but fell sharply afterwards.

Simultaneously, there also emerged a domestic market for cultivation products which grew slowly in the 1960s, but expanded rapidly in the following years. Put together, growing demand for irrigation and cultivation products created a fairly large market for agricultural machinery in Pakistan.

FOOTNOTES

CHAPTER TWO

1/ The Indus Basin is spread over 204,000 square miles or 65.7% of the country's total area. The overall average rainfall in the Indus Basin area is less than 15 inches per annum; 60% of it receives less than 10 inches, while another 16% of the total gets less than 5 inches per year.

2/ Two significant policy changes to occur in this period were: (1) launching of emergency food self-sufficiency programme following a particularly poor wheat crop; and (2) the adoption of agricultural development as a planning priority. Government took up the task of diffusion of green revolution technology as a high priority by way of incentives. These included subsidies on the purchase of fertilizer seeds, insecticides, and water rates, while agricultural machinery import was allowed at official (concessional) exchange rates. The second set of measures adopted in 1960, related to price support for all the major crops. Improved availability of new inputs encouraged their usage by the farmers. Governments' commitment to agricultural development is evident from the increased public sector allocations for the procurement and distribution of essential inputs and extension services. /Table Appendix A.2.3/. The overall impact of the policy changes showed itself in improved agricultural prices and agriculture sectors terms of trade vis-a-vis manufacturing. /Table Appendix A.2.4/.

3/ In 1982, Indus Basin irrigation system included 2 storage reservoirs (dams), 17 barrages, 8 link canals and an extensive conveyance system consisting of canals, branches, distributaries and so on. /WAPDA, n.d./.

4/ As a result of many decades of large-scale canal irrigation without proper water management and drainage facilities, the subsoil water table rose in this area - affecting respiration of crop plants and, thus, reducing their yield. The excessive water near the surface also caused salts build up, gradually resulting in soil salinization. The first survey in 1959 showed that of the 18.83 million hectares surveyed, 24.3% was poorly drained, 10.4% severely saline and 24.0% had saline patches. /WAPDA, n.d./.

5/ For this section we rely on the data produced by Ghulam Mohammad (1965) and Nulty (1972).

6/ Until 1981, most of tubewell raw materials (scrap, steel, gun metal, etc.) were imported. Some large-scale firms also used imported parts and continue doing so till today.

CHAPTER THREE

INDUSTRIALIZATION POLICY IN PAKISTAN

3.1 The First Phase: (1950-70)

The first phase of economic development in Pakistan covered the period 1950-1970. During these two decades the development strategy remained essentially unchanged. In this period industry was the leading sector of the economy as the development strategy emphasised industry-led growth. The high rate of industrial growth in this phase was achieved through a combination of commercial, monetary and fiscal policies offering private investors lucrative investment opportunities in modern, large scale manufacturing.

In the early period (1950-60) of the first phase, three factors particularly accounted for rapid industrial growth: (1) large domestic market for the manufactures; (2) timely public-sector support; and (3) pro-industrialization development strategy.

Observers of the industrial scene in Pakistan have noted that the basis of imports substitution-led industrial growth in the early years was provided by the nature of the domestic market and the availability of raw materials. /Papanek (1967), Lewis (1969), Griffin and Khan (1972), Islam (1973), White (1974)/. In 1947, Pakistan had a very small share in the subcontinents' total manufacturing capacity. Only a few agro-based units and steel re-rolling mills existed in the country. In 1949/50, the share of manufacturing sector in the GDP was only 8.2%, while agriculture commanded a predominant position by contributing 53.2% /Table 3.1/. Thus vast opportunities existed for establishing domestic manufacturing capacity. On the other hand, deterioration in terms of trade for Pakistan's raw materials exports of cotton and jute in the post-Korean war years (1953 onwards) added weight to the governments' decision to set up domestic industries based on the same raw materials. A large domestic market and abundance of raw materials made the establishment of domestic consumer goods industries easy and profitable. The policy of import substitution was supported by a number of economic measures including high tariffs, exchange controls, industrial licences, import quotas and tax concessions, all providing incentives for private investors to shift their capital into the industrial sector.

Import controls in the post-Korean war years led to a sharp increase in industrial investor's profitability. This was reported by an observer of Pakistan economy thus:

> 'With high prices for consumer goods and low prices for the capital goods needed to produce then, annual profits of 50-100 per cent were possible', /Papanek, 1967, p. 33/.

The favourable investment climate attracted into industry large funds from the commercial sector of the economy which had established itself by then in Pakistan.

Table 3.1

Structural Changes in Gross Domestic Product (Pakistan)

(Percentages)

Sectors	1949-50	1959-60	1969-70	1979-80
Agriculture	53.2	45.8	38.9	31.8
Manufacturing[a]	8.2	12.4	16.5	15.7
(i) Large-scale	-	-	-	11.0
(ii) Small-scale	-	-	-	4.7
Services Sector	37.4	39.3	40.4	52.0
Others:				
(Quarrying, Construction, etc.)	1.4	2.5	4.2	0.5
Total	100.00	100.00	100.00	100.00

Note: (a) Manufacturing includes mining except in 1979-80.

Sources: (1) Baqai 1979; p. 7.

(2) P.I.D.E., 1981; p. 3.

Another author summarises the economic scene by saying that: 'Circumstances put a premium on entry into business, first in commodity imports and later in the manufacture of basic consumer goods, particularly textiles', /Hanna Papanek, 1972, p. 18/. Thus there existed attractive opportunities for entrepreneurs to enter trading business and later move into the manufacturing sector, or to occupy both.

Since the planners expected the thrust of industrial development to come from the private sector, a major part of the development allocations went to its share during the three development plans period 1955-70 /Appendix Table A.3.1/. The public sector industrial investment played an important promotional role. This task was mainly carried out by the Pakistan Industrial Development Corporation.[1/] The major contribution of P.I.D.C. in this respect was to give lead to the private sector in new and risky areas of investment.

From 1952 till the time of its bifurcation in 1962, P.I.D.C. set up 21 projects in a wide range of industries like fertilizers, natural gas, ship-building, sugar, cement, carpets, woollen textiles, chemicals, pharmaceutical products, and many others. Between 1962 to 1968, West Pakistan Industrial Development Corporation completed another 48 projects with a total outlay of Rs. 900 million /Government of Pakistan, 1968(a), p. 82/. A large number of new projects have been added to the list since then. During this period, P.I.D.C. also disinvested in many highly profitable units in favour of certain influential industrial groups of Pakistan.[2/]

The private sector's growth was sought through direct controls on trade and foreign exchange. The planners maintained that the inexperienced Pakistani industrialists could not withstand international market competition and needed protection against imports. The government's choice of direct controls against indirect monetary and fiscal measures in the 1950s was based on the argument that since a part of the economy was still non-monetised, the chances of indirect controls succeeding were not bright. The policy of direct controls however, stayed on in some form or another until 1970. These measures achieved accumulation and growth. The economy registered an average annual growth rate of 3.4%, between 1950-60, while the manufacturing sector recorded a rate of 7.8% in the same period /Table 3.2/.

The development strategy in this period emphasised the special role of the new industrial enterprises. The financing of industrialization was planned to suit the growth of the private industrial sector. A part of the development finance had to come from the redistribution of income in favour of the capitalist class who were assumed to have high propensity to save; hence numerous fiscal and other concessions were given to them. Taxes and public savings were kept low to provide incentives to private investors. The other part of the finance was expected to come from foreign sources, especially aid /Griffin, 1965/.

Table 3.2

Growth Rates of Production Sectors and G.D.P. (Pakistan)

(% Annual Average)

Sectors	1950-60	1960-70	1970-80
(1) Agriculture	1.7	5.0	2.3
(2) Mining[(a)]	-	-	4.2
(3) Manufacturing	7.8	9.8	4.1
(1) Large-scale	15.4	13.4	3.0
(2) Small-scale	2.3	2.9	7.3
(4) Services	3.7	7.1	6.3
(5) G.D.P.	3.4	6.3	4.5
(6) G.D.P./capita	1.0	3.5	1.4

Note: (a) Upto 1969/70 manufacturing and mining statistics were put out together.

Sources: (1) Pakistan Institute of Development Economics, 1980, p. 2.

(2) Naseem 1981, p. 46.

(3) Khan and Hirashima, 1980, p. 10.

In so far as the growth objective was concerned, this strategy proved successful. The manufacturing sector registered an annual average rate of 7.8% in 1950-60 and 9.8% in 1960-70. /Table 3.2/. Much of this growth was attributable to the large-scale industries which far exceeded the overall growth of the manufacturing sector; recording 15.4%, during 1950-60 and 13.4% in 1960-70. It thus came to occupy a predominant position in the manufacturing sector.

The sharp increase in the 'large-scale' private industrial investment in the first half of the 1960s was attributable to a number of, factors, viz., (1) greater business confidence, (2) high profit rates, (3) expansion of the domestic market, and (4) large inflow of foreign aid. /Amjad, 1982/. The widespread industrial activity in this period was also aided by special financial institutions set up to help large-scale investors. All these factors contributed to the creation of the predominant position that the large-scale firms came to occupy in the manufacturing sector.

3.1.1 The Privileged Large-Scale Firms

Rapid growth of large-scale firms in Pakistan was essentially the result of the industrial policy which provided preferential support to the large-scale over the small-scale sector. There were three main aspects of this policy, viz., (1) investment licensing system; (2) import licensing and exchange control system; and (3) lending policies of the financial institutions. /Lewis, and Guisinger (1968), White (1974), Amjad (1982)/.

Investment Licensing System

Industrial investment licences were used by the government to control foreign exchange allocations for machinery imports. Though it's provisions were revised from time to time, the investment sanctioning criteria remained geared to needs of large-scale firms. The investment licences issued to large-scale firms entitled them to get foreign exchange at official (cheaper) rates for capital goods imports at the time of their establishment and for raw materials and spare parts purchases subsequently.

Though, official sanction was essential to import capital goods , there did not exist any industrial schedules in the 1950s. The investors had to approach the appropriate government agency which took decisions in each case on its merits. By and large, private investors enjoyed great degree of freedom to carry out investment in industries of their choice. This led to concentration of large-scale firms in the consumer goods sector, especially textiles.

The first investment schedule to serve as a guideline for investors was issued in 1960. Although it fixed targets in terms of different industries they could be practically ignored by the investors. This could happen because: (1) the investment schedule was not meant to be a rigid framework; and (2) the special financial institutions, viz., Pakistan Industrial Credit and Investment Corporation (PICIC) and Industrial Development Bank of Pakistan (IDBP) followed a flexible policy of loans sanctioning for industrial investors.[3/] For these reasons, there arose a difference between the actual investment and the allocations for various categories of industries, particularly during the Second Plan period (1960-65). The Second Plan had fixed resource allocations for consumer, intermediate and capital goods industries in the ratio of 39:53:8, respectively, whereas the actual investments come out to be 47:45:8 /Islam, 1973 p. 82/. This was largely on account of the large firms being able to enter sectors of their choice with state financial help. Only during the Third Plan period (1965-70) government insisted on stricter adherence to the Investment Schedule. This became necessary as foreign aid inflow was reduced after the 1965 Indo-Pakistan war.

Import Licensing and Foreign Exchange Control System

Entry of a new firm and the scale at which it could enter an industry depended on its ability not only to obtain finance, but also foreign exchange for the import of machinery and raw materials. Hence import licensing acted as major constraint on investment. In other words, the government used direct means to influence industrial investment in this period.

The import licensing was part of the exchange control system of the post-Korean war years. This system was originally designed to cope with the balance of payment problems of the early 1950's, which were caused by the crash in the export prices of Pakistan's waw materials after the cessation of hortilities in Korea. But the system was continued to be used as an instrument of industrial promotion until 1971. In this regard it performed two functions: it (1) arranged the supply of essential raw materials at official exchange rates (from 1955 to1972, Pakistan maintained an official exchange rate of Rs 4.76 = US $ 1.00); and (2) helped raise the prices of manufactured goods by means of tariffs and import restrictions. In this way, the licensing system created a protected market for domestic producers. /Amjad, 1982/.

The system of import licensing brought unequal benefits to different industrial investors. Large-scale firms, with fixed industrial import licence entitlements, had access to foreign exchange at official rates and paid a lower import duty on the capital goods and raw materials than those to whom these licences were not available; small-scale firms had to buy the same, commercially imported, goods at much higher market prices. The duties on commercial imports were much higher than on industrial imports. In particular, the practice of fixing raw material import quotas on the basis of installed capacity served as an incentive for investors to go for large-scale projects. By obtaining raw materials at official rates, and in excess of their own needs, the privileged industrialists could make proifts by selling these imported materials at black market prices. Discrimination against non-privileged firms was based on the standard procedure of granting privileged status to a firm if it required foreign exchange for imports at the time of its establishment. Since the small firms were not sanctioned foreign exchange quotas for capital goods imports at the time of establishment, they could never become licensed industrial importers. /Lewis and Guisinger, 1971/.

Lending Policies of the Financial Institutions

Large-scale firms were also privileged to get valuable help from various financial institutions. The big business, the monopoly houses of Pakistan, had established close links with banks, insurance companies and financial intermediaries. They controlled Rs 9608.0 million or 65.4% of the total domestic bank deposits and Rs 6087.5 million or 57.0% of the loans/advances in the United Pakistan in 1970, and owned Rs 768.9 million or 76.1% of the shares of the insurance companies in 1969. /Appendix Table A.3.2 and A.3.3/. Still more significant was their influence on the specialized financial institutions such as the PICIC and IDBP, and two financial intermediaries, the Investment Corporation of Pakistan, and the National Investment Trust. Different monopoly houses had representation on the boards of directors of one or more than one of the financial institutions. /Appendix Table A.3.4/. Since these institutions were the main source of scarce foreign exchange as well as domestic capital, the large-scale firms managed to obtain a major share of industrial loans advanced at concessional rates. In the case of PICIC, 37 monopoly houses received 63.5% of the total loans disbursed between 1958 and 1970, and IDPB distributed 31.9% of its loans to 30 monopoly houses during the 1961-70 period. /Appendix Table A.3.5/. There existed two distinct advantages in getting these loans: (1) the firms could import machinery at the official exchange rate; and (2) paid concessional rate of interest on these loans. /Amjad, 1976/.

Thus, a privileged large firm could benefit in the following ways: (i) obtain foreign exchange for imports at official rates; (ii) borrow finance at concessional rates; (iii) import raw materials and spare parts on installed capacity basis; and (iv) if it were a consumer goods producer it was protected against competition by (a) high tariff rates, (b) licensed competitive imports, and (c) could also obtain import loans from the financial institutions. Lewis and Guisinger (1968) attempted to measure the effect of this protection on large-scale industries and observed that half of their sample of 32 industries received 78.5 per cent of its value added from overall protection system existing in 1963-64; in the case of consumer goods industries it was even higher - 87.0 per cent. Whatever precise weight one may attach to these results, there can be little doubt that large-scale manufacturing firms enjoyed very considerable protection during the period 1950-70 and that this contributed very significantly to their efficiency - as measured by international standards.

3.1.2 The Small-Scale Sector

Up to this point we have referred to large-scale privileged firms without offering any definition of this class of enterprises. The type of the large-scale privileged firm that we have referred to is easily identified by some of its characteristics - the most notable among them being the access to: industrial licences, foreign exchange allocations, institutional finance, and the imported technology. However, only a small proportion of 'large' firms, as defined by various government departments, fall into the category of privileged enterprises. Thus, before considering the role of 'small-scale' firms in the industrialization process in Pakistan, the question of definition needs to be clarified.

Unfortunately, no single definition of small-scale firms is adhered to by different government agencies. Until 1976, the Federal Bureau of Statistics (Statistics Division) classified all production units employing 20 or more workers as large-scale. Thus, all units with a labour force of less than 20 were designated as small. Since 1976, all registered firms with 10 or more workers have been classified as large and, thus, all units with less than 10 labourers as small. However, a number of official agencies concerned with credit allocations and provision of certain services, etc., use classifications different from those mentioned above. Prominent among these agencies is the Small Industries Corporation (SIC). Until 1965, a small-scale firm was defined as one with assets of Rs 0.5 million or less. Since that year this limit has been gradually raised to Rs 5.0 million. Another serious problem encountered in estimating the size of the small-scale sector from official statistics is that these invariably refer to 'registered' units. And, of course, numerous establishments, workshops, and even units employing wage labour remain unregistered. Thus, they never appear in official estimates of the small-scale sector.

In the national income statistics, the contribution of the small-scale sector is estimated in an extremely arbitrary fashion. Various estimates have been made using 1959-60 as the benchmark year. The calculations for this year was based on the estimates of the number of persons engaged in the small-scale sector (employing up to 20 workers) and imputed value added per person. From 1959/60 to 1970, in the official estimates of the small-scale sector's contribution to G.D.P., it was assumed that this sector grew at an annual rate of 2.9 per cent, this figure being the same as the population growth per annum. After 1970, the assumed growth rate of the small-scale sector was arbitrarily raised to 7.3 per cent.

From these considerations it would appear that because of the changes in definitions over 1950-80 period, and different definitions used by various official agencies, and the arbitrary nature of the assumptions made for estimating the size of the small-scale sector, it is extremely difficult - in fact, impossible - to construct any reliable picture about the size and growth of this sector from published official data. However, we present below some of the features of the small-scale manufacturing sector in Pakistan.

During the period 1950-70, the small-scale sector was able to expand by taking advantage of the favourable economic conditions characterized by high profit expectations, business confidence, and availability of raw materials, machinery and skills. The principal government agency overseeing the development of the small-scale sector was the Small Industries Corporation, set up in 1960.[4/] It has sought to provide financial[5/] and technical services to small-scale firms. However, it is difficult to identify the type of firms within the small-scale sector (which is very broadly defined to include household units as well as firms with assets worth Rs 5 million) which have benefited from government financial assistance. For example, of the 68 small-scale agriculture engineering (ARE) firms included in our sample,[6/] only 2 reported the use of S.I.C. loan in the past. The very small proportion of the small-scale ARE firms in our sample which managed to have an access to S.I.C. finance highlights the difficulties faced by really small firms in obtaining government finance. Similarly, governments' technical and advisory services have failed to reach the small-scale ARE firms in the Punjab. None of the small-scale firms in our sample reported having received any government help in the acquisition of technology and skills.

Compared to the past, the small-scale sector received much more government support in the 1970s. Firstly, the government took direct measures to promote small-scale sector which included: (1) transfer of decision making for small-scale sector from the centre to the provinces; (2) complete tax exemption to some of the small-scale industries like agricultural machinery manufacturing, poultry farming, fruit and vegetable packing, etc; (3) tax concessions on capital goods imports for small-scale firms set up in the underdeveloped areas of the country;[7/]

(4) liberalization of imports to ease raw material shortages, which particularly helped small-scale firms. Secondly, certain economic policies of this period also indirectly supported this sector. The government's decision in 1972 to nationalize large-scale firms turned investors away from the large-scale to the small- and medium-scale sector as it offered relatively secure investment opportunities.

3.2 The Second Phase (1970-80)

During the 1970-80 period, Pakistan's industrial policy passed through two phases. In the first phase, which coincided with the period of late Mr. Bhuttos' government from 1971 to 1977, the old protectionist policy was greatly relaxed to promote industrial efficiency and exports, and there was a marked change of emphasis from private to public industrial investment. In the second phase, which began with the overthrow of Mr. Bhutto and the installation of a martial law regime, industrial policy was revised to restore the private sector to its old position, and to gradually reduce the size of the public sector.

When Mr. Bhutto, after the separation of East Pakistan, came to power in December 1971, some of the important features of the industrial scene in Pakistan were as follows:

(1) There existed a multiple exchange control system in the country which favoured the large-scale manufacturing firms: first, the industrial license holding firms paid lower prices for industrial inputs; second, the prices of manufactured products were raised through tariff protection and import restrictions; and, third, manufactured goods exports earned 'bonus' (subsidy) at varying rates for different goods. Thus, the large-scale manufacturing firms could utilise cheaper industrial raw materials to produce for a well protected domestic market and also earn 'bonus' on exports which entitled them to import any item on the bonus list. Because of the scarcity of foreign exchange, bonus vouchers were usually sold at a very high premium of 150-180 per cent of their face value [Amjad, 1982, p. 38]. So the cost of importing inputs on bonus was substantially higher than if imported as industrial raw materials.

(2) The other important feature of Pakistan industry was concentration of industrial and financial assets in the hands of few families. The 'monopoly houses' which managed these assets virtually controlled the large-scale industrial sector, the banking and the insurance business in the country.

(3) Growing regional inequalities, stagnating real wages of industrial labour, and concentration of economic power led to political unrest and progressive breakdown of law

and order in East Pakistan in the late 1960's. As a result of that real private industrial investment in Pakistan declined during 1969-71, despite economic incentives given to investors.

(4) Loss of the East Pakistan market in 1971 caused serious problems for industrialists. There existed a surplus of productive capacity in Pakistan's manufacturing, sector - constituted mostly of consumer goods industries. The industrial market was already saturated with over production and did not offer new investment opportunities.

<u>Government Policies in the 1970s</u>

In the early 1970s the government introduced a number of reforms aimed at changes in the old economic structure:

(1) Government's first priority was dismantling of the protective system and removal of multiple exchange rates which benefited the large-scale manufacturing sector. To correct this system, the government devalued currency by 131 per cent and changed the tariff structure to ease imports of raw materials, and capital goods.

(2) The second important decision was nationalization of a number of major industries in 1972. The nationalization

in the industrial sector was initially limited to capital and intermediate goods industries, which meant that less than 20 per cent of the value added of the large-scale manufacturing firms was taken over. [Amjad, 1978]. Later, another round of nationalization in 1976 took over flour mills, vegetable oil mills, ginning factories and rice husking mills.

(3) Another related decision taken in 1972 was nationalization of banks and insurance companies. This policy was aimed at breaking the link between industrialists and financiers which had been instrumental in the emergence of monopoly houses in Pakistan.

(4) The government also introduced revolutionary labour reforms[8/] in 1972 which had far reaching impact on the economy. The new laws brought substantial material gains to industrial labour and also strengthened their bargaining position. [see Appendix Table A.8.2].

(5) Finally, the government undertook large investment in a number of major industrial projects like Karachi Steel Mill, heavy foundry and forge complex at Taxila, and a number of fertilizer and cement factories. The increased public sector investment was large enough to make up the fall in private industrial investment in the 1970s.

Effects of the Government Policies

The economic policies of the 1970s are often blamed for adversely affecting the performance of the industrial sector. A comprehensive review of the impact of these policies on the industrial sector is yet to be made. However, it is possible to identify some new developments in the industrial sector following the introduction of the economic policies in the early 1970s.

(1) The economic policies of the 1970s completely shook the large-scale manufacturing sector. Devaluation of currency and tariff reforms removed in one go the privileges of the large-scale firms. Moreover, loss of the East Pakistan market resulted in excess production capacity, leaving no scope for new investments in the traditional consumer goods industries.

(2) Risks of nationalization, higher wages, and increased costs of inputs resulted in a decline of large-scale manufacturing sector. During 1969/70 to 1979/80, the growth rate of the large-scale sector remained very low at 3.0 per cent in comparison with much higher growth rate of 13.4 per cent in the 1960s. /Table 3.2/. In fact, the period between 1969/70-1976/77 witnessed still lower growth rate of 1.2 per cent in this sector. /P.I.D.E., 1980, p. 2/.

(3) The slow growth of the industrial sector in the 1970s is often attributed to nationalization of industries and poor management of the nationalised units. This assertion

is seldom supported by concrete evidence. On the contrary, the available statistics on production indicate that most of the public sector industries fared reasonably well in the 1970s, but output in the private sector either declined or stagnated. /P.I.D.E., 1980/. The reasons commonly advanced for the poor performance of the large-scale private sector in this period are: (1) excess productive capacity; (2) withdrawal of old concessions; (3) increased wage and material costs; and (4) inability to export. This explanation is general, and the matter needs further investigation, including industry-level study, to assess the real impact of the new economic policies on the two sectors.

(4) Despite devaluation of currency, the large-scale manufacturing sector could not capture the export markets. Though the manufactured goods exports (in quantity) picked up during 1972/73 and 1973/74, they stagnated afterwards, and registered only a nominal growth over the decade of the 1970s. Only the traditionally export-oriented small-scale industries like carpet weaving and sport goods made their mark in this period, though carpet exports too suffered a decline in the late 1970s due to slackening of world demand.

(5) The economic policies of the 1970s changed the direction of industrial investment from the large-scale to small-scale sector. The change in the pattern of investment can be seen from the data set out in Table 3.3 which shows a sudden decline in the private large-scale

Table 3.3

Private and Public Industrial Investment (Current Prices)

(Million Rupees)

Year	Private Industrial Investment Large-Scale[1]	Private Industrial Investment Small-Scale	Public Industrial Investment	Total Industrial Investment
1963/64	1,044.1	124.4	39.8	1,208.3
1963/65	1,188.1	135.4	132.7	1,456.2
1965/66	1,084.0	146.0	133.5	1,363.5
1966/67	1,022.2	162.9	134.1	1,319.2
1967/68	1,050.8	167.1	148.5	1,366.4
1968/69	1,033.3	174.0	93.7	1,271.0
1969/70	1,208.2	187.7	179.2	1,575.1
1970/71	1,224.0	201.7	68.2	1,493.9
1971/72	1,016.3	219.1	98.5	1,333.9
1972/73	763.1	255.9	110.6	1,229.9
1973/74	697.3	325.5	382.3	1,405.6
1974/75	990.4	446.5	1,064.9	2,501.8
1975/76	1,309.4	509.5	3,181.6	5,000.1
1976/77	1,209.9	585.3	4,560.3	6,355.3
1977/78	1,888.9	642.3	5,463.9	7,295.1
1978/79	1,569.1	724.3	6,659.4	8,952.7
1979/80	2,177.3	818.3	6,592.9	9,588.5

Note: (1) Criteria for classifying small-scale and large-scale industries has changed over time: the Federal Bureau of Statistics classifies all registered factories with 10 or more labourers as large-scale industry. Prior to 1976, all those that employed more than 20 labourers were included in the large-scale industry.

Source: Pakistan Basic Facts: 1971-72 and 1980-81, Governments of Pakistan, Islamabad, 1973 and 1982.

investment in 1971/72, but an increase in the small-scale investment. This change was caused by the following factors: (1) greater risk of nationalisation attached to large-scale firms; (2) increased costs of new industrial investments; (3) problems of labour management in the large-scale sector; and (4) sudden increase in foreign demand in the early 1970s for carpets and sports goods (traditionally produced in small-scale sector) which attracted substantial new investment in this. In the Punjab alone, the number of carpet manufacturing small-scale firms increased by 66.58 per cent between 1970 to 1975 [P.S.I.C., 1976].

(6) Another notable trend of industrial investment in this period was a sharp increase in the public sector investment which was planned to undertake a number of major industrial projects. The public sector investment, thus, jumped from Rs. 98.5 million in 1971/72 to Rs. 4,560.3 million in 1976/77, and stood at Rs. 6,592.9 million in 1979/80.

The overthrow of the civilian government of Mr. Bhutto by the military dictatorship in 1977 produced yet another change in industrial policy. This policy aimed at the restoration of private sector to its old position. This was planned through: selective denationalization of state managed industrial units, and concessional fiscal and non-fiscal incentives to new investors. The important measures thus adopted included: (1) denationalization of cotton ginning, rice milling and flour milling units, plus one major engineering unit; (2) opening up of areas to private sector previously closed under the Economic Reforms Order of 1972; (3) lowering of interest rates for industrial investment credit; and (4) special incentives for balancing and modernization of the ailing textile industry.

The new industrial policy had set out two major priorities for the future: (a) continuation of on-going major public sector industrial projects of steel, fertilizer, cement, etc.; and (b) increased emphasis on the small and medium-scale industries producing commodities for export markets. The first was to help in building up a substantial base of basic industries so that the capital goods requirements of the manufacturing and agricultural sectors could be internally met. The renewed emphasis on the small-scale industries was in acknowledgement of its past growth performance. /Government of Pakistan, 1978(b)/.

Summary

To sum up, we have noted above that: (1) the first phase of industrial development (1950-70) was guided by protectionist policies which favoured large-scale private manufacturing firms and neglected the small-scale sector; (2) between 1972 to 1977, there was a break with the old protectionist policy in favour of industrail efficiency and export promotion, and a major shift in favour of public sector investment, along with the encouragement of small-scale firms, and, finally, (3) there was yet another change in the industrial policy aimed at restoration of private investors' confidence, and additional government

Chapter Three

Footnotes

1/ P.I.D.C. was set up in 1952 and later bifurcated into two separate institutions for the two provinces (East and West Pakistan) in 1962, though their role remained unchanged.

2/ This policy was controversial and invited criticism from certain quarters; see Griffin (1965).

3/ Government set up specialized institutions for the supply of local and foreign industrial finance: P.I.C.I.C. (1958) and I.D.B.P. (1961). Both these institutions supplement commercial finance for long and medium term credit for industrialists. P.I.C.I.C. also directly participates in proejct equity.

4/ Small Industries Corporation was first set up for the Federal Area of Karachi in 1955, followed by a similar institution for East Pakistan in 1957. The West Pakistan Small Industries Corporation was established in 1960 which operated in areas outside Karachi and the tribal areas. The Federal Area Corporation was later merged with West Pakistan Industraal Development Corporation in 1962. In 1965, government decided to set up separate Small Industries Corporation for West Pakistan. Following dissolution of West Pakistan into four units, this organization was also split into four corporations in 1972. Since then each provincial corporation has carried out various small industries development schemes. At the time of its' dissolution in 1972, the West Pakistan Small Industries Corporation had completed 87 projects at the cost of Rs. 40 million.

5/ Financial assistance to the small-scale firms is managed with the assistance of a consortium of Pakistani commercial banks, Industrial Development Bank of Pakistan, the International Development Agency and the Small Business Finance Corporation.

6/ A detailed account of our sample is given in the Introduction.

7/ In 1971, government also established Federally Administered Tribal Area Development Corporation to promote industrial development in the tribal areas of the N.W.F.P.

8/ Mr. Bhutto's government also introduced radical land reforms which had a big impact on the landlord tenant relationship in the rural sector.

Part II

CHAPTER FOUR

AGRICULTURE-RELATED ENGINEERING INDUSTRY IN THE PUNJAB: PRESENT STAGE

In this chapter our purpose is to: (1) define 'agriculture-related engineering' /ARE/ industry; (2) assess the size of the industry; (3) identify its structure and (4) determine the geographical location of the ARE firms in the Punjab province. This will be done in two stages: first we will review the results of the previous studies and official statistics, and then present our own estimates of the ARE industry based on our survey findings.

4.1 Definition of the Agriculture-Related Engineering Industry

The agriculture-related engineering industry /ARE/ is defined here as: including all such engineering firms that manufacture or/and assemble machines, including parts and components, implements and attachments for use in the agriculture sector.

The products of this industry can be classified into two major groups viz., (1) irrigation-related /ARE (I)/ machinery such as diesel engines, electric motors, water pumps and their parts; and (2) cultivation-related /ARE (C)/ implements and machinery such as ploughs, cultivators, threshers, and many others. The irrigation-related firms primarily produce tubewell machinery and parts but may also manufacture other items, including cultivation machinery.

So we find single as well as multiproduct firms of various sizes in both sectors of the ARE industry. The major products of the irrigation sector firms are: diesel engine, electric motors, centrifugal water pumps, water pipes, strainers and other spare parts for tubewell sets. [Table 4.1]. The cultivation sector firms produce many products including modern and traditional ploughs, cultivators, harrows, threshers, fodder cutters, tractor parts, reapers, harvesters and others. [Table 4.2].

4.2 The Size of the ARE Industry in the Punjab: A Review of Previous Studies

In this section we review the estimated size of the ARE industry in the Punjab on the basis of previous studies, including the published official statistics.

It is impossible to estimate the actual size of the ARE industry in the Punjab as no official sensus survey of this industry has been carried out. Therefore, we have to rely on various other sources to make an assessment of the size of the industry. There exist four main sources of statistical information on the ARE industry viz., the Census of Manufacturing Industries [CMI], the Punjab Small Industries Corporation Survey [PSIC], the Child and Keneda study [1974-75] and the Farm Machinery Institute Survey [FMI]. Each of these sources has some shortcomings which need close scrutiny.

Table 4.1

Important Irrigation-Related Products of the 'ARE' Industry in the Punjab, Pakistan

	Products		Product Specifications and their Uses	
(1)	Slow Speed Diesel Engine	(i)	Speed:	Up to 500 rpm
		(ii)	Structure:	Horizontal, single cylinder
		(iii)	Horsepower:	15-45
		(iv)	Engine:	4-Stroke
		(v)	Uses:	Private Irrigation; agro-industry
(2)	Medium-Speed Diesel Engine	(i)	Speed:	500-1250 rpm
		(ii)	Structure:	Horizontal, single cylinder
		(iii)	Horsepower:	20-50 HP
		(iv)	Engine:	4- Stroke
		(v)	Uses:	Private agriculture, agro-industry
(3)	High-Speed Diesel Engine	(i)	Speed:	1500 rpm and above.
		(ii)	Structure:	vertical, single cylinder
		(iii)	Horsepower:	7.5-20 HP
		(iv)	Engine:	4-Stroke
		(v)	Uses:	Private irrigation, agro-industry, marine engine, mining industry and others.
(4)	Piston Water Pump:	Single or double action, piston operated, water pump for domestic or irrigation purposes.		
(5)	Centrifugal Water Pump (low, medium and high lift)	(i)	Capacity:	0.4-4 cusec
		(ii)	Type:	single stage
		(iii)	Design:	horizontal
		(iv)	Head:	8-91 metres.
		(v)	Size:	2"X1½"-8"X6".
		(vi)	Speed:	900-2900 rpm.
		(vii)	Uses:	Private irrigation, industrial plants, airconditioning, pumping oil and condensate.

Table 4.1 (Cont'd.)

(6)	Turbine Water Pump	(i)	Capacity:	Up to 6 cusec
		(ii)	Type:	single or multiple stage
		(iii)	Design:	vertical shaft
		(iv)	Head:	Up to 134 metres
		(v)	Speed:	Up to 3000 rpm
		(vi)	Size:	6"-14"
		(vii)	Suspended Depth:	Up to 100 metres
		(viii)	Uses:	Public sector irrigation, lowering of groundwater, dewatering of mines, urban water supply, etc.
(7)	Submersible Water Pump	(i)	Capacity:	Up to 1.5 cusec.
		(ii)	Total Head:	Up to 140 metres
		(iii)	Motor Ratings:	15, 20, 25 and 30 (HP)
		(iv)	Motor Speed:	2900 rpm at 50 cycles/Sec
		(v)	Operating Voltage:	380 volts/3 phase current
		(vi)	Uses:	Public-sector irrigation and sub-surface drainage, urban water supply pressure boosting installations, air-conditioning, etc.
(8)	Non-clogging Water Pump (Horizontal)[1]	(i)	Capacity:	Up to 6 cusec
		(ii)	Head:	Up to 120 metres
		(iii)	Speed:	Up to 2900 rpm
		(iv)	Sizes:	3" X 2½" to 8" X 8"
		(v)	Uses:	Sewage, building, industry, mining, industry, chemical industry, and food industry

Table 4.1 (Cont'd.)

(9)	Tabular Casing Water Pumps (Axial Propeller)	(i)	Capacity:	10-20 cusecs
		(ii)	Head:	4-11 metres
		(iii)	Speeds:	960-1450 rpm
		(iv)	Size:	350 X 350 mm
		(v)	Uses:	Pumping of screened liquids, irrigation and drainage, mine drainage, etc.

1/ Vertical type non-clogging water pumps are also produced by K.S.B., a multi-national incorporated in Pakistan.

Table 4.2

Important Cultivation-Related Products in the 'ARE' Industry in the Punjab, Pakistan

Products[1/]	Product Specifications and their Uses
I: Traditional Products	
A. (Animal-drawn indigenous implements)	
(1) Indigenous plough	Made with 1/4" wide steel plate and 3/9" wide sheet, and used for land preparation.
(2) Roller	Has varying width and thickness, and used for land levelling.
(3) Earthmoving implements viz., spade, scythe, rake, fork, sickle, axe and others.	Various simple implements made with iron steel bars/sheets and used for land preparation.
B. (Hand-drawn/machine-driven improved implements)	
(4) Cane crusher	Metal roller type crusher for sugar juice extraction from sugarcane.
(5) Sugar centrifugal machines	Performs the same job as a cane crusher but runs on an electric motor (5 h.p.) or a diesel engine.
(6) Fodder cutter	It has metal structure and rotating blades which can be hand or motor operated.
(7) Juice boiling pan	Requires 1/8" thick metal sheet for boiling sugar juice for brown sugar making.
(8) Wheat grinder	Uses stone as a rotary grinder and can be hand operated or motor powered.
(9) Chillies grinder	Makes use of stone or metal rotary grinder and can be hand operated or motor powered.
(10) Oil expeller	A rotary grinder made with strong steel which uses rollers to expel oil.

Table 4.2 (Cont'd.)

II. **Modern Products**	
C. (Tractor-driven agricultural implements)	
(11) Ploughs	
(1) Mouldboard ploughs	Used as primary tillage implement for mechanical soil stirring actions for crop nurturing. It consists of warped surfaces, equipped with cutting edges which crumble and invert the soil. It works up to 12 inches deep into the soil and burries weeds by complete inversion.
(2) Disc plough	Consists of independent, free-turning disc blades inclined at an angle to the soil. Used on extremely hard soil, abound in roots and rocks. It works up to 14 inches deep in the soil.
(3) Lister plough	Primary tillage implements with planting attachments. It's bottom resembles a double mouldboard. It requires less power and has greater field capacity than other tillage practices. Suits floodlands or oil with moisture retention properties.
(4) Chisel plough	A mul istandard ripper designed to operate 10 to 12 inches deep. It has narrow, pointed teeth and has 3 tines.
(12) Ripper (Sub-soiler)	Strongly constructed ripper used for breaking up deep, compacted layers of soil to improve their drainage.
(13) Cultivator:	They are constructed more lightly than the tillage implements like chisel plough and have closer spaced standards to operate from 3 to 5 inches deep. These implements are used more for weed control and seed bed preparation than for primary tillage. It may have 9-13 lines.

Table 4.2 (Cont'd.)

(14)	Harrow Disc	It is commonly used for seedbed preparation. It has high capacity due to its' width; some may have 16-22" wide discs for mixing manures under the soil to make a suitable bed. Some disc harrows are built in sizes up to 30 feet wide so as to utilize the maximum power from tractor.
(15)	Seed Drill	A machine which prepares the soil, meter the seed, and position the seed in one operation. It may also be combined with fertilizer box to add another function during the operation.
(16)	Row-Crop planter	It is distinguished from grain drills in that it puts seeds in spaced rows to permit interrow cultivation. It is made in different types according to suit the planting requirements.
(17)	Fertilizer distributor	Used for wider distribution of fertilizer on the fields. Different models are used for dry as well as liquid fertilizer. Almost all of them are of variable orifice-mechanical feeder type.

Table 4.2 (Cont'd.)

(18)	Cutter-binder	It is substitute machine of combine harvester. It can be attached to medium powered tractor (35-40 HP) and performs the harvesting and binding job at the same time. It is cheaper to buy and easy to operate. The average hourly covered area by cutter-binder is 2 acres.
(19)	Thresher	Two types of threshers are produced in Pakistan: the ordinary, which just threshes wheat, and the automatic, which threshes as well as loads the wheat into the threshing machine.

Note: (1) For a detailed list of products see Appendix table A.9.1.

4.2.1 The Census of Manufacturing Industries

Inspite of being a major source of official statistics on Pakistan manufacturing industries, the CMI has a number of shortcomings. First, the CMI covers only those units as are registered under section 2 (j) and 5 (i) of the Factories Act, 1934. The former includes those firms which employ 20 or more workers on any one day during a year and use power, while the latter covers only such firms as employ 10 or more workers and carry out work with or without the use of power. So the CMI excludes many small-scale firms, household units and workshops which do not satisfy its critieria or are not officially registered. Hence, the first limitation of the CMI data relates to its limited coverage of the existing firms. Second, the CMI data show inconsistency in reporting about firms over time. For example, data set out in Table 4.3 show how the number of reporting units included in the CMI fluctuated year after year between 1967/68-1977/78 just because of the vagaries of firms response to the CMI annual questionnaire. These fluctuations arise on account of a number of factors: (1) the state of mailing list, i.e. how many firms are registered and whether they are put on the list or not; (2) the number of returns received from the registered factories; (3) the number of firms giving incomplete information; and (4) the number of public owned units excluded from the list for various other reasons. Thus, the published CMI information is far from accurate on the actual number of firms existing at any time.

Table 4.3

Estimated Size of the Agriculture-Related Engineering Industry in the Punjab

(Based on the C.M.I. Data)

	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78
No. of Units	127	143	176	129	173	137	138	135	123	125	139
Total Employment	4,718	6,229	7,826	4,105	9,556	3,606	3,964	2,719	2,715	2,972	3,190
Value of Industrial Production During the Year (Rupees)	61,662	85,115	121,099	58,478	111,892	74,126	77,346	102,443	262,942	139,048	140,221

Notes: (1) No. of units refers to the reporting firms producing (1) pumps and compressors; (2) engines and turbines; and (3) agricultural machinery.

Source: (1) C.M.I. 1967/68-1975/76, various issues, Statistics Division, Ministry of Finance, Planning and Development, Government of Pakistan.

(2) The data for 1976/77 and 1977/78 are taken from the C.M.I. unpublished sources.

In short, the CMI data fails to provide a satisfactory basis for assessing the size of the ARE industry because: (1) it may not include all the existing registered firms; (2) the published statistics indicate consistent fluctuations in reporting over the years; and (3) many small-scale firms are not included in it. Hence, we do not find enough reason to accept the CMI data on the ARE industry as a basis for estimating its size.

4.2.2 The Punjab Small Industries Corporation Statistics

The PSIC statistics provide information on small-scale ARE firms only, thus completely excluding the medium-sized and the large-scale firms. The PSIC data has a few other limitations also. Its second shortcoming is related to the changes in criteria used for classifying firms over the years. The PSIC criteria of upper limit on fixed assets of firms has been gradually increased from Rs. 0.5 million in 1965 to Rs 5.0 million in 1984. Since the basis on which firms were included in the PSIC statistics in various years has kept changing, it renders these figures strictly uncomparable. Hence this type of data cannot provide a completely satisfactory basis for estimating the size of even the small-scale sector of the ARE industry. Thirdly, in addition to small-scale firms, the PSIC data also include 'household units' which are defined as: 'a single person or a number of persons who normally live together and are engaged in manufacturing activity for economic benefit'.

Inclusion of household units into PSIC data adds another element into an already complicated situation and reduces its worth for estimating the real size of the small-scale ARE sector in the Punjab. Fourthly, the two surveys of 1975/76 and 1977/78, on which the PSIC statistics are based, used two different industrial classifications which made their results strictly uncomparable.

However, it is possible to use the PSIC data for making rough estimates of the small-scale ARE industry in the Punjab. By disaggregating 1977-78 PSIC data and selecting relevant statistics from both the surveys we prepared estimates of the small-scale ARE industry in the Punjab which are set out in Table 4.4. According to these statistics, there existed 317 diesel engine and water pumps producing small-scale firms in the Punjab in 1977-78, which employed 1,540 workers. Between 1970 and 1976, the total number of such firms increased at an annual rate of 21.96 per cent. The second group of firms, the agricultural equipment producers, consisted of 323 units and employed 2,175 persons. They maintained 12.63 per cent annual growth rate during the period 1970-76. There also existed 62 small-scale firms which produced electric motors, used as an alternative to diesel engines for tubewell running. These firms employed 2,800 persons and maintained a high growth rate of 22.00 per cent per annum in this period. In all, there existed at least 702 small-scale ARE firms in the Punjab in 1977-78, which produced the final products (and their components) for use in the agriculture sector.

Table 4.4

Size and Growth of Small-Scale Agriculture-Related Engineering Industry in the Punjab, (Pakistan): 1977-78

(Based on Punjab Small Industries Corporation Data)

Industry	Units[1]	Employment[2]	(Average Annual % Growth Rates (1970-76)	
			No. of Units	Fixed Investments
(1) Diesel Engines and Water Pump[3] (for Irrigation)	317	1,540	21.96	20.84
(2) Agricultural Equipment[4]	323	2,175	12.63	8.18
(3) Electrical Motors[5] (for Tubewells)	62	2,800	22.0%	37.8%
(4) Iron Castings[6] (for 1, 2 and 3 above)	419	2,185	18.41	16.5
(5) Light Engineering servicing[7] (for Specialist Service to manufacturers)	3,141	10,485	21.5	7.5

Notes:

(1) This survey was a follow up of a 'census survey' of 'the Small and Household Manufacturing' 1975-76) in the urban areas of the Punjab, P.S.I.C. Lahore. These numbers are calculated from the survey results on the basis that the actual number of firms surveyed constituted about 80% of the actual population.

(2) These employment figures are calculated from the 'Basic Statistics on Small Light Engineering Industry in Punjab', P.S.I.C., Lahore, 1977-78, and include total employment by firms. These figures appear to be an understatement in view of the overall growth in the 'ARE' industry since 1969.

(3) These firms manufacture oil engines, water pumps and their parts /accessories.

(4) These firms manufacture various types of machinery and implements used for cultivation.

(5) Electric motors are used as an alternative machine to oil engines, used as a generator.

(6) Iron casting is required for a number of metal products. There is no way possible to separate castings work for 'ARE' industry from the rest.

(7) The activities in this industry include turning, shaping, milling, cylinder boring and other such activities. It is not possible to identify 'ARE' industry's exact share in these services.

Moreover, there were 419 foundry firms and 3,141 general engineering firms that provided castings and certain specialist services for components making for the ARE firms.

It must be reiterated that these estimates /Table 4.4/ are rough and may be taken as only broad indicators of the state of the ARE industry in that period.

4.2.3 The Child and Kaneda Study

So far the best account of the small-scale sector of the ARE industry is found in Child and Kaneda's study of 1974-75. This non-official, interview-based study was completed in 1969-70. It documented the following facts about the ARE industry in the Punjab:

(1) There were an estimated 533 ARE firms in the Punjab in 1969, of which 254 were small-scale (1-7 production workers), 171 medium-sized (8-15 production workers) and 108 large-scale (more than 15 workers) /Table 4.5/. These estimates were obtained by 'blowing up' some of the variables observed in the actual sample of 173 firms which was included in the study /p. 251/. Arguably, the 'blowing-up' method used by the authors is not an ideal way of obtaining reliable statistics on industry size. At best, these results could be taken as extrapolation of the sample-based data, but certainly not as an evidence on the total number of firms actually existing in that year. So care must be taken in accepting the Child and Kaneda estimate of the size of the small-scale ARE industry in the Punjab.

Table 4.5

Industry Population and Sample Taken by Size, Location, and Type of Product

(Number of Firms)
(Child and Kaneda's Estimates: 1969)

Location	No. of Production Workers			(a) Total Sample	Type of Firm[1/]		(b) Esti-Mated Popu-Lation	(a)(b)
	1-7	8-15	16 or more		Tube-well	Non Tube-well		
Lahore	8	19	25	52	52	0	170	31%
Daska	23	13	7	43	43	0	167	26
Multan	5	6	2	13	13	0	60	22
Sahiwal	1	1	4	6	6	0	16	38
Gujranwala	7	4	5	16	13	3	49	33
Gujrat	2	4	3	9	3	6	14	64
Lyallpur	1	7	26	34	0	34	57	60
(1) Total Sample	47	54	72	173	130	43	...	...
(2) Estimated Population	254	171	533	...	...	...	533	...
(1)/(2)	19%	32%	67%	32%	...	...	...	...

Note:

(1) Tubewell firms: those firms whose primary but not necessarily exclusive output is equipment for tubewell installations, i.e. diesel engines, pumps, pipe, strainers. Non-tubewell firms: those firms which do not produce tubewell equipment.

Source: Child and Kaneda, 1974-75, table 1, p. 251.

(2) Child and Kaneda reported that the industry consisted of a large number of small-scale firms with quite low average employment at firm level. For example, out of a sample of 130 tubewell firms, 84 per cent employed less than 30 employees and 46 per cent had less than 10 workers each. This sample based data showed how small was the average small-scale ARE firm in the Punjab in 1968-69. Similar trends were noted by PSIC survey of 1975-76 which recorded that the average employment in 306 cultivation-sector firms was only 7.10 workers [PSIC, 1977-78, p. 41]. The subsequent PSIC survey of 1977-78 too observed a very low average employment in both the sectors of the ARE industry i.e. 4.85 in the irrigation-sector firms and 6.7 in the cultivation-sector firms [Table 4.4]. But, strictly speaking, the two sources do not provide corroborative information because they use totally different definitions of small-scale firms. Hence each source should be assessed on its own merits.

(3) Another important observation about the ARE industry was that the tubewell (irrigation-sector) firms were more dynamic during the 1960s. According to Child and Kaneda the tubewell firms were more aggressive than the non-tubewell (cultivation-sector) firms and this explained their rapid expansion in this period. To support their observation they produced the evidence that while employment in the non-tubewell sector did not change during the 1964-69 period, the number of production workers in the tubewell sector increased from 3,246 as to 5,133 in the

same period /p. 265/. These estimates may be taken as a broad indication of the growth of the irrigation-sector during the 1960s.

Thus, a broad conclusion on the state of Punjabs' ARE industry in the 1960s, drawn on Child and Kanedas' observations, would be that: (1) it included a large number of small-scale firms; and (2) the tubewell firms made up the larger and the more aggressive sector of the ARE industry and maintained a high growth rate during the 1960s.

4.2.4. The Farm Machinery Institute Statistics

The most recent source of data on the ARE industry is the 'Handbook of Agricultural Machinery Manufacturers', published by the Farm Machinery Institute of Government of Pakistan /FMI/ in 1983. This handbook serves two important purposes: first, it provides the latest official list of agricultural machinery manufacturers in the Punjab as well as in the other provinces; and, second, it contains information on firms of all sizes. Firms are classified on the basis of investment in fixed assets, excluding land: the small-scale firms have investment of less than Rs. 0.5 million; (2) the medium-sized firms have investment in the range of Rs. 0.5-Rs. 5.0 million; and (3) the large-scale firms are those with investment of more than Rs. 5.0 million. According to this criteria, there existed 397 firms in the Punjab ARE Industry in 1982; of which 378 were small-scale, 13 medium-sized and 6 large-scale: /Table 4.6/.

Table 4.6

Size and Structure of Cultivation Sector of the 'ARE' Industry in the Punjab, Pakistan, 1982 (Based on F.M.I. Data)

Provinces	Size of Firms[1]			Total
	Small-Scale	Medium-Sized	Large-Scale[2]	
(1) Punjab	378	13	6	397
(2) Sind	33	5	4	42
(3) N.W.F.P.	18	-	-	18
(4) Baluchistan	5	-	-	5
	434	18	10	462

Notes:

(1) According to F.M.I. (1982), firms are classified as follows: (1) Small manufacturers are those which have investment of less than Rs. 0.5 million excluding land, (2) medium, with investment in the range of Rs. 0.5 million to Rs. 5.0 million; and (3) large, with investment over Rs. 5.0 million.

(2) Six out of ten firms produce tractors.

Source: A Hand Book of Agricultural Machinery Manufacturers in Pakistan, Farm Machinery Institute, National Agriculture Research Centre, Islamabad, Pakistan, 1983.

But the information provided by F.M.I. is of only limited value as it tells nothing more than the location and products of the firms. Secondly, it excludes firms which produce diesel engines or electric motors, thus completely leaving out the irrigation-sector firms. Finally, because of its criteria of classification, the F.M.I. data cannot strictly be compared with the data from other sources. All that the FMI data show is the presence of a large number of cultivation-related engineering firms, producing a variety of agriculture machinery and implements, in the Punjab in 1982.

To sum up the review of the previous studies, we have observed that due to (1) the differences in the objectives and scope of various studies, and (2) absence of a single criteria for firms classification, the data produced by them is strictly incomparable. So nothing definite can be said about the overall size or growth of the ARE industry in the Punjab in any period. However, what is significant and noteworthy is the presence of a large number of ARE firms, especially at small-scale level, whose number is still growing.

4.3 The Structure of the ARE Industry

It is equally difficult to make out a complete picture of the structure of the ARE industry on the basis of available data. As discussed in the preceding section, we face two types of problems dealing with the existing data on the industry: (1) statistics do not relate to the entire ARE industry; and (2) data taken from different sources are incomparable. So, at best, these statistics can be used to sketch out a broad outline of industry structure.

Of the four sources discussed above, only Child and Kaneda (1974-75) have given some account of the ARE industry in the Punjab, though their main interest centres around small-scale firms. However, they use a peculiar definition of 'small', 'medium' and 'large' firms, according to which the 'small', employ less than 8 workers, the 'medium' employ 8-15 workers, and the 'large' employ 16 or more workers. It is on this basis that they estimated the presence of 108 large, 171 'medium' and 254 'small' firms, making a total of 533, in the Punjab in 1969. Of these, the tubewell (or the irrigation), sector had 67 large, 137 medium and 240 small firms, while the cultivation sector had 41 large, 34 medium and 14 small firms /p. 265/. According to their estimates, the tubewell sector of the industry in the province had greater concentration of the small firms than the non-tubewell sector. Child and Kaneda also reported existence of an informal link between the small-scale and large-scale firms for the purchase of selected components of diesel engines. In particular, the small firms in their sample (employing less than 8 workers) were found to be primarily assemblers of component purchased from the large-scale firms, while they fabricated minor parts themselves. Since this study primarily dealt with the small-scale sector of the ARE industry in the Punjab, it contained very little about the place and role of the large-scale firms in the development of the industry except by reporting that "the larger, more diversified firms are likely to be found in Lahore" /p. 250/.

No other agency has used Child and Kaneda's criteria for estimating the size of small-scale sector of the ARE industry since then. For example, PSIC (1977-78) statistics were collected on a different basis (maximum assets limit of Rs. 2.0 million) according to which there existed 702 small-scale ARE firms in the Punjab in 1976-77, of which 317 were in the irrigation sector and 323 in the cultivation sector. /Table 4.4/. As the PSIC criteria is different from that of Child and Kaneda, it is impossible to say definitely whether or not the entire small-scale sector of the ARE industry, or the cultivation-related or/and the irrigation-related firms, had really grown between 1969 and 1976/77; and, if they did, by how much. Nor are the FMI (1983) statistics of any real help in estimating the existing structure of the ARE industry or the changes in it over time. This is so because, as recorded in the section above, the F.M.I. use yet another criterion for firms classification, and its data relate to the cultivation sector only.

In short, use of different definitions by different organizations and changes in these definitions over time creates formidable difficulties in assessing the present structure of the ARE industry, particularly the changes in it over time.

4.3.1 The Structure of the ARE Industry in 1982-83: An Overview

Our survey of the ARE industry has indicated that different firms or, rather groups of firms, have different characteristics which refer to the type of 'resources' they own. These characteristics are listed in Table 4.7, and for simplification, they are divided into two sets. The first set that is shared by one type of firms refers to the characteristics of enterprises that we have called 'large'. The other set refers to those that are 'small'. It will be seen that the 'privileged' firms referred to earlier on in the previous chapter will all fall in the first category. Most of the enterprises covered by official surveys and denoted as 'small' will fall in the second category. A large number of enterprises in the ARE industry will share some of the characteristics of the first category and some of the second. For instance, a firm may lack the capability to enter into collaboration with foreign enterprises for know-how but may have access to institutional finance. Such firms we will designate as medium-sized. (A more detailed account of those three categories of firms will be given in the following chapters)

In the remainder of this section we present a brief overview, based on our survey, of the ARE industry structure in the Punjab in 1982-83.

As discussed in the Introdiction, the sample of our study consisted of 102 firms located in different towns of the Punjab. The information about the industry was obtained

Table 4.7

Resource Characteristics of Large and Small 'ARE' Firms in the Punjab

Firm Type		Characteristics
Large:	1.	Formal management structure with specialization of functions; professional managers (non-family) even when family owned-controlled; distribution networks, extensive public relations, etc.
	2.	Own design capability; technical collaboration with foreign enterprises for know-how; access to technical information from abroad through various means.
	3.	Access to institutional finance/ capital market; also to public sector financial institutions.
	4.	Access to omport licences for materials/ equipment import.
	5.	Access to government departments for advice/assistance on foreign technical assistance,export promotion, etc.
Small:[1/]	1.	No formal management structure; management invaribaly family based; owner often engaged in production/ manual work; some part time accounts staff; workshop often attached to family dwelling.
	2.	Access to technology type III only[2/]; labour force without formal technical training; informal owner-labour relations.
	3.	Little or no access to institutional finance; almost total reliance on own funds and supplier credit.
	4.	No access to import licences.
	5.	Limited access to government-sponsored advisory services ror small-scale industries.

1/ The 'medium-sized' firms incorporate some characteristics of both the small and the large firms.

2/ For description of technology types, see Table 7.6, Chapter 7.

through interviews with the managers/owners of firms and many other people who were associated with the ARE industry in different capacities. Our findings on the ARE industry can claim to have three merits: (1) cover both (the irrigation and the cultivation) sectors of the industry; (2) are gathered through detailed interviews, and hence are more reliable; and (3) relate to the latest conditions in the industry.

Given below is our assessment of the size and structure of the Punjabs' ARE industry in 1982-83.

Starting from a very small base in 1947, the Punjab's ARE industry had grown into a fairly large size, consisting of about 800 firms in 1982-83. The entire industry - consisting of irrigation and cultivation sectors - was made up of 12-15 large-scale firms, 40-45 medium sized firms and hundreds of small-scale firms.

The irrigation sector [ARE (I)] had 4 large-scale firms, namely, BECO, KSB, Ittefaq, and Climax which specialized in the manufacturing of high quality, high-priced products. Then there existed 10-12 medium-sized firms which produced relatively simpler, qualitatively inferior and cheaper products as compared with the products of large-scale firms, and also had lower productive capacity [Table 4.8]. In addition to these, though not included in Table 4.8, were hundreds of small-scale firms which produced slow-speed, low quality products. During the first half of the 1970s, the growth of the irrigation sector slowed down, and from 1975 the

Table 4.8

Size, Location and the Productive Capacity of the ARE Firms (Irrigation Sector) in the Punjab, 1981[1/]

(Large-Scale and Medium-Sized Firms Only)

No.	Name of the Firm	Location	Size of the Firm[2/]	Major ARE Products	Productive Capacity (Units) Per Annum[3/]
(1)	Beco[4/]	Lahore	Large	Diesel Engine (Slow Speed)	650
				Diesel Engine (High Speed)	3,600
				Water Pumps (Centrifugal and Deepwell)	3,400
(2)	Ittefaq Foundries	Lahore	Large	Diesel Egnine (Slow Speed)	3,000
				Diesel Engine (High Speed)	600
				Water Pump (Centrifugal)	9,000
				Water Pump (Deepwell Turbine)	N.A.
(3)	KSB	Hasan Abdal	Large	Water Pumps (Centrifugal)	1,400
				Water Pumps (Deepwell Turbine)	700
				Water Pumps (Non-clogging)	100
				Water Pumps (Domestic)	100
(4)	Climax Engineering Co.	Gujranwala	Large	Water Pump (Centrifugal)	N.A.
(5)	Kissan Tubewell Corporation	Lahore	Medium	Diesel Engine (Slow Speed)	200
				Water Pump (Centrifugal)	300
				Water Pump (Turbine)	20

Table 4.8 (Cont'd.)

No.	Name of the Firm	Location	Size of the Firm[2]	Major ARE Products	Productive Capacity Per Annum[3]
(6)	Nawab Tubewell Industries	Lahore	Medium	Diesel Engine (Slow Speed)	100
(7)	National Engineering Works	Lahore	Medium	Water Pumps (Centrifugal)	200
(8)	Golden Industries	Gujranwala	Medium	Water Pump (Piston)	600
				Water Pump (Centrifugal)	300
(9)	Sultan Foundry	Lahore	Medium	Water Pump (Centrifugal	1,200
(10)	Premier Engineering	Lahore	Medium	Water Pump (Centrifugal)	300
				Diesel Engine (Slow Speed)	240
(11)	Mujahid Foundry	Lahore	Medium	Water Pump (Centrifugal)	600
				Diesel Engine (Slow Speed)	200
(12)	Plaza Tubewell Corporation	Lahore	Medium	Water Pump (Centrifugal)	500
(13)	Modern Engineering Company	Lahore	Medium	Water Pump (Piston)	800
				Water Pump (Centrifugal)	400
(14)	Moghul Union Works	Daska	Medium	Diesel Engine (Slow Speed)	150
				Diesel Engine (Slow Speed)	300
(15)	Matchless Engineers	Lahore	Medium	Diesel Engine (Medium Speed)	50
				Diesel Engine (High Speed)	-

Notes: (1) This table is based on: (i) N.D.I.S.C., 1976, Appendix VII, p. 366-368, and (ii) our estimates based on personal interviews. (2) For firm-size classification, see table chapter. (3) Capacity per annum is calculated on one-shift basis. (4) In 1972 Beco was nationalized and renamed; Pakistan Engineering Company (PECO).

size of the small-scale sector began to decline. Since then many small-scale diesel engine firms have either gone out of business or switched to other product lines.

The structure of the cultivation sector of the ARE industry in 1982-83 was somewhat different from that of the irrigation sector. The main difference lay in the number of the medium-sized firms: there were at least 25-30 cultivation sector firms as against 10-12 irrigation sector firms. Otherwise, both the sectors had a broad base, consisting of small-scale firms, and narrow top, made of a small number of large-scale firms.

The cultivation sector's small-scale firms, including workshops that produced and repaired cultivation equipment, existed in every large town of the Punjab. These firms have 'grown' rapidly during the 1970s and the early 1980s. This observation also gets support from the PSIC (1977-78) and FMI (1983) data. On the other hand, there were only six large-scale cultivation sector firms in the Punjab which included Millat Tractors; Beco, Fecto, Associated Agencies, Ittefaq and Pakland, all situated in or near Lahore. These firms specialized in the manufacturing of technically superior products like the reaper, the cutter-binders, the multi-purpose thresher, the harvester and the tractors.

4.4 Location of the ARE Firms

Pakistan's ARE industry is highly concentrated in the Punjab. There exist only a few ARE firms in the other provinces, viz., the Sind, the N.W.F.P., and the Baluchistan.[2]

As for the Punjab, the PSIC survey (1977-78) identified two interesting features of its small-scale industry: (1) that there was a general trend of concentration of industries in a few districts of the province; and (2) there was centralization of industries in selected cities on the basis of product specialization.

Regarding the general trend of concentration of industries in some districts, it was observed that 5 out of 21 districts had over 76.0 per cent of the total light engineering units in the province. These five districts were Lahore, Gujranwala, Sialkot, Faisalabad and Gujerat. /Table 4.9/. This phenomenon, though more striking in the case of Punjab, is also noticeable in other provinces. In the N.W.F.P., for example, the small-scale industry is mostly located in Mardan, Nowshera, Dera Ismail Khan and Bannu, whereas most of Sind's small-scale firms are centred in Karachi, Hyderabad and Sukhar.

The Punjab's ARE firms, both large and small, are located around 5 major industrial centres, viz., Lahore, Faisalabad, Daska, Gujranwala and Sargodha. Of these, Lahore and Daska are two important centres of diesel engine manufacturing, though a few small-scale firms also exist in Sahiwal, Multan and Gujranwala. Lahore, however, remains the largest centre of diesel engine manufacturing firms which include large-scale firms like Batala Engineering

Table 4.9

Light Engineering Industry in Punjab

District-Wise Location: 1977-78

Name of District	Foundry	Agril. Equip.	Inds. Plants including Diesel Engine	Auto parts	Weights & Msrs.	Sewing Machine	Light Engg. Services	Fabr. Strs	Standard Metal Articles	Hardware	Wire Drawing	Wire Netting	Elect. Equip.	Ctly. & Surg.	Brass & Copper Wires	Total
Rawalpindi	34	1	4	62	-	4	68	84	2	4	-	-	1	-	-	264
Campbellpur	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	4
Jhalum	-	-	1	3	-	-	12	6	-	-	-	-	-	-	-	22
Fujrat	48	9	7	14	-	1	81	61	-	1	-	-	145	-	10	377
Sargodha	3	30	-	-	1	4	92	77	-	1	-	-	-	-	-	208
Jhang	1	8	1	1	-	-	153	2	-	-	-	-	-	-	-	165
Mianwali	-	-	2	-	-	-	-	7	-	-	-	-	-	-	-	9
Faisalabad	38	100	41	-	5	9	541	162	3	18	-	-	1	-	1	919
Lahore	175	25	122	76	13	50	993	426	36	112	32	25	75	13	28	2,201
Kasur	-	7	-	-	-	4	73	18	-	-	-	-	-	-	-	94
Sheikhupura	-	2	-	9	-	9	33	13	-	3	-	-	1	-	-	70
Gujranwala	193	59	90	24	26	16	374	323	11	58	-	2	106	83	291	1,656
Sialkot	33	10	119	9	-	-	167	221	21	24	-	-	5	496	—	1,105
Multan	19	29	18	62	6	13	191	139	7	-	-	-	-	-	-	484
Sahiwal	18	21	18	30	1	6	201	35	-	8	2	-	-	3	2	345
Vehari	4	5	1	4	-	2	65	17	-	-	-	-	-	-	-	98
D.G. Khan	-	-	-	-	-	-	19	3	-	-	-	-	-	-	-	22
Muzaffargarh	-	-	-	-	-	1	15	7	-	-	-	-	—	-	-	23
Bahawalpur	-	-	-	-	-	-	-	21	-	-	-	-	17	-	-	38
Bahawalnagar	-	-	-	-	-	-	6	15	-	1	-	-	—	-	-	22
R.Y. Khan	4	-	2	2	-	-	53	18	-	5	-	-	-	-	-	84
G. Total	570	306	426	296	52	119	3,141	1,647	60	235	34	27	351	595	332	8,210

Source: Basic Statistics on Small Light Engineering Industry in Punjab; Survey Report, P.S.I.C., 1977-78, p. 21.

Company and Ittefaq Foundries, and half a dozen or so medium-sized firms. In addition, there are many small-scale firms, including workshops that provide specialist services to tubewell firms.

The other important centre of irrigation-sector products, especially diesel engine manufacturing, is Daska which developed very rapidly during the 1960s. Though an old centre of scissors and razor manufacturing, Daska's development as an engineering centre in this period was facilitated by a number of factors, viz., (1) location in the centre of an area where private tube-well sinking first started; and (2) local peoples' talent for skill learning, ingenuity and entrepreneurship.

Faisalabad remains the biggest centre of cultivation-sector firms. According to the PSIC survey of 1977-78, this city had 32.6% of the small-scale cultivation-sector firms, while the rest were located thus: Gujranwala (19.2%), Sargodha (9.8%), Multan (9.5%), Sahiwal (6.9%), and others (22.0%). /p. 20/. The predominant position of Faisalabad has since been weakened as other centres (like Mian Channu) of cultivation sector firms have also emerged and the already-existing centres have grown more rapidly. In 1982, Faisalabad still had 15.4% of the small-scale firms and 14.6% of all cultivatinn-sector firms of the Punjab. /F.M.I. 1983, pp. 19-25/.

To sum up, the ARE firms are located mostly in a few cities of the Punjab on the basis of product specialization. The general trend of industrial concentration in a few places appears to have been determined by the following factors: (1) proximity to the market; (2) presence of other industries, especially servicing firms; (3) availability of raw materials and skilled workers,; and (4) infrastructure facilities. Above all, what appears to be single most important factor is the existence of external economies i.e. the effect of investment in one firm on reducing the costs of others. Since repair and specialist servicing firms are centred in a few cities of the province, so are the ARE firms.

FOOTNOTES

CHAPTER FOUR

1/ Following Joan Robinson (1956), we define industry as consisting of a group of firms which share some common technical characteristics, viz., production methods, same suppliers, or distributors, same labour skills and so on. Yet these firms may not sell homogeneous product since some possibility of substitution always exists.

2/ Most of the Sind firms produce water pumps and agricultural implements and are situated at Karachi, Nawabshah and Hyderabad. Karachi also has 3-4 small-scale, slow-speed diesel engine manufacturing units. In the N.W.F.P., there exist a few small-scale ARE firms, producing piston water pumps and simpler agricultural implements, mostly located in Mardan, Nowshera, and Dera Ismail Khan. Baluchistan's only firm is a large-scale diesel engine unit, Bella Engineering at Lesbella, which specializes in the manufacturing of high-speed and high-powered engines suitable for buses and trucks, with 55, 83 and 108 H.P. capacity. In 1978, this firm, in collaboration with an international firm - Siemens - started manufacturing medium-speed diesel generating sets, designed especially for agro-industries. These generating sets are exported to Middle East and Africa, besides being used for running agro-industries in Pakistan. According to one source, Baluchistan also has 5 small-scale agricultural implements firms in Quetta, but does not specify their products. [F.M.I., 1983].

CHAPTER FIVE

HISTORICAL DEVELOPMENT OF PUNJAB's AGRICULTURE-RELATED ENGINEERING INDUSTRY: DEVELOPMENT OF RESOURCES, MARKET EXPANSION AND TECHNOLOGICAL DIFFUSION

This chapter deals with the development of the Punjab's ARE industry from pre-1947 to 1960. This review is divided into three parts viz., (1) historical perspective (pre-1947); (2) rehabilitation of the engineering industry (1947-50); and (3) emergence of the ARE industry (1950-60).

5.1 The Engineering Industry in Indo-Pakistan Subcontinent - A Historical Perspective

North India, or what later became West Pakistan in 1947, had only a few centres of engineering industry. Pakistan's share in this was however relatively large, though mainly consisting of small-scale metal working units. These were concentrated in four important centres, namely, Lahore, Gujranwala, Sialkot, and Wazirabad. The fifth major centre of the undivided Punjab was Batala, now part of the Indian Punjab. Outside Punjab, Calcutta in West Bengal, was a well known centre of this industry. Other centres of the engineering industry, mainly small, were spread all over India, especially in Madras and Utter Pradesh. These firms produced various goods - involving heterogenous engineering skills and technologies - chaff cutters, oil expellers, cane crushers, domestic pumps, simple machine tools and other similar items. This widespread activity owed its existence to the availability of cheap indigenous iron and steel and craftsmen.

The most popular and important activity then, and even today, in India and Pakistan, was foundry working, the most fundamental type of metal working job. All metal products, old or modern, require some sort of foundry work. So as the demand for metal products increased in India, so did foundry working. The growth of general engineering activity in the Indian Punjab in the 19th century could thus be attributed to the overall expansion in the Indian economy. Demand for traditional agricultural implements was consistently growing with increased cultivation and, at the same time, general skills in engineering crafts were needed in the growing manufacturing sector /Rungta, 1970/. In addition we must consider two specific determinants of broad based metal working activity centred in the Punjab in the mid-19th century: (1) the battles of Indian Chiefs (Sardars) against the British which contributed to the capability to manufacture sophisticated armoury for the local Sikh Sardars; and (2) the introduction of canal irrigation in British India which, along with colonisation of previously barren lands, increased demand for locally produced agricultural implements. /Thornburn, 1904/.

Before partition of the subcontinent there were at least three centres of general engineering in East Punjab (now Indian part of the Punjab): Batala, Ferozepur and Jullundar. The first, Batala, then a sub-division of Gurdaspur District, was known as the "moulding" centre of the province as it had a large population of foundry workshops. According to one source, Batala had at least 50 engineering units. Most of them were managed by Hindu entrepreneurs but manned by Muslim workers who constituted 70-80 per cent of the skilled workfroce. The metalworking labour force of Batala in 1940s was estimated to be around 10,000 most of whom were engaged in small-scale manufacturing activity.[1/] Apart from general purpose foundry working, two well-known products of Batala were: chaff-cutters (locally called, toka) and cane crushers (Bailna).

Jullundar and Ferozepur were the two engineering centres of the East Punjab, with largely Hindu entrepreneurship. These firms were mostly family owned and small-scale, producing, in 1940, products such as oil expellers, foundry products, steel re-rolling, domestic pumps and even diesel engines. At this time, one Muslim owned firm, H. Mohammad Hussain and Sons, of Ferozopur, also had the capability to produce machine tools, though on a limited scale. (This firm had begun manufacturing on irregular basis, cold-start, slow speed diesel engines in the 1930s.)

As noted, in the Western Punjab (now part of Pakistan) Lahore, Gujranwala, Sialkot and Wazirabad were old centres of metal working activities. While Gujranwala was (and still is) known for utensils, non-ferrous products manufacturing, Sialkot and Wazirabad became famous for producing surgical goods and cutlery, respectively. Lahore had the unique position of 'being the largest centre, producing, such diversified products as cane crushers (sugar centrifuge machines), oil expellers, diesel engines, flour milling machinery, machine tools (lathes, etc.), handsaw machines (for tree logging) and rice shellers. Though Lahore was the largest centre of engineering industry in pre-partition Punjab, there existed only about 6-8 firms that employed 15-20 labourers. Despite their small size, some of the more resourceful of these firms were even commissioned to produce general purpose machine tools and foundry castings for the war effort.

A new and perhaps singularly important product taken up for production in India in the 1940s was the slow-speed diesel engine. This product was too complicated and technically demanding for the indigenous skills to produce. Hence the manufacturing of diesel engine did not involve regular production line of complete sets; it consisted of fabrication of simpler parts and assembly of the more complicated ones imported from abroad. The technical expertise needed for diesel engine production was acquired through practical experience. It was a typical case of learning-by-doing. By undertaking repair and maintenance of imported diesel engines, used in India since the 1920s, a few firms in the Punjab acquired the skills needed to start its partial manufacturing in the early 1940s.

The pioneer diesel engine manufacturing firms of India relied on their knowledge of traditional production techniques. The design and quality of locally made engine did not strictly conform to specifications of the imported product as they relied on copying the foreign machines. But through 'tinkering', etc., the local producers acquired the capability to make necessary changes in design and specifications to suit their production capacity.

To conclude, at the time of partition of the Indian subcontinent in 1947, this industry possessed the ability to produce numerous engineering products. However, the firms specializing in agricultural machinery manufacturing including diesel engines were a part of the general engineering industry in the subcontinent; the ARE industry had not yet emerged.

5.2 Partition and After: Rehabilitation of the Engineering Industry (1947-50)

The conditions surrounding partition of the subcontinent created economic and social chaos. Millions of people migrated across the new frontiers of the two states. At that time, Pakistan had little industry and was without any significant industrial and commercial classes. But a nucleus of engineering industry existed even in these years. As already noted it was located in Lahore, Gujranwala and Sialkot. The larger establishments were previously owned by Hindu entrepreneurs who, at the time of partition, migrated to India leaving their physical assets behind. The vacuum left by their departure was filled by the local and entrepreneurs and skilled workers coming from Batala, Jallundar, Ferozepur and other towns of East Punjab with traditions of metal working.

Most of these people were experienced business associates of Hindu entrepreneurs linked through trading or subcontracting, etc. who dominated this industry in pre-partition days. A few others were already in business in Lahore as independent entrepreneurs and fully experienced in manufacturing engineering products.

Another facilitating factor in the rehabilitation of the engineering industry in Pakistan was abundant supply of skilled manpower. At the time of partition, the entire Muslim population of the East Punjab migrated to West Punjab. Many among them were skilled workers who were either employees of engineering firms in East Punjab or independent artisans and village blacksmiths. Thus, in the early years, Pakistan had an 'army' of unemployed workers possessing diverse metal working skills seeking employment and/or business opportunities. There was at this time thus no shortage of general engineering skills in the country. Nor did there exist any serious shortage of metal working equipment. The incoming Muslims got allotted machinery and equipment left behind by the outgoing Hindus in lieu of the Muslim assets left in the East Punjab and elsewhere. The old well established firms of Lahore, Gujranwala and Sialkot had owned substantial assets in terms of machines, equipment and buildings which could be commissioned by the new owners. Some of the well-known firms of pre-partition days like Ahmad Baksh, Aulia Engineering and others had supplied, during the 1930s and the 1940s, machine tools to markets as far off as Bengal and Madras. Besides, there were hundreds of small, and some medium-sized Hindu-owned firms around the main centres of the West Punjab. They were occupied, with all their physical assets, by Muslims. Thus the new occupier/owners got the basic and essential machinery and tools to start their business.

Moreover, some pioneering large firms like Beco and Ahmad Baksh (Lahore) and Aulia (Gujranwala) took early lead in the fabrication of simple machine tools. A new machine tool shop was one of the first Beco projects to go into production. Work on it started in late 1947 and the first Beco lathe (model BE - 250) was produced in 1949. [Beco, 1973]. This progress towards the domestic manufacture of engineering products was supported by the industrial policy of that period. The policy proved successful as the domestic demand for lathes, shapers and other products of the same kind was expanding fast and the domestic manufacturing firms had previous experience of factory production of these machines. Liberal imports of machines, both new and old, around 1950 also greatly helped in meeting the equipment needs of these firms. Though the import policy allowed import of machinery from any country the most important sources were Britain, Russia and Czechoslovakia.[2/] (Some of these machines for hobbing, planing, machining, grinding, etc., are still in use in these firms.) Finally, another important source of machine tools, etc., was the Pakistan Railways. (Lahore was for long the headquarter of the North Western Railway of India, and has since partition been the head office of (West) Pakistan Railways.) The largest railway workshop of the Indian sub-continent was situated in Moghulpura, Lahore, This workshop has over a long period been a source of second-hand machines, parts and tools for local engineering firms. These machines were cheap and appropriate for the newly established firms' requirements. In some cases these had to be re-conditioned or overhauled. However, the buyer firms had the required capability to do so.[3/]

Finance was hard to get. Commercial banks were reluctant to advance long term credit for working capital to small manufacturing firms. Larger firms, and to a lesser extent, medium sized enterprises did have access to bank credit, whereas small firms relied on personal loans, personal savings or the suppliers' credit. In order to encourage industrial investment, the government, in 1949, set up the Pakistan Industrial Finance Corporation (P.I.F.C.O.) This too could not meet the financial needs of small-scale engineering firms.

The early years (1947-50) saw the rehabilitation of abandoned Hindu-owned units and an increase in their productive capacity. The economic situation in Pakistan at the time, characterised as it was by the country having been cut off from its traditional sources of supply of manufactured goods in India, offered many opportunities of industrial expansion. As a result of this expansion demand for a variety of engineering products increased rapidly. Thus the old firms like Beco, Ahmad Bukhash and Aulia started manufacturing a variety of machines and their parts/components. These products, included: (a) diesel engines (used as generators in agro-industries), lathes, drilling and shaping machines, oil expellers, rice husking machines, sugarcane crushers; (b) mechanical and structural metal products; and (c) parts and components for industries like textile, ginning, sugar, chemicals, and railways.

Thus, around 1950, the situation in the Punjab was as follows. There was one large enterprise (Beco) (employing about 300 workers) situated in Lahore. It was producing a wide variety of enginering products, including simpler machine tools. This firm established foreign technical collaboration to acquire the capability to produce relatively more sophisticated products - new types of diesel engine, centrifugal pumps, including turbines, etc.

In addition, there were about 10 middle-sized units (employing say, 20-50 workers) owned and managed by entrepreneurs with experience of metal working at the medium scale. They produced castings and a variety of simple engineering products, including diesel engines and water pumps on a limited scale. These enterprises were surrounded by numerous small scale units (situated in

Lahore as well as other cities), artisan and blacksmith-type shops and a large labour force with a background of metalworking experience and habit of hard work. This was the initial base which gradually expanded and provided resources and experience for the emergence of the agriculture-related engineering industry (ARE) in the 1950s.

5.3 The Emergence of the 'ARE' Industry: 1950-60

The emergence of the ARE industry in the 1950s was the result of the interplay of two sets of factors which are conveniently divided into those on the demand side and those on the supply side. In this section we seek to explain how gradually increasing demand for the ARE products in this period led to the development of resources and technological diffusion which were essential for the emergence of this industry.

5.3.1 Market Expansion: Increased Demand for 'ARE' Products

In chapter 2 above we identified a trend of gradually increasing demand for irrigation-related products such as tubewells in the 1950s. Data set out in Table 2.7 and 2.10 (chapter 2) showed that, during the 1950s, the average annual tubewell installation by public and private sectors was increasing, though at a rather modest rate. According to one estimate, the number of private tubewells in West Pakistan (the present Pakistan) alone increased from 1,780 in 1954 to 5,180 in 1959 /Government of Pakistan, 1970, p. 7/.

Two other sources of demand for tubewells were (1) the gradually expanding agro-industries such as cotton ginning, oil expelling, and wheat milling and others, and (2) tubewell use for municipal water supplies and public health engineering. Taken together, all these sources of demand represented an expanding market for tubewells throughout the 1950s.

5.3.2 Supply Response

The opportunities offered by expanding market (for tubewells) in the 1950s brought quick response from the existing ARE firms, mainly a few large-scale and a number of medium-sized units. Two important developments to take place in this industry in this period were the learning and upgrading of skills, and the gradual diffusion of technology in which large-scale firms made a significant contribution.

5.3.2.1 Diffusion of Skills

The first important supply side development of the 1950s was the diffusion of skills in the labour force. The learning and upgrading of skills took place at two levels: first, private large-scale firms trained their engineers and workers in modern skills and, second, government started vocational training schemes to build up trained manpower in the country. The efforts of private firms to acquire foreign technology for producing modern ARE products (diesel engines, water pumps, etc.) involved gradual development of new skills in the country.

In the early years, large-scale firms like Beco obtained technical know-how and technology from abroad for the production of various products. The technical know-how acquired from abroad included the services of engineers and technologists who helped in organizing production of new products by the large-scale firms. For example, Beco, engaged several German engineers to re-organize its production after partition.

Moreover, Pakistani engineers were also sent abroad for training by the large-scale firms like Beco and KSB (KSB is multinational water pump manufacturing company which, in collaboration with Beco, has operated in the Pakistani market since the early 1950s). Gradually, the Pakistani engineers took over the responsibilities of production in these firms. The large-scale firms also arranged local training of engineers in higher skills. For example, Beco organized a three-year 'Practical Training Programme' for young engineering graduates. Beco also organized a training school for fitters and turners. [Beco, 1973].

The workers trained by the large-scale firms in the 1950s formed the nucleus from which new skills were to spread out to other firms in the following years. Many of small-scale firms set up during the 1960s were actually owned by workers who had initially acquired their skills as employees of large-scale and medium-sized firms.

Government too played an important part in promoting development of skills in Pakistan. In 1950, the government accepted the recommendations of the officially appointed Technical Education Committee which asked for public sector effort to promote vocational education and training. [Government of Pakistan, 1957, p. 558]. Meanwhile 'The Interim Manpower Survey Report' of the Ministry of Labour, 1955, identified for the first time emergence of occupational shortages in the country. Thus, the First Five Year Plan (1955-60) envisaged the setting up of four polytechnic institutes to produce skilled workers in various crafts.

The government, with the assistance of foreign agencies also set up special institutions like Pakistan Industrial Technical Assistance Centre (P.I.T.A.C) for technical training in a variety of engineering skills. The subjects taught at P.I.T.A.C. include design and draughting, machines and tools pattern making, foundry practice and heat treatment. Employees from private and public sector firms have benefited from the short training courses. It is, however, not possible to make any estimate of the magnitude of this assistance and the consequent improvement in skills.

Two other important public sector sources of skills diffusion were the defence establishments and Pakistan Industrial Development Corporation Institute of Personnel Training. The P.I.D.C. Training Institute organized 'training within-industry' programmes, both in P.I.D.C.

and private plants. This was part of the government's scheme of promoting, regulating and standardizing industrial apprenticeship on a national basis [Government of Pakistan, 1957, p. 555].

Thus, private firms' initiative to acquire foreign technical know-how and training of their employees in new skills, and public sector training facilities gradually built up trained manpower in Pakistan to match the needs of expanding ARE industry in the 1950s.

5.3.2.2 Diffusion of Technology

Large-scale firms were the main agents of technology diffusion in the ARE industry in the 1950s. They acquired foreign technology and helped in its diffusion by successfully adopting it for production. The process of technology diffusion was slow and gradual: the new irrigation technology spread out from the large-scale to the medium-sized and, then, to the small-scale firm in stages with a time lag of 3-5 years.

The most critical stage of this process was that of acquisition of foreign technology and putting it to use for regular production of modern diesel engines, water pumps, electric motors, etc., which was largely managed by the large-scale firms. It must be mentioned here that during this period the government also obtained technical assistance for the local firms under Colombo Plan and U.S. technical assistance programme. Around 1955, expert advisory services were arranged for guiding production of metal products in the Punjab. Moreover, the Industries Department of the Punjab Government distributed literature, formulae and designs for the benefit of tubewell manufacturers. The programme sought to disseminate knowledge on improved methods with respect to the casting and design of products and use of certain raw materials.

The first large-scale firm to start diesel engine and centrifugal water pump manufacturing on regular basis was Beco. Prior to 1950, there was 'no organized factory for producing standardized diesel engines in large numbers' /Beco, 1973, p. 10/. The company acquired designs and machines and technical know-how from Britain with a view to making a standard product. Part of the machinery was fabricated in Beco machine tool shop. This model of slow-speed diesel engine /S.S.D.E./ became very popular and the firm produced more than 10,000 during 1953-1973.

In 1952, Beco expanded its area of operations and set up a joint company with a multi-national company, KSB-AG for turbine pumps.[4/] Through this collaboration, Beco acquired technological capability and know-how for manufacturing pumps. Over the years, Beco produced, improved and re-designed centrifugal pumps for low, medium and high-lift purposes in the capacities of 0.4 to 4.0 cusec, with discharge opening ranging from 2 inches to 7 inches. Meanwhile, Beco continued its plan for product diversification and improvements. In this endeavour a new type of pump for dewatering in water logged areas was planned for production. Those pumps use vertical-shaft and are commonly known as turbine pumps.

Beco also acquired the necessary facilities for producing turbines under license from Messrs Jacuzzi Brothers, U.S.A. In 1959, Beco went into the production of vertical hollow shaft electric motors (to go with its turbine pumps). Those were produced under license from Messrs Newman of the U.K.

In the second half of the 1950s Beco started manufacturing high-speed diesel engines (H.S.D.E.). Again, the engine design for this (7.5 HP - 1500 RPM machine) was acquired from an international firm of repute: Farrymann and Wade of Germany. In the beginning, this engine was evaporation cooled; later on in 1958, a series of 1, 2 and 3 air cooled engines were added to the production line under license from another world famous German firm MWM of Mannheim. These air cooled engines were used in agriculture as well as in small industrial sector all over the country. Introduction of this product was synchronized with the installation of a production line, with latest foreign machinery. In addition, special single purpose machines were installed for machining engine crank case. The new set up of machining, assembly, inspection and testing was claimed at every stage to equal any modern diesel engine manufacturing factory in the West [Beco 1973]. Thus, over this decade, this large firm obtained technical know-how and machines required for the production of various ARE (I) goods, for different segments of the market.

The first group of firms to benefit from the new manufacturing technology imported by Beco and KSB and the reservoir of skills available in the Punjab at the time was made up of the then existing medium-sized firms. These firms had their old employees (trained in jobs like machining) in addition to those trained by large firms like Beco. They also had access to components and equipment produced by the large firms. But the production of diesel engines and pumps required imported parts and components. For example, in the early years, quite a few of the components of diesel engines were imported. The following break-up of diesel engines and the sources of supplies gives an idea of the extent of the technological capability of diesel engine manufacturing Pakistani firms in the mid-1950s:

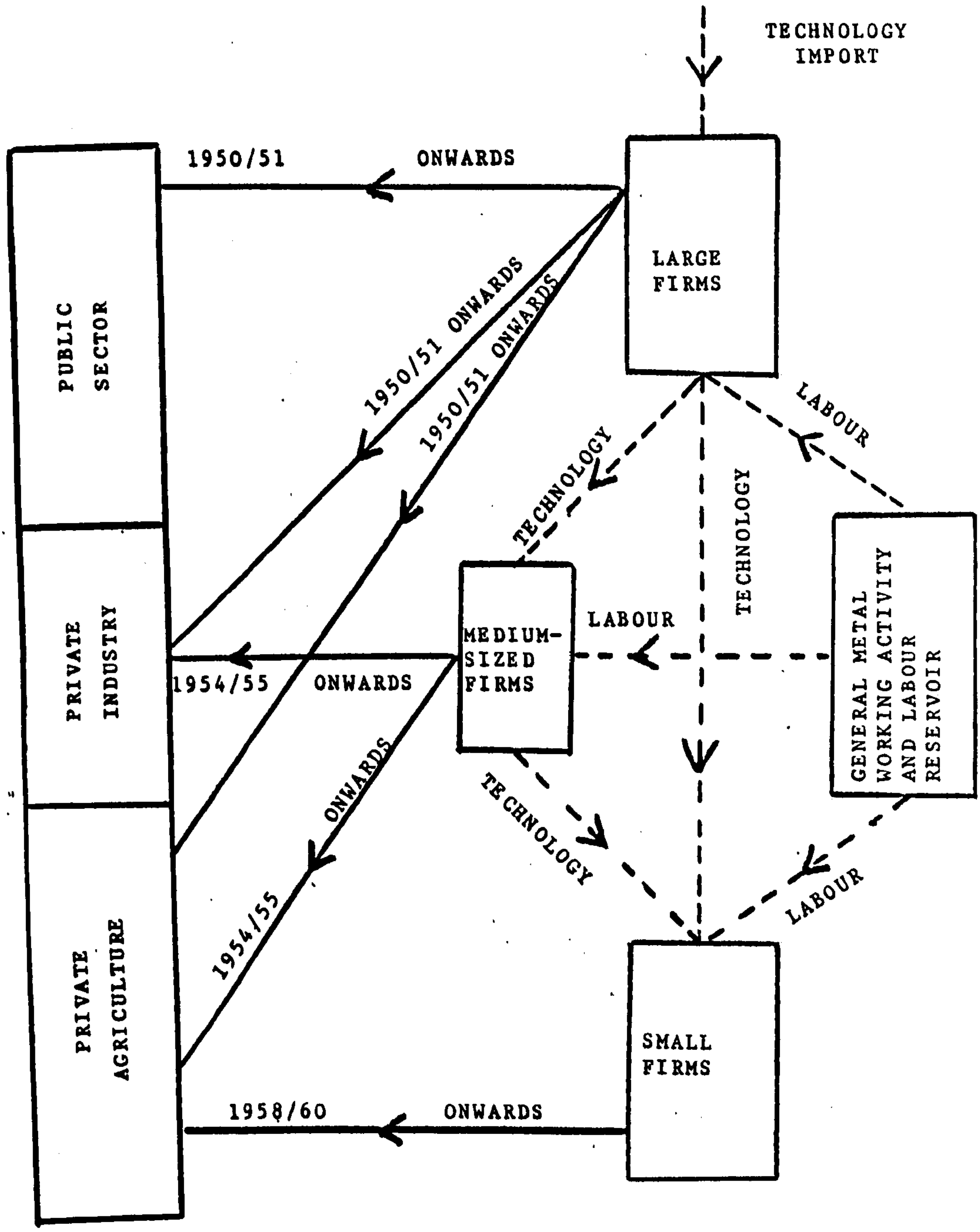
Imported Components:	Fuel injection system: governor; lubrication system: crankshaft; connecting shaft: and forged equipment.
Locally manufactured Components:	Engine body: fly wheel: silencer box; cylinder head; piston and cylinder liner.

Over the years, the industry gradually developed its capacity for the manufacture of other components and by 1959 only the fuel injection system was being imported for the domestically produced diesel engines.[5]

Widespread metal working, including limited tubewell production, in the 1950s, also afforded opportunities for the acquisition of skill and technology by small-scale firms. But the small-scale firms acquired the requisite skills and technical knowledge only after a slow and gradual process of technological diffusion. Expanding production of ARE products by large and subsequently by medium-sized firms opened up opportunities for the learning and application of new skills by workers, while it enabled small workshops to improve their techniques and capability. While the large-scale firms remained more integrated in that period, some medium-sized ARE firms put out part of the tubewell manufacturing work to small-scale firms. The services provided by the small-scale firms for the manufacture of tubewells included such basic jobs as turning, shaping, planing, milling, cylinder boring, and other such engineering activities. Thus, small-scale firms had the opportunities to slowly learn the new tubewell technology, though they did not have the means to enter production of tubewells in the 1950s.

A schematic outline of technology diffusion process described above is given in figure 5.1. It shows that the process started with import of technology by large-scale firms in the early 1950s. In the next stage, with a time-lag of 3-5 years, medium-sized firms acquired the new technology and skills, and started producing modern tubewells. Meanwhile, small-scale workshops got an opportunity to acquire the new skills by acting as suppliers of parts and components to medium-sized firms during the expansion phase. In this way the know-how was passed on to many small-scale engineering firms or workshops who later established independent manufacturing business.

Figure 5.1 Resources, Markets and Diffusion of Technology



Two features of the process of technology diffusion in the ARE industry may be emphasised here: (1) the process was slow and gradual, involving a time lag of at least 3-5 years before it could reach from the large-scale to the medium-sized, and then to small-scale firms; and (2) different types of firms could only enter certain markets determined by the type of technology they had access to.

5.3.3 Economic Policy

During this period domestic manufacturing firms received full support of the economic policy which aimed at removing bottlenecks in the way of domestic production of imported goods. Because of Korean War trade surplus, the government had allowed 85 per cent of the imports without licenses. Almost all essential imports (including raw materials) required for diesel engines manufacturing were importable by industrial and commercial importers. The established large-scale and medium-sized ARE firms benefited from this opportunity in a significant way. They imported not only raw materials like iron, billets, etc., but also machinery, both new and second-hand. In a similar fashion, various types of machines and equipment were imported by commercial firms. Even after the Korean War trade surplus had disappeared in 1953/54 the axe of import restrictions fell on consumer goods, while imports of industrial raw materials and machines were maintained. During 1952/53-1959/60, annual imports of capital goods and industrial raw materials constituted more than 40.0 per cent of the total imports. /Table 7.6, Chapter 7/. Thus, the supply of capital goods did not impose a constraint on ARE's growth in the 1950s.

To sum up, entry of large-scale and medium-sized firms into the production of tubewells on a regular basis in the 1950s was aided by a number of factors, viz., (1) expanding demand for these products; (2) import and diffusion of technology through the efforts of private big firms and assistance of the government; (3) availability of trained workers and other inputs, including imported components; and (4) government policy to encourage local manufacture of imported products.

FOOTNOTES

CHAPTER FIVE

1/ Based on interview with Mr. C.M. Latif, managing director Batala Engineering Company, until 1972. This and other information on the ARE industry has been obtained from personal interviews with various persons associated with the industry.

2/ The present developed countries also relied on second-hand machinery at certain phases of their development. It was more a means of saving initial capital than of maximizing profitability. For example, Holland purchased second-hand steel making furnace from Bessemer in Germany around 1900, and Italy bought from Britain a wide-gauge railway system in 1892. /Saul, 1972, p. 43/.

3/ It is worth noting at this point that small metal working units faced considerable difficulty in obtaining finance most of which came from personal sources. Commercial banks were extremely reluctant to advance credit for working capital needs to small units. The Pakistan Industrial Finance Corporation (PIFCO) set up by the Government in 1949 also played a negligible role in meeting the credit requirements of small firms.

4/ This collaboration ended in 1959, when KSB-AG established itself as an independent firm. In 1976, KSB was made a public limited company.

5/ Only one firm, Beco has kept using up to 25 per cent imported parts of S.S.D.E. till 1984.

CHAPTER SIX

CHOICE OF TECHNIQUE IN THE IRRIGATION SECTOR OF THE 'ARE' INDUSTRY

In this chapter we propose to estabiish that there exist (i) possibilities of choosing alternative techniques at different stages of tubewell (i.e. slow-speed diesel engine and water pump) production, and (ii) a definite link between technology and product characteristics. This discussion is intended to provide the setting for our explanation, in a later chapter, of the growth of the irrigation sector of the ARE industry.

6.1 Factors Influencing Product Quality

To appreciate the product-technology link in the irrigation-sector, it will be helpful first to identify the factors which determine the quality of the products (tubewell).

Three factors affect the quality of tubewells and its constituents parts viz., (1) quality of raw materials, (2) technology as embodied in the machines and tools, and (3) labour and management skills. We first study these factors in some detail with reference to two types of diesel engines viz., slow-speed diesel engine (S.S.D.E.) and high-speed diesel engine (H.S.D.E.)

(1) Quality of Raw Materials

The first factor affecting the differences between S.S.D.E. and H.S.D.E. is the quality of raw materials.

For example, the piston of a slow-speed diesel engine needs to be cast in grey iron, with nickle alloy. This material gives it good mechanical strength, ductility (toughness) and resistance to wear. The alloying of iron with nickle is accomplished in locally made cupola furnaces.

The piston of high-speed diesel engine, on the other hand, is made of co-crystallized aluminium alloy, melted in low frequency electric arc furnace. The merit of aluminium alloy against the ordinary grey cast iron prepared in cupola furnace is the durability of the product. The piston rings of H.S.D.E. are also cast in special metal alloy with high pressure, in single elliptical mould. The use of selected raw materials and pressure casting techniques ensure the high quality required for resisting the high pressure[1/] to which the piston of H.S.D.E. is subjected. This example shows that the functional differences between the two types of diesel engines are partly determined by the raw materials used in their production.

(2) Machines and Tools

The second set of factors affecting the product quality or functional characteristics is the machines and tools used for producing the two types of diesel engines. [For detailed information on equipment owned by different firms in our sample, see Tables 7.1, 7.2, 7.3 and 7.4, Chapter Seven]. The S.S.D.E. and H.S.D.E. have quite different designs, physical structure and technical specifications and, hence, their production requires different sets of machines and tools, embodying different technologies. For example, at the machining stage, different types of metal cutting machines will be required to ensure the desired product characteristics. The machining of H.S.D.E. parts is possible only on more advanced machine tools which are capable of turning hard alloys with precision. For instance, the cylinder block and cylinder liners of H.S.D.E. need to be bored to a high standard of finish for smooth running of piston inside the cylinder. This requires the use of special boring machines or grinders for sharpening the surface edge of the cylinder to a 25-30 micro inch finish. This is essential as the cylinder size of H.S.D.E. is quite small and its valves are subjected to major thrust of combustion pressure and the connecting rod angle. The compact body of H.S.D.E. demands precision manufacturing of parts and components which can be accomplished on sophisticated machines only.

By comparison, the cylinder block of S.S.D.E. is large and made of cast-iron, and the cylinder liner is inserted separately into the block. Because of its large size and physical structure, the boring of S.S.D.E. cylinder liner can be accomplished on a lathe machine. However, piston boring on a lathe machine fails to ensure the same degree of precision as that achieved on a sophisticated grinding machine. Thus, the machines and tools constitute another variable affecting the functional differences between different types of diesel engines.

(3) <u>Labour and Management Skills</u>

The third variable affecting product quality is the skill of labour and management. Not only that the functional characteristics of products require different labour skills and the management ability; the importance of these two factors increases as the sophistication of the product increases. For example, while machining of S.S.D.E. parts can be accomplished with average skills, often informally acquired, the same skill will not, in general, be sufficient to undertake machining of H.S.D.E. parts on automated machine tools. The skills required for machining H.S.D.E. parts include (1) the ability to work on the basis of drawings, (2) the ability to use jigs, tools and dies, and (3) greater knowledge about materials and the appropriate processing methods. These skills are normally acquired through formal education and training.

Products with different characteristics also require different types of management ability for their production. For example, most of the small-scale S.S.D.E. manufacturing firms do not keep professional staff to supervise production. Production decisions are taken with little or no explicit planning. But their informal style of management fails to ensure uniform product quality. By contrast, the management structure of large-scale ARE firms is formal. They employ professional staff to supervise production. The qualified engineering staff promotes development of new skills and adoption of new machines and methods. The quality of management, thus, becomes an important variable affecting the quality of product.

6.2 Choice of Technique in Diesel Engine Manufacturing

In the last section we observed that functional characteristics of diesel engines are determined by three factors viz., raw materials, machines and labour and management skills. One corollary of this is that qualitatively different diesel engines require different techniques of production. To put it another way, techniques of production are linked with given characteristics and quality of diesel engines. Looked at from this angle, the 'product quality' becomes a critical variable in determining the choice of techniques in diesel engine manufacturing.[2/] Following this line of argument, we plan to study the choice of technique in slow-speed diesel engine manufacturing with special reference to its quality; later we will extend this analysis to centrifugal water pumps.

6.2.1 The Product: Slow-Speed Diesel Engine

As noted earlier, a tubewell set consists of a diesel engine/electric motor and a centrifugal water pump. Here we deal only with slow-speed diesel engine and single-stage centrifugal water pump. For purposes of clarity, we will consider the two products separately. First, the slow-speed diesel engine.

hot climate and fuel injection system was changed to reduce oil consumption /Child and Kaneda, 1974-75, p. 256/.

6.2.1.1 Production Techniques

Diesel engine manufacturing process can be divided into five important stages of production.[4/] (1) designing and pattern making; (2) casting of body parts and components; (3) machining of the cast parts; (4) assembly of the machined parts; and (5) finishing and testing. Of these, stage (2) and (3) are relatively more important for determining the product quality. It is also at these two stages that product-technology link emerges most clearly. Therefore, we restrict our analysis to these two stages.

Casting: Importance of Raw Materials

The main components and body parts of S.S.D.E. requiring casting are (1) mainframe or the body; (2) cylinder and its liner; (3) ring and piston; (4) crankshaft; (5) fly wheel; and (6) fuel system. Manufacturing of various parts and components, however, require different casting materials, machines and skills. Let us take the case of piston casting for S.S.D.E. and examine: (1) the importance of high-grade raw materials for producing a standard piston; and (ii) whether or not it is possible to produce pistons with low-grade raw materials.

The pistons of slow-speed diesel engine are fairly large sized and made of cast iron, with nickle alloy. Ideally, the piston should be cast by mixing nickle with iron having low graphite carbon so that it can withstand the pressures to which it is subjected. This is important as the piston works under severe operating conditions. Since the piston top is exposed to the heat of combustion,[5/] it should be light in weight to reduce the inertia forces to the minimum, a property which proper alloying of iron and nickle can ensure. Moreover, the graphite (flakes of carbon) contents of grey iron are also known to determine pistons' strength. Thus, in order to produce a good quality grey iron piston, not only the iron-nickle alloy is necessary, but the low-graphite property of the casting must also be ensured. If the graphite (carbon) contents are more than the desired level, it will cause low temperature resistance in the piston. The actual percentage of carbon in the casting would depend on the pig-iron scrap: iron ratio and the quality of scrap iron. Hence, if non-graded scrap is used it will lead to the production of poor quality grey iron, and, also sub-standard piston.

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However, for cost economy, it is common for the small-scale ARE firms of the Punjab to use low-quality grey-iron (i.e. high non-graded scrap: pig-iron ratio) for making diesel engine pistons.[6] The high graphite contents in the low-quality grey iron make it suitable only for producing poor quality piston. Such a piston has two major defects: (1) it may seize up as a result of overheating; and (2) it is less durable. To compensate for the poor quality raw materials, the small-scale diesel engine manufacturing firms have devised some rule-of-thumb methods. For instance, it is common for the small-scale firms to add on manganese (1.0%), carbon (1.5%) and silicon (3.0%) to the scrap for improving the quality of casting to an acceptable level. This is done without proper control of the other variables of the casting process i.e. temperature and the quality and quantity of coke. It may be noted here that the lump size of the coke and the porosity of the coke influence the metal to coke ratio and the burning rate, and the heat in the furnace. [Datsko, 1966].

Without much regard to the other variables, the small-scale ARE firms rely exclusively on scrap: pig iron ratio as a means of achieving the desired metal quality as well as price competitiveness. For example, 34 out of 43 small-scale irrigation sector firms in our sample reported use of inferior quality raw materials in the past for cost considerations; the other 9 firms attributed this decision to non-availability of high-quality raw materials. So, in fact, all the small-scale firms reported use of inferior quality raw materials for one reason or another. What is particularly notable in this case is that the small-scale diesel engine firms are under considerable pressure to keep their prices low, even at the cost of product quality.

Another notable feature of the small-scale S.S.D.E. manufacturing is that the engines are produced on one-off basis, and the product is custom-made in so far as the quality of raw materials is concerned. Thus, the buyer has the opportunity to choose the quality of raw materials to be used for his diesel engine.

As a result of this practice, no two S.S.D.E. produced by the small-scale firms are alike and their parts can not always be interchanged. However, this facility widens the choice of raw materials used for producing slow-speed diesel engines in the small-scale sector.

The large-scale firms, on the other hand, always use better quality raw materials for piston making and other parts of the S.S.D.E., while the medium-sized firms produce a piston which, in terms of quality, lies somewhere between those made by large-scale and small-scale firms. Neither large-scale nor medium-sized firms offer 'custom-made' services (in regard to quality of raw materials) and these firms maintain fairly uniform product standards. For example, none of the medium-sized and large-scale diesel engine firms included in our sample reported use of inferior quality raw materials in times of shortages, or willingness to change the raw materials or modify the engine design or parts to suit customer demands. The large-scale and medium-sized firms meet the occasional raw material shortages by raising the prices of the diesel engines rather than lowering the quality of raw materials. We, thus, have a situation where at least three (and probably more) quality brands of pistons for S.S.D.E. can be distinguished. Broadly, the same considerations apply to other components of the slow-speed diesel engine.

Machining

Casting is followed by the machining of diesel engine parts. At this stage a firm can choose from among a number of available machining techniques, embodying different types of technologies.

Before considering the choice at this stage two general observations may be made about the nature of the machining process. First, the machinability[7] of a metal is partly determined by the chemical composition (which determines its tensile strength) of casting obtained at an earlier stage. For example, grey iron may be machinable on an ordinary lathe machine, but nodular iron, because of its high strength, would require a milling machine for the same job /Sylvia, 1972, p. 234/. The advantages of a milling machine over the lathe are that its tool material, tool shape and the cutting process are more effective, and it has provisions for rotating a multiple tooth cutting tool to obtain the desired cutting speed. Thus, machining efficiency of different firms will be different. For example, it is possible to turn a 3.55 inch diameter in cast iron with an ordinary lathe, a centre lathe, a milling machine or a grinding machine, though the efficiency with which these machines will perform this job will vary significantly. It thus needs to be emphasised that even though a machine tool is designed for a specific[8/] set of jobs it is seldom so specialized that it will not perform other jobs. This means that, in general, there exist possibilities of using various machines for doing particular machining jobs.

Two qualifications may be made to these observations on the machining process: (1) the cost of doing a particular job on different machines will be different; and (2) the quality of the finished jobs will also be dissimilar.

Let us, in this light examine the machining of diesel engine. As noted earlier, the cylinder block, and cylinder liner of the S.S.D.E. need to be bored to a good finish to ensure smooth running of the piston inside the cylinder. This requires the use of a cylindrical grinding machine or a boring machine for sharpening the surface edge of the cylinder. The same job may, however, be accomplished on an ordinary lathe machine, which is less sophisticated and also cheaper than the other machines. Substitution of a lathe for the grinding machine in this case would, however, fail to turn out the perfect finish inside the cylinder, which the grinding machine or the boring machine would have ensured.

Although the quality of the S.S.D.E. cylinder bored on a lathe machine will generally be poorer, the operation cost[9] will be less than that on a cylinderical grinder on a boring machine. Thus, despite its disadvantage with respect to product quality, the lathe may still be preferred.

Alternatively, a small-scale firm may have the boring job done by the specialist firms which exist in every major centre of the ARE industry in Pakistan. Thus, on technical grounds, there exists a scope for choosing one of the following alternative methods of cylinder boring, viz., (1) a firm may use a grinder or a boring machine, a (2) it may accomplish this job on a lathe machine, or (3) get it done by the specialist firm on special purpose machines. It follows that each slow-speed diesel engine manufacturing firm has the option to choose a technique appropriate to its capital and organizational resources.

In Table 6.1 we present data showing the degree of dependence of small-scale, medium-sized, and large-scale tubewell firms on the services of enterprises specializing in jobs such as crankshaft forging, cylinder boring, milling, hardening and annealing. We observe that all the small-scale diesel engine firms in our sample depended on the services of specialist enterprises; of the 7 medium-sized firms, 5 used the services of specialist firms while both the large-scale firms were in this regard wholly independent. It is also interesting to note the degree

Table 6.1

Irrigation Sector Firms' Dependence on the Services[1] of Special Enterprises

(Based on a Sample of 62 Irrigation Sector Firms in the Punjab 1981-82)

Major Products of the Firm	No. of Firms[2]	Firm Size	Level of Dependence[3]			
			High	Medium	Low	Nil
(Diesel Engine)	30	Small-Scale	14 (46.6)[4]	11 (36.6)	5 (16.6)	-
	7	Medium-Sized	-	-	5 (71.4)	2 (28.6)
	2	Large-Scale	-	-	-	2 (100.0)
(Water Pump)	13	Small-Scale	3 (23.1)	4 (30.7)	6 (46.2)	-
	9	Medium-Sized	-	-	7 (77.7)	2 (22.3)
	3	Larg-Scale	-	-	-	3 (100.0)

Notes:

(1) These services include casting, forging, hardening, annealing, milling, boring, grinding, etc.
(2) The total number of firms shown in the table is 64 rather than 62 (the sample size) because 2 large-scale firms produce both D.E. and W.P. on large-scale and are included in both the groups.
(3) Levels of dependence are defined thus: 'high" means more than 50 per cent of the entire job, including casting, is done outside the producing firm 'medium' means 25-50 per cent; 'low' means up to 25 per cent; and 'nil' completely integrated production.
(4) Figures in parenthesis are percentages of the group of firms.

of dependence of small-scale and medium-sized firms on specialist units. All the five medium-sized units show a low level of dependence while there is considerable variation within the group of small-scale firms. For instance, 5 of them reported low level of dependence, that it had only up to 25 per cent of the entire job done by the specialist firms, relying for the remaining 75 per cent of the task on their own general purpose equipment. In this manner, they were able to achieve cost reductions but only at the expense of poor quality of the product. This also applies to 11 of the small-scale units with 'medium' level of dependence on specialist firms though of course to a smaller extent. One significant aspect of this evidence is that there were important differences within the small-scale sector, some firms using the services of specialist enterprises, produced a relatively better quality (but also higher cost) product than others who relied, to a much greater extent, on their own general purpose equipment.

6.2.2 Centrifugal Water Pump

A centrifugal water pump (CWP) is a machine consisting of a set of rotating vanes (which constitute an impeller) enclosed within a casing. The vanes impart energy to a fluid through centrifugal force. A C.W.P. has over 100 parts of various sizes, but the principal components are (1) impeller, (2) casing, (3) shaft, and (4) bearings.

There are different ways of classifying C.W.P., but the two broad categories cover all types of water pump: (1) single-stage C.W.P. in which only one impeller is used; and (2) multi-stage C.W.P. which uses two or more impellers. A C.W.P. could be a horizontal or a vertical unit, depending upon the axis of the rotating shaft. The vertical multi-stage water pump is commonly called turbine pump or deep-well pump, which is a technically superior product, often produced by large-scale firms. The single-stage C.W.P. is a relatively simple machine, requires simple technology for production and can be produced by small-scale and medium-sized firms.

The technology required for the manufacture of the centrifugal water pump is quite similar to that of an S.S.D.E. However, the C.W.P. manufacturing involves less sophisticated technique as the number of machining jobs is substantially smaller than that in the case of the S.S.D.E. As in S.S.D.E. manufacturing, there exists in the production of the C.W.P. considerable scope for vertical specialization: separability of production processes permits firms to have certain jobs (e.g. castings, polishing, etc.) done by the specialist firms.

6.2.2.1 Choice of Technique

There is considerable choice in the production of the C.W.P. To consider this choice we will take the case of one type of C.W.P. - the single-impeller horizontal pump. This type is commonly used in private agriculture in Pakistan. The following technical stages in the production of the C.W.P. are conveniently identified:

(1) Casting

(2) Machining of certain parts e.g. shafts, bearing body, etc.

(3) assembly of parts

(4) finishing and testing

We will examine the choice of technique in C.W.P. manufacturing by focussing our attention on the casting stage.

A single-impeller centrifugal water pump can be fabricated in almost all known common metals and alloys. The choice of material is determined by the service conditions and the nature of the liquid to be pumped. The usual casting material is cast iron. But various pump parts require cast iron of different tensile strength; otherwise they will fail to withstand the pressure of work. Hence cast-iron alloys are essential to obtain greater strength for selected parts. For example, as cast-iron loses tensile strength and becomes brittle at low temperatures, pumps handling saline water usually have casings of alloyed cast-iron or cast-steel.

Although materials are often chosen on the basis of their corrosion and abrasion resistance properties, the structural features of a pump may also play a part in the selection of materials. Some parts e.g. hub of the impeller, require extremely thin wall sections for which cast-iron would be unsuitable despite its corrosion resistance. Other parts like shaft sleeves require a high degree of polish, and only materials capable of receiving such a finish should be used in a standard water pump.

According to the Hydraulic Institute, U.S.A. definition, a 'standard' C.W.P. has cast iron casing, steel shaft, bronze impeller, bronze weaving rings and bronze shaft sleeves. /Karassik and Carter, 1960, p. 166/.

However, the materials actually used for pump casting are often not the best. For example, the small-scale pump producing firms of the Punjab make large use of low-quality cast-iron to fabricate the C.W.P. parts which should be made with superior materials or alloys. It is common for these firms to cast shaft and its sleeves in cast-iron. This choice is influenced by the need to keep the price low but this also results in a low-quality product. The large-scale firms use materials, and parts that are of better quality than those used by the small-scale firms. The medium-sized firms make use of materials which are better than those of the small-scale firms, but inferior to what is used by large-scale firms. Similarly, there is ample scope for choosing alternative methods at the subsequent stages of machining, assembly, finishing and testing, and each firm selects a technique appropriate to its resources and the product requirements.

What is still more important is the scope for vertical specialization in C.W.P. manufacturing. Separability of processes permits firms to have certain parts made by the specialist firms, while doing the rest themselves. However, since the jobs at stages (2), (3) and (4) of

C.W.P. production are relatively simple, the overall dependence of the pump manufacturing firms on the specialist firms is less than in the case of diesel engine firms. For example, 3 out of 13 (23.1%) small-scale water pumps firms in our sample were highly dependent on other firms as compared to 14 out of 30 (46.6%) small-scale diesel engine firms. /Table 6.1/. Moreover, 6 out of the 13 (46.2%) water pump firms had low dependence on the specialist firms in comparison with 5 out of 30 (16.6%) diesel engine firms. The rest of the small-scale pump firms, 4 out of 13 (30.7%) had medium level dependence on the services of other firms, while 11 out of 30 (36.6%) of the small-scale diesel engine firms had similar level of dependence, on the specialist firms. Over all, the small-scale water pump firms reported less dependence on other firms compared to the diesel engine firms. However, there was no marked difference between the dependence levels of the medium-sized or the large-scale firms in both the sectors. Thus, a small-scale or any other type of firm can produce a complete tubewell set or a part and procure the other components from other firms. Similarly, a wide range of choice exists for manufacturing auxiliary parts of tubewells such as strainers, pipes and tools.

From the preceding account of choice of technique in tubewell production we have a certain degree of divisibility in production processes. This divisibility has two aspects. The first relates to the technical separability of different stages of production, and the second is implicit in the 'general purpose' nature of machines and equipment. The existence of the first aspect means that a firm has a significant choice on the extent of its vertical integration - provided a certain degree of 'division of labour' in this industry sector has been established. That is, the firm in question has access to sources of components and services that it does not wish to produce or perform itself. The second aspect adds a further degree of flexibility to the production system since, in general, in engineering activities certain types of equipment can be used as if it were multi-functional. This aspect of technical choice has a bearing on product quality. The other two influences on product quality noted in this chapter are the quality of materials, and management and labour skills. In the discussion that follows (Chapter Seven) we will see that these factors had an important bearing on the emergence of different types of firms in the irrigation sector of the ARE industry.

FOOTNOTES

CHAPTER SIX

1/ The compression pressure in H.S.D.E. is about 500 lbs per square inch compared to 400 lbs per square inch in the case of S.S.D.E.

2/ A number of writers have drawn attention to the significance of the link between product quality and characteristics on the one hand and technique on the other. This relationship has clearly been established in a number of volumes in the David Livingstone Institute Series on Choice of Technique in Developing Countries, Scottish Academic Press. See, for instance, Eric Rahim, 'Editorial Introduction' in S.J. Uhlig and B.A. Bhat, Choice of Technique in Maize Milling (1979), PXVII, 'Editorial Introduction' in J. Keddie and W. Cleghorn, Brick Manufacturing in Developing Countries, (1980), pp. XVI-XVII. See also Amsden (1977), Stewart (1977), and Khan and Rahim (1985).

3/ Founded in 1857, Ruston, Procter and Co. traded in Britain and abroad, especially in Eastern Europe. Its products included oil engines, steam engines, threshing machines, centrifugal pumps and many others. During 1857-1870, the company expanded its business very rapidly, increasing its workforce from 25 to 700. /Wright, 1982, p. 143/. This company was among the early exporters of oil engines to the Indian sub-continent in the first quarter of the twentieth century.

4/ This method of examining the characteristics of different techniques is based on that used in the David Livingstone Institute Series on the Choice of Technique in Developing Countries. For the formal scheme describing this methodology, see Rahim, 'Editorial Introduction' in J. Keddie and W. Cleghorn, Brewing in Developing Countries (1979), pp. XX-XXW.

5/ The high compression pressure inside the piston raises the temperature to about 1,000 degree F. /Jones and Schubert, 1963, p. 363/.

6/ In 1981-82, the market price of pig iron was Rs 3,100 per ton, and that of scrap Rs. 2,000 per ton.

7/ Machinability may be defined as the characteristics that indicates the cutting speed at which the material can be machined.

8/ There also exist a few multipurpose machines like Universal Milling, Universal Grinder, and the Centre lathe.

9/ The total cost of any machining operation is comprised of four individual item; loading and unloading; actual cutting; tool changing; and the tool cost /Datsko, 1966, p. 433/.

CHAPTER SEVEN

BURGEONING OF THE IRRIGATION SECTOR OF THE AGRICULTURE-RELATED ENGINEERING INDUSTRY: 1960-1973

In this chapter we attempt to explain the phenomenon of the 'burgeoning' of the irrigation sector small-scale firms during the 1960s. This explanation is divided into two parts. First, we deal with the question of entry and establishment of a substantial number of small-scale firms amidst the already established small number of large-scale and medium-sized firms. Later, we give an explanation of the survival of the small-scale firms over the period 1960-73 by the side of large-scale firms.

As already discussed in Chapter 4, the decade of 1960s witnessed rapid expansion of the ARE industry; towards the end of the decade there were at least 533 firms in the Punjab, employing 6,033 workers. Most of the expansion in the industry took place in the irrigation sector which was estimated to have 444 firms in 1969, a large majority being small-scale. /Child and Kaneda 1974-75, p. 264/. The emergence of a new and fairly large small-scale sector, without direct government assistance, is not an everyday occurence in less developed countries. To explain what made this development possible we discuss two aspects of this problem separately:

(1) the manner in which the small-scale firms, despite their limitations, overcame barriers to entry into an industry producing fairly advanced products (for Pakistan

at the time) like diesel engine and centrifugal water pump; and (2) how the small-scale irrigation firms managed to co-exist with the large-scale and the medium-sized firms.

7.1 Entry of the Samll-Scale Firms

All the evidence shows that, with very few exceptions, the entry of the new irrigation sector firms in the 1960s took place at the small-scale end of the industry, and that the bulk of the expansion in this sector was accounted for by the continued new entry over this period, and by the expansion of the newly entered units. This phenomenon of the small-scale units entering an industry producing technically advanced products when a few large-scale and medium-sized firms were already established in this industry calls for an explanation.

7.1.1 Theoretical Background[1/]

It is appropriate to start our discussion of the entry of new, small enterprises into the tubewell industry, which to start with was dominated by a very small number of large firms, by briefly stating the now widely accepted theoretical position on the entry question. Although these theories deal essentially with the question of new entry by large firms into oligopolistic industries in advanced industrialised situations they serve a useful starting point for our examination of the Punjab situation in the 1960s. In the traditional oligopoly theory the existing firms were assumed (unlike the competitive or monopolistic competitive firms) to take into account, in determining their pricing behaviour, the possible reactions of their rivals already in the industry. The "Fundamental innovation" /to quote Bhagwati' 1970 p. 298/ in oligopoly theory "came with the realization that the oligopoly theory must deal with 'potential' competition..." (italics added). In other words, theory must incoporate the reactions to industry profits in the form of new entry. The first contributions on this point came from Kaldor (1935) and Andrews (1949) /See Bhagwati, op. cit. p. 299/. However, it was the work of J.S. Bain (1956) and p. Sylos-Labini (1962) and the formalisation of their models by Modigliani (1958) that achieved the first real breakthrough in this theory. These authors were mainly concerned with questions of equilibrium price determination and the existence of above-normal (or oligopolistic) long-run profits in situations of 'free' entry (absence of institutional barriers). The answers given hinged on the nature of barriers to entry. One of the major barriers lay in the nature of technology (This, incidentally, provides an important reason for our interest in these theories.)

Let us take Bain's 'model' (as formalised by Modigliani) first. One of the most critical assumptions in this model refers to the nature of technology, and the relation of optimum output associated with it to market size. More specifically, Bain, assumes very sharp economies of scale as defined by these two assumptions. That is, the output from an optimal sized plant is a very significant proportion of market size. It is further assumed that potential entrants will act on the supposition that existing firms, when faced with new entry, will maintain their output levels and thus let price fall to the new equilibrium level corresponding to pre-entry industry output plus the output from the new plant(s) operating at the optimum or minimum efficient scale. On these assumptions, the price - given that all firms produce a homogeneous product - relevant to the potential entrants decision is not that which prevails before entry but that which obtains after his entry. In this situation the existing firms (presumably acting in collusion) can prevent entry by finding a price-output combination such that the post-entry price is below the long-run average cost (including oligopolistic profits) of the potential entrant. The existing firms thus enjoy long-run oligopolistic profits in a situation when a homogeneous product is produced and entry is free. Entry is prevented by the use of price policy. This brief statement of Bain's theory does very little justice to its richness; however, it seems adequate for our present purpose. The central point relates to the nature of technology as barrier to entry and source of long-run oligopolistic profits.

In such a situation there is very little scope for the small-scale firm to enter the industry. Such a firm is confronted with two problems: its inability to find a technique that is appropriate to even modestly efficient, small-scale production, and the difficulty in having access to resources for entry at or near the optimal scale - a difficulty that is imposed by the very fact of being small.

In its general approach, the 'model' of Sylos-Labini is similar to that of Bain. However, there are some important differences between the two and it is to these that we direct our attention. The most important difference lies in the assumption made by Sylos-Labini with respect to a technology. In this model there are techniques which relatively to those in Bain's, are more appropriate for medium-sized and small-scale production. In other words, economies of scale are much less marked than is the case in Bain. Thus, medium and small sized firms may coexist with large firm(s) though the large have a distinct cost advantage over the former types of firm. The long-run industry equilibrium will be characterised by the coexistence of different types of firms; with a hierarchy of firms associated with a hierarchy of profits. There are two important implications of this model. First, the small (and the medium sized though perhaps to a lesser extent) exist at the mercy of the large who are always in a position (by temporarily lowering the price below the long-run cost of the small) to squeeze the small (and the medium size, though to a lesser extent) out of the industry.

Second, the small and the medium sized firms must always occupy a peripheral position in the industry. More significantly the market space occupied by them should not be greater than the optimal output from a single plant in use in the large-scale sector. If that space was greater than that, the industry equilibrium will be unstable because this would provide an incentive to an existing large firm or a potential new entrant to occupy this space. Thus, the only stable situation is one with the small and the medium-sized enterprises occupying what Dobb /1966, p. 348/ and Penrose /1959, p. 222-3/ both have described as 'interstices' of the industry.

It is worth noting that in both the Bain and Sylos-Labini models which capture the equilibrium situation it is necessary to assume product homogeneity. This is the case because price determination is being discussed with respect to the industry demand curve, a concept which is meaningful only in the case of a homogeneous product. However, outside the framework of their formal models they relax this assumption. In that case product differentiation provides an additional barrier to the entry of new firms. But with this relaxation it is difficult to establish a determinate equilibrium price.

The conclusion to be drawn from this discussion is that in both these models technology is seen to be one of the major barriers to entry into an oligopolistic industry. In the case of Bain this barrier is insuperable for small firms; in Sylos-Labini the technical rigidity though less extreme is sufficiently strong to prevent small and medium-sized firms from occupying more than the fringes of the industry.

Unlike Bain, Sylos-Labini carries his discussion of oligopoly at the individual industry to the macro-economic level and draws certain important implications for employment and economic growth in the context of industrialized countries. It is not intended here to state Sylos-Labini's position on these issues. However, one or two considerations raised by Sylos-Labini are of interest to our present discussion as we will see below. Here again it is necessary to say that the present brief account of Sylos-Labini's argument, contained in the second part of his book, does not do justice to its complexity.) A principal proposition suggested by Sylos-Labini is that with technical progress, the optimal scale of production, in manufacturing industry in general, and in some major activities in particular, is increased. There is thus a strong tendency in the present-day capitalist countries for monopoly - oligopolistic industry structures to emerge. The forces of competition, which in the classical system provided a mechanism of expanding employment and growth is gradually superseded by those of monopoly. A corollary of this is that price-flexibility that characterised the entire economic system in the classical model is superseded by price-rigidity in the monopolistic-oligopolistic sectors of the present day economies. We thus see the emergence of high-technology "privileged" firms and industries characterised both by price and wage rigidities. By contrast, there are non-privileged sectors (e.g. agriculture) characterised by low profitability and price and wage flexibility. From these micro-economic considerations Sylos-Labini constructs a macro-economic theory that predicts stagnation in industrialized countries.

These propositions of Sylos-Labini have been used and modified to extend their relevance to the present-day less-developed countries. Meir Merhav (1969), following Sylos-Labini, discusses the problem of market forces, which relates to individual firms and industries, to arrive at results which pertain to the growth prospects of the economy. The central proposition of Merhav is, to use his own words, as follows:

> development (of today's less developed countries) consists chiefly of the transplantation of an advanced technology into a backward economy which is unable to produce it endogeneously, as the outcome of its own evolutionary processes. The adoption of these alien techniques can only take place through the importation of the equipment that incorporates them. But this machinery has historically become adapted to the factor proportions and the scales of output appropriate to the size of the markets and the degree of specialisation in its countries of origin. When it is introduced into the underdeveloped countries, which by definition have a low initial level of aggregate demand, the disparity between the *scales of output* to which it is geared and the extent of the markets, produces, at an early stage of growth, an industrial structure in which *technically inevitable* monopolies are dominant, [p. 6; italics added].

The conclusion is that in the less developed countries, the problem of stagnation, directly associated with monopolistic structures - a congenital feature of modern technology - assumes immediate relevance on the theoretical and policy level at the very outset of the development process.

7.1.2 Demand Side Factors

We consider two aspects of demand for the irrigation sector products, viz., the size and the type of the market. The 'size' refers to the extent of demand for the irrigation products in this period, and the 'type' to the demand preferences of the different types of buyers.

(1) Size of the Market

As already discussed in detail in Chapter 2, demand from a variety of sources created a market for water pumps, diesel engines, electric motors and their parts. The decade of the 1960s witnessed a very rapid increase in demand for these products in Pakistan.

The most important source of the increased demand was private agriculture. For instance, the number of private tubewells installed per annum increased in the following manner: 1954/55 - 59/60 (1975); 1960/61 - 64/65 (8,000); 1965/66 - 69/70 (12,050); and 1970/71 - 74/75 (14,700). [see Table 2.10, Chapter 2].

A significant, though small, proportion of the industry's output (especially diesel engines) was purchased by private agro-based industries which used diesel engines as power generators. No statistical evidence on the purchase of diesel engines by private agro-based industries is available, but their rapid expansion in rural areas (often without electricity supply) makes it reasonable to assume that a significant portion of the product of the irrigation sector firms went to this sector. In addition to the established users of diesel engines like wheat milling, oil expelling, ginning and other small firms, one very important new user to adopt diesel engines in the 1960s was the small-scale loom unit[2/] It is interesting to note that the growing power loom sector of the textile industry was also concentrated in and around Faisalabad (an important ARE industry centre) and its growth coincided with the expansion in the irrigation sector of the ARE industry in Pakistan. By 1965, 5,000 and 32,000 power looms were installed in East and West Pakistan, respectively. In order to meet the growing domestic demand for coarse cloth, government planned additional 20,000 and 35,000 power looms for East and West Pakistan during 1965-70 [Government of Pakistan, 1965, p. 543]. Large scale expansion of power loom sector in the Punjab, thus, further increased the size of the market for diesel engines.

Public sector tubewells installation was also considerably higher in the 1960s as compared to the 1950s. The annual average of tubewells (including turbine pumps) installed in West Pakistan increased from 398 in 1954/55-59/60, to 2,141 in 1960/61 - 1964/65, and to 3,703 in 1965/66 - 69/70. In addition, the government planned installation of 19,080 water pumping sets and sunk 665 tubewells in East Pakistan between 1960-70 [see Tables 2.6 and 2.7, Chapter 2].

There also existed limited export market for S.S.D.E. in the 1960s though its actual size can not be determined because of non-availability of statistical information. This market was dominated by a few medium-sized 'diesel engine manufacturing firms which exported S.S.D.E. to Iraq, Iran and Saudi Arabia. The absence of the large-scale firms from the export markets was however surprising and could be explained in terms of their preoccupation with more lucrative domestic markets.[3]

Thus, following increased demand from a variety of sources (i.e. private agriculture, private industry, public sector irrigation, and drainage, urban water supply, and others) the overall size of the market for irrigation-sector products increased very considerably during the 1960s.

(2) <u>The Type of the Market</u>

The other important demand side factor was the type of the market i.e. the demand preferences of various types of buyers. In this respect, we identify two important points.

(1) The market for tubewells was made up of different segments. The upper end of this market consisted of demand for technically advanced products. (e.g. deepwell pumps plus high-powered electric motors) and special types of pumps used for industrial purposes. The data included in Table 7.10 show the marked differences in the

technical characteristics of water pumps and other products used in different segments of the market. For example, the deepwell pump (with 4-6 cusec capacity) used in the public sector is a far more technically sophisticated product compared to an ordinary centrifugal water pump (with 1-2 cusec capacity) used in private agriculture. Though the deepwell pump and the C.W.P. are both water pumps, the cross elasticity of demand between the two is negligible. Because of their diverse characteristics (output capacity, etc.) the two products may well be considered as different products.

As noted in Chapter 6, different technologies are often associated with differences in product characteristics, and in particular, the production of a deepwell turbine pump calls for a particular type of technology which in the conditions of Pakistan was possessed by the large-scale firms only.

(2) Another major segment of the market was constituted of tubewells (an ordinary C.W.P. plus diesel engine/small electric motor) for private agriculture. The tubewells installed by private farmers had certain distinctive technical features which separated them from the tubewells sunk in the public sector. The most common private tubewell consisted of a single-stage centrifugal pump (with an average capacity of 1-2 cusec) and, horizontal, single-cylinder S.S.D.E. of 15-25 HP (In 30-40 per cent cases the tubewells were run with electric motors.)

This part of the tubewell market was further fragmented mainly, though not entirely, on the basis of product quality. A significant quality/price difference existed in the private agriculture tubewell market. At one end of this market existed high-quality/high-price water pump and diesel engine which were patronised by the rich farmers. This segment was served by the large-scale or the expanding medium-sized firms. The other part of the private tubewell market was left to the small-scale and medium-sized firms which produced relatively cheaper, lower quality products. The differences in products attributes can best be appreciated with respect to product specifications i.e. actual horsepower, pump capacity durability and availability of spare parts. For example, speaking about the diesel engine produced by the small-scale firms in the Punjab, Child and Kaneda remarked; "the engine is neither a thing of beauty nor an engineering masterpiece, yet it functions well and is, economically, a triumph" (p. 257).

A substantial part of the market was undiscriminating with respect to produce quality. What many farmers, particularly the poor and less informed, wanted was the cheapest possible tubewells. The low-quality/low priced tubewells were appropriate to the needs of the low-income farmers: they were as compared with the high-quality/high priced products, significantly cheaper to install and yet yielded a high return on investment [See Chapter 2].

Thus, we conclude by observing that (1) the size of the irrigation products market increased rapidly during the 1960s, and (2) this market was segmented into different sectors on the basis of product characteristics and demand preferences of the buyers.

7.1.3 Supply Side Factors

(1) Technology

We recall from the detailed discussion on the product-technology link in Chapter 6 that there exist: (1) possibilities of choosing alternative techniques at different stages of tubewell production; (2) a definite link between technology and product characteristics, and (3) opportunities available to firms to differentiate their products by using not only different types of equipment but also treating the quality of materials as a variable.

The point which needs to be reiterated here is that the production processes involved in diesel engine and water pump manufacturing are divisible to a certain degree. This divisibility has two aspects: of technical separability, at different stages of production and the 'general' purpose nature of machines and equipment which adds further flexibility to the production process.

Thus technical flexibility gives small-scale firms significant scope for entering the industry. When the product quality is treated as a variable the scope for entry is further increased provided that the structure of market demand is favourable. Entry of small firms into the industry would, however, require that the vertical division of labour that is technically possible is also feasible in the existing situation. That is, the components and the technical services that cannot be internally produced and provided are available through the market; and that there is a market demand for the components, etc., that the firm in question produces. From this it would appear that the assumption of a unique relation between technology and scale of production in the case of S.S.D.E. and water pump would neglect the possibilities that may be present for vertical specialization within that industry. Because of the separability of production processes, firms could choose between different jobs suited to their overall resources. The barriers to entry, in this way, are lowered for the small-scale firms and technological flexibility is seen to lead to structural flexibility.

(2) Physical Inputs

(a) Equipment

In Chapter 6 we observed that the choice of technique made by the tubewells manufacturing firms is influenced by the characteristics of the products they produce and their resources. Thus various firms possess different types of equipment and machinery to suit their requirements. We now examine, on the basis of our sample, the type of equipment/machinery used by the irrigation sector firms of the Punjabs' ARE industry.

The first thing to note in this regard is the general availability of machinery required for tubewell production. The ARE firms of the Punjab have never faced dearth of essential machines used in S.S.D.E. and C.W.P. production. Those machines are produced domestically as well as imported. So the establishment of irrigation-sector firms was never made difficult by lack of important physical inputs.

However, the machinery used by different types of tubewell firms was different. While small-scale firms put greater reliance on general purpose, simple machines like lathes, shapers, etc., large-scale firms, in addition to these, also used special purpose, sophisticated equipment, such as milling machines, honing machines, etc. The data presented in Tables 7.1, 7.2, 7.3 and 7.4 show the composition of machinery used by the small-scale, medium-sized and large-scale diesel engine and water pump producing firms,separately. It is evident from this data that the small-scale firms, producing diesel engines as well as water pumps, were equipped with simple and general purpose machines like ordinary lathes, drilling machines, and simple grinding machines; and that sophisticated machines like milling machines, cylindrical grinders, honing machines and boring machines, etc., are rarely possessed by these firms. But the composition of machinery changes from the simple to sophisticated machines as the size of firms increases. The medium-sized firms, thus, had more sophisticated machines than the small-scale firms, and, the large-scale firms were far better equipped with modern and special purpose machines compared to the medium-sized firms. The nature of machines used by different types of firms was consistent with their production requirements and resources.

The other notable feature of the machinery which emerges from our sample of firms is that the small-scale firms use relatively old machines compared to the

Table 7.1

Composition of Machinery[1] in the Small-Scale Diesel Engine Manufacturing Firms in the Punjab,

(Sample Based: 1981-82)

Type of Machinery[2] \ Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ordinary Lathe Machine	2	4	4	3	3	3	4	2	4	2	4	5	3	5	2	4	4	3	4	3	3	4	2	3	3	4	4	2	3	4
Modern Lathe Machine	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Milling Machine	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Planning Machine	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	1	-	1	-	1	1	1	-	-	1
Shaping Machine	-	1	-	1	1	1	-	-	1	2	1	2	1	2	1	1	1	1	1	2	1	1	2	1	-	-	1	-	1	1
Bench grinder	-	-	1	1	-	1	-	1	-	-	-	1	1	1	2	1	1	1	1	1	1	2	1	-	-	1	1	1	-	2
Pillar Drilling Machine	1	1	2	2	1	1	1	2	2	1	-	3	1	2	1	2	1	1	2	1	1	2	1	-	-	2	1	1	-	1
Boring Machine	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Cylindrical Grinding Machine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hacksaw	-	-	1	-	-	-	-	1	-	-	-	1	1	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-	-
Cupola Furnace	-	-	-	-	-	-	-	2	-	-	1	1	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Crucible Casting	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Other Special Machines	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

(1) Machines are not exclusively used for diesel engine manufacturing.
(2) Reliable information on tools could not be obtained.

Table 7.2

Composition of Machinery[1] in the Medium-Sized and Large-Scale Diesel Engine Manufacturing Firms in the Punjab, (Sample Based: 1981-82)

Units / Type of Machinery[2]	Medium-Sized							Large-Scale	
	1	2	3	4	5	6	7	1	2
Ordinary Lathe	3	6	5	7	8	5	9	25	35
Special Lathe	6	-	4	1	3	2	4	12	15
Milling Machine	1	-	1	-	-	-	1	3	5
Planing Machine	1	-	1	-	1	-	1	4	7
Shaping Machine	2	2	3	1	1	2	2	6	10
Grinding Machine	2	1	2	2	3	1	3	10	7
Pillar Drilling Machine	3	2	3	1	2	3	2	8	6
Boring Machine	3	1	2	1	1	-	1	6	10
Cylindrical Grinding Machine	2	-	1	1	-	1	-	4	7
Hacksaw	1	-	1	-	1	-	-	8	5
Cupola Furnace	3	-	2	3	2	1	2	15	10
Other Furnace	-	-	-	-	-	-	-	10	7
Radial Drilling Machine	1	-	1	-	-	-	1	4	5
Other Special Machines	10	-	2	1	3	4	5	20	50

Notes:

(1) This machinery is not exclusively used for diesel engine manufacturing.
(2) Reliable information on the tools could not to be obtained.

Table 7.3

Composition of Machinery[1] in the Small-Scale Pump Manufacturing Firms in the Punjab, (Sample Based: 1981-82)

Units / Type of Machinery[2]	1	2	3	4	5	6	7	8	9	10	11	12	13
Lathe Machine	2	2	4	3	4	5	3	2	3	3	4	3	2
Special Lathe Machine	-	1	-	-	-	-	-	-	-	-	-	-	-
Drilling Machine	1	1	1	1	2	2	1	2	2	1	2	1	2
Shaping Machine	1	1	2	1	1	2	1	1	3	1	2	1	1
Ordinary Grinding Machine	1	-	-	2	3	2	1	1	2	1	1	2	1
Milling Machine	-	-	-	-	-	-	-	-	1	-	-	-	-
Electric welding Plant	-	-	-	1	2	1	1	-	1	-	-	-	1
Special Grinding Machine	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Special Machines	-	-	-	-	-	-	-	-	-	-	-	-	-
Cupola Furnace	-	-	-	-	1	-	-	-	1	-	-	-	-
Other Furnaces	-	-	-	1	-	1	-	-	2	-	1	-	-

Notes:

(1) This machinery is not exclusively used for water pump manufacturing.
(2) Reliable information on the tools could not be obtained.

Table 7.4

Composition of Machinery[1/] in the Medium-Sized and Large-Scale Pump Manufacturing Firms in the Punjab (Sample Based: 1981-82)

Units / Type of Machinery[2/]	Medium-Sized									Large-Scale		
	1	2	3	4	5	6	7	8	9	1	2	3
Ordinary Lathe	3	4	3	4	4	5	6	8	4	25	35	30
Special Lathe Machine	3	2	1	-	2	1	1	2	1	12	15	8
Milling Machine	-	-	-	-	-	1	-	1	-	3	5	9
Shaping Machine	2	1	2	1	2	1	3	2	1	6	10	5
Pillar Drilling Machine	2	3	1	3	1	2	2	3	1	8	6	5
Grinding Machine	1	2	1	2	2	2	1	1	1	10	7	10
Electric Welding Plant	2	3	1	2	1	1	3	2	1	6	10	8
Radial Drilling Machine	-	-	-	1	-	-	1	1	-	7	5	4
Other Special Machines	4	2	1	2	1	3	3	2	1	20	50	35
Cupola Furnaces	-	-	-	1	2	2	2	3	2	15	10	-
Other Furnaces	-	-	-	-	-	-	-	2	-	10	7	4

Notes: 1/ This machinery is not exclusively used for water pump manufacturing.
2/ Reliable information on the tools could not be obtained.

other types of firms. For example, among 43 small-scale firms included in our survey, 20 used more than 20 years old machines, 19 used 10-20 years old, and 4 used 5-10 years old equipment /Table 7.5/. By comparison, 2 out of 16 medium-sized firms in the sample had more than 20 years old machines, 7 used 10-20 years old, 5 used 5-10 years old, and only 2 used less than 5 years old machines and equipment. The large-scale firms generally made use of the latest machines: 2 out of 3 firms used 5-10 years old machines and one reported use of less than 5 years old machinery. Whereas the large-scale ARE firms in the Punjab had the means to replace old with new machinery, the medium-sized and, in particular, small-scale firms relied more on old machines by overhauling and reconditioning them. The relative costs of new machines for the small-scale firms were more than the expected advantages.

Thirdly, firms had the option to buy either domestic or foreign machinery, which could be new or second-hand/ re-conditioned. So firms with limited resources could economize by purchasing second-hand domestic machines. Alternatively, they could buy second-hand foreign machines or, a new domestic or foreign machine of the same type, depending upon their resources. The data set out in Table 7.5 show that majority of small-scale firms in our sample used domestically produced machinery and only 2 such firms reported use of foreign made machines of old vintage. The medium-sized firms too relied more on domestically produced machines, though a greater proportion of these firms also used foreign made machinery, both new and second-hand. All the three large-scale firms reported

Table 7.5

Average Age and Origin of the Machinery Used by the Irrigation-Sector Firms, Punjab, Pakistan (Sample Based = 1981-82)

Age of Machinery				Origin of Machinery		
Average Age (Years)	Number of Units		%[1]	Origin[2]	Number of Firms	
Up to 5 years	Small	-	-	Domestic	Small	43
	Medium	2	12.5		Medium	15
	Large	1	33.3		Large	2
5 to 10 years	Small	4	9.3		Small	7
	Medium	5	31.3	Foreign	Medium	8
	Large	2	66.7		Large	3
10 to 20 years	Small	19	44.2		Small	5
	Medium	7	43.7	Self-made[3]	Medium	2
	Large	-	-		Large	2
More than 20 years	Small	20	46.5			
	Medium	2	12.5			
	Large	-	-			

Notes:
1. Percentages refer to a particular group of firms i.e. small, medium and large.
2. A firm may have machinery of more than one origin.
3. Self-made means fabricated by the same firm for its' use.

use of foreign machines, while two of them also relied on domestically produced machines. The general picture that emerges from this data is that the small-scale firms relied more heavily on the domestically produced, cheaper machines than the medium-sized and large-scale firms.

Finally, some firms, including small-scale, had also fabricated certain machines for their own use. [Table 7.5]. The existing fund of engineering knowledge, available skills and years of 'tinkering' helped these firms to produce a part of their machinery needs themselves. The medium-sized, and in particular large-scale multi-product firms, had a distinct advantage in machinery fabrication over the small-scale. Two of the 3 large-scale firms (66.6%), 2 out of 16 (12.5%) medium-sized and 5 out of 43 (11.6%) small-scale firms in our sample reported use of self-made machines, in addition to ready made equipment.

To sum up, the tubewell producing firms of the Punjab had easy access to the most important input of machinery and equipment which was available from domestic and foreign sources. Firms could purchase new or old machines or even fabricate some machines themselves to suit their requirements and resources. Overall, the small-scale firms did not face any difficulty in having access to basic and essential machinery for tubewell production.

(b) Materials

Governments' import policy in the 1960s ensured avoidance of shortage of imported raw materials like mild steel, pig iron, scrap, and components of machinery including that of diesel engines and water pumps. Liberal import of the raw materials under Open General License scheme between 1960-64, and on Free List until 1967, resulted in abundant supply of essential material inputs for industrial production. The value of import of industrial raw materials rose from Rs. 523.1 million is 1959/60 to Rs. 1,451.0 million in 1967/68. /Table 7.6/.

From the point of view of tubewell manufacturing firms, import on a regular basis of pig iron and scrap, engine components and chemicals for foundry work was liberally expanded both for industrial users as well as for commercial sales. The major imported items of raw materials used in tubewell manufacturing include pig iron, mild steel, brass, ball bearings, coke and copper wire. Of these, pig iron constituted the single most important item in terms of its' share in the materials cost of tubewells and was entirely imported until domestic production started in 1980/81. The imported raw materials were purchased by firms through the following channels: Trading Corporation of Pakistan; and local manufacturers e.g. foundries; wholesalers; and local retailers. While the large-scale and medium-sized firms had their raw materials import entitlements, the small-scale firms mostly relied on (the more expensive) commercially imported materials available through local wholesalers and retailers. It is interesting to note that all the 43 small-scale irrigation-sector firms in our sample purchased raw materials from

Table 7.6

Import of Capital Goods and Industrial Raw Materials by Pakistan

(Current Prices)

(Rs Million)

Year	Capital Goods[1] (1)	Industrial[2] Raw Materials (2)	Total Imports (3)	Percentage Share (1+2)/3
1951-52	356.9	234.8	1,962.8	30.1
1952-53	219.5	159.9	936.2	40.4
1953-54	242.9	155.3	735.1	54.1
1954-55	398.7	170.1	926.7	61.3
1955-56	313.2	202.2	989.3	52.0
1956-57	465.7	265.5	1,592.6	45.9
1957-58	582.5	270.9	2,049.9	41.6
1958-59	544.7	270.5	1,578.4	51.6
1959-60	808.7	523.1	2,458.0	54.1
1960-61	1,214.0	1,043.0	3,188.8	70.7
1961-62	1,477.0	954.0	3,109.0	78.1
1962-63	1,920.0	1,133.0	3,819.0	79.9
1963-64	2,084.0	1,390.0	4,430.0	90.9
1964-65	2,689.0	1,497.0	5,374.0	77.8
1965-66	2,235.0	1,225.0	4,208.0	82.2
1966-67	2,346.0	1,661.0	5,192.0	77.1
1967-68	2,210.0	1,451.0	4,655.0	78.6

Notes: (1) Capital goods include machinery of all kinds, iron and steel manufacture and non-ferrous manufacture.

(2) This include all materials used in capital and consumer goods industries.

Source: (1) Twenty Five Years of Pakistan in Statistics: 1977-72, C.S.O., Economic Affairs Division, Government of Pakistan, Karachi, 1972, Table 18.04.

(2) Economy of Pakistan: 1948-68, Ministry of Finance, Government of Pakistan, 1968, Table 36, p. 118.

the wholesalers or the retailers, while all the medium-sized and large-scale firms held entitlements for raw material imports.

One important reason for the small-scale firms to buy raw materials from the commercial importers was their inability to hold stocks because of the shortage of working capital. As already noted in Chapter 3, it is almost impossible for small enterprise to import materials it needs from abroad because the import entitlements are reserved for the large-scale firms. However, the firms can get quotas of raw materials sanctioned through the provincial Directorate of Industries but are constrained by capital shortage.

In the second half of the 1960s, following reduction in foreign aid, the supply of industrial raw materials became erratic. This compelled some producers of tubewells to use inferior quality raw materials. As already noted in Chapter 6, 34 out of 43 small-scale irrigation-sector firms in our sample reported use of inferior quality raw materials in the past for cost considerations, and 9 firms attributed it to non-availability of high-quality raw materials. The medium-sized and large-scale firms faced such a situation only rarely as they held import entitlements for their raw materials requirements on the basis of their production capacity.

The only major shortage of raw materials to affect all firms uniformly was that of fuel injection nozzles during the Indo-Pakistan war of 1971. The positive effect of this shortage showed itself in encouraging some pioneering Pakistani firms to produce nozzle domestically.

Currently, both indigenous and imported nozzles are in use.

(c) Buildings

As for land and building requirements were concerned not a single small-scale unit in our survey entered the industry with a new building or acquisition of land. Almost every unit used a rented building at the time of entry or set up in personally owned premises. The already existing units which expanded their business also did so by either expanding existing facilities, or by fuller utilization of existing premises. In many cases, involving all types of firms, the workshops existed on rented property, either land or building, or both. This resulted in lower financial requirements for entry by the firms, especially the small-scale.

(3) Finance

(a) Financial Requirement

The first point to note about finance is the small capital needed to enter tubewell manufacturing at the small-scale. This was a consequence of technology type, nature of equipment, possibilities of vertical dis-integration, level of output and the organizational structure of the small units. In the case of the already established engineering workshops who entered this market, the transition involved still smaller finance since they already possessed general purpose machines like lathes, shaping machines, drills, etc - the essentials of diesel engine and water pump manufacturing.

Table 7.7 shows the value of the fixed assets (excluding land and building) owned by different types of tubewell firms in the Punjab. We observe that 25 out of 43 (58.2%) small-scale irrigation firms had assets less than Rs. 50,000, while 18 (41.8%) units owned assets worth between Rs. 50-100 thousands. By comparison, value of fixed assets owned by the medium-sized firms was higher than that of the small-scale units: 5 out of 16 (31.3%) medium-sized firms were in the Rs. 50-100 thousand class, 9 units (56.2%) in the Rs. 100-500 thousand class; and 2 units (12.5%) in the over Rs. 1 million class. Compared with these, all the three large-scale firms owned fixed assets of over Rs. 1 million.

An important conclusion drawn from this information is that the financial requirements (for fixed assets excluding land and building) for entry into the tubewell industry at small-scale were quite small. A number of factors like access to second-hand equipment and possibilities of vertical disintegration of production made it possible for small-scale firms to enter this market with ease. Moreover, as already noted none of the small firms entered the industry with a new building. The availability of old premises that could be rented further reduced the financial requirements for entry into the industry.

(b) <u>Sources of Finance</u>

The initial finance required by small-scale firms was mostly drawn from private sources, e.g. family savings and loans from friends and relatives. For example, 28

Table 7.7

Estimated Value of Fixed Assets (Excluding Land and Building) of the Irrigation Sector Firms, Punjab, Pakistan

(Sample Based = 1981-82)

Fixed Assets	Type of Firms	Number of Firms	Percentages[1/]
Less than Rs 50,000	Small-Scale	25	58.2
	Medium-Sized	-	-
	Large-Scale	-	-
Rs 50,000 - Rs 100,000	Small-Scale	18	41.8
	Medium-Sized	5	31.3
	Large-Scale	-	-
Rs100,000 - Rs 500,000	Small-Scale	-	-
	Medium-Sized	9	56.2
	Large-Scale	-	-
Rs500,000 - Rs1,000,000	Small-Scale	-	-
	Medium-Sized	-	-
	Large-Scale	-	-
Over Rs1,000,000	Small-Scale	-	-
	Medium-Sized	2	12.5
	Large-SCale	3	100.0

Note: 1/ Percentages refer to a particular group of firms i.e. small, medium and large.

out of 43 (65%) small-scale firms in our sample used this source of finance. A second important source of finance was savings out of profits from previous business. Thus 15 firms (35%) also utilized savings from previous business such as general engineering workshops, specialist services like pattern making, foundry work, etc. [Table 7.8].

The present medium-sized and large-scale ARE firms of the Punjab also reported use of private finance at the time of entry into the industry: 12 out of 16 (70%) medium sized firms and 2 out of 3 large-scale firms utilized this source. Moreover, 14 out of 16 (87%) medium-sized firms; and all the three large-scale firms included in our sample reported having utilized previous business savings at the time of entry. It may be noted here that all these firms were small at the time of entry into the industry and had limited access to institutional finance in the early period.

Institutional finance was not accessible to small-scale ARE firms at the time of entry. No small-scale firm in our sample reported use of bank credit as part of the initial finance. However, 4 out of 16 (25%) of the present medium-sized firms and all the three large-scale firms availed bank credit for short term needs e.g. raw materials purchase.

Thus, at the time of entry, the new small-scale firms were at a disadvantage compared to those which were already in business: advantage lay in having access to institutional finance plus business savings to reinvest in their business. The new firms, with no business experience, had to solely rely on private sources of finance.

Table 7.8

Sources[1] of Initial Finance for the Irrigation-Sector 'ARE' Firms in the Punjab, Pakistan: (Sample Based = 1981-82)

Firm Type	Private Savings	Previous Business Savings	Bank Credit	Suppliers Credit
Small-Scale (43)[2]	28	15	-	43
Medium-Sized (16)	12	14	4	16
Large-Scale (3)	2	3	3	2

Notes:

1/ Sources of finance may be more than one in each case.

2/ Figures in parenthesis are the number of firms in each group.

An important source of initial finance was the suppliers credit which proved extremely helpful and entry promoting in the case of small-scale ARE firms. All the small-scale and medium-sized firms, and 2 out of 3 large-scale firms in our sample reported use of suppliers credit in the early phase of their entry into the ARE industry. This form of credit is widely used, in all sectors of Pakistan industry. The suppliers' credit is mostly provided in the form of raw materials supply, paid according to mutually agreed schedule. The emergence of Daska as a diesel engine centre and Faisalabad as a centre of cultivation sector firms in the 1960s owed much to the suppliers' credit.

(4) Skilled Manpower

The small-scale firms entering tubewell industry in the 1960s had access to the required skills. Since these firms produced inferior quality S.S.D.E. and C.W.P., their labour requirements, in terms of skills, were accordingly low. They employed informally trained workers who learnt their skills on-the-job. They lacked the understanding for more complex production processes; nor were they trained to work systematically on the basis of drawings. Thus, while machining S.S.D.E. parts they found it difficult to ensure accuracy and to keep tolerances. Yet these skills were sufficient to produce low-quality S.S.D.E. and did not constitute any serious constraint on entry into the industry.

Many small-scale firms were lucky to have skilled family workers. The presence of family workers was doubly beneficial: they worked longer hours; and only shared the profits i.e. were not paid wages. This practice, still common in the small-scale firms, is an important means of cost reduction and higher efficiency, besides reducing dependence on hired labour. For example; 27 out of 43 (63%) small-scale firms in our sample still employed some family workers in 1981-82. Compared to this, only 4 out of 16 (25%) medium-sized firms, and none of the large-scale firms reported use of family workers.

It was also common for firms, especially the small-scale, to employ apprentices. Since the apprentices were paid, on average, 30-50%[4] less than fully trained workers, and were not entitled to other benefits such as paid holidays and sick-leave, etc., it was a form of cheap labour and every firm was keen to employ them, along with skilled workers. Since on-the-job training was the main means of skills learning, there was no shortage of would-be apprentices seeking employment. On the other hand, since it was a form of cheap and semi-skilled labour every master-worker (machinist, fitter, etc.) was willing to employ one or two apprentices. Moreover, larger firms were also required by law to employ apprentices and in this manner provided training to unskilled workers.

It is worth noting that in our sample of small-scale and medium-sized firms all the skilled workers had acquired their skills through on-the-job training. None of these firms employed a skilled worker who had formal training e.g. from a vocational or technical school.

(5) Management

The most important thing to note here is that the management and organization required for entry into the ARE industry at small-scale level was very simple and informal, and has remained so since the time of the emergence in this industry of large number of small firms.

The small-scale firm has a personalised management and there is a complete absence of professional and administrative staff. Management problems are solved intuitively, while production decisions are taken with little or no explicit planning. The management functions are concentrated in the hands of one person, usually owner/manager. His duties are more technical than administrative. In this respect, the difference between medium-sized and small-scale firms was observed to be rather small. The medium-sized firms also had an informal, personalised management structure. By contrast, all the three large enterprises had formal management structure with a clear cut division of labour between different departments managed by professional and trained staff.

The small-scale firms do not keep regular accounts. Either the firms do not keep accounts at all or they maintain irregular and 'bogus' record of business transactions. A common practice is to employ a part-time accountant for preparation of accounts to meet the tax regulations. The medium-sized firms had regularly employed part-time or full-time accounts clerks.

The small-scale firms also try to avoid registration with different government departments such as labour, tax, excise, social security, and others. The purpose is to minimize cost and government supervision which such registration inevitably entails.

Our survey of the ARE industry in 1981-82 showed that all the 43 small-scale firms had informal management structure; 36 kept only irregular accounts; and all were registered with one government department or another, but very few units were registered with all the government departments. /Table 7.9/.

For entry into the industry, this type of management structure did not constitute a serious constraint. In fact, informal management practices, irregular book keeping and non-registration with government departments suited their production practices, cost environment and market conditions.

7.1.4 An Explanation of Entry of Large Number of Small-Scale Firms

Now we propose to give an explanation of large-scale entry of small-scale firms into the tubewells industry on the basis of factors discussed above. This explanation rests on two sets of related factors viz., (1) the nature of technology and (2) the economic feasibility.

Table 7.9

Management Structure of the Irrigation-Sector Firms, Punjab, Pakistan

(Sample Based = 1981-82)

Management Type / Type and No. of Firms		Formal Management			Informal Management		
		Management	Account Keeping[1]	Registration[2] with Government Departments	Management[3]	Account Keeping[4]	Registration with Government Offices
Small-Scale	43	-	7	43	43	36	-
Medium-Sized	16	2	8	16	14	8	-
Large-Scale	3	3	3	3	-	-	-

Notes: (1) The difference between the formal account keeping of small-scale and medium-sized firms and the large-scale firms is that the first two types of firms employ accountant for regular book keeping, while the latter have more professional system of accounting, supervised by chartered accountants.

(2) A manufacturing firm (depending upon its' size and activities) is supposed to register itself with government departments for various purposes e.g. labour, tax, excise, social security, and others. Only a few small-scale units were register with all the departments, they were supposed to under law.

(3) Informal management includes personalised management, absence of professional or administrative staff and peronal sales.

(4) Informal accounts mean 'irregular' record of transactions, often kept by a part-time accounts clerk. In certain cases it may mean no account keeping at all.

(1) The Nature of Technology

Let us first consider the nature of technology used in tubewell production. From the account of choice of technique in tubewell manufacturing presented in Chapter 6, we observe that there exists a certain degree of divisibility of production processes. The divisibility has two aspects. First, there exists possibilities of technical separability of different stages of production, namely, casting, machining, forging, and so on. This means that a firm has significant choice on the degree of its' vertical integration, provided the firm has access to sources of components and services that it does not perform on economic grounds itself. The second aspect of divisibility is related to the choice in the use of equipment and machinery. This adds further flexibility to the production system since, in general, it is possible to use certain types of equipment (e.g. lathes, drills, etc.) as multifunctional.

Thus, from technological viewpoint there were no barriers for the emergence of a large number of firms undertaking complementary activities as independent units. For example, it was possible for a firm to dis-integrate the entire process of S.S.D.E. production thus: obtain castings for the engine body and the parts from the foundry firms; machine some parts of the engine itself; assign more delicate jobs such as cylinder boring and forging to the specialist firms - not necessarily large units - and complete the rest of the jobs itself. This enabled a large number of small enterprises to effect an entry into the production of components and parts (cylinder boring cranksahft forging, etc.) at specialized levels and to supply specialist services to diesel engine producing firms.

There existed a large number of small units engaged in iron casting and other activities which provided specialist services to small-scale tubewell firms. According to the Pünjab Small Industries Corporation Survey, there were 419 iron-casting units employing well over 2,000 workers, and 3,141 light engineering services units employing 10,500 workers in the Punjab in 1975-76 (PSIC, 1977-78, p. 22). These units provided specialist services to small-scale firms producing diesel engines, water pumps, electric motors and the others. The size of the specialist firms was usually not much larger than the tubewell firms but their scale of production was larger than what the tubewell firms could economically sustain in that activity.

So what we observe is a situation where the entire process of tubewell production is vertically divided among different firms, specialising in the manufacturing of different parts and components. The best insight on this problem is provided by Adam Smith by pointing out two aspects of division of labour. First, he discusses the intra-plant division of labour and illustrates it with pin manufacturing, and, second, is the inter-firm or inter-industry division of labour illustrated by the large number of operations needed to produce a labourer's coat.[5/] Smiths' analysis suggests that in cases where processes are technically separable, there will be possibility of vertical division of labour.

Firms may find it convenient to subcontract their work to specialist firms. In other words, such a possibility of inter-firm division of labour would permit a degree of choice with respect to capital and organizational requirements. To put it differently, the entry by firms would not be possible if the production processes are technically integrated. Professor Robinson made the same point in connection with the development of industrial structure. He observed:

> 'Where some given process requires a scale of production considerably greater than the smaller firms in an industry can achieve, this process tends to be separated off the main industry, and all the smaller firms to get this particular process performed for them by an outside specialist firm ..... The specialist firm, working for a number of the smaller firms, is on a larger scale than any of the individual firms could have achieved for that particular process or product. /1958, p. 20./

Hence, in cases where technical separability of processes is possible, specialisation among firms in the production of 'final' product is likely to happen. In actual life, the realization of the possibility will depend on a number of economic factors, the most important being expressed in Adam Smith's famous theorem: 'division of labour is limited by the extent of the market'.

A large market for the 'final' product creates demand for its parts and components, and thus encourages emergence of specialist firms. The specialist firms can enjoy economies of scale in the production of certain products which are not available to individual producers. The barriers to entry set up by the technical indivisibilities are, thus, removed as the specialist firms provide the services to other firms which may be present in large numbers. In this way, the economies of specialization are made available even to small-scale i.e. indirectly through purchase of inputs. Thus the entry of the small-scale production units can be viable despite the sharp economies of scale involved in integrated production of final product or at certain specific stages of the production process. What we observe here is technological flexibility which leads to structural flexibility, something conventional theories do not consider.

As discussed in section, 7.1.1 above, in both Bain's and Sylos-Labini's models technology appears as the major barrier to entry into an oligopolistic industry. In Bain's model small-scale firms are confronted with (1) their inability to find technique which is appropriate for small-scale firms, and (2) difficulty in having access to resources necessary for entry at the minimum optimal plant size. Sylos-Labini's model admits the possibilities of co-existence of large, medium and small firms (because of less economies of scale) but the small exist only on the periphery or what Penrose (1959, p. 222-3) and Dobb (1966, p. 348) both have described as 'interstices' of the industry. Moreover, these models do not take into account the product differentiation and its' relation with the entry of the firms; hence the 'type' (i.e. segmentation) of market which led to the emergence of dualistic structure in the Punjabs' ARE industry is not considered.

To sum up, from technological point of view there was considerable scope for vertical disintegration of tubewell production process and emergence of a large number of small units performing complementary activities, including the specialist services. This allowed small-scale tubewell producing firms to enjoy economies of specialization as well as economies of scale realized by the specialist firms. This lowered the technical barriers for the small-scale firms and they had an opportunity to enter the ARE industry which until the early 1960s was dominated by a few large firms.

The other set of factors facilitating entry of small-scale units into the ARE industry were the essential inputs.

(2) <u>The Economic Feasibility</u>

The other important factor to consider in this case is the "economic feasibility" of entry into the tubewell industry. We propose to deal with the question of economic feasibility in two stages: first, by considering the availability of essential inputs; and, second by analysing the nature of demand for the tubewells. Let us first look into the supply of inputs required for tube-well production.

The Input Availability

We recall from section 7.1.3 above that the tubewell firms of the Punjab - large, medium and small - had access to all the essential inputs viz., physical inputs, manpower, and management skills. It was also noted that, given the nature of technology, total input requirements of small-scale firms were far less than the large-scale firms.

For example, we observed that the tubewell firms of the Punjab had easy access to the most important input of equipment which was available from domestic and foreign sources. Firms could purchase new or old machines or even fabricate machines for themselves to suit their requirements and resources. Whereas the large-scale and medium-sized units had special-purpose and sophisticated machines like cylindrical boring machine and honing machine, the small-scale firms mostly relied on general-purpose and simpler machines such as lathes and drills. Substitution of the general-purpose for the special-purpose machines did not constitute great technical disadvantage to the small-scale firms since this type of equipment was quite appropriate for producing the low-quality tubewells in which small-scale firms specialized. Nor the small-scale firms faced serious difficulty in having access to basic and essential machinery for tubewell production.

The tubewell firms also had access to required raw materials like pig iron, coke, etc. Liberal import of industrial raw materials during the 1960s ensured avoidance of shortages of material inputs. However, the cost of raw materials to different firms was different: while the large-scale and medium-sized firms had their raw materials import entitlements, the small-scale firms mostly relied on the more expensive, commercially imported materials sold through retailers and wholesalers. The method adopted by the small-scale firms to overcome their cost disadvantage was to use inferior quality raw materials. This strategy suited their cost environment and demand conditions.

Nor did other physical inputs such as buildings constitute a serious constraint on the entry of small-scale firms into the tubewell industry. It was usual for the small-scale firms to rent buildings for starting new business. In the case of already established firms, it was a matter of expanding the existing facilities or fuller utilization of the existing capacity. This resulted in lower financial requirements for entry by the small-scale firms.

As a result of the technology used, nature and availability of equipment, and possibilities of vertical disintegration of production processes, the capital requirements for fixed assets (i.e. machinery, tools, etc. minus building/land) were low:58.2 per cent small-scale firms in our sample had these assets worth below Rs. 50,000; and the other 41.8 per cent between Rs. 50-100 thousands. By contrast, all the three large-scale firms had fixed assets of more than Rs. 1 million. This indicates that even firms with limited finance could enter the industry at small-scale level.

Because of the limited capital requirements for entry the small-scale firms could arrange finance from private sources as the institutional credit was hard to get. Some of the small-scale units also utilised savings from previous business like general engineering workshops, etc. The working capital requirements were met through suppliers credit which proved to be an entry promoting facility. The suppliers' credit is still widely used by the small-scale and medium-sized ARE firms of the Punjab.

As for labour skills, the small-scale firms entering the industry could rely on the reservoir of labour with metal working experience as well as those who were trained in tubewell manufacturing by the large-scale enterprises. In fact, many of the new firms entering this industry in the 1960s were owned by the ex-employees of the large and medium enterprises. Moreover, since the small-scale firms produced inferior quality S.S.D.E. and C.W.P., their labour requirements in terms of skills were accordingly low. They employed informally trained workers, apprentices and family workers to cut down wage cost. Thus, the small-scale firms entering tubewell industry in this period had access to the required skills.

Finally, the organizational and management requirements for the small-scale tubewell firms were minimal. Even today, these firms have a personalised management, with no professional or administrative staff. The informal management also includes personal sales, absence of formal office, irregular book keeping, avoidance of registration with government departments, tax evasion, etc. But the thing to note is that this type of management structure did not constitute a constraint on the entry of the small-scale firms into the industry, and suited their cost environment and market conditions.

To conclude this section, in the 1960s the small-scale firms had access to all the essential inputs, viz., machinery, raw materials, buildings, finance, and labour and management skills. Possibilities of vertical division of labour were present in the Punjabs' tubewell industry and entry into a number of operations required relatively small investment, and, initially, only ordinary skills. Certain stages in production process required relatively advanced skills and large amount of capital which were provided by the specialist firms. In other words, the small-scale firms had access to all the necessary inputs to effect entry into the industry. However, actual entry of large number of firms could start only with the rapid increase in demand for tubewells.

The Nature of Demand

Two features of the 1960s irrigation sector market need to be recalled in order to explain the entry of small-scale firms into the industry: (1) that this period witnessed a rapid expansion in demand for irrigation-related equipment i.e. the 'size' of the market; and

(2) this demand originated from a variety of sources, viz., private agriculture, private industry, and public sector i.e. the 'type' of the market.

As regards the size of the market, the total demand for tubewells expanded very rapidly in the 1960s. The most important source of this demand was private agriculture: the number of tubewells (S.S.D.E. plus C.W.P., with an average capacity of 1-2 cusecs) installed per annum increased from 975 in 1954/55-1959/60 to 8,000 in 1960/61-1964/65, and to 12,050 in 1965/66-1969/70; and further higher to 14,700 in 1970/71-1974/75. /Table 2.10, Chapter 2/. On this basis, the total number of 100,250 private tubewells were installed between 1960/61-1969/70, and additional 73,500 sets during 1970/71-1974/75. In addition, slow-speed diesel engines were demanded for use as power generators in the agro-based industries situated in the rural areas without electricity supply. The third source of demand for S.S.D.E. to emerge in the 1960s were the small power-loom units which rapidly increased in numbers in this decade.

There was a simultaneous increase in public sector demand for tubewells (turbine pump plus electric motor, with an average capacity of 3-4 cusecs) in the 1960s. The public sector tubewells installation in West Pakistan increased from 398 in 1954/55-1959/60 to 2,141 in 1960/61-1964/65, and to 3,703 in 1965/66-1969/70. Thus, 5,844 high capacity turbine pumps were installed in the 1960s. Moreover, government plans included installation of 19,080 water pumps and 665 tubewells in East Pakistan during 1960-70 /Table 2.6 and 2.7, Chapter 2/.

Put together, these sources of demand constituted a rapidly expanding market for tubewells and its constituents. The fast rate of expansion of the tubewell market created entry opportunities for the firms.

Now we turn to the conditions which offered opportunities to the small-scale firms to enter the irrigation-sector market in the presence of already established two large-scale and a number of medium-sized firms. In other words, we look into the 'type' of the market faced by the small-scale firms.

First, we recall that the tubewell market was divided into two parts: (i) the 'upper' segment consisting of demand for turbine pumps, high-powered electric motors, high-speed diesel engines, etc.; and (ii) the 'lower' segment which consisted of S.S.D.E., C.W.P. and low-powered electric motors. The decade of the 1960s witnessed simultaneous expansion of demand in both the segments of the markets.

Second, the demand for the sophisticated and high-quality products was provided mainly by the public sector, whereas, the demand for low-capacity, low-quality tubewells originated from the small farmers. While during the 1950s, demand for private tubewells came largely from rich farmers, from 1959/60 onward middle-class (owing 25-50 acres) and small-sized (owning less than 25 acres) became important source of demand. Because of exceptionally high return on tubewell investment, it became a high priority for the farmers of all classes. In keeping with their means, the small farmers demanded low-quality /

low-priced tubewells which were supplied by the small-scale firms.

Third, to complete the picture, at the time of rapid expansion in demand in the early 1960s, the industry was dominated by two large-scale firms. These enterprises were surrounded by a number of medium-sized firms. The two large-scale firms were mostly confined to the upper end of the market and specialised in advanced type of products such as deepwells, H.S.D.E., etc. This was an important and distinctly different segment of the market which was open to only some firms with requisite resources. The large enterprises also produced high-quality S.S.D.E. and C.W.P. for private agriculture but priced them much higher than the tubewells of the small-scale firms.

Thus, the 'size' and the 'type' of the tubewell in the 1960s were such that they offered entry opportunities to the small-scale firms. The small enterprises used cheaper inputs and produced low-quality / low-priced tubewells for the low income farmers. In this manner, they managed to create a segment of the market in which the large-scale firms did not operate.

7.2 Co-existence of the Small-Scale and Large-Scale Firms

So far we have presented an account of entry but not continued co-existence of the small-scale and the large-scale firms which lasted until 1973. For this we need to show how the comparative advantages of the small-scale and large-scale firms permitted sharing of the irrigation-sector market.

It may be recalled that there existed two broad segments of the irrigation-sector market: the upper end consisting of sophisticated products like turbine pumps and high-powered electric motor; and the lower end constituted of single-stage C.W.P., S.S.D.E., etc. The cross elasticity of substitution between the products of the two segments was zero or near zero. This became a basis for the sharing of the market between the small-scale and large-scale firms.

Three things may be noted regarding the co-existence of large-scale and small-scale firms. First, that product differentiation is conditioned by technology. We noted from the discussion on choice of technique in the irrigation-sector (Chapter 6) that the small-scale firms have access to certain type of technology only. The large-scale firms have another type of technological base which is suited to the production of different kinds of products. [see Table 4.7, Chapter 4]. In other words, on pure technical grounds, the product differences are attributable to the resource position of different firms. Second, production of different kinds of products calls for different types of technologies. For example, production of high-speed diesel engine would require a different type of technology from the one needed for slow-speed diesel engine. Following from these two propositions, we get a third: product differentiation will form a basis of horizontal division of labour between small-scale and large-scale firms. The large-scale firms will have an advantage in more 'sophisticated' products requiring advanced technology, while small-scale firms inhabit 'less sophisticated' products market, where entry requirements are low.

We use this framework to explain the co-existence of the small-scale and large-scale firms in the irrigation-sector of the ARE industry. Table 7.10 gives a picture of the type of market served, products produced and the technology required by different types of ARE firms in the Punjab. According to this table, there are two segments of the irrigation-sector market viz., the public sector end and the private sector end. The public sector market requires high-quality and sophisticated products (deepwell pumps and high-powered electric motors, etc.) which can be produced by firms having access to technology type I. This technology involves more advanced methods, the skills and the machinery. These inputs involve additional costs compared to the products requiring technology type II. Moreover, the minimum efficient scale of production is larger in this case. Finally, operating in the public sector market demands certain organizational ability i.e. public relations, etc. Since these resources are not available to the small-scale firms, they have no place in this segment of the market.

However, firms of all sizes operate in private agriculture market, which has different segments. This segmentation is based on the water table in the area, the farm area, the farm size and prospects of sale of water. /Ghulam Mohammad, 1965./ So we observe a variation

Table 7.10

Technology, Product Characteristics and Markets

Product, Characteristics and Technology: Market:	Products[1/]	Technology Type[2/]
(1) WAPDA (Public Sector) (Served by large firms only)	(i) Deepwell Turbine Pumps Capacity: up to 6 cusec (ii) Submersible Pumps Capacity: up to 1.5 cusec (iii) Electric Motors: 3 phase, high speed, 5-50 HP	I
(2) East Pakistan (Public Sector) (Large firms only)	(i) Diesel Engines: (Slow Speed) 15-40 HP (High Speed) Up to 12.5 HP (ii) Centrifugal Pumps: low capacity (iii) Deepwell Turbines: up to 6 cusec (iv) Electric Motors = 5-50 HP	
(3) Public Health Engineering (Public Sector) (Mainly large firms - possibly some medium sized firms also)	(i) Deepwell Turbine Pumps: 3-6 cusec (ii) Electric Motors: up to 50 HP	I & II
(4) Industry: (Large firms - possible some medium sized firms also)	(i) Diesel Engines: High Speed Capacity: 12-70 HP (ii) Non-clogging pumps: Horizontal /vertical Suction Size: 80-200 mm	II
(5) Private Agriculture: (Large, medium and small firms)	(i) Diesel Engine: Horizontal, Slow Speed / Medium Speed Capacity: 15-50 HP (ii) Electric Motors: Single and Three Phase (iii Capacity: 1-20 HP (iii) Centrifugal Pumps: below 1 cusec - 2 cusec	II & III

NOtes: 1/ For product details see Table 4.1, Chapter 4. 2/ Technology Types:

I Involves modern casting methods (including Arc furances) and use of cylindrical grinding machines, turret and other multiple-head lathes, etc., aimed at ensuring standard specifications, precision work and good quality products. These methods often entail at least some design capacity on the part of the firm, and initially at least some foreign technical collaboration. They also require the back up services of qualified /trained engineers /technologists.

II Involves Casting, in 'cupola' furnaces and machining/finishing on ordinary /modern lathes, drill machines, etc., better production organization and quality control.

III Consists mainly of traditional casting in 'crucible' or 'cupola' furnaces and minimum of machining, etc., on ordinary machines, and a good deal of improvisation.

in the type, size and quality of private tubewells installed in Pakistan.

The large-scale firms kept a competitive advantage in the production of high-quality/high-priced products, while the small-scale fought for their own share of the market by producing cheaper products for the lower segment of the private sector market. Their products e.g. S.S.D.E. was largely made of scrap, specification less precise, needed more maintenance, and were less durable. Yet the engines were workable machines, and 70-100% cheaper than the high-quality product of the large-scale firms. The small-scale firms enjoyed advantages over the large-scale firms in the lower end of the market.

As for the large-scale firms they possessed the type of technology - the equipment mix, and the technical and managerial staff - which was suitable for a certain range of products. The large-scale firms of the Punjab have had modern organization commercial and technological expertise, but this organizational structure also entailed some costs e.g. arising from operations in the public sector market and foreign technical collaboration. Thus the large-scale firms' attempt to compete against a small-scale firm would not succeed as the prices will fail to ensure a return it has come to take as normal. In other words, they would have been at a disadvantage (technically and economically) in producing low-quality S.S.D.E. and C.W.P. These firms lacked the technical flexibility to match the small-scale firms.

It seems that a firm can enjoy advantages only in lines where its' resources are best utilized. Penrose (1959) made this point very explicitly:

'In these circumstances the large firms would not find it profitable to compete in the market with small firms producing the same products at low cost and willing to put them on the market at a lower price. If a given product of a large firm cannot bear its share of research, development, and other 'necessary' investment expenditure, that is to say, cannot be sold at a price that will permit a substantial margin over direct costs (whether this margin be hidden in the average cost figure or treated as profit), that product will be 'unprofitable' for the firm, whose comparative advantage lies precisely in its ability to undertake such expenditures. At the same time the product may be very profitable for a small firm.' [p. 227].

It is, thus, difficult to accept Child and Kaneda's view that the large-scale ARE firms in the Punjab had clear cost advantage over the small-scale in the lower end of the market. In fact, there existed other markets and market segments and, thus, co-existence of the large-scale and small-scale firms in this industry.

It may be noted that the large-scale irrigation sector firms did not respond to expanding private agriculture market by competing against the entry of small-scale firms. They did not lower their prices, nor the quality of their products, nor made extra efforts to promote their sales in this market segment. For example, the large-scale firms did not establish retail-outlets to compete against the small-scale producers. As a matter of fact, they did not attempt to capture a fairly big share (30-40%) of the private agriculture market from the small-scale firms.

In fact, the large-scale firms were occupied in diversifying their production and upgrading their technological capacity for producing high-quality and sophisticated products. So the thrust of their expansion was in the direction of advanced products and the public sector market. [see Chapter 5].

Although the large-scale firms possessed greater resources, including foreign technology, these resources could not be considered suitable for the lower end of the private agriculture market. While their organizational structure and technological capacity enabled them to operate in certain parts of the market, it also put them at a relative disadvantage aginst the small-scale firms in the private agriculture market.

7.3 Summary

In this chapter we have presented an explanation of the entry and continued co-existence of the small-scale firms among the large-scale and medium-sized firms in the tubewell industry of Pakistan. The above given detailed analysis may be summarized thus:

Regarding the 'entry' question, we observed that:

(1) There existed an expanding irrigation sector market in Pakistan in the 1960s which was divided into two broad segments: the high-quality sophisticated products (e.g. H.S.D.E., turbine pumps, and high-powered electric motors, etc.) end, which met public sector demand; and the low-quality inferior products (e.g. S.S.D.E., C.W.P., etc.) end, which largely catered to the needs of private agriculture.

(2) The lower part of the tubewell market was further fragmented, mainly on the basis of quality. The high-quality end of the private agriculture was served by the large-scale or expanding medium-sized firms, whereas the other end was left to the small-scale and medium-sized firms.

(3) From technological point of view there was considerable scope for vertical disintegration of tubewell production process and emergence of a large number of small units performing complementary activities, including the specialist services. This lowered the technical barriers for the small-scale firms and they had an opportunity to enter the industry which until the early 1960s was dominated by a few large-scale firms.

(4) The small-scale firms' entry into the industry was also facilitated by their access to all the essential inputs, namely, machinery, raw materials, building, finance, and labour and management skills. In short,

possibilities of vertical division of labour and access to specialist services, and all the essential inputs allowed small-scale firms to enter the ARE industry in the 1960s. The co-existence of small-scale and large-scale firms in the industry is explained as follows:

(1) The two segments of the irrigation-sector market provided the basis for the sharing of the market between the small-scale and large-scale firms.

(2) Whereas the large-scale firms had an advantage in more 'sophisticated' products requiring advanced technology, the small-scale firms inhabited 'less sophisticated' products market where entry requirements were low.

(3) Despite rapid expansion in the private agriculture market, the large-scale firms did not compete against the small-scale firms by lowering their price or quality, or by sales promotion. They remained occupied in diversifying their production and upgrading their technological capacity for producing high-quality and sophisticated products. Thus, the small-scale and large-scale firms continued to co-exist in their segments of the irrigation market.

Footnotes

Chapter Seven

1/ This restatement of the theoretical position of J.S. Bain and Sylos-Labini draws on Aftab and Rahim. (1983).

2/ The power loom units located in rural areas with no electricity supply used diesel engines as sources of power. The units located in areas with access to electricity supply often used diesel engines as stand-bys.

3/ The information is based on our survey of the industry.

4/ The differential was determined by the demand for particular skills and the skills already acquired by the apprentice.

5/ Talking about the pin manufacturing he says: 'But in the way in which this business is now carried on, not only the whole work is a peculiar trade, but it is divided into a number of branches, of which the greater part are likewise peculiar trades. One man draws out the wire, another straightens it, a third cuts it, and fourth points it, a fifth grinds it at the top for receiving the head, to make the head require three distinct operations; to put it on is a peculiar business, to whiten the pins is another, it is, even a trade in itself to put them into the paper; and the important business of making a pin is, in this manner, divided into about eighteen distinct operations.

Then he goes on to give the example of labourer's coat making thus: 'The woollen coat, for example, which covers the day-labourer, as coarse and rough it may appear, is the produce of the joint labour of a great multitude of work men. The shepherd, the sorter of wool, the wool-comber or carder, the dyer, the scribller, the spinner, the weaver, the fuller, the dresser, with many others, must all join their different arts in order to complete even this homely production. /1982, Chapter I/.

CHAPTER EIGHT

THE DECLINE OF THE IRRIGATION SECTOR AFTER THE BURGEONING: 1973-83

Here our aim is to review and analyse the developments taking place in the irrigation sector of the ARE industry in the post-burgeoning period and compare it with the sectors' growth over 1960-73.

The irrigation sector of the Punjab's ARE industry suddenly declined around 1973, with a sharp fall in diesel engine production which continued till 1983. One official source reported the presence of about 100 diesel engine manufacturing units in the Punjab in 1979 - indicating a big fall off from 444 tubewell firms, most of which produced diesel engines, estimated by Child and Kaneda in 1969. /Government of Pakistan, 1979, p. 10; Child and Kaneda, 1974-75, p. 265/. Our survey of the industry in 1981-82 and 1983 indicated a further 45-50 per cent decline in the number of diesel engine manufacturing firms during 1978/79 and 1982/83. Most of the firms to decline in this period were small and medium-sized enterprises.

This raises the question: why did the expanding small-scale irrigation sector suddenly start declining around 1973? We present below an explanation of this change by identifying two sets of factors: (1) the "economic" factors which affected the irrigation sector in this period; and (2) "new barriers" which the small-scale firms failed to cross for their continued survival after 1973.

8.1 The Changes in Economic Conditions

The important economic factors affecting the irrigation sector of the ARE industry in this period were: (1) decline in demand for tubewells; (2) relaxation of import restrictions; (3) increased raw materials cost; (4) increased oil prices; and (5) labour reforms.

(1) Decline in Demand for Tubewells

As noted in Chapter 2, the average annual private tubewell installation - the major source of demand for the irrigation products - fell sharply from 14,700 in 1970/71 - 1974/75 to 7,400 in 1975/76 - 1979/80. /Table 2.10, Chapter 2/. This decline continued in the following years and the annual average of private tubewells installation was further reduced to 6,400 during 1979/80 - 1982/83. /Government of Pakistan, 1983(a), p. 285/. Moreover, the overall decline in demand fell more on diesel tubewells than the electric tubewells because the former were more expensive to instal and maintain than the latter. /Table 2.12, Chapter 2/.

The overall decline in the private tubewell installation in that period was attributable to a number of factors given below:

(a) At least in certain areas tubewell installation had reached near saturation level. In some cases this had happened at a much earlier data, around the end of 1960s. In some areas, for pure technical reasons, there did not exist scope for new installations of tubewells because the water table had been slowly dropping and the recharge to the groundwater reservoir was not sufficient. /Planning Commission, 1970/.

(b) Another cause for this decline was a substantial increase in canal water supplies in some areas following completion of major irrigation projects. For example, completion of Tarbela Dam in 1976 released 8-9 MAF of additional water in 1976-77 and reduced the need for private tubewells in areas benefiting from its waters.

(c) The extension of public sector schemes of SCARP and the completion of some Irrigation Department projects in the 1970s were partly responsible for the continuing declining trend in private tubewell installation. For example, 1523 SCARP tubewells and 579 public sector irrigation tubewells installed during 1978-83 provided a total of 1.11 MAF of additional water for irrigation purposes /Government of Pakistan, 1983,[(a)] p. 285/. As for the effect of these schemes on the irrigation sector firms, it worked both ways: installation of public tubewells created additional demand for the large-scale irrigation sector firms producing turbine pumps and high-powered electric motors, but reduced demand for the small-scale and medium-sized firms which produced slow-speed diesel engines and ordinary centrifugal water pumps.

(d) Rural electrification also had similar effect on the irrigation sector of the ARE industry. As a result of increased village electrification between 1971/72 - 1979/80, more farmers installed electric tubewells, which were cheaper than diesel tubewells. /Appendix Table A.8.1/. This led to a peculiar situation in which the firms producing water pumps and/or electric motors were better off but those manufacturing diesel engines were not, though they all belonged to the irrigation sector of the ARE industry. Thus, overall, the large-scale firms were better off than the small-scale firms, and among the small units, the water pump manufacturing firms were less affected by the declining demand compared to the diesel engine firms. So the worst affected were the small-scale diesel engine producing firms.

(e) Finally, with the separation of Bangladesh in 1971, the ARE(I) industry lost an important market for its products. Although not as many tubewells were installed in East Pakistan in the past as in the West, many firms catered to the needs of that province. /Table 2.6, Chapter 2/. These firms included medium-sized and large-scale manufacturers. East Pakistan constituted an expanding market, particularly for the diesel engine firms of West Pakistan. A few diesel engine firms of Lahore, which relied solely on East Pakistan market, failed to take the loss and were forced out of this business.

To counterbalance the falling demand for the diesel engines and also to help farmers - particularly of non-irrigated areas - the government offered them subsidy (of about Rs. 20,000 per head) on the purchase and installation cost of diesel tubewells. During 1972/73 - 1979/80, 17,199 tubewells were installed under the tubewell subsidy scheme at the total cost of Rs. 171.5 million /Table 8.1/. Thus, on average, 2,653 subsidised tubewells per annum were installed in this period.

The beneficial effects of tubewell subsidy scheme are, however, disputed by some manufacturing firms on the ground that this has led to reduced total demand for private tubewells as farmers would rather wait for subsidy than purchase tubewell with their own money. So, in effect, the annual average of private diesel tubewell installation has not only been falling but the gap between it and the tubewell subsidy awards is also reduced. For example, during 1975/76 - 1979/80, the annual average of diesel tubewells installed was 2,956 and the per annum tubewell subsidy awards were 2,203. In other words, only 25 per cent of the private diesel tubewells were self-financed. The net effect of above mentioned developments was shown in reduced demand for diesel tubewells.

(2) <u>Relaxation of Import Restrictions on Irrigation Products</u>

From 1972, there was a clear shift in the economic policy away from excessive protection of the domestic industry and towards greater emphasis on economic efficiency. The economic policies included, among others, measures aimed at relaxing exchange control and trade restrictions.

Table 8.1

Amount Disbursed Under Diesel Engine Tubewell Subsidy Scheme: 1972/73 to 1979/80

(Pakistan)

Year of Disbursement	Number of Tubewells Installed	Amount Disbursed (Rs million)
1972-73	3,195	20.1
1973-74	4,440	25.4
1974-75	2,575	27.1
1975-76	1,599	15.0
1976-77	5,737	57.4
1977-78	1,199	10.0
1978-79	1,345	19.6
1979-80	1,135	19.8
Total	17,199	171.5

Source: Based on the official record of the office of the Assistant Agricultural Engineer, Department of Agriculture, Lahore.

The revised economic policy, by allowing import of high-speed diesel engine (H.S.D.E.) created serious situation for the domestic irrigation sector firms. It is interesting to note that H.S.D.E. was imported as an attachment of agricultural machines or mining equipment, while its import as a generating set was banned. Moreover, as an agricultural machinery its import was allowed free of duty. Thus, it was available at a lower price than a comparable S.S.D.E., and this led to reduced demand for the domestically produced S.S.D.E.

The imported H.S.D.E. compares favourably with the S.S.D.E. for a number of reasons viz., (1) lower price (a 12.5 HP H.S.D.E. costs, on average, Rs. 7,500/- compared with Rs. 20,000/- for 18-20 H.P. S.S.D.E.), (2) low running cost (i.e. H.S.D.E. consumes less fuel without sacrificing efficiency), (3) greater mobility, (can be carried on a trolley), and (4) greater reliability i.e. its better quality and improved technical features ensure smooth and trouble free service compared to an ordinary S.S.D.E. So, by virtue of its technical and economic superiority, the H.S.D.E. won easy acceptance of the farmers as a multipurpose machine used for tubewell running, threshing, etc.

(3) <u>Increased Raw Material Cost</u>

The Currency devaluation of 1972 changed the per value of Pakistani rupee from Rs. 4.76 to Rs. 11.00 per U.S. $ i.e. by 131 per cent. This decision substantially raised the import costs of industrial raw materials and capital goods. The impact of currency devaluation on the ARE firms was especially severe because they were excessively dependent on the imported raw materials. Moreover, since raw materials cost constitute 60-70% of the total cost of the ARE products, the ARE firms were particularly sensitive to the sudden increase in costs following devaluation. The increased capital costs of business proved prohibitive for many small-scale firms which already operated under severe financial constraints. For the industry, increased costs meant higher prices of tubewells and lower demand.

The sudden increase in oil prices in 1973 not only worsened the countrys' balance of payments position but also adversely affected individual industries of Pakistan to varying degress. As for the effects of the higher oil prices on the ARE industry, it worked indirectly by raising the operating cost of a diesel engine tubewell relatively to an electricity operated one. Following the oil crisis, the price of light speed diesel (L.S.D.) jumped from Rs. 1.75 per gallon in October 1973 to Rs. 2.73 in December 1973, and stood at Rs. 4.76 in 1976. [Government of Pakistan, 1981, p. 143]. Consequently, the running cost of diesel tubewells increased manifold relatively to electric tubewells, resulting in reduced demand for diesel engines in Pakistan.

(4) Labour Reforms

The labour reforms of 1972 adversely affected the development of private industrial sector in Pakistan. The 'New Labour Deal' substantially changed the industrial environment for the private employees by bringing many benefits to the industrial labour, including increased economic benefits, the right to strike, and protection against arbitrary dismissal. /see Appendix Table A.8.2/. For example, as a result of these reforms, the monthly wages of industrial labour in Pakistan more than doubled from Rs. 192.00 in 1970/71 to Rs. 454.00 in 1974/75. /Appendix Table A.8.3/.

At the same time, the labour reforms of 1972 led to massive industrial strikes and a sharp deterioration in employer-employee relationship, resulting in fall in labour productivity. So the new conditions marked by higher wage costs but lower productivity did not favour entrepreneurs at all.

To sum up, after 1973 the irrigation sector firms of the Punjab confronted substantially different conditions than those from the past. The factors that determined the new set of conditions included: (1) reduced demand for private tubewells; (2) increased raw materials cost; (3) higher diesel oil price; (4) increased labour cost; and (5) strong competition from the superior imported high-speed diesel engine.

8.2 Diversification into New Product Lines

Declining domestic tubewell market and import of Chinese H.S.D.E. in Pakistan in the 1970s created a new set of conditions for the Punjab's diesel engine firms. Overall, the producers of S.S.D.E. now faced a challenge from a superior and cheaper product in a declining diesel engine market. The real threat was posed to the small-scale diesel engine firms which now faced strong competition in the private agriculture market from; (1) the domestic large-scale and medium-sized producers of S.S.D.E. who dominated the subsidized tubewell market through aggressive marketing and (2) the imported H.S.D.E.

The continued survival of small-scale firms under these conditions depended on diversification of production into new lines. Broadly, the firms could diversify either into (1) related but technically sophisticated products like H.S.D.E.; or (2) simpler (inferior) products such as cultivation machinery and implements.

The irrigation sector firms' ability to diversify output into new product lines can be seen from the data shown in Table 8.2. This data show the number of irrigation-sector firms (diesel as well as water pump) which introduced new product(s) or failed to do so, since entering this industry: (i) overall, 39 out of 62 irrigation sector firms in our sample had introduced some new product. Of these 39 firms, 22 were small enterprises, 12 medium-sized, and 3 large-scale firms. Among the 22 small-scale firms in this group, 6 had introduced new products in the

Table 8.2

Introduction of New Products by the Irrigation-Sector Firms of the Punjab, Pakistan

(Based on Sample of 62[1] Firms = 1981-82)

Firms	Number of Firms	Type of New Products[2]			Period of Product Introduction[3]		No Change in the Product Line
		Inferior	Similar	Superior	Pre-1973	Post-1973	
Diesel Engine[4]							
Small-Scale	30	11	2	-	3	10	17
Medium-Sized	7	3	4	-	3	4	-
Large-Scale	2	-	-	2	2[5]	2	-
Water Pump							
Small-Scale	13	9	-	-	3	6	4
Medium-Sized	9	3	-	2	-	5	4
Large-Scale	3	-	-	3	3	3	-

Notes: 1/ The number of firms surveyed was 62, but two large-scale firms appeared in both the groups i.e. diesel engine and water pump producing. Thus, the total adds up to 64.

2/ Here the newly introduced products are divided into three groups = (1) "technically inferior" i.e. those which require inferior technology than that needed for the principal ARE products (S.S.D.E. and single-stage C.W.P. for the two groups of firms respectively); (2) which use the same 'level' of technology as is used in the case of S.S.D.E. and C.W.P.; and (3) which uses superior technology than the two products.

3/ The year 1973 marks the beginning of the decline in demand for the ARE products.

4/ Firms are classified on the basis of the principal product of the firms. A diesel engine firm, for instance, may also produce other irrigation products or their parts.

5/ The two large-scale firms introduced superior products in pre-1973 as well as post-1973 period.

pre-1973 period, and the other 16 in the post-1973 years. Of the total firms which failed to introduce new products, 21 were small-scale and 4 medium-sized firms.

(ii) Moreover, among the 22 diesel engine firms that diversified, 13 were small-scale, 7 medium-sized and 2 large-scale. Of the 13 small-scale firms in this group, 11 firms introduced technically inferior products, and 2 firms such products as ammonia compressor which required the same level of technology as S.S.D.E. The diversification effort of the medium-sized diesel engine firms was also restricted to products requiring inferior or similar technology. However, the two large-scale firms introduced technically superior products in both pre and post-1973 period.

(iii) In the case of water pump firms, all the 9 small enterprises diversified into inferior products like agriculturul implements, etc., whereas, 2 out of 5 medium-sized and all the 3 large-scale firms introduced technically superior products.

Thus, overall, the small-scale firms diversified their production far less than the medium-sized and the large-scale firms, and those which introduced new items, in any period, failed to produce technically superior products. The broad conclusion to be drawn from this data is that the small-scale irrigation-sector firms of the Punjab were generally unable to diversify into new product lines, especially those which required superior technology.

8.2.1 Diversification into Technically Superior Products

We can examine the barriers faced by the small-scale firms in diversifying into technically superior products by focussing our attention on one such product - the high-speed diesel engine.

The small-scale firm's ability to produce H.S.D.E. in Pakistan depended on two types of factors: the economic and technological. The first group of factors included the following: the size of the market for H.S.D.E., and the small firm's access to finance for new investment. The second group of factors consisted of access to new technology and production capability, and organizational ability.

As for the extent of demand, we have already noted an expansion in the H.S.D.E. market since 1972/73. However, domestic demand for H.S.D.E. in the 1970s had not yet become sufficiently large to justify its production in the country. The market for H.S.D.E. expanded gradually in this period, but there was no explosion of demand as was seen in the case of S.S.D.E. in the 1960s. According to Beco's estimates, even by 1982-83 the total demand for H.S.D.E. in Pakistan had not exceeded 3,000 units per annum; and it was much lower in the mid-1970s. Thus, the H.S.D.E. market in the 1970s did not offer ample investment opportunity to the existing small-scale irrigation firms.

Limited resources of the small-scale firms also constituted a barrier to diversification into H.S.D.E.

production. The initial finance required for producing H.S.D.E. is considerably larger than that needed for S.S.D.E. manufacturing. The distinguishing feature of H.S.D.E. production is that the technique in this case admits greater economies of scale as compared to the S.S.D.E. and, hence, requires heavy capital investment and high minimum efficient scale of production. This calls for a regular production line typical of the modern factory.

It may be reiterated that the private agriculture market for tubewells was highly competitive and the small-scale firms did not generate enough surplus for reinvestment. Nor did they have access to institutional finance. The main source of finance for these enterprises was private saving which were insufficient for meeting the investment requirements of H.S.D.E. production. Thus, scarcity of finance was a major obstacle in the way of those small-scale firms that might have contemplated diversifying into a higher technology product line.

8.2.1.1 The Technological Barriers

The small-scale irrigation sector firms confronted formidable barriers in having access to the advanced technology required for H.S.D.E. manufacturing. We examine the technological barriers by identifying the product characteristics and the technology required for producing the H.S.D.E.

The modern H.S.D.E. is a compact machine, weighing about 250 kg. All the major parts such as cylinder head, crankshaft, fuel system etc., are closed in the engine. Because of its small size and other technical features (e.g. high compression ratio, fast speed, fuel economy), the manufacturing of H.S.D.E. requires detailed designing and precision engineering at every stage of production. Since the production of H.S.D.E. involves use of advanced technology, so the materials and the skills required must also be qualitatively superior. Let us first consider the casting methods involved in H.S.D.E. production.

A firm must have modern (electric) furnace for producing certain parts of H.S.D.E. For example, the piston of a H.S.D.E. is made of co-crystallized alluminium alloy, melted in low frequency electric furnace. The piston rings are cast in special alloy with high pressure, in single elliptical moulds.

The crankshaft and connecting rod of H.S.D.E. are cast in fine and selected nodular[1/] cast iron under high pressure. The modern method of crankshaft making involves teatment with 'atmosphere soft nitration' which increases the fatigue strength by 70 per cent. By comparison, the crankshaft of a S.S.D.E. is usually forged or, in some cases, simply machined on a lathe.

The H.S.D.E. cylinder liner is produced with the multiposition centrifugal cast of high phospherous cast-iron material. The addition of phospherous increase the hardness of iron as well as its fluidity /Sylvia, 1972, p. 236/. On the other hand, cylinder of a S.S.D.E., is mostly cast in grey iron melted in cupola furnaces. Thus, the casting equipment, materials and skills required for H.S.D.E. production are very different from those for an ordinary S.S.D.E.

At the machining stage too, the producer of H.S.D.E. needs to have access to modern machines and higher skills to suit the production requirements of H.S.D.E. The data set out in Table 7.1, chapter 7, shows that the small-scale diesel firms in the Punjab mostly rely on general-purpose and simple machines like lathes and shaping machines, and do not have special-purpose, sophisticated equipment required for H.S.D.E. production. It is, thus, impossible for the small-scale firms to produce H.S.D.E. with their limited equipment.

To match the advanced machines used in H.S.D.E., production, the skills must also be accordingly high. What is particularly needed is the workers' ability to operate machines according to drawings so as to ensure precision and standardization of engine parts. The required level of skills can only be achieved through formal education and training which is often found lacking among the workers of the small-scale firms. Because of limited opportunities for formal education and training in the country, the in-service employees of the small enterprises seldom get a chance to improve upon their skills.

The crucial skills required for diversification into H.S.D.E. production are the engineering expertise and designning ability. These skills presuppose the presence of engineering staff, something completely missing among the small-scale ARE firms of the Punjab. For example, none of the 43 small-scale firms in our sample had qualified technical staff, nor did they use their own designs and patterns for slow-speed diesel engine production. Instead, they relied on ready-made patterns made by the foundry firms. Thus, absence of required skills posed yet another obstacle for the small-scale firms in their diversification effort into technically superior products.

8.2.1.2 Organizational Limitations

The organizational requirements of modern production methods involved in H.S.D.E. manufacturing are far from trivial. Production of H.S.D.E. requires decision making in a number of matters such as choice of technique, selection of machinery, possibilities of subcontracting, and so on. Since only large-scale production of H.S.D.E. was feasible, so the managerial functions included continuous planning of inventories, materials flow and machinery maintenance which was beyond the organizational capacity of the small-scale firms. By contrast, the typical organizational structure of small-scale firms was characterized by personalized management and absence of professional and administrative staff. An important point to emphasise is that while this management style was adequate for entry into the S.S.D.E. market, the same was not sufficient to move up into H.S.D.E. production; and a move in that direction demanded up-grading of the existing organizational structure of the small-scale firms.

In the section above we have recorded the barriers faced by the small-scale irrigation sector firms in producing the H.S.D.E. It was observed that technological barriers constituted the most formidable obstacle for the small enterprises' diversification into technically superior products. However, the technological barriers were not faced by small-scale firms alone; the medium-sized and large-scale firms also came up against similar obstacles. We now consider the diversification effort of the medium-sized and large-scale irrigation sector firms in the post-1973 period.

In the case of medium-sized firms, only 2 water pump manufacturing units included in our sample reported production of a superior product (turbine pumps) in the post-1973 period, and no medium-sized diesel engine manufacturing firm produced a technically superior product (such as high-speed diesel engine). The only exception was the Matchless Engineering of Lahore, which claimed to have the technical ability[2/] to produce H.S.D.E. but did not do so for economic reasons. The reason given for not producing H.S.D.E. was the firm's inability to compete against cheaper imported H.S.D.E. So, none of the medium-sized firms, including the pioneering diesel engine firms of pre-1947 years, had managed to get into H.S.D.E. manufacturing till 1983.

A still more important point to note was that while some medium-sized firms like Mohammad Hussain and Sons, Matchless Engineering and others upgraded their technological capability for producing medium speed diesel engine (500-1200 rpm), they could not manage to cross the technological barriers to the production of H.S.D.E. It may be noted that there is greater technical similarity between S.S.D.E. and M.S.D.E. than between M.S.D.E. and H.S.D.E. To put it differently, the technological gap between the medium-speed diesel engine and the high-speed diesel engine is bigger than between the slow-speed diesel engine and the medium-speed diesel engine. The knowledge of engineering and the technological base of the medium-sized firms, while being sufficient for the S.S.D.E. and the M.S.D.E., was not good enough for the H.S.D.E. manufacturing and needed upgrading, including access to foreign technology which was not available till 1983.

Hence, 4 out of 7 medium-sized diesel engine firms in our sample diversified into such product lines (ammonia compressors,[3] etc.) as required the same level of technology as S.S.D.E. or M.S.D.E. (The new products were produced along with the S.S.D.E.) The other three diesel engine producing medium-sized firms started manufacturing inferior products like cultivation equipment or just concentrated on foundry production. A few other medium-sized firms (not included in our sample) had gone out of the industry into trading, etc. These were the firms that experienced serious labour-management problems in the post-1972 period, in addition to a declining diesel engine market and the inability to upgrade technology.

The cases of large-scale irrigation-sector firms provide useful insight into the mechanism of overcoming the technological barriers to diversification into technically superior products. Our sample included 3 large-scale irrigation-sector firms; of which two (Beco and Ittefaq) manufactured diesel engines and pumps, and the third (K.S.B.) specialised in water pumps production only.

Beco was the first large-scale firm to produce modern H.S.D.E. in West Pakistan. It may be recalled here that H.S.D.E. was not an absolutely new product for Beco. It produced a 1950 vintage German evaporation-cooled H.S.D.E. since 1956, and air cooled engine since 1958. Those air-cooled engines were used in agriculture as well as in small-scale industry, though their number was small compared to the total production of S.S.D.E. Beco produced only some parts (40-50%) of this H.S.D.E., and imported the balance from Germany for assembly into complete sets. However, over the years the German H.S.D.E. lost ground to more economical Chinese[4/] H.S.D.E. The average price of German engine in 1982 was about Rs. 11,000, whereas the Chinese engine sold for Rs. 7,500.

Moreover, the latter is fuel efficient and so more attractive for the buyer.

Production of modern Chinese H.S.D.E. (Dong Feng) by Beco (nationalized since 1972) started with assembly of parts and components in the late 1970s. By 1983, Beco manufactured 25 per cent of the parts and imported the balance for assembly. In 1983, most of the important engine parts such as cylinder head, connecting rod, crankshaft, gear casing were imported from China and assembled in Pakistan. In the next phase of production, 40 per cent of the parts were to be domestically produced, finally raising this to 70-80 per cent of the total, if economically feasible.

Beco also acquired assembling equipment for producing the Chinese H.S.D.E. The assembly of H.S.D.E. was done with pneumatic and other special tools for pressing, heating, hoisting and transport. In addition, Beco acquired the services of engineering and technical staff in matters such as design of assembly line, training of technicians and workers, as well as production of diesel engines. Beco also acquired the designs, technical details, working drawings and component assembly guidelines from the Chinese exporters. Access to the modern technology greatly helped Beco to start production of H.S.D.E. in the country.

Another constraint was the high minimum efficient scale of production for H.S.D.E.: the minimum efficient scale of integrated production was 10,000 units per year, and the total demand in the country was between 2,500-3,000 in 1983. Beco resolved this problem by making the H.S.D.E. into a multipurpose machine i.e. modified its features to suit the power needs of water pump, thresher, power tiller, and marine engine. This decision was expected to gradually bridge the gap between the demand and the minimum efficient output level. To top it all, Beco was exerting pressure on government to ban import of H.S.D.E. before it should start domestic production of the engine on a large-scale. The firm maintained that domestic production of H.S.D.E. was simply not feasible in the face of foreign competition.

Thus, even for a large-scale firm like Beco diversification into H.S.D.E. was conditional upon acquisition of foreign technology, inspite of its existing wide resource base. Moreover, the firm sought protection against imported H.S.D.E. as it was unable to withstand foreign competition.

The other large-scale diesel engine manufacturing firm (Ittefaq) was nationalized during 1972-79; so its diversification programme was interrupted in this period. However, Ittefaq made impressive product diversification efforts before and after nationalization. Between 1950-80, this firm introduced a number of major products including S.S.D.E., road rollers, threshers, M.S.D.E., machine tools, water pumps and steel structures. This firm specailizes in steel fabrication and foundry work, and had the largest steel manufacturing capacity in the private sector in 1970. In 1982-83, Ittefaq also assembled a Chinese H.S.D.E. from imported parts and components. The firm had plans to gradually produce parts and components of the H.S.D.E. domestically under license from the Chinese firm, but the project was still in early stages of planning. However, this firm too emphasised the need for protection of the domestic manufacturing firms against imported diesel engine and admitted its inability to compete against cheaper foreign engines.

To sum up the upmarket diversification by firms in the post-1973 period, we have dealt with different types of firms separately. In the case of small-scale firms, we noted that:

(1) The small enterprises confronted insurmountable technical barriers in taking a leap forward into H.S.D.E. production. First, these firms did not have access to the modern technology required for H.S.D.E. production. Second, there existed limited technical possibilities for vertical separation of production process involved in H.S.D.E. manufacturing. This is so because H.S.D.E. is a "closed" type machine i.e. its major parts such as cylinder head, crankshaft, fuel system, etc., are all covered in one body. By comparison, the ordinary S.S.D.E. is an 'open' machine in which even the fuel system is outside the main body. So, the design of the H.S.D.E. restrict the vertical separation of production i.e. division of labour among firms. Hence, production of H.S.D.E. is carried out at higher level of vertical integration than in the case of S.S.D.E.

(2) Wherever possible, vertical separation of processes demanded use of new (superior) equipment and higher skills. The gap between the 'existing' and the 'required' equipment and skills was too large to be filled by the small-scale firms. Thus, the small-scale firms did not even have the essential equipment and skills required for the H.S.D.E.

(3) Moreover, the cost of technology upgrading was too high for the small-scale irrigation sector firms whose very slim profit margins left them with little resources to invest in new equipment incroporating more advanced technology.

(4) Finally, even if finance was available, it required a certain degree of managerial and technical competence to operate the advanced technology, which was found lacking among the small-scale firms.

Thus, limited technical possibilities of separation of production process, high cost of equipment, lack of required technical skills and insufficient managerial ability put together raised formidable barriers against the small-scale firms' diversification into H.S.D.E.

The medium-sized diesel engine producing firms also came up against formidable technological barriers to diversification into superior products. An important point to note is that while these firms managed to upgrade their technology to move from S.S.D.E. to M.S.D.E.

production, they failed to cross the technical barriers to still superior H.S.D.E. which required far advanced type of technology.

The large-scale firms, however, managed to start partial production of H.S.D.E. But even the partial production was not possible without acquiring foreign technology. Though large-scale firms had a substantial resource base and experience in producing sophisticated products, acquisition of the new technology from abroad was necessary for producing H.S.D.E.

8.2.2 <u>Alternative Product Lines for the Small-Scale Firms</u>

Indeed the small-scale firms could diversify into alternative product lines in the post-1973 period. Some even diversified in pre-1973 years. This diversification took place in three directions: (1) inferior products; (2) similar products; and (3) general engineering workshops.

First, the diversification into inferior products. Data included in Table 8.2 show that 11 out of 30 small-scale diesel engine producing firms in our sample produced inferior products, while 9 out of 13 water pump manufacturing firms diversified into such products. The principal products introduced by the diesel engine firms were C.W.P. and cultivation equipment, whereas the water pump manufacturing firms mostly diversified into cultivation equipment. One thing common to both the groups was that the firms which also had a foundry concentrated on casting business in the period of declining demand for tubewells. Lastly, only one small-scale diesel engine firm reported production of single-phase electric motors. The reason for the firms not to enter electric motor market was simple: the electric motor market was overcrowded. According to one estimate,the total existing annual capacity in the country for producing electrical motors was 0.573 million H.P. while its utilization was around 50% in 1976. [N.D.I.S.C., 1976, p. 96].

It may be noted that diversification into inferior products did not require upgrading or major adaptation of the existing production capacity of the small-scale firms. As discussed in Chapter 7, these firms had general purpose machines and equipment which was generally sufficient to produce the new but technically inferior products. A few necessary changes required in some cases could be easily made. These firms also had the necessary skills and experience in engineering goods production. Finally, the possibilities of division of labour, at least in the case of some products, made diversification easy. For example, a diesel engine firm could easily add C.W.P. to its products by obtaining the casting from the existing foundries, and doing the rest (machining, fitting, finishing) itself. So given demand, the small-scale firms had the resources to diversify into inferior product lines.

A few small-scale firms also diversified into similar products: 2 out of 30 diesel engine firms in our sample produced products requiring the same level of technology as S.S.D.E. /Table 8.2/. The new product they introduced was 'ammonia compressor' used for refrigeration purposes. Since these firms make an exception in this respect, their cases need detailed examination.

Though possessing the general characteristics of the small-scale ARE firms, these two enterprises also had a few distinctive features. For example, the owner of the first firm had been formally trained in foundry technology at a government technical training institute. First established in 1956 as a general engineering workshop, this firm started diesel engine manufacturing in 1962. It managed to expand its business through the 1960s but declined after 1969. This firm possessed more machines than an average small-scale firm, a part of which was inherited from the father of the present owner, who also owned a general engineering workshop in Lahore. Though the firms' initial finance came from private sources, it also used institutional finance for working capital during the expansion phase. For instance, this firm obtained a bank loan of over Rs. 50,000 for two years in 1968. This firm did not use institutional credit in 1981-82. But its business also included trading in engineering products.

The second small-scale firm that diversified into 'similar' products was also overall more resourceful than most of the small enterprises. The owner of this firm attended a high school, though he had received informal technical training. However, his workers included three family members, including a brother, who was an ex-employee of an old pioneering diesel engine firm, and had the ability to copy product designs and work out the production details. During the peak period in the late 1960s, this firm employed 8-10 workers, and produced 30-40 S.S.D.E. per annum. In the contraction phase, however, the firm suffered big sales losses, and started producing ammonia compressors.

These two cases show that, irrespective of its size, a firm's ability to diversify is determined by its strength to use certain types of resources and technology, and exploitation of certain type of market.

Finally, there also existed a number of diesel engine small-scale firms which had given up production of diesel engine and gone back to their original position of engineering workshops. Their entry into and exit from the irrigation market constituted an important industrial development in Pakistan. For these firms the decline in demand for their only product (S.S.D.E.) came too unexpectedly. The suddenness of the fall in demand for diesel engine did not allow them to diversify which was a reflection of their limited resources. These limitations were of two kinds: (1) narrow technological base and

(2) limited organizational ability. However, given their resources and experience, they could revert to their original position of general engineering workshops. These firms admitted their inability to diversify into new product lines in the short run but had not totally given up plans of entering a new market, should an opportunity arise in future.

<u>Summary</u>

We now bring together various (the demand side and supply side) factors that suggest an explanation of the sudden decline of the small-scale irrigation sector in the post-burgeoning period (1973-83).

At the macrolevel, economic policy seems to have played its role in shaping the new events in the industry. Contrary to the economic policy of the 1960s which promoted private industrial activity, the industrial policy of the 1970s shifted the emphasis to the public sector. As a result of this, private industrial investment dried up in this period. This was largely compensated by public sector industrial investment, but it was entirely in large (e.g. steel mills, cement factories etc.) projects which had their backward linkages with the foreign suppliers, and were too remote to offer small firms any opportunity to enter or expand.

A number of other factors also adversely affected the ARE industry in this period viz., (1) decline in demand for tubewells, (2) increased raw material cost, (3) increased price of diesel oil, and (4) relaxation of import restrictions on H.S.D.E. Of these, the single most important factor was the decline in demand for private tubewells, especially for diesel tubewells. Thus, we observe a sharp decline in the private agriculture market in the 1970s: the average annual private tubewell installation fell from 14,700 in 1970/71-1974/75 to 7,400 in 1975/76-1979/80, and further down to 6,400 in 1979/80-1982/83.

Declining domestic tubewell market and import of H.S.D.E. in the 1970s posed a threat to the continued survival of the small-scale irrigation sector firms. Under these conditions, the survival of the small-scale firms lay in diversification. But when the private agriculture market rapidly declined, other markets were not available for the small enterprises to enter i.e. there did not exist opportunities appropriate to the resources and the technological capability of the small-scale firms. It may be noted that there did not exist any export prospects for the small-scale firms because they neither produced export-quality products nor had the organizational ability to sell abroad.

So, as for the diversification possibilities for those firms, there were two broad alternatives: (1) superior products market, or (2) similar and inferior products market.

The most important and related, though technically superior, product was H.S.D.E. But the small-scale firms were unable to diversify into this line because: (1) there existed limited demand for H.S.D.E. in the 1970s; (2) the small enterprises were unable to acquire foreign technology without which H.S.D.E. could not be produced (which is evident from the fact that even the large-scale firms could not produce without acquiring foreign technology); (3) because the H.S.D.E. was a closed machine, there were few possibilities of technical separability (vertical division of labour) of the production process; (4) small-scale manufacturing of H.S.D.E. or its parts was economically not feasible because the individual items of equipment required for production was too 'indivisible' and expensive; (5) the firms did not have access to institutional finance; and (6) they lacked the engineering and organizatonal capability for H.S.D.E. manufacturing.

The resources required to produce H.S.D.E. indicate that a small-scale firm could diversify into it only by growing into a big enterprise i.e. possessing the required minimum resources which they did not have till 1983. This raises the question: why did the small-scale firms fail to build up their resources during the expansion phase (1960-73) when the market opportunities were favourable?

As observed in Chapter 7, the lower end of the private agriculture market in which the small enterprises operated was highly competitive. These firms worked on very low profit basis and could hardly accumulate capital for reinvestment; hence, their inability to upgrade their technology, The main point is that there was neither an incentive nor the resources for the small-scale firms to upgrade their technology in this period for possible diversification into superior products. For example, at least some of the small-scale firms could have moved into the upper end (the high-quality segment occupied by firms like Beco) of the S.S.D.E. market by upgrading their technology but the costs were too high for these enterprises. Because of their relative cost disadvantages, small-scale firms could not compete against the large-scale firms in that segment of the market.

The other alternative for the small-scale firms in these conditions was to diversify into 'similar' or 'inferior' products. In fact, very few firms diversified into products requiring the same level of technology as used in S.S.D.E. manufacturing. This was also mainly attributable to their limited resources. Most of the small-scale firms which diversified managed to get into inferior products like cultivation machinery and equipment. Diversification into inferior products was comparatively easy as it did not require technology upgrading. Firms made use of their existing resources, machines, tools, and technical and management skills to produce a number of simple products. This diversification effort was helped by possibilities of division of labour, at least in the case of some products like the ordinary centrifugal water pump. For example, a small-scale diesel engine firm could easily produce an C.W.P. by buying castings and some of the parts from the specialist firms, and finishing off the job itself.

Thus, given demand, these firms had the ability to diversify into new product lines requiring inferior or similar technology, though there did not exist many opportunities in the 1970s. Only the cultivation machinery market appeared to offer investment opportunity appropriate to the resources of these firms. But the expansion of the cultivation market in this period did not warrant large-scale entry of these firms into it.

Lastly, some of the firms totally gave up diesel engine manufacturing and returned to their original position of engineering workshops. These firms had the least resources and organizational ability. The suddenness of fall in demand for tubewells did not give these firms sufficient time to find alternative lines of production. Their inability to diversify into any other product showed the extent of their limited resources.

To conclude, the explanation of the decline of irrigation sector firms in the post-1973 period rests on four factors: (1) the nature of the markets in the 1970s; (2) narrow technological base of the firms; (3) shortage of capital; and (4) limited organizational ability.

Footnotes

Chapter Eight

1/ This refers to the shape of carbon in cast iron. Nodular (with lumpy carbon contents) iron is stronger then the ordinary cast iron.

2/ This firm displayed a self-manufactured vertical H.S.D.E. in its show room but did not produce it on regular basis.

3/ Compressors are used to increase the pressure of wide variety of gases and vapours for a multitude of purposes. The ammonia compressor (used for refrigeration) compresses the gas formed in the evaporator. In a simple compressor, like those produced by these firms, a light weight piston of the type used in an internal combustion engine is reciprocated by a crank and connecting rod. The internal structure of S.S.D.E. and compressor have many similarities, and so is the technology required to produce them.

4/ The Chinese H.S.D.E. is known to be a prototype of a Japanese engine called Yanmar.

Part III

INTRODUCTION

We now turn to the cultivation sector of the Agriculture-Related Engineering Industry of the Punjab which consisted of about 400 firms in 1982-83. Although the irrigation and cultivation sectors of the ARE industry started from a similar background around 1950, the expansion of the latter started much later than that of the former. From 1950, and through the 1960s, the cultivation sector did not increase much in size, the only major development being the establishment of a few tractor-assembly plants in the 1960s.

The majority of cultivation firms in this period operated at the small-scale, without significant increase in their number or size. Child and Kaneda noted the slow growth of the cultivation sector firms until 1968-69 and pointed out that the "tubewells firms are typically younger, smaller and more aggressive than the non-tubewell firms /1974-75, p. 250/. According to their estimates, there existed in 1969, 89 cultivation sector firms in the Punjab which employed 1,391 production workers; in 1964 the same number of firms had employed 1394 workers. /p. 265/. This sector remained almost unchanged between 1964 and 1969. These estimates show two things: first, that the number of cultivation firms in the Punjab was much smaller than the irrigation firms (444 in 1969); and, second, judging by the number of production workers employed, the size of the existing cultivation sector did not grow at all between 1964 and 1969.

The real expansion of this sector started in the early 1970s which coincided with the decline of the irrigation sector. By 1982, there existed 397 cultivation firms in the Punjab; out of which 378 were small, 13 medium sized and 6 large.[1] These firms are conveniently divided into two groups: (1) those which produced traditional implements; and (2) others that specialized in modern cultivation equipment.[2]

These observations raise three questions: (1) why did the rapid growth of the cultivation sector start so late? (2) what factors led to the emergence of a pyramid like structure of the cultivation sector?; and (3) in what respects was it different from that of the irrigation sector?

Discussion of these issues also throws up the question of growth barriers confronted by the cultivation sector firms which need to be identified. The following two chapters deal with these questions.

Footnotes: Introduction to Part III

1/ This classification is based on fixed assets of the firms. For details see section 4.2.4, Chapter 4.

2/ Though separate statistics on the two types of firms are not available, but our survey revealed that most of the newly established firms entered the modern cultivation machinery sector. It may be noted that this division is by no means absolute as some firms produce both types of products.

CHAPTER NINE

EMERGENCE AND GROWTH OF THE CULTIVATION SECTOR: 1950-83

We attempt to explain the emergence and growth of the cultivation sector by analysing the interaction between market expansion and the cultivation firms' response to it. For this purpose we divide the entire period (1950-83) into two phases: phase I = 1950-70; and phase II = 1970-83.

9.1 Phase I (1950-70): Slow Growth of the Cultivation Sector

This period can be subdivided into two phases consisting of the 1950s and the 1960s.

9.1.1 1950-60

Inspite of a well established metal working tradition, including fabrication of cultivation implements, and village level blacksmith workshops, no significant change was observed in the cultivation sector till 1960. The existing small-scale firms operated as 'general engineering' workshops which undertook variety of jobs. During this period no significant new product was introduced by firms in this sector. Even a large-scale firm such as Beco, continued to confine its production of cultivation equipment to traditional implements such as ploughs, sugarcane crushers and chaff cutters.

The primary reason for this stagnant state of this sector was the lack of any important change in demand for the cultivation equipment in this period. Since the agriculture sector stagnated until the end of the 1950s, there was little scope for the introduction of mechanical techniques. For example, the number of privately-owned tractors on farms increased from 500 in 1947 to only 2,624 in 1958 /Government of Pakistan, 1970,(b) p. 37/. Whatever little modern cultivation equipment existed on the farms was imported.

There existed very few import restrictions on cultivation equipment in this period. Prior to 1952, tractors and other types of equipment were freely imported. From that year commercial import of a cultivation equipment was placed under restricted licencing, while private farmers could import under the open general licence (OGL) scheme, which continued until the mid-1960s. Despite easy availability of modern cultivation equipment, its adoption was largely restricted to a small number of big landlords. The main reason for lack of diffusion of modern cultivation equipment in agriculture was its' high cost. Because of the overall slow agricultural growth in this period only the big landlords could invest in imported modern cultivation equipment. Hence the aggregate demand for it remained very low. The other factors responsible for the slow adoption of modern cultivation machinery in the 1950s were: (1) lack of appropriate machinery; (2) lack of credit; (3) lack of spare parts; and (4) absence of local repair and manufacturing facilities. /Government of Pakistan, 1968(b)/.

To sum up the conditions existing in the cultivation sector in the 1950s, there was insufficient demand for the cultivation equipment which failed to induce the domestic firms to take up manufacturing of modern equipment. The large-scale as well as small-scale firms produced traditional cultivation equipment and made no efforts to acquire designs, skills, machinery etc., for producing modern products. The cultivation sector of the ARE industry remained as static as the agricultural sector until the end of the 1950s.

9.1.2 1960-70

From the cultivation sector perspective, the decade of the 1960s can be separated from the earlier period by one significant development, namely, the entry of a few private large-scale firms, of which two were located in the Punjab. Otherwise, this sector expanded slowly, without showing the buoyancy noted in the irrigation sector in the same period.

As already noted in Chapter 2, the stage for the entry of large-scale tractor/implements assembly/manufacturing firms into this sector in the 1960s was set by the new agricultural policy which created a new economic climate 'that permitted or induced the use of improved physical inputs' /Falcon and Gotsch, 1968, p. 300/.

Following the introduction of the new agricultural technology in the mid-1960s the cropping intensity in the irrigated areas substantially improved. Increased cropping intensity created a situation where harvesting of one crop and ground preparation for the next could not be carried out rapidly enough using labour-intensive methods. To put it differently, the full benefits of the new irrigation technology could not be reaped without some form of mechanisation of cultivation.

To promote mechanisation of cultivation government allowed liberal import of tractors and also supported it with subsidies and cheap credit /Ahmad, 1976/. The number of tractors in Pakistan rapidly increased from 2,642 in 1958 to 18,909 in 1968; 88 per cent of these were privately owned. (Punjabs share in the total was 79 per cent). /Government of Pakistan, 1970(b), p. 57/.

To make effective use of tractors on farms it was also necessary to select appropriate cultivation equipment. However, the import of tractor-driven implements and machines remained far below that of the tractors and their total number was quite small even towards the end of the 1960s. According to official estimates, there existed a total of 22,088 units of tractor-driven equipment in Pakistan in 1968. /Government of Pakistan, 1970(b), p. 62/. According to one study, a farmer needs at least 3-4 modern implements to make proper use of a tractor in the irrigated areas of the Punjab. Thus, by this standard, there was ample scope for producing modern cultivation implements in the country because till then they were imported and not readily available.

In response to the existing demand in the 1960s, a number of private firms were established for assembly-cum-gradual manufacturing of tractors and their attachments.

These firms had planned a phased programme of progressive changeover to domestic manufacturing over 3-9 years. It was believed that these firms would be in a position to save 35-80 per cent of the existing foreign exchange cost of imports by producing up to 80 per cent of the tractor parts domestically.[2]

However, these large projects ran into serious difficulties on two accounts: (1) supporting industries' inability to supply parts and components;[3] and (2) unfavourable changes in import policy.

The import policy revision in the second half of the 1960s affected the progress of the large-scale tractor projects but also the overall growth of the cultivation sector in this period. First, additional restrictions on the import of industrial raw materials (e.g. iron, steel and coke needed for cultivation implements/machinery) in the second half of the 1960s sharply increased their cost, resulting in price increase of domestically produced equipment. [Appendix Table A.9.2]. Moreover, the existing fiscal system in 1968-69 had created an anomaly: while pig iron and M.S. sheets were taxed at the rate of 25% and 40%, respectively; agricultural implements imports were taxed at a very favourable rate of 5%. [Appendix Table A.9.3]. The conditions were further compounded by the provision that whereas the raw materials required for cultivation products were imported under cash-cum-bonus scheme, the cultivation machinery imports were arranged under foreign loans. Thus the imported equipment was far less expensive than the domestically manufactured-cum-assembled. All those regulations created a situation where the domestically produced cultivation products became non-competitive against their imported counter-parts, resulting in slow growth of the domestic cultivation sector till the end of the 1960s.

In contrast, tubewell manufacturing firms of Pakistan enjoyed protection against imported machines in the 1960s. Government had disallowed import of diesel engines of less than 20 H.P. Similarly, import of low capacity (below 4 cusecs) centrifugal water pumps was disallowed, thus providing a secure and expanding market to the irrigation sector firms in this period.

Thus, till the end of the 1960s farm mechanisation effort in Pakistan remained essentially import dependent. The large-scale firms imported tractors and other cultivation equipment in completely knocked-down (CKD) or partly knocked down (PKD) form. These large-scale firms failed to establish links with small enterprises because they had their backward linkages with foreign suppliers. Therefore the assembly of tractors, etc. did not promote domestic manufacturing of parts of cultivation machinery, with the exception of some minor components like nuts and bolts. The large and small firms existed almost independently of each other - something entirely different from what happened in the irrigation sector in the same period.

To sum up the state of the cultivation sector in the first phase (1950-70), the demand for farm machinery increased slowly in this period. By the late 1960s, the size of the cultivation sector was still quite small, consisting of only 89 firms. There existed at least 6 large-scale firms, four of which set up tractor/implements assembly/manufacturing plants, and small-scale enterprises that produced traditional cultivation implements using very simple technology. Two of the four tractor assembly plants were in the Punjab, and the other 2 in Karachi, Sind. Most of the small-scale firms were located in the Punjab, particularly in the district towns of Faisalabad, Multan, Sargodha and Gujranwala [see section 4.4, Chapter 4].

9.2 Phase II (1970-83): Rapid Growth of the Cultivation Sector

Widespread diffusion of the new agricultural technology, especially tubewells, in Pakistan from the mid-1960s led to increased demand for farm power input because timely sowing and cropping of HYV of crops became essential. Traditional cultivation techniques, using human labour and draught animals, largely remained unchanged. According to official estimates, there was, on average, 0.1 HP available per acre of cultivated land in Pakistan in 1968, but a minimum of 0.2 HP per acre was required for the proper utilization of the new technology. [Government of Pakistan, 1970(b), p. 8].

Thus, the need for filling the gap between the available and required power input through suitable increase in tractors and other cultivation equipment was explicitly stated in the Report of the Farm Mechanization Committee, Government of Pakistan, 1970. These considerations determined the set of direct and indirect incentives provided by the government to promote investment in farm mechanisation. /see Section 2.4, Chapter 2/.

This led to increased import of agricultural machinery, particularly tractors, in the 1970s. The tractor import into Pakistan jumped from an annual average of 3,613 in 1965/66-1969/70 to 6,461 in 1970/71-1974/75, and to 15,393 in 1975/76-1981/82. /Table 2.13, Chapter 2/. In 1983, tractors provided almost 53 per cent of the farm power available in the country; the rest came from animal power and humanpower.

One outcome of the widespread use of tractors on farms was a significant increase in demand for agricultural machinery and implements; not only there arose additional demand for the products already in use, there also emerged demand for new types of cultivation equipment e.g. seed drills, fertilizer distributor, power tiller, reaper-binder, etc.

9.2.1 Market Segmentation:

As already noted in Chapter 2, the use of cultivation machinery rapidly expanded in Pakistan during the 1970s. By 1982-83, a fairly large domestic market for the cultivation products had developed to justify increased indigenous production. /Table 9.1/. The products included both the traditional and modern agricultural machinery and implements. In 1982-83 the sales of most popular 'modern' cultivation equipment were: cultivators (23,000); tractors trolleys (12,800); wheat threshers (12,300); tractor rear blades (5,400): and seed drills (1,250). Among the 'traditional' products, the two with high sales were: chaff cutters (20,000) and cane crushers (27,700). Demand for these products came from different farm groups: the small, the medium and the large, each with its special needs.

The small farms (area less than 12.5 acre and covering 30 per cent of the total farm area) were essentially subsistence units, and not really able to adopt modern mechanised farming methods. They relied mostly on manual or animal-driven traditional agricultural implements. Those agricultural implements were produced by village workshops and the small-scale urban firms. Since only about 25 per cent of their demand is met by the urban firms, it was not easy to determine the actual sales of traditional implements. Hence any estimates of these sales remain at best a guess.

The next group of farms (area between 12.5 to 50 acres) claimed the largest share (45 per cent) of the total farm area in the country. These farms needed cheaper but modern cultivation machinery like small tractors (below 45 HP). The machinery requirements of medium-sized farms were mostly met by the medium-sized and the large-scale firms or by imports. It is worth

Table 9.1

Estimated Sales of Domestically Manufactured And Imported Cultivation Machinery and Implements in Pakistan: 1982-83

Machines/Implements	Origin	Local Content (%)	Unit Price (Rs)	Quantity Sold
TRACTORS:				
Beylarus MTZ-50 (55 hp)	USSR	25	93,000	600
Fiat-480 (50hp)	Italy	15	101,750	6,000
Fiat-640 (64hp)	-do-	nil	146,800	400
Ford-4610 (62hp)	U.K.	nil	126,000	410
Ford-3610 (50hp)	U.K.	nil	112,000	11
IMT-560 (64hp)	Yugoslavia	nil	98,600	305
IMT-540 (52hp)	-do-	40	76,400	3,740
MF-26 (62hp)	U.K.	nil	115,000	1,500
MF- (47hp)	-do-	40	85,000	7,769
MF-210 (25hp)	Japan	nil	57,000	300
POWER TILLERS:				
Dung-Fong (12hp)	Peoples Republic of China	nil	24,300	100
LAND DEVELOPMENT IMPLEMENTS:				
Front Blade	Pakistan	100	4,900	270
Rear Blade	-do-	100	1,800	5,400
Land Leveller	-do-	100	2,700	200
Cultivator	Pakistan	100	3,200	23,000
Cultivator	U.K.	nil	8,000	60

Table 9.1 (Cont'd.)

Machines/Implements	Origin	Local Content (%)	Unit Price (Rs)	Quantity Sold
PLANTING IMPLEMENTS:				
Seed Drill	Pakistan	100	4,100	1,250
Seed Drill	Denmark	nil	12,000	22
Maize & Cotton Planter	Pakistan	100	5,000	618
Groundnut Planter	-do-	100	3,900	14
Ridger	-do-	100	3,700	444
Ridger	U.K.	60	7,600	26
Post Hole Digger	U.K.	nil	16,250	15
Potato Planter	Pakistan	100	3,500	107
WEEDING & HOEING IMPLEMENTS:				
Bar Harrow	Pakistan	100	2,600	180
SPRAYERS & BROADCASTERS:				
Power Sprayer	Pakistan	100	11,000	177
Power Sprayer	Italy	12	15,000	3
Scraper	Pakistan	100	11,000	170
Plank (Iron)	-do-	100	11,100	20
Border Disc	-do-	100	4,100	164
Border Disc	U.K.	60	5,000	20
Ditcher	Pakistan	100	3,000	71
PRIMARY TILLAGE IMPLEMENTS:				
M.B. Plough	Pakistan	100	4,400	250
Disc Plough	Spain	60	17,000	43
Chisel Plough	Pakistan	100	3,600	520
Chisel Plough	Spain	nil	8,000	25
Rotavator	Italy	nil	15,000	25
Rotavator	Yugosalvia	nil	16,000	250
Rotavator	West Germany	nil	12,000-16,000	240
Sub-Soiler	Pakistan	100	1,800	55

Table 9.1 (Cont'd.)

Machines/Implements	Origin	Local Content (%)	Unit Price (Rs)	Quantity Sold
SECONDARY TILLAGE IMPLEMENTS:				
Disc Harrow	Spain	60	4,500	175
Disc Harrow	Yugoslavia	nil	7,100	50
Disc Harrow	Australia	nil	11,000	15
Wheel Barrow Sprayer	Pakistan	90	3,500	10
HARVESTING MACHINERY:				
Reaper-windrower	Pakistan	100	14,000	461
Combine Harvester	Denmark	nil	115,000	33
Potato Digger	Pakistan	100	5,700	19
Groundnut Digger	-do-	100	3,500	155
THRESHING MACHINERY:				
Wheat Thresher	Pakistan	100	16,500	12,300
	-do-	100	21,000	16
Sunflower Thresher	-do-	100	11,000	63
Maize Sheller	-do-	100	4,100	80
HANDLING & HAULAGE MACHINERY:				
Trolley	Pakistan	100	12,000	12,800
OTHERS:				
Cane Crusher	Pakistan	100	1,900	17,700
Chaff Cutter	Pakistan	100	600	20,000
Manure Spreader	U.K.	nil	196,967	1
Grain Dryer	U.S.A.	nil	140,000	7
Sugar Extractor	Pakistan	100	1,200	10
P.T.O. Pulley	Pakistan	100	950	2,000

Notes: The sales figures for imported items are actual, while those for locally produced items are projected from a limited survey carried out by the Farm Machinery Institute.

Source: Country Report: 1983-84, presented by Dr. S.I. Ahmad, at 2nd International Conference on Agricultural Mechanisation, Amsterdam, The Netherlands, Table 4, page 9.

emphasising here that the medium-sized firms of the Punjab were broadly divided into two groups: (1) those which produced the popular but traditional products like cane crushers and fodder choppers; and (2) the others that specialized in modern products such as seed drills, harrows, etc. There existed only a few units that produced both types of products in this category of firms.

The large farms (over 50 acres in size) and commanding 25 per cent of the total farm area were the first to be mechanised. Their farm machinery needs had been met through imports for a long time. The best example in this case was that of high powered tractor (47-75 HP) which, even after more than 30 years of use, was still an essentially imported item.[6/] So was the case with the other similar items like reaper binder and harvester used at large farms.

To sum up, we have noted that the overall size of cultivation products market expanded quite rapidly in this period. Second, this market had two main segments consisting of traditional and modern products. Much of the growth in the cultivation sector in this period took place in the modern products segment. Within the modern products sector, demand for simpler tractor-driven equipment such as cultivators, harrows, etc. far exceeded that of the sophisticated machines like combine harvesters.

9.2.2 Supply Response of the Cultivation Sector Firms

Following the continuous growth over the years, the demand for modern cultivation equipment in this period reached a level at which indigenous production offered good investment prospects, and led to the entry of many small-scale firms in this sector. For instance, our survey based data on the age structure of 42 cultivation firms show that: (1) the entry of firms into the cultivation sector as compared with the previous period almost doubled during 1970-83; and (2) the number of small-scale firms entering this sector between 1970-83 more than doubled over the previous period i.e. 1960-70 /Table 9.2/.

Rapid growth of the cultivation sector in this period took place in an environment determined by: (1) technology; (2) availability of physical inputs; (3) finance; and (4) government policy. A study of these factors seems essential for understanding the mechanism of growth in this sector. It is to this task that we now turn.

9.2.2.1 The Nature of the Technology

First, let us see what role technology played in the rapid growth of the cultivation sector in this period (1970-83).

The cultivation sector of the ARE produces numerous and varied products, ranging from simple

Table 9.2

Age Structure of Cultivation-Sector Firms[1/] in the Punjab, Pakistan

(Survey Based: 1981-82)

Type of Firms	Number of Firms and the Period of Entry into Cultivation Sector				
	Pre-1947	1947-60	1960-70	1970-83	Total
Small-Scale	2	2	6	15	25
Medium-Sized	-	3	5	7	15
Large-Scale	1	-	1	-	2
	3	5	12	22	42

Note: (1) These firms do not include any tractor manufacturing/assembling units.

traditional ploughs to the modern tractor-driven machines like the cutter-binder, and even the tractor. Hence we find in this sector a fairly broad range of techniques being used to suit the production requirements of different products. We will deal only with the tractor-driven cultivation equipment, which includes numerous products, viz., (1) ripper (sub-soiler), (2) ploughs (disc, mouldboard and chisel) (3) cultivation (tiller, row crop); (4) harrow; (5) rotavator, (6) scrubber, (7) seed drills, (8) row-crop planter, (9) transplanting equipment; (6) fertilizer distributor, and many others. /Appendix Tables A.9.1 and A.9.2/.

One noteworthy point about the cultivation sector technology is that, except in the case of the tractor and the harvester, it is simple and within the means of a typical small engineering enterprise. The only engineering bottleneck is the availability of appropriate product designs; these are mostly obtained by the large-scale firms and copied by the small-scale firms. Production of these implements generally does not pose serious technical problems for small-scale firms. The manufacturing of most of the cultivation equipment basically involves nothing more than blacksmiths' job. The production process consists of the following stages:

(1) casting of iron/steel or procurement of cast iron from specialist foundry firms.

(2) cutting of profiles

(3) metal joining and welding

(4) machining of shafts

(5) assembly and finishing.

The raw materials and the cast parts and components are usually obtained from the specialist firms which saves the manufacturing firms the heat treatment (e.g. hardening, tampering, annealing etc.) of metals. Thus, the small-scale cultivation sector firms have access to the specialist casting services - as is the case in the irrigation sector. Manufacturing of cultivation equipment requires both ferrous and non-ferrous metals. The ferrous metals used in this case include cast iron, carbon steels and alloy steels. The non-ferrous metals used in cultivation machinery are copper, zinc, lead, aluminium, brass and bronze. These metals may be used in any one of the different forms viz., profiles, angle irons, pipes strips, springs and iron sheets of certain specifications. In addition, use is also made of certain types of plastics, canvas and rubber. Majority of the firms produce most of the components themselves. Only a few sophisticated components are either imported or purchased from specialist firms. Those include ball bearings, bearings, seals, belts, springs, roller chains, discs, cultivator sweeps and plough shares.

Manufacturing of cultivation equipment does not require sophisticated machinery because the processes involved are quite simple. The equipment needed in this sector consists of basic metal working machines such as ordinary lathes, drilling machines, welding sets, shearing machines, presses, etc. Data included in Tables 9.3 and 9.4 show the composition of machinery used by small-scale, medium-sized and large-scale

Table 9.3

Composition of Machinery in the Small-Scale Cultivation-Sector Firms (in the Punjab

(Sample Based = 1981-82)

Type of Machinery \ Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Ordinary Lathe Machine	-	3	2	4	1	2	2	1	2	1	2	-	1	-	-	1	2	1	2	2	1	-	2	1	1
Modern Lathe Machine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drilling Machine	1	2	1	2	1	1	1	3	2	2	2	3	2	1	2	1	1	3	2	2	2	2	1	2	2
Gas Welding Equipment	3	1	2	1	2	3	1	1	2	1	1	2	1	2	1	2	1	2	2	1	1	1	3	1	2
Electric Welding Equipment	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grinders		1	1	2	-	1	-	-	1	1	1	2	1	1		1	1	2	2	1	1	1	2	1	1
Shearing /Bending Machine	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Shaping Machine	1	-	-	1	-	-	-	1	-	-	-	1	-	1	-	-	-	-	1	-	1	-	1	-	-
Presses (Manual)	-	1	1	-	1	1	-	2	-	-	-	1	-	1	-	-	-	-	1	1	-	-	-	-	1
Cupola Casting Furnaces	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Special Machine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

(1) Machines are not exclusively used for cultivation products manufacturing.
(2) Reliable statistics on tools could not be obtained.

Table 9.4

Composotion of Machinery[1] in the Medium-Sized and Large-Scale Cultivation-Sector Firms in the Punjab

(Sample Based = 1981-82)

Units / Type of Machinery	Medium-Sized															Large-Scale	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2
Ordinary Lathe Machine	5	4	2	3	6	4	4	3	3	4	4	3	5	3	4	25	35
Special Lathe Machine	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	12	15
Drilling Machine	3	3	2	2	3	1	2	2	3	2	2	2	3	2	4	8	6
Gas Welding Plant	1	2	2	1	2	1	1	1	1	2	1	2	1	1	3	10	5
Electric Welding Plant	1	1	-	-	-	1	-	-	-	-	-	-	-	1	1	6	10
Grinding Machine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	7
Shearing Machine	-	-	-	-	1	-	-	-	-	-	-	-	1	-	1	3	5
Shaping Machine	2	1	-	1	2	-	2	-	-	-	-	-	1	1	2	6	10
Press	1	-	-	1	2	-	-	-	-	1	2	1	1	1	1	5	8
Cupola Furnace[2]	1	1	-	-	2	-	-	1	-	2	-	1	2	3	2	15	10
Special Purpose Machine	1	-	-	-	2	-	1	-	-	-	-	-	1	-	1	20	50

Notes:

(1) The machines are not exclusively used for cultivation equipment manufacturing.
(2) The large-scale firms also have electric furnaces.
(3) Reliable statistics on tools could not be obtained.

firms. We observe from this data that, on average, a small-scale cultivation firm uses 1-2 ordinary lathes (often domestically-made), 1-2 drilling machines, a gas welding plant, a manual shearing machine, and a manual press. (The very small enterprises, producing the implements, do not possess lathes, etc.) These machines are less sophisticated than those used by the small irrigation enterprises (e.g. planing machines, shaping machines, etc.) and cost much less to buy.

It was also interesting to note that there was no great difference between the machinery composition of medium-sized and small-scale firms, though some medium-sized cultivation firms used some special-purpose equipment e.g. honing machines. The major difference between the two types of firms was that many (9 out of 15) of the medium enterprises had their own foundry shop which they also used for supplying castings to small-scale firms. As for the similarity in the machinery composition between the small-scale and medium-sized firms, it was attributable to the similarity of the products produced, and the production methods (often manual) adopted by the two types of firms.

9.2.2.2 Choice of Technique in the Manufacture of Wheat Thresher

We take the case of the wheat thresher (a machine very widely adopted in the Punjab agriculture during this period)[5/] to examine the role of technology in the cultivation sector's growth.

The Wheat Thresher

The wheat threshing machine removes the grain from the ear by a revolving drum (cylinder). The bars (or beaters) on the revolving drum knock the grain out of the ears, and the grain is separated from the straw at a later stage. The cylinder (drum) and 'concave' (a curved grid) are two vital components of a threshing machine. The periphery of the drum is made up of beater bars which can be of different types The 'concave' is set relative to the beater bars of the cylinder, and rotates on its central spindle. This rotation draws the wheat in between the beater bars of the cylinder and the cross bars of the concave, and takes the grain out of the ears.

The threshing rate can be changed by altering the drum speed and the position of the concave; but this is possible only in a multi-crop thresher or a combine harvester which use variable speed pulleys to control the threshing speed. The point to note is that various crops require different degrees of threshing to remove the grain from the ear.

Thus, we may divide threshing machines into two broad categories; single crop or multi-crop. Whereas the single-crop thresher, as its name implies, is suitable for threshing grain from one crop only, the multi-crop (variable speed) threshing machine can be used for different crops. The best example of a multi-crop thresher is a combine-harvester which combines threshing with reaping, and even baling. It is also possible to produce a multi-crop thresher without a reaper.

The stationary wheat threshers produced in Pakistan are designed for single crop[6] and do not have provisions for speed variation. This machine operates by threshing grains from wheat stems by violent impact and in this process also yields cut and pulverized straw, a by-product used as animal feed. The wheat thresher is powered by a large tractor (45 HP or more), a 25 HP electric motor, or by a 35 HP stationary diesel engine.

The technology required to produce the single crop thresher is quite simple. The production process involves shearing of metal sheet, perforation of sheet, welding into different shapes, fixing of beater bars, and assembling it into the main frame which is made of iron angles, bars and profiles. The entire process can be carried out manually, the use of automated or other advanced type of equipment is not essential. Two important tasks involved are shearing and bending for which machines should be used to ensure precision and quality. However, the same work can be done manually though with some loss of quality. For example, most of the small-scale and medium-sized cultivation firms in our sample were observed to produce threshers manually, on a one-off basis or, in some cases, in small batches though still using labour intensive methods. In fact, there was hardly any difference between the production techniques of the two types of firms except the scale of output.

What was really unexpected was the absence of even simple machines like press and mechanical shearer in some of the medium-sized firms. The main reason advanced for using the simple manual techniques was uncertainty about future demand, thus, reluctance to invest in specialized machinery. This was perhaps not the sole reason for choosing the most labour intensive techniques of production at this scale of production. Another factor that favoured the use of this technique was the seasonal demand for threshers. Because of this the firms could plan production - using labour intensive methods - well in advance of actual sales. In this context it was also common for the medium-sized manufacturing firms to engage temporary labour in off-peak season in order to cut down on wage costs and other levies payable on the employment of permanent labour.

In essence, the production organization of the small-scale and medium-sized cultivation firms differed only in terms of scale of output. Otherwise, the two types of firms used (including reconditioned) similar machines, employed workers with almost similar skills, and followed the same management practices.[7/]

However, there was a notable difference between the quality of the products produced by different types of firms. Higher product quality was achieved by medium-sized firms by using relatively better raw materials and labour with longer experience than by more modern production methods.

Thus, we note two salient features of the technology used in the manufacture of cultivation equipment excluding tractor and combine harvester: (1) its' level of sophistication is low i.e. the machines, skills and engineering knowledge required are simple and accessible even to small enterprises; and (2) there is limited scope for specialisation (vertical division of labour) because of the simplicity of operations at different stages of production which can be carried out with general purpose equipment. For example, our sample-based evidence showed 'low' level of dependence of 42 cultivation firms on specialist enterprises /Table 9.5/. Comparison with the irrigation sector showed that, overall, the cultivation firms were less dependent on the specialist enterprises than the irrigation firms /See Table 6.1, Chapter 6/.

The 'low' dependence of the cultivation firms on specialist enterprises may be explained in terms of the nature of their products. For example, thresher, cane crusher and cultivator (three major cultivation products) are much less complicated products than a diesel engine. Their production does not involve jobs (precision machining etc.) which normally require the services of specialist enterprises. Hence, the cultivation firms are observed to be relatively more integrated than the irrigation firms.

It was also interesting to note that even the small-scale cultivation firms had low dependence on the specialist firms: 5 out of 7 'traditional' equipment producing firms, and all of the 18 'modern' equipment producing small enterprises were in the 'low' dependence group. This showed that within the small-scale

Table 9.5

Cultivation-Sector Firms' Dependence on Services[1] of Specialist Enterprises

(Based on a Sample of 42 Firms in the Punjab, 1981-82)

Major Product of the Firms	Number of Firms	Firm Size	Level of Dependence[2]			
			High	Medium[3]	Low	Nil
(1) Traditional Cultivation Equipment (ploughs, fodder cutter, sugar cane crusher, etc.)	7	Small-Scale	-	2 (28.5)	5 (71.5)	-
	9	Medium-Sized	-	-	2 (22.3)	7 (77.7)
	-	Large-Scale	-	-	-	-
(2) Modern Cultivation Equipment (Tractor driven implements)	18	Small-Scale	-	-	18 (100.0)	-
	6	Medium-Sized	-	-	4 (66.6)	2 (33.3)
	2	Large-Scale	-	-	-	2 (100.0)

Notes:

(1) These services include casting, forging, hardening, annealing, etc.
(2) Levels of dependence are defined thus: 'high' means more than 50 per cent of the entire job, including casting, is done outside the producing firm; 'medium' means 25-50 per cent; 'low' means less than 25 per cent; and 'nil' completely integrated production.
(3) Figures in parenthesis are percentages of the group to which firms belong.

sector, the 'modern equipment' manufacturing firms were still less dependent on the specialist firms. Thus, owing to the technical limitations, the traditional products firms had to rely on the specialist firms more than the modern cultivation equipment producing firms.

It needs to be emphasised that product quality, choice of technique and the level of integration (i.e. dependence of a firm on other firm(s) are closely related. A firm may be integrated (self-reliant) either because it has access to necessary equipment, or because of the low level of technology and the general purpose nature of equipment required - which allows a firm to undertake a relatively larger number of stages in the production process.

Hence, a small-scale cultivation firm's self-reliance compared to that of a small irrigation firm is due to (1) the low product quality, and (2) the low level of technology and the general purpose nature of equipment required for production. Similarly, the medium-sized cultivation firm's self-reliance is also attributable to the two above mentioned factors. But the case of the medium-sized irrigation firms is different because their technological requirements are higher and resources not always sufficient for self-reliance in production. In the use of large-scale firms, both cultivation and irrigation, the enterprises undertake a large number of stages in the production process. They even have the capability to carry out the specialist jobs because their scale of production makes it acceptable.

Besides, unutilized capacity of the special purpose machines can be used in the manufacturing of other products by the multiproduct large-scale firms. Thus, the differentiation between the factors determining the level of vertical integration of the small-scale and large-scale firms must be noted.

Hence the explanation of overall higher level of vertical integration noted among the cultivation sector firms may be sought in the product characteristics and the nature of technology. The type of technology required for manufacturing cultivation equipment (except tractors, combine harvestors, etc.) is simpler and less expensive to acquire than that needed for the irrigation products. Thus, even the small-scale firms have access to the essential machinery and other inputs needed for cultivation equipment production. For example, imported welding equipment is normally used by the large-scale cultivation firms for joining sheets, etc. These firms use full range of gas and electric welding techniques for shaping different products. The small-scale and the medium-sized firms, on the other hand, rely on oxy-acetyline and transformer-type manual arc equipment for this job. This equipment does not ensure as good a quality of welding as can be obtained by the other methods. The method is less efficient as it uses excess material, consumes more electricity and electrodes, and also causes heat distortion. Still it is widely used because (1) it is simple and familiar to the workers, and (2) at smaller scales costs less than the advanced techniques.

To sum up the discussion on the role of technology in the cultivation sector's growth, we have identified two main points: (1) the technology type required for cultivation products (excluding sophisticated products like tractors and combines) is simpler than that used in the irrigation sector; and (2) the degree of specialisation prevailing in the industry is much less than that in irrigation sector-technology. Hence, there exists higher degree of vertical integration among the cultivation firms.

9.2.2.3 <u>Physical Inputs</u>

Easy access to physical inputs, especially machinery, also contributed to the rapid growth of the cultivation sector in the 1970s.

As for the machines, their availability never posed a serious problem for the cultivation firms in the past. There always existed essential machines and tools in Pakistan, old and new, indigenous as well as imported to suit the requirements of various firms. Since 1947, the domestic machine tool industry had gradually developed its' productive capacity. In the early years, a few pioneering firms like Beco and Aulia Engineering produced general purpose machine tools which proved extremely useful in restoring the engineering industry after its' disruption in 1947. Over the years, these firms improved their production capabilities and started manufacturing sophisticated machine tools [see Section 5.2, Chapter 5].

So there was abundant supply of indigenous machine tools of various kinds in the 1970s and the firms could choose machines to suit their requirements. Imported machine tools were also widely accessible. What is noteworthy about the small-scale cultivation sector is that its' machinery requirements are generally low, and there exist considerable choice in production techniques. Thus, the cultivation firms had easy access to the essential machines and tools during the period of rapid growth in the 1970s.

However, unlike the irrigation sector firms, the cultivation sector firms were observed to use machines of relatively recent vintage. For example, 28 per cent of the small-scale firms in our sample used less than 5 years old machinery, 40 per cent firms between 5-10 years old, 24 per cent between 10-20 years old, and only 8 per cent made use of machinery older than 20 years /Table 9.6/. Comparison of this data with that of the irrigation sector small-scale firms /Table 7.5, Chapter 7/ indicate some notable differences in the age structure of the machinery used in the two sectors. For example, we note that as many as 46.5 per cent small-scale irrigation firms (compared to only 8 per cent in cultivation firms) used machines which were over 20 years old. Another 44.2 per cent of the small-scale irrigation firms relied on 10-20 years old machines, while only 24 per cent cultivation firms used machines of this age. Broadly similar, though less significant, differences also existed in the case of medium-sized firms of the two sectors. Overall, the cultivation sector

Table 9.6

Average Age and Origin of the Machinery Used by the Cultivation Sector Firms in the Punjab, Pakistan

(Survey Based: 1981-82)

Age of Machinery				Origin of Machinery		
Average Age[1] (Years)	Type of Firms	Number of Firms	%[2]	Origin[3]	Type of Firms	Number of Firms
Up to 5 years	Small	7	28.0			
	Medium	2	13.3	Domestic	Small	25
	Large	1	33.3		Medium	15
					Large	1
5 to 10 years	Small	10	40.0			
	Medium	7	46.6	Foreign	Small	-
	Large	2	66.7		Medium	3
					Large	2
10 to 20 years	Small	6	24.0			
	Medium	6	40.0	Self-Made[4]	Small	-
	Large	-	-		Medium	-
					Large	2
More than 20 years	Small	2	8.0			
	Medium	-	-			
	Large	-	-			

Notes: 1/ This refers to the 'average age' of the total machinery used by firm(s).
2/ Percentages refer to different groups of firms i.e. small, medium and large.
3/ A firm may have machinery of more than one origin.
4/ Self-made means fabricated by the same firm for its' use.

firms used relatively new machines and tools than the irrigation sector firms. There are two main reasons for this: (1) even the new machines used by the cultivation firms were relatively simpler and therefore cheaper and so within the means of small-scale cultivation firms; and (2) the average age of the cultivation firms, especially the small-scale, was less than that of the irrigation firms; therefore the average age of the machinery used by the cultivation firms in our sample was also less than that in the irrigation sector.

In short, the small-scale cultivation firms required simple and general purpose machines/tools, and generally employed relatively new machinery than the irrigation firms. These firms had easy access to the essential machines: new and old; imported and domestic.

9.2.2.4 Finance

The rapid growth of the cultivation sector in the 1970s was also helped by the low capital requirements, especially at the small-scale. Our data set out in Table 9.7 show that in a sample of 25 small-scale cultivation firms, all the units had fixed assets (excluding building and land) of less than Rs 50,000/-. In the case of medium-sized firms, 11 out of 15 (73.4 per cent) enterprises had fixed assets of between Rs 50,000/- to Rs100,000/-, and the other four firms (26.6 per cent) between Rs. 100,000/- to Rs. 500,000/-. The fixed assets of the two large-scale cultivation firms were substantially higher (i.e. more than Rs. 1,000,000) than those of the medium-sized and small-scale firms.

Table 9.7

Estimated Value of Fixed Assets (Excluding Land and Building) of the Cultivation Sector Firms in the Punjab, Pakistan

(Survey Based[1] = 1981-82)

Value of Fixed Assets	Number and Type of Firms		Percentages[2]
Less than Rs. 50,000	Small-Scale	25	100.0
	Medium-Sized	-	
	Large-Scale	-	
Rs 50,000 - Rs 100,000	Small-Scale	-	-
	Medium-Sized	11	73.4
	Large-Scale	-	-
Rs 100,000 - Rs 500,000	Small-Scale	-	-
	Medium-Sized	4	26.4
	Large-SCale	-	-
Rs 500,000 - Rs1,000,000	Small-Scale	-	-
	Medium-Sized	-	-
	Large-Scale	-	-
Over Rs1,000,000	Small-Scale	-	-
	Medium-Sized	-	-
	Large-Scale	2	100.0

Notes: 1/ The sample includes 25 small, 15 medium and 2 large enterprises.

2/ Percentages refer to the group in which a firm falls i.e. small, medium or large.

This data show that the capital cost of fixed investment (machinery and tools) was quite low at small-scale. It is also interesting to note that the financial requirements of entry at small-scale into the cultivation sector were lower than in the irrigation sector. Whereas all the 25 small-scale cultivation firms had fixed assets of less than Rs. 50,000/-, only 25 out of 43 (58.2 per cent) irrigation firms were in this group, the other 18 (41.8 per cent) irrigation units had assets worth between Rs. 50,000/- to Rs. 100,000/-. [see Table 7.7, Chapter 7]. So, when the cultivation sector market started expanding rapidly in the 1970s, the firms needed only small capital to start producing the cultivation products at small-scale level.

The most important source of 'initial' finance for the small-scale and medium-sized firms was private savings. As in the case of irrigation sector firms, all the cultivation firms in our sample relied on private finance to start their business. Similarly, all the medium-sized firms also utilized private savings at the time of entry into the cultivation sector. [Table 9.8]. Moreover, 5 out of 25 (20%) small-scale, and 9 out of 15 (60%) firms also made use of previous business savings for this purpose.

Institutional credit was another source of initial finance but it was available only to some of the medium-sized and the two large-scale private firms. Institutional credit for the cultivation firms was provided by a number of agencies, including Agricultural

Table 9.8

Sources[1] of Initial Finance for the Cultivation-Sector Firms in the Punjab, Pakistan

(Sample Based = 1981-82)

Firm Type	Private Savings	Previous Business	Institutional Finance	Suppliers Credit
Small-Scale (25)[2]	25	5	-	25
Medium-Sized (15)	15	9	7	15
Large-Scale (2)	1	2	2	-

Notes:

(1) Sources of finance may be more than one in each case.

(2) Figures in parenthesis show the total number of firms in each group i.e. small-scale, medium-sized and large-scale.

Development Bank of Pakistan, National Finance Corporation, Pakistan Industrial Credit and Investment Corporation, National Development Finance Corporation and commercial Banks. These agencies continue to provide working and development finance to the firms at different rates of interest ranging between 9 to 15 per cent. Because of the high cost of borrowing and lack of organizational ability, and their lower credit worthiness small enterprises have not been able to use institutional credit to any significant extent.

9.2.3 Policy Incentives

Finally, the government policy of encouraging domestic production of the cultivation equipment also contributed to the rapid growth of the cultivation sector during 1970-83. First, government provided direct incentives to the manufacturing firms by offering import duty and other tax concessions. These incentives were aimed at: (1) promotion of farm mechanisation in Pakistan; and (2) support of domestic cultivation firms. For example, in 1981-82, tractors could be imported at a very low rate (10 per cent) of customs duty if in CBU (Completely built up) condition and completely free of duty if imported in CKD (completely knocked down) condition. Moreover, tractors imported for farm use were free of sales tax. These concessions were aimed at greater farm mechanization, especially the adoption of tractor-driven modern cultivation equipment (cultivators, harrows, etc) which were already being produced in the country.

To promote domestic manufacturing of the cultivation equipment, government allowed refund of customs duty paid on the import of raw materials used for cultivation machinery production. Moreover, the income of agricultural machinery manufacturing firms was completely exempted from tax. These policy measures encouraged the entry of many firms into the cultivation sector.

The government also played a critical role in product development and R and D for the cultivation firms in this period. The first important development in this regard was the establishment of two public sector agencies for cultivation sector R and D: the Farm Machinery Institute (FMI), Islamabad; and Agricultural Mechanisation Research Institute, Multan. These institutes were assigned two basic tasks viz., designing and development of appropriate cultivation machinery for local use, and promotion of domestic production of suitable machines through dissemination of designs and technical knowledge. These institutes have helped in the development of various cultivation machines including tractor front mounted reaper, groundnut digger, multicrop thresher, rise transplanter, zero tillage seeder, sugarcane planter, and sugarcane harvester.

An important contribution of these institutes is the industrial extension work carried through commercialization of design and technical assistance to the manufacturing firms. This has established closer contact between the manufacturing firms and the public sector agencies and is likely to prove extremely helpful in the growth of the cultivation sector.

For instance, as a result of the collective efforts of BMI, Agricultural Mechanisation Research Institute and Ittefaq Brothers (a leading private cultivation firm), a new version of the vertical conveyor type Chinese reaper was developed in 1982 which has been in production since then. Overall, government policy sought to promote the growth of the cultivation sector in this period more than ever in the past.

Summary

To sum up the explanation of the emergence and growth of the cultivation sector during 1950-83, we have observed that:

The lower level of demand for cultivation equipment till 1960 kept the cultivation sector growth very slow. During the 1960s the cultivation sector started growing in response to the expansion in agriculture. However, the real growth of the cultivation sector came in the 1970s which was the result of increased farm mechanisation in Pakistan.

On the supply side, a number of factors (viz., technology, availability of physical inputs and government policy) helped in the growth of the cultivation sector. Of these, technology seems to have played the most important role in the growth of this sector.

The cultivation technology was conducive to the growth of this sector because: (1) its' level of sophistication was low i.e. the machines, skills and engineering knowledge required were simple and accessible to even small-scale firms; and (2) there was limited scope for specialisation and the simple operations could be carried out with general-purpose machines. Thus the available technology was particularly suited to the entry of small-scale firms in the cultivation sector.

By comparison the role of technology in the irrigation sector's growth was different from that of the cultivation sector. In the irrigation sector, the production process was relatively more complex but admitted a significant degree of division of labour among firms specialising in different stages of production. Because of the relatively more complex technology, the equipment embodying it was expensive. However, this did not present a serious barrier to entry. Vertical specialisation among firms made entry by small firms possible. In the cultivation sector entry was easy in the more conventional sense. Simple technology embodied in simple, relatively cheap equipment made entry possible.

Footnotes

Chapter 9

1/ These firms included: (1) Adamjee-Deutz, Pak, set up at Wah (Punjab) but later shifted to Karachi (Sind); (2) Rana Tractors (now nationalised and renamed Millat Tractor) at Lahore (Punjab), (3) Ford Tractors at Karachi (Sind); and (4) Shahnawaz at Karachi (Sind).

2/ Farm Mechanization Committee Report (1970) considered this claim to be unrealistic and estimated it to be, at best, around 45 per cent, if the diesel engines for the tractors were also domestically produced. /p. 94-95/.

3/ According to a UNIDO study (1981), Pakistan was placed in the category of countries which had domestic manufacturing facilities of up to 20-30 per cent local content of agricultural tractors.

4/ Import of large tractors has passed through various phases of regulations. Until 1957, tractor imports were liberal and up to 30 different makes and models were in use. In 1958, the imports of tractors was restricted to 7 makes, but again increased to 13 in 1977. In July 1978, the import policy once again restricted the number to 5 makes (7 models). /Khokhar et. al., 1982/. Another restriction imposed on tractor imports (whether in CKD or PKD condition) in 1978 was the imposition of obligation for the importing firm to take definite steps towards progressive indigenous manufacturing of tractor and its parts. In 1982, five agencies (2 public and 3 private) imported tractors. Earlier, from 1974 onwards, tractors and agricultural machinery was importable only by Pakistan Tractor Corporation - a public sector agency. Four different makes of tractors viz., Fiat, IMT, Massey Ferguson and Beylarus were at different though early stages of domestic manufacturing in Pakistan, in 1983. /See Table 8.5/.

5/ Following increased demand for wheat thresher since the mid-1960s, many firms took up its' production. According to one source, there existed at least 77 thresher manufacturing firms in Pakistan in 1977; of which a large majority were small enterprises. It may be noted that locally made threshers for rice, sun flower, soyabean and other small seed crops are also available since 1981-82.

6/ In 1982, some more resourceful firms also produced multicrop threshers.

7/ One notable difference in the management organization of the two types of firms was that whereas all the medium-sized firms were formally registered under the Factories Act (1934), only 60 per cent small-scale firms had the registered status.

CHAPTER TEN

STRUCTURE OF THE CULTIVATION SECTOR

We now look into the industry structure and attempt to identify (1) the factors that led to the emergence of a pyramid like structure of the cultivation sector, and (2) the differences in the growth of firms in the cultivation and irrigation sector.

10.1 Industry Structure: The Role of the Market and Technology

It was noted in Chapter 9 that the cultivation sector of the Punjab's ARE industry consisted of about 400 firms in 1981-82, most of which were small. The large number of small-scale firms formed a broad base, medium-sized firms the middle order, and 6-8 large-scale firms the top of the pyramid like structure of the cultivation sector. In this respect the cultivation sector resembled the irrigation sector.

The emergence of this industry structure was related to the nature of the market and the technological requirements of production for different kinds of cultivation products. In other words, different types of firms had found a place in the market appropriate to their resources. Let us examine in some details the influence of the nature of market and technology on the structure of the cultivation sector.

For this purpose we divide the cultivation sector into the following three broad segments:

(1) the lower segment: consisting of small-scale firms producing traditional, simple implements.

(2) the middle segment: consisting of small-scale, medium-sized and large-scale firms producing tractor-driven implements.

(3) the upper segment: consisting of large-scale firms producing tractors and sophisticated cultivation machinery.

10.1.1 The Lower Segment

In the last chapter, we observed that the cultivation implements market in Pakistan is segmented into three parts viz., the small farmer, the middle-sized farmer and the large farmer, each with his own machinery needs. The first group, consisting of small farmers, live on essentially subsistence farms, (area less than 12.5 acres) and occupy 30 per cent of the total farm area. They employ manual and animal-driven cultivation implements. Most of these implements are traditional, though some modern implements have also been adopted by them in recent years. All the simple implements are produced in Pakistan, which include the spade, shovel, sickle, fodder chopper (hand operated) and plough, cultivation, hoe roller, scraper, fodder cutter, single row drill (animal driven). /See Appendix Table A.9.1/.

These implements are usually of poor quality, poorly designed and operationally inefficient. Yet they are widely used for two main reasons, their low cost and simplicity. The low prices of these implements put them within the means of small farmers, and simple designs ensure easy repair and maintenance.

The technology required for the production of these implements is very simple. Manufacturing of these products basically involves casting, and reshaping of cast materials and assembling of the parts. At the simplest level, casting work can be accomplished with the help of "bellow forge", an ordinary anvil and simple hand tools. Use of these implements requires nothing more than blacksmiths' skills. This casting technique is more commonly used in the rural areas. Alternatively, the required cast materials (e.g. mild steel, grey iron, galvanized pipes, round bars, etc.) can be obtained from foundry specialists who are located in every centre of the engineering industry in Pakistan.

Because of the simple designs, the fabrication and assembly of these implements does not require sophisticated machinery. Even the modern animal-driven implements (ploughs, seed drills, etc) can be produced with the help of simple and inexpensive machines and tools. This option keeps the production cost low and the prices within the purchasing power of the small farmers.

Thus, a large market dispersed over a large geographical area, simple products, availability of raw materials, machinery, skills, and low capital investment makes this segment of the cultivation sector very attractive for the small enterprises. Traditionally, this type of cultivation equipment was produced by the village blacksmith, but since the early 1970s many small urban enterprises have entered this segment of the market and are located around Faisalabad, Sargodha, Mian Channu and other cities of the Punjab. However, according to unofficial estimates, even now only about 25 per cent of the total production of these implements is produced by the urban small-scale firms; the rest originates in the rural blacksmiths shops.

To sum up, there exists a large market for the traditional and modern animal-driven and hand-operated cultivation implements in Pakistan. The technology needed for manufacturing these products is very simple and accessible to the small-firms, including the rural blacksmiths. Entry into this segment of the industry is easy on economic as well as technological grounds. Consequently, a large number of firms operate in the lower segment of the cultivation market which is distributed over a fairly large geographical area.

10.1.2 The Middle Segment

The middle segment of the cultivation sector consists of the firms producing tractor-driven implements and machinery (excluding the tractor and the combine harvestor). As observed in Chapter 2, the market for the tractor-driven implements rapidly expanded in the 1970s. However, this demand has been mostly confined to a small range of cultivation equipment, viz., cultivators, mould board ploughs, disc ploughs, disc harrows, levelling blades, fertilizer distributors, chisel ploughs, sub-soilers and seed drills.

The materials used and the technology required for these products have been discussed in some detail with reference to thresher manufacturing in Chapter 9. The technology needed for these products is also simple and within the means of medium-sized or even small-scale firms.[1/] Limited capital investment required to enter this segment of the market has attracted many small and medium enterprises during 1970-83. The large scale entry of these firms has also been encouraged by the fiscal and other concessions for the cultivation firms discussed in Chapter 9. But above all it is the simple technology and the consequently the low capital requirements which permit entry of the small enterprises in this segment of the cultivation market.

10.1.3 The Upper Segment

The upper segment of the cultivation sector is comprised of technically sophisticated products like tractors and combine harvesters. This is a fast expanding segment of the market. The demand for tractors in Pakistan has rapidly increased since the mid-1960s, leading to sharp rise in imports: the annual average of tractor imports increased from 3,613 in 1965/66-1969/70 to 6,461 in 1970/71-1974/75, and to 15,393 in 1975/76-1981/82 /Table 2.13, Chapter 2/. Despite the rapid increase in demand over the years, domestic manufacturing of tractors in Pakistan is still in an early stage. In 1983, 4 large-scale firms, 2 public-sector and 2 private, were at different, though early stages of production of high-powered (45-75 HP) tractors.

The slow progress towards domestic production of tractors is attributable to two types of barriers faced by the firms, namely the economic (i.e. access to finance for new investment), and the technological (i.e. access to new and advanced technology).

Technically the tractor is a more complex machine than a high speed diesel engine (H.S.D.E.) Among its' major parts are a high-powered, high-speed diesel engine, and electrical, transmission, and hydraulic systems, etc. The tractor provides power for many farming operations such as soil preparation, sowing, cultivating, harvesting and threshing. For these operations different types of implements/machinery are attached with tractor either through its hydraulic system or the power take-off shaft.

Domestic production of tractors in Pakistan faces three main obstacles. First, the firms confront formidable barriers raised by advanced foreign technology needed for tractor manufacturing, This involves procurement of designs, patents, machines, raw materials, and skills. Second, since only large-scale production of tractors is possible, its' managerial functions are also very different. For instance, production of tractors requires continuous planning of inventories, materials flow, and maintenance which are beyond the organizational capacity of the small-scale and medium-sized cultivation firms. Third, because of the high minimum efficient scale of production and the advanced technology required for tractor manufacturing, the capital investment is very high and far beyond the resources of small-scale and medium-sized firms. In short, the small and medium enterprises have neither the financial resources nor the technological capability for undertaking production of sophisticated products such as the tractor. It should be emphasised that the gap between the 'existing' and the 'required' technology is too large to be filled by these firms. Thus, tractor manufacturing may be compared with high-speed diesel engine production as the two products require the type of resources which are not accessible to the small and medium enterprises.

10.1.4 An Explanation of the Structure of the Cultivation Section

The preceding analysis of the emergence of the pyramid like structure of the cultivation sector leads us to present the following explanation:

(1) The cultivation sector markets in Pakistan expanded significantly during the 1970s. This market was divided into three segments: (1) the lower segment, consisting of the low quality animal-drawn and hand-operated equipment; (2) the middle segment, comprising of tractor-driven equipment plus motor operated traditional products like fodder cutter and cane crusher; and (3) the

upper segment, consisting of the technically superior products such as the tractor and the combine harvestor.

(2) The lower segment of the cultivation market was further divided into two parts: one comprised of the traditional equipment (e.g. axe, scythe, plough, etc.) and the other consisted of the modern animal-driven equipment viz., land leveller, seed drills and others.

(3) The lower segment of the cultivation market was large as the simple implements were used by a large number of small farmers. Production of these implements needed simple technology which was available to the small-scale firms. Because of the simple designs, the fabrication and assembly of these implements did not require sophisticated machinery. The manufacturing firms, including the village blacksmiths, needed very little help of the other firms to produce this equipment. Moreover, the low capital cost of entry into the segment made it very attractive for small enterprises. Thus, on both economic and technical grounds, the small-scale units found it easy to enter this segment of the cultivation market. This explains the presence of a large number of small-scale firms in the lower segment of the market.

By comparison, the entry of the small-scale firms into the irrigation sector in the 1960s greatly depended on the technical separability of the production process and the availability of specialist services rendered by other firms. So, the small-scale cultivation firms faced very few technical barriers to entry compared to the small-scale irrigation firms, thus forming a broad base for the cultivation sector.

(4) The middle segment of the cultivation sector comprised of the firms producing tractor-driven implements and power operated traditional cultivation equipment like the fodder cutter, sugarcane crusher, etc. The technology required to produce these products was also simple and accessible to the medium-sized or even the more resourceful small-scale firms. The general-purpose machines and skills possessed by these firms gave them flexibility to operate in the middle segment of the cultivation market which expanded considerably during the 1970s.

In contrast, the middle segment of the irrigation market was relatively smaller than that of the cultivation sector. Moreover, the medium-sized irrigation firms, operating in this segment, produced relatively superior products than the cultivation products of the medium-sized cultivation firms. Therefore, technological resources of an average medium-sized irrigation firm were much greater than a cultivation firm of the same.size. The irrigation firms employed special-purpose machines, more experienced workers, had more fomralized organizational structure, and required larger capital investment than the medium-sized cultivation firms. It is not surprising, thus, to note that even during the 1960s only 6-8 medium-sized irrigation firms operated in the market.

(5) The upper segment of the cultivation sector consisted of large firms which produced technically sophisticated products like tractors and combine harvesters. The notable fact about this segment was that despite a fairly large market, at least for the tractors, their domestic production had not progressed much till 1982-83. These firms faced two main obstacles to domestic manufacturers of tractors: (1) heavy investment requirements; and (2) difficulty in access to new and advanced technology. Thus, only 4 large-scale cultivation firms were in early stages of domestic assembly/manufacturing of tractors in 1982-83.

We notice some similarity between the upper segments of the irrigation and cultivation sectors. Like the cultivation sector, there existed only a few large-scale irrigation firms in Pakistan. This was explained both by supply and demand considerations. On the supply side, the irrigation firm's entry into the sophisticated products (high-speed diesel engine, turbine pumps, etc.) segment required access to new and advanced technology, formal management structure and large capital investment. In short, production of the H.S.D.E. or the turbine pump presented similar problems to the irrigation firms as tractor manufacturing did to the cultivation firms. Moreover, limited demand for the H.S.D.E. put further constraint on the firm's plans to produce it in Pakistan. Thus, in both the sectors, firms faced formidable economic and technical barriers moving into the upper market segments consisting of technically sophisticated products. Consequently, only a few firms operated in this segment of the market.

In sum, the structure of the industry was related to the nature of the market and the technological possibilities which in turn determined the financial and managerial requirements of entry. In other words, different types of firms could find a place in the market appropriate to their resources.

10.2 The Growth of the Cultivation Firms

So far we have discussed the size and structure of the cultivation sector; now we consider the growth capability of the different types of cultivation firms i.e. whether or not they could diversify into new product lines. What type of technological barriers to growth are confronted by the cultivation firms?

To answer this question we need to have evidence on the diversification efforts of the cultivation firms. The cultivation firm's ability to diversify output into new product lines can be judged from the data set out in Table 10.1. This data show the number of different types of cultivation firms which introduced new products, or failed to do so, since entering this industry. We observe that:

(i) thirteen out of 25 small-scale cultivation firms had introduced some new products (mostly in the 1970s); the other 12 enterprises did not make any new product. It may be noted that in majority of the cases (9 out of 13) the new products were similar to those

Table 10.1

Introduction of New Products by the Cultivation Sector Firms of the Punjab, Pakistan

(Based on Sample of 42 Firms[1] = 1981-82)

Firms	Number of Firms	Type of New Products[2]			Period of Product Introduction[3]		No Change in the Product Line
		Inferior	Similar	Superior	Pre-1970	Post-1970	
Small-Scale	25	-	9	4	3	10	12
Medium-Scale	15	-	8	2	1	9	5
Large-Scale	2	-	-	2	-	2	-

Notes: 1/ This sample does not include tractor manufacturing firms.

2/ The newly introduced products are divided into three groups i.e. technically inferior, similar and superior, and this classification is based on comparison with the principal products first produced by different types of firms (i.e. small, medium and large). Thus, a 'superior' product for a small-scale firm may not be so for a medium-sized or a large-scale firm. Hence, the three groups of firms (small, medium and large) must be treated separately.

3/ The year 1970 marks the beginning of a period of rapid growth of the cultivation sector.

already produced by those firms. (It may be recalled that the small-scale cultivation firms mostly produced traditional hand or animal-driven cultivation implements of the simplest type). However, 4 out of 13 small-scale firms diversified into superior products (e.g. tractor-driven implements) which required techniques which were only slightly more advanced than those used for the manufacture of traditional products.

(ii) Among the medium-sized firms, 10 out of 15 introduced new products, while 5 failed to make any change in their production lines. Of the 10 medium-sized firms which introduced new products, only 2 diversified into superior product lines. Again, most of the product diversification took place in the post-1970 period.

(iii) Both the large-scale firms in our sample reported introduction of superior products during the 1970s.

The broad conclusion to be drawn from this data is that the small-scale and medium-sized cultivation firms were generally unable to diversify into new products which required use of superior technology. So, what growth barriers did these firms face?

10.2.1 The Growth Barriers

First, it may be noted that the small-scale and medium-sized cultivation firms had grown from small, general engineering or foundry shops. This transformation did not involve any significant upgrading of technology. They continued to rely on general-purpose machines and skills,and maintained their informal management structure. The techniques those firms used were fairly simple and standardized and could be copied by other firms. The general-purpose nature of their machines and skills gave them "flexibility" to move across the lower and middle segments of the cultivation market. But this also prevented their diversification into superior products. The general purpose machines and skills did not enable them to expand into product lines where superior technological capability was required. So, the small-scale firms' lack of access to advanced technology constituted the first barrier to diversification into superior products.

Second, small-scale firm's inability to have an access to modern equipment and technical skills was an obstacle to act as supplier of parts /components to the large-scale firms in the production of advanced products such as the tractor.

Third, the cost of technology upgrading, was beyond the means of small and medium-sized enterprises. They had neither their own resources nor access to institutional finance required for moving into the upper segments of the cultivation market.

Fourth, the operation of advanced technology required a certain degree of managerial and technical competence which was found missing among the small-scale and medium-sized cultivation firms.

Thus, as in the irrigation sector, the small-scale and medium-sized cultivation firms faced a number of growth barriers viz., lack of access to advanced technology, finance and managerial ability. The technological capability of these firms was suitable for a limited range of products only. Beyond this point, their technological resources needed substantial upgrading which required resources beyond their means.

10.3 Conclusion

In part III, we have attempted to answer these two questions: (1) whey did the rapid growth of the cultivation sector start so late (as compared with that of the irrigation sector)?; and (2) what factors led to the emergence of a pyramid like structure of the cultivation sector? And, in what respects was this structure different from that of the irrigation sector?

Regarding the first question, we observed that:

(1) The late growth of the cultivation sector was attributable essentially to low demand for the cultivation products. During the early phase (1950-70), the demand for the cultivation equipment increased slowly, and so did the cultivation sector. The real expansion of this sector took place in the 1970s which led to its' rapid growth.

(2) On the supply side, a number of factors (e.g. access to technology, physical inputs, finance, etc.)

facilitated the rapid growth of the cultivation sector. Among these, technology played the most important role in the growth of the cultivation sector.

Two features of the cultivation technology which particularly suited the growth of the small-scale firms were (1) its' low level of sophistication and (2) absence of the need for specialist services. Thus, all the operations involved in the cultivation equipment (except tractor and combine harvester) could be carried out by the producing firms themselves using general-purpose machines.

(3) The role of technology (which was relatively more advanced) in the irrigation sector was different from that of the cultivation sector. In the irrigation sector, the technical separability of processes offered opportunities for vertical division of labour and the small-scale firms were able to rely on the specialist services of other firms. This resulted in the establishment of technical linkages between different firms, which helped in the rapid growth of the sector.

On the question of industry structure, we have noted that:

(1) both the sectors had 'similar industry' structure during their expansion phase. Each sector had a broad base consisting of a large number of small-scale firms, a middle segment comprising of a small number of medium-sized firms, and the upper segment where only a few large-scale firms operated. The emergence of this

structure was determined by (1) the nature of the market, and (2) the technological requirements of production for different products.

(2) We also observed that the structure of the cultivation sector was related to the growth barriers against entry into different segments of the markets. As the growth barriers were low in the lower and middle segments of the cultivation market, so firms found it easier to operate in these, but were unable to move into the upper segment of the market by diversifying into the technically superior products. It resulted in the entry of a large number of firms in the lower segments, and the concentration of output of the upper segment in the hand of a relatively small number of firms.

Footnote

Chapter Ten

1/ It may be noted that only the more resourceful of the small-scale firms have access to this type of technology.

CHAPTER ELEVEN

CONCLUSION AND POLICY IMPLICATIONS

11.1 In this study, we set out to study the emergence, survival and growth of the small-scale sector of the ARE industry in the Pakistan Punjab. We have discussed these questions separately with reference to the irrigation and cultivation sector of the ARE industry.

The sudden emergence of small-scale irrigation firms in the early 1960s was the product of the competitive process at work in the private agriculture market. At the time of entry of a large number of small enterprises the private agriculture market was dominated by a few large firms which produced high-quality/high-priced tubewells. This period witnessed rapid expansion in the private agriculture market which came largely as a result of government emphasis on agricultural development. Thus, demand for private tubewells substantially increased which was partly met by small-scale firms who, as compared with the products of large firms, introduced cheaper, but workable machine to the market.

Further it is interesting to observe that small enterprises were not confined to what Dobb (1946) and Penrose (1959) call the 'interstices' of the industry. During the expansion phase of the ARE industry (1960-73) the small-scale firms captured almost 40 per cent of the private agriculture market. It is also worth noting that in response to the entry of small-scale firms, the large firms chose to compete on the basis of high-quality/high-price product. They did not reduce the prices of their existing products to engage the small in a competitive struggle, nor did they market a new, relatively cheaper tubewell. Thus, (1) there emerged a segmentation of the private agricultural market, the small operated in the 'lower' and the large in the 'upper' end of the product range; and (2) the large firms chose to expand in markets that were protected and into which the small, and even the medium-sized, firms could not enter. This industrial 'division of labour' provided the basis for the survival of the small firms in the irrigation segment of the ARE industry during the 1960-73 period.

However, the decline of private tubewell market in the 1970s seriously affected the small-scale sector. Import of more efficient and cheaper high-speed diesel engines put all domestic producers of slow-speed diesel engines under extreme competitive pressure. The small-scale firms were unable to diversify into technically superior products as they lacked the resources, in particular technology, for this purpose. In fact, the limitations of small enterprises were the result of the circumstances characterizing their position in the ARE industry. Since the lower end of the private agriculture market in which the small enterprises operated was highly competitive, these firms worked on very low profit margins and could hardly accumulate any capital for reinvestment and expansion. During the expansion phase, they neither had the incentive nor the resources to upgrade their technology for diversification into technically 'superior' products.

Thus, the alternatives avaialble to small-scale firms included diversification into 'similar' or 'inferior' products. But there did not exist sufficient market opportunities for small enterprises to diversify into similar lines; hence, an overall decline of the small-scale irrigation firms in this period

The large firms, however, managed to adjust relatively easily to the impact of the import of cheaper and more efficient high-speed diesel engine. Of the three large firms, Beco was already well diversified and its "S.S.D.E. division" was one of the 14 "divisions" of this firm. Moreover, it started negotiations with the Chinese manufacturers of the H.S.D.E. for collaborative production of the new and cheaper Chinese diesel engine which was to replace the old and expensive German H.S.D.E. being produced by Beco. In 1983, Beco manufactured 25 per cent of the parts of the H.S.D.E. and imported the balance for assembly. The second large firm (Ittefaq) made impressive product diversification and introduced a number of major products like road rollers, threshers, M.S.D.E., machine tools, water pumps, steel structures and sugar manufacturing plants, during 1950-83. In 1983, Ittefaq also assembled a Chinese H.S.D.E. from imported parts and components, and had plans to gradually produce its parts and components too. The third large firm (KSB) was not affected as it always coupled its water pumps with electric motors. Thus, the large firms managed to adjust relatively easily to the impact of the import of H.S.D.E. by acquiring foreign technology as well as relying on their own substantial resource base.

Another important factor was the unequal impact of government tubewell subsidy scheme on different types of firms. While the large and medium-sized firms managed to capture a major share of the tubewell subsidy market because of their better organizational ability, the small-scale firms were left with a very small share. Thus, in a period of declining demand for private tubewells, the tubewell subsidy scheme proved helpful for the medium-sized and large firms, but not so much to the small-scale firms. The burden of adjustment to the declining market fell more on the small-scale firms than on the large and medium-sized firms.

11.2 In the case of the cultivation sector, we observed that the cultivation market was divided into three segments: the small-scale and medium-sized firms operated in the lower and middle segments consisting of relatively simple traditional and modern equipment, respectively; and the large-scale firms in the upper segment made up of modern and sophisticated products like tractors and combine harvesters. The entry of small enterprises into the lower segments was easy because the sophistication level of technology was low, and there was no need for any specialist services. This attracted many small-scale firms into this segment, particularly in the 1970s.

It was also observed that the structure of the cultivation sector was influenced by barriers against entry into different segments of the markets. Because of the low barriers to entry into the lower segments many firms managed to enter and operate in them, but very few firms had the means to diversify into technically sophisticated products. Consequently, the upper end of the cultivation market was dominated by a few large firms. The middle segment of the market was occupied by a limited number of medium-sized firms which produced modern cultivation implements, as well as some of the traditional products. In consequence, there emerged a pyramid like structure of the cultivation sector. Thus, the structure of this segment of the industry was determined by the nature of the market and the technological requirements of production for different products.

11.3 In the course of this study we have had occasion to refer to the theses of Sylos-Labini (1962) Dobb (1946) Penrose (1959) and Merhav (1969) on the role of small-scale sector. In the light of our evidence on the establishment and growth of small-scale ARE firms in the Punjab, we have taken a fresh look on these views.

One element common to these viewpoints refers to the limited role - because of technological factors - of small enterprises in a capitalist economy. For example, two important implications of Sylos-Labini's model are that, first, small firms (and the medium-sized, though to a lesser extent) exist at the mercy of the large firms who are in a position to squeeze them out of the industry through price competition and, second, the small and the medium-sized firms occupy fringes of the industry. Sylos-Labini maintains that the market space occupied by the small will not be greater than the optimal output from a single large plant or, else, it will attract entry of new large firm to occupy this space: hence, small enterprises must remain in the 'interstices' of the industry.

The situation of the irrigation sector is much more complex; it is not easily fitted into the Sylos-Labini type model. We observed that small-scale firms did enter the industry initially occupied by large firms, which was made possible by the emergence of a network of complementary activities among small enterprises. The large firms did not find it profitable to seek to squeeze the small out of a substantial-sized segment of the market. Our discussion has emphasised the developing and changing aspects of the industrial situation in the Punjab. The survival of small-scale firms was ensured by the availability of more profitable opportunities for expansion to large firms. They thus had little incentive to engage the small in a price war. However, in certain other aspects models such as those suggested by Sylos-Labini do appear to have relevance to the Punjab situation. Large firms did enjoy substantially higher profits and greater security than those available to small firms. These profits and security resulted from the large firms being able to move into markets which were sheltered behind high barriers to entry by small and medium-sized firms. Further, when demand declined and a new imported product offered strong competition the large firms with substantial resources and opportunities for diversification into protected markets were in a much stronger position than small enterprises. The burden of adjustment therefore entirely fell on the small-scale sector.

The evidence on the ARE industry does not support the Merhav's extreme view (1969) which emphasises the technological basis for the emergence of monopolistic industry structure and, therefore, limited or no scope for the small-scale firms in LDCs. Merhav's viewpoint of 'technological determinism' underlines the dependence of LDCs' on foreign technology (assumed to be unsuitable for LDCs) and little scope for the real development of domestic industrial sector. The industries of LDCs are generally considered incapable of producing capital goods, and unable to diversify into new product lines. So economic stagnation of LDCs is taken as inevitable. What we have observed in the case of the ARE industry is the emergence and growth of the small-scale domestic firms which produced relatively advanced products like diesel engine, centrifugal water pump, etc., showing small enterprises ability to produce capital goods as well as survive among already established large firms. We have identified a mechanism which enabled a substantial small-scale sector to emerge and grow in the industry during its expansion phase - something that Merhav does not envisage.

However, the decline of the irrigation sector small enterprises in the 1970s seems to reinforce Penrose (1959) view which predicts only limited growth opportunities for small-scale firms, because of their inability, due to lack of access to essential inputs and technology, to diversify into new product lines. We have observed in the case of ARE industry that whereas small-scale firms were unable to diversify into technically superior products, the large firms managed to do so and, thus, grew over the years.

11.4 Policy Implications

What lessons of general relevance does our case study on the ARE industry in the Punjab offer? We have identified four factors (viz., historical, technological, demand and economic policy) to explain the emergence, survival and growth (or decline) of the ARE firms during 1950-83. The first two factors explain technical possibility of manufacturing of different products and availability of essential engineering skills without which the establishment of industry would not have been possible. The other two factors (viz. demand and economic policy) created favourable environment which permitted diffusion of skills and technical know-how, and offered investment opportunities to small enterprises.

(1) An important point shown by this study is that the small-scale sector mobilised resources (such as savings, skills, etc.) that would not have otherwise come into the process of economic development. Thus, the small-scale sector made an important contribution to the development of industry as well as agriculture. Further, the small-scale sector contributed to employment, distribution of industry over regions, diffusion of technology and skills, etc. Thus, the important role that small enterprises can play in the industrialization needs to be explicitly recognised in policy formulation.

(2) From technological viewpoint, there existed possibilities of separation of production processes and, thus, vertical division of labour among firms, including small. In industries characterized by such technologies there will be scope for the emergence, survival and even growth of small enterprises. Such industries may have large, integrated enterprises, as well as smaller specialized firms. In such situations the advantages enjoyed by large enterprises (based among other things on economies of scale) will not be strong. Such industries can thus contain small enterprises which can efficiently compete with large firms. It is important that in policy making this point - industries with certain type of technologies are favourable to small-scale - is explicitly recognised.

(3) We have observed that new small-scale firms emerge in the process of economic development. Although there was no explicit policy to promote small-scale sector in the 1960s, this type of enterprise flourished because expanding economic activity was offering appropriate opportunities to upgrade skills as well as to market products. During the 1970s, the nature of the investment activity was such that it did not offer appropriate opportunities to the small-scale sector. The bulk of the industrial investment was directed to a few large public sector projects with no linkages with the small sector; thus the decline of the small enterprises.

(4) This draws attention to the important role of economic policy in creating the right environment to help firms in adjusting to the changes in economic conditions. Economic policy help for the small-scale sector must be based on the realization of (1) the complementarity between large and small enterprises; (2) the need to assist the small-scale firms in areas in which they have comparative advantage; and (3) the need for the small enterprises to have access to essential inputs and new technology.

(5) The economic policy should aim at reducing the excessive privileges of large firms (such as sheltered markets) which resulted in the competitive weakness of the ARE industry. Import substitution based industrial policy during 1950-70 rendered the domestic manufacturing firms uncompetitive against foreign competition. Thus, import of

efficient and cheaper H.S.D.E. in the 1970s dealt a severe blow to the domestic producers of S.S.D.E. At the same time, the policy towards small-scale sector should be kept under constant review to match the requirements of different types of firms in the process of economic development.

Appendices

Table A.2.1

Share of the Punjab and Sind in the Total Population and Agricultural Labour in Pakistan, 1961 and 1972

	Population				Agricultural Labour[a]			
	1961		1972		1961		1972	
	Million	%	Million	%	Million	%	Million	%
(i) Pakistan	42.9	100.0	65.3	100.0	7.6	100.0	9.7	100.0
(ii) Punjab	25.6	59.7	37.8	57.9	4.8	63.8	5.8	59.6
(iii) Punjab and Sind	34.1	79.5	52.0	79.6	6.5	85.4	8.2	84.8

Note: (a) Agricultural labour force includes people 10 years and over.

Source: 'Underdevelopment and Agrarian Structure in Pakistan', M.H. Khan, 1981, Table 1.1.

Table A.2.2

Production Index of Major Crops

(1959-60 = 100)

Year	July-June	All Crops	Food Crops	Fibre Crops	Other Crops
1948-49	.. ..	89	..	..	..
1949-50	.. ..	86	..	..	..
1950-51	.. ..	90	..	..	..
1954-55	.. ..	86	..	..	..
1955-56	.. ..	86	..	..	..
1959-60	.. ..	100	100	100	100
1960-61	.. ..	100	98	103	103
1961-62	.. ..	109	105	111	122
1962-63	.. ..	119	108	128	151
1963-64	.. ..	118	108	144	124
1964-65	.. ..	128	120	130	162
1965-66	.. ..	127	107	142	181
1966-67	.. ..	135	114	156	189
1967-68	.. ..	157	150	171	170
1968-69	.. ..	168	160	181	184
1969-70	.. ..	186	177	185	214
1970-71	.. ..	174	164	188	195
1971-72	.. ..	183	170	245	169
1972-73	.. ..	188	181	243	163
1973-74	.. ..	196	190	228	188
1974-75	.. ..	187	183	220	171
1975-76	.. ..	199	207	176	193
1976-77	.. ..	203	212	149	224
1977-78	.. ..	209	208	197	223
1978-79	.. ..	219	238	162	212
1979-80	.. ..	239	245	250	210
1980-81 (P)	.. ..	249	251	250	240

Note: (P) - Provisional.

Source: Pakistan Basic Facts: 1980-81, Table 4.2, Government of Pakistan, 1982.

Table A.2.3

Public Sector Allocations in the First, Second and Third Plans for Agricultural Sector (Current Prices)

Sub-Sector	First Plan		Second Plan		Third Plan	
	Rs Million	%	Rs Million	%	Rs Million	%
1. Agriculture Development Corporation	-	-	200.00	8	204.3	4.0
2. Fertilizers	200.3	13.3	420.5	16.7	1167.2	23.6
3. Plant Protection	60.3	4.0	331.4	13.2	655.9	12.9
4. Seed Supplies	64.5	4.3	161.1	6.4	90.1	1.8
5. Mechanization	48.7	3.2	70.2	2.8	565.0	11.1
6. Soils	1.1	0.1	16.3	0.6	27.4	0.5
7. Agriculture Marketing and Storage	59.4	3.9	190.2	7.5	254.1	5.0
8. Agriculture Extension and Research	52.0	3.4	218.4	8.7	303.2	5.9
9. Soil Conservation	7.4	0.5	18.8	0.7	110.7	2.2
10. Agriculture Economics and Statistics	8.6	0.5	9.2	0.4	20.7	0.4
11. Colonization	114.9	7.6	135.9	5.4	117.4	2.3
12. Animal Husbandry	113.8	7.5	112.5	4.5	201.6	3.9
13. Range Management	10.3	0.7	11.6	0.5	20.9	0.4
14. Forestry	90.1	5.9	159.0	6.3	348.8	6.9
15. Fisheries	34.9	2.3	59.8	2.4	235.4	4.6
16. Land Reforms	11.5	0.7	71.8	2.8	12.8	0.2
17. Co-operatives and Credit	107.1	7.1	30.3	1.3	185.0	3.6
18. Miscellaneous	519.5	34.5	298.0	11.8	449.5	8.9
	1504.90	100.0	2515.00	100.0	5058.78	100.0

Note: These figures are for United Pakistan i.e. East and West.

Source: (i) First, Second and Third Plan Year Plans of Pakistan, Government of Pakistan, 1956, 1960 and 1965.

Table A.2.4

Index Numbers of Agricultural and Manufacturing Prices and Agriculture's Terms of Trade (Three-Year Moving Averages)

Year	West Pakistan			East Pakistan		
	Agri-cultural Prices	Manu-factured Prices	AGR./MFG.	Agri-cultural Prices	Manu-factured Prices	AGR./MFG.
1958-61	101.25	97.87	103.44	107.24	99.15	108.14
1959-62	105.79	99.47	106.37	111.34	100.01	111.41
1960-63	108.53	100.29	108.25	112.36	100.66	111.78
1961-64	109.19	101.90	107.87	101.93	100.57	101.35
1962-65	112.55	103.10	109.15	105.46	100.11	105.37
1963-66	115.46	104.98	110.01	112.91	101.38	111.19
1964-67	121.47	108.37	112.10	129.10	104.67	123.07
1965-68	121.44	111.95	108.46	134.03	108.62	123.41
1966-69	122.44	114.97	106.55	140.79	111.68	126.13

Note: Weights for agricultural prices are estimated marketings of agricultural commodities. Weights for manufactures are estimated purchases of manufactured goods by agriculture. Both are estimated for 1959-60.

Source: S.R. Lewis, 1970, Table 1, p. 385.

Table A.3.1

Comparative Shares of the Public and Private Sector (Industries)

(United Pakistan)

	Planned		Actual		Percentage Implementation
	Amount	%	Amount	%	
A: 1955-60					
Public Sector	1,480	47	1,100	59	74
Private Sector	1,730	53	750	41	43
Total	3,210	100	1,850	100	58
B: 1960-65					
Public Sector	1,460	29	1,305	23	89
Private Sector	3,660	71	4,304	77	118
Total	5,120	100	5,609	100	110
C: 1965-70					
Public Sector	3,513	27	2,331	48	66
Private Sector	9,257	73	2,550	52	28
Total	12,770	100	4,881	100	38

Source: Pakistan Economic Survey: 1970-71, and Final Evaluation of the Third Plan, Government of Pakistan, 1971.

Table A.3.2

Control of Banks by Monopoly Houses: 1970

(Pakistan)

Bank	Controlling Group	Deposits (Rs. Million)	Loans and Advances (Rs. Million)
Habib Bank	Habib	4270.8	2622.7
United Bank	Saigol	3234.5	2032.4
Muslim Commercial Bank	Adamjee	1326.4	843.7
Commerce Bank	Fancy	375.4	312.9
Australasia Bank	Colony (F)	338.8	245.0
Premier Bank	Arag	41.9	23.7
Sarhad Bank	Faruque	20.2	7.1
(a) Total controlled by monopoly houses		9608.0	6087.5
(a) as per cent of all banks, domestic and foreign		59.3	51.0
(a) as per cent of all domestic banks		65.4	57.0
(a) as per cent of all domestic private banks (i.e. excluding those which were state-controlled)		86.9	84.2

Note: It should be pointed out that the smallest of these seven, Sarhad Bank, controlled by the Faruque group, was launched in the late sixites, while the others were in existence for the entire peirod of the sixties.

Source: Amjad, 1982; p. 48 .

Table A.3.3

Control of Insurance Companies by Monopoly Houses in Pakistan: 1969

	Insurance Company	Controlling Group	(Rs million) Total Assets
1.	Eastern Federal	Arag	332.8
2.	Habib	Habib	152.8
3.	New Jubilee	Fancy	72.9
4.	Adamjee Insurance	Adamjee	67.2
5.	Premier	Premier	39.4
6.	Central Insurance	Dawood	23.4
7.	United	Valika	15.5
8.	Eastern Insurance	A.K. Khan	14.0
9.	International General Insurance	Wazir Ali	12.1
10.	Crescent Star	Milwala	9.9
11.	National Security	Colony (N)	9.8
12.	Khyber	Zafar-ul-Ahsan	8.7
13.	Union	Nishat	6.0
14.	Universal	Ghandara	4.4
		(a) Total	768.9
1.	(a) as per cent of all insurance companies domestic and foreign		50.4
2.	(a) as per cent of domestic insurance companies		76.1

Source: Amjad, 1982 p. 49.

Table A.3.4

Representation of Monopoly Houses on Financial Institutions in Pakistan, 1970

Institution	Total number of directors	Number belonging to monopoly houses
P.I.C.I.C.	25	7 (Adamjee, Dawood, Fancy, Valika, Rangoonwala, Crescent, A.K. Khan)[a]
I.D.B.P.	11	1 (Ferozesons)
I.C.P.	13	5 (Habib, Arag, Saigol,[b] Adamjee, A.K. Khan)
N.I.T.	13	6 (Dawood, Habib, Bawany, Adamjee, Saigol)[b]

Note: a A.K. Khan came on the Board of Directors in 1969. Before him for the entire period of the sixties, A. Jalil of the Amin Group was on the Board of Directors.

b They were not represented by family members of the group but by the managing directors of banks and insurance companies controlled by the group.

Source: Amjad, 1982, Table 2.5, p. 58.

Table A.3.5

Loans from P.I.C.I.C. and I.D.B.P. to monopoly houses

(From 1958 to 1970 in the case of P.I.C.I.C. and from 1961 to 1970 in the case of I.D.B.P.)

P.I.C.I.C.	(As % of total loans disbursed)	I.D.B.P.	(As % of total laons disbursed)
13 Monopoly houses	44.7% (Rs 640.9 million)	7 Monopoly houses	22.1% (Rs. 260.2 million)
37 Monopoly houses	63.5% (Rs. 911.3 million)	30 Monopoly houses	31.9% (Rs. 374.5 million)

Source: Amjad, 1982, Table 2.6, p. 51.

Table A.8.1

Villages Electrified in Pakistan

Years			Punjab	NWFP	Sind	Baluchistan	Total
1959-60	..	..	177	116	2	-	295
1960-61	..	..	204	146	1	-	351
1961-62	..	..	163	69	4	-	236
1962-63	..	..	64	79	20	-	163
1963-64	..	..	6	64	15	-	85
1964-65	..	..	63	37	18	-	118
1965-66	..	..	79	89	27	-	195
1966-67	..	..	35	28	22	-	85
1967-68	..	..	27	26	24	-	77
1968-69	..	..	37	21	32	-	90
1969-70	..	..	33	56	21	-	110
1970-71	..	..	19	60	18	-	97
1971-72	..	..	16	44	6	-	66
1972-73	..	..	70	81	114	3	268
1973-74	..	..	307	144	119	10	580
1974-75	..	..	379	155	319	-	853
1975-76	..	..	339	127	280	22	768
1976-77	..	..	428	108	223	25	784
1977-78	..	..	852	167	371	42	1,433
1978-79	..	..	596	197	359	53	1,095
1979-80	..	..	651	192	271	55	1,169

Sources: Agricultural Statistics of Pakistan, 1980-1981, Table 88, p. 146, Ministry of Agriculture, Government of Pakistan, Islamabad.

Table A.8.2

Salient Provisions of the New Labour Deal, 1972

1. Collective bargaining was accepted as the fundamental concept of the new industrial relations system. Freedom to constitute an association of labourers was guaranteed under the Constitutiin of 1973. Union Office bearers were protected against arbitrary dismissal or transfer by the employers. Employers intereference in union affairs was declared unlawful and hence punishable.

2. Every factory or company employing not less than 50 workers was obglied to set up management board comprising not less than one third of its members drawn from the workers.

3. Labour was promised service security under law. Any arbitrary dismissal was justiciable in a labour court.

4. Workers were allowed 5% share in the net profits of companies employing 50 or more people.

5. Every employer was obliged to pay 'gratuity' at the rate of 20 days wages for every completed year of service in the event of a worker 'resigning' from service or his services being terminated for reasons other than mis-conduct.

6. All permanent employees of firms employing 50 or more workers were entitled to 'group insurance', free of cost.

7. A minimum 'bonus' at the rate of 30% of profits (where the profits are not less than the aggregate of one month's wages of the workers), and at the rate

Table A.8.2 (Cont'd.)

of 15% (if the profits were less) were declared compulsory. The bonus payments were in addition to labour's 5% share in the net profit of a firm employing 50 or more workers.

8. The 'Employees Old Age Benefit Scheme' of 1975, and covering all establishments employing 10 or more workers, paid up to Rs. 1,000 per month, made a payment of Rs. 75 per month per worker compulsory.

9. The new policy replaced worker's contribution by the employees contribution at the rate of 7% of wages towards social security scheme.

Source: New Deal for Labour, Ministry of Labour and Manpower (Labour Division), Government of Pakistan, Islamabad (n.d.).

Table A.8.3

Real and Money Wages of Production Workers in Large-Scale Manufacturing in Pakistan

Year	Money Wages		Real Wages	
	(Rupees)	(1959/60 = 100)	(Rupees)	(1959/60 = 100)
1954	981	90	1,122	103
1959/60	1,091	100	1,091	100
1962/63	1,189	109	1,110	102
1965/66	1,464	134	1,245	114
1967/68	1,536	141	1,116	102
1970/71	2,094	192	1,384	127
1974/75	4,953	454	1,730	159

Source: R. Amjad, 1978, Table 10, p. 23.

Table A.9.1

List of the Traditional Animal-Driven Cultivation Implements and Machinery available in Pakistan

I. Hand Tools and Implements

1. Spade
2. Shovel
3. Axe
4. Podder chopper
5. Sickle
6. Sword
7. Pickaxe
8. Hand hoe
9. Juice pan
10. Weeder
11. Ridger

II. Animal Drawn Implements and Machinery

1.	Munnh	Hal	(P. ough)
2.	Desi	Hal	"
3.	Sindhi	Hal	"
4.	Meston	Hal	"
5.	Raja	Hal	"
6.	Cultivator		
7.	Hoe Roller		
8.	Land Planer		
9.	Scraper		
10.	Yoke		
11.	Single Row		
12.	Cotton Drill		
13.	Wheat Drill		
14.	Cane Crusher		
15.	Lister Planter		
16.	Groundnut Digger		
17.	Ditcher		
18.	Crop Sprayer		
19.	Potato Digger		
20.	Paddy Thresher		
21.	Maize Drill		
22.	Bar Harrow		

Table A.9.1 (Cont'd.)

List of Modern Cultivation Equipment

I. Tractors

II. Land Development Equipment

(1) Land Planer
(2) Bulldozer
(3) Agricultural Scrapper
(4) Ditcher
(5) Border Disc.
(6) Blade (Rear & front mounted).

III. Primary Tillage Equipment

(1) Ripper Subsoiler
(2) Ploughs:
    (a) Disc.
    (b) Mouldboard
    (c) Chisel

IV. Secondary Tillage Equipment

(1) Cultivator:
    (a) Tiller
    (b) Row Crop
(2) Harrow
(3) Rotocutter /Rotovator
(4) Cultipacker /Rell
(5) Planker /Scrubber

V. Seeding Equipment

(1) Drain Drill	cotton corn, potato etc. with or without fertilizer attachment
(2) Row-Crop Planter	
(3) Transplanting equipment	

Table A.9.1 (Cont'd.)

VI. Chemical Application Equipment

(1) Fertilizer Distributor /broadcaster

(2) Sprayer

(3) Duster

VII. Harvesting and Threshing

(1) Combine

(2) Reaper

(3) Mower

(4) Binder

(5) Thresher (Stationary)

(6) Sheller

(7) Cotton Picker

(8) Potato Digger

(9) Corn Picker

(10) Cotton Striper

(11) Peanut Digger

(12) Sugar beet Digger

(13) Swather

VIII. Processing Equipment

(1) Seed Cleaner

(2) Grading Equipment

(3) Drier

(4) Elevator

(5) Power Cane Crusher

(6) Khandsari (Mechanical)

(7) Seed Treatment

IX. Transportation Equipment

(1) Farm Trailer

(2) Farm Wagon

Table A.9.1 (Cont'd.)

X. **Feed and Fodder Machinery**

(1) Hammer Mill

(2) Hay Chopper

(3) Forage Harvester side delivery rake

(4) Power Chaff Cutter (ensilage cutter)

(5) Hay Saler

XI. **Miscellaneous**

(1) Manure Spreader

(2) Rotary Chopper

(3) Loader

(4) Post Hole Digger

Table A.9.2

Market Prices of Selected Industrial Raw Materials Used in the Agriculture-Related Engineering Industry, Punjab, Pakistan, Selected Years

Commodities	Prices[1] Per Ton (Rupees)				
	1960	1965	1970	1975	1982
(1) Pig Iron	250/-	500/-	1,375/-	2,925/-	3,088/-
(2) Scrap	120/-	300/-	700/-	1,800/-[2]	2,000/-
(3) Hard Coke	500/-	900/-	1,400/-	2,200/-	3,000/-
(4) M.S. Bars	800/-	1,200/-	1,700/-	3,850/-	4,300/-
(5) Galvanised Sheets	1,700/-	1,850/-	2,000/-	6,330/-	11,181/-

Notes: (1) These are average wholesale market prices except where indicated.
(2) Calculated on the basis of C & F price plus customs duty payable in 1975.
(3) Calculated on the basis of C & F price plus customs duty payable in 1982.

Sources: (1) Twenty Five Years of Pakistan in statistics: 1947-72, Central Statistical Office, Government of Pakistan, 1972, Table 17.03.
(2) Ten Years of Pakistan in Statistics: 1972-82, Federal Bureau of Statistics, Government of Pakistan, 1983, in Table 17.3.
(3) Industrial Consumers.

Table A.9.3

Government Levies on Raw Materials Imported Under Cash in Pakistan: Selected Years

Items	Levies		
	1968-69	1974-75	1983-84
(1) Pig Iron			
(a) Customs duty	25%	33.5%	40%
(b) Sales tax	5%	10.0%	-
(c) Surcharge	25%	-	5%
(d) Rehabilitation tax	1%	-	-
(2) Billets			
(a) Customs duty	50%	37.5%	50%
(b) Sales tax	10%	10%	-
(c) Surcharge	25%	-	5%
(d) Rehabilitation tax	1%	-	-
(3) M.S. Sheets			
(a) Customs duty	40%	62%	70%
(b) Sales tax	15%	-	10%
(c) Surcharge	25%	-	5%
(d) Rehabilitation tax	1%	-	-

Sources: (1) Farm Mechanization Committee Report, Government of Pakistan, 1970, p. 112.

(2) Record of the Central Board of Revenue, Government of Pakistan, Islamabad.

Table A.9.4

Import of Raw Materials and Capital Goods in Pakistan: Current Prices

(Million Rupees)

Year	Raw Materials for Capital Goods Industry		Capital Goods	
	Value	Percentage 1/	Value	Percentage
1971-72	366.6	10.5	1,482.1	42.4
1972-73	830.2	9.9	2,498.8	29.8
1973-74	904.0	6.7	3,975.3	29.5
1974-75	1,802.2	8.6	6,152.2	29.4
1975-76	1,261.0	6.1	7,158.2	35.0
1976-77	1,463.6	6.4	8,750.2	38.0
1977-78	1,920.8	6.9	9,315.7	33.5
1978-79	2,160.2	5.9	10,970.5	30.1
1979-80	2,915.7	6.2	16,679.0	35.5
1980-81	4,054.7	7.6	14,882.0	27.8
1981-82	4,869.4	8.3	17,502.9	28.3

Note: 1/ Percentages refer to the total imports value.

Sources: Ten Years of Pakistan in Statistics: 1972-82, Statistics Division, Government of Pakistan, 1983, Table 18.9, p. 573.

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