RURAL INDUSTRIALIZATION: ECONOMIC LOGIC AND INSTITUTIONAL REQUIREMENTS

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NOTE

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Dr. Akmal Hussain

TABLE OF CONTENTS

EXECUTIVE SUMMARY

I. RURAL INDUSTRIALIZATION: WHY?

1. The policy imperative of increasing labour absorption in the rural sector emanates from Pakistan's urbanization trends on the one hand and the high cost of urban infrastructure on the other. Even if we take the minimum population forecast of 143 million for the year 2000, then at present rates of urbanization (4.7 percent per annum), the urban population for the year 2000 is estimated at 56.7 million, compared to 28 million estimated during the last census. What makes the problem particularly acute is that the increase in urban population over the next 11 years is expected to be concentrated in the large cities. Such an urbanization pattern is clearly unsustainable in view of the severe resource constraints involved. (The infrastructure cost of population absorption in large cities is 6 times greater than in rural areas). For example, the resource requirements of absorbing the expected 57 million urban population by the year 2000, at current minimum standards of infrastructure has been estimated to be three times the total resource availability over the period. Consequently by the year 2000, as much as 60 percent of the urban population could be living in unserviced localities (Katchi Abadis) compared to about 25 percent today.

2. It is Pakistan government's financial inability to provide minimum conditions of civilized life to the projected urban population that creates the policy imperative of increasing the labour absorption of the rural sector. The question that now arises is in which part of the rural sector should government efforts be focussed? The rural sector has two components: (a) The crop sector (b) the non-farm sector in the rural areas consisting of small scale industries.

3. My estimates of labour absorption capacity of the crop sector show that even if a 3.7 percent growth rate of crop production is maintained over the next 11 years, with an associated increase in cropping intensities and crop yields, a net increase in labour demand of only 292 million man days can be expected. This means that at existing minimum income standards and average household size we cannot expect more than a total increase of population absorption of 8.4 million people over the next 11 years as opposed to the expected total increase in Pakistan's population by 40 million over the same period. This is an important result,

because it shows that we cannot rely on the crop sector to bear the brunt of the population increase. We would have to tap the employment and population absorption potential of the non-crop sector in the rural areas over the next decade. In short, there is no alternative but to go for a rural industrialization drive, if we are to avoid politically explosive levels of unemployment and urban decay over the next decade.

II. RURAL INDUSTRIALIZATION: OBJECTIVES AND CONSTRAINTS

1. The Task

The growth of small scale industries (SSI) not only needs to be substantially accelerated but also needs to be given a geographic disposition that results in the emergence of SSI based centres of self-sustained growth called growth nodes in the small towns of Pakistan. These growth nodes of SSI should be linked with the agriculture sector (producing farm implements and food processing) on the one hand, and with large scale manufacturing sector in large cities (through sub-contracting) on the other. Such forward and backward linkages would enable both an increase in agricultural productivity and also a reduction in the import costs of the large scale manufacturing sector.

2. Constraints to the Rapid growth of SSI's

Field visits to a large number of SSI units in Punjab and NWFP have revealed that while the skill potential in many cases is high, the units are producing low value added items like steel shutters or car exhaust pipes, instead of components for large scale manufacturing units, or high quality farm implements. This results in low profitability, low savings and hence slow growth. Following are the specific constraints to accelerated growth of SSI's in small towns:

i) Inability of small units to get orders for components manufacture from large scale manufacturing units (LSM) and/or farm implements from the agriculture sector.

ii) Inability to achieve quality control and to meet tight delivery schedules.

iii) Lack of certain special skills like advanced mill work, metal fabrication and precision welding, all of which are needed for producing quality products with low tolerances and precise dimensional control. In other cases accounting and management skills may be inadequate.

iv) Difficulty faced by small units in getting good quality raw materials, which often can only be ordered in bulk (for which the small entrepreneurs do not have the working capital) and from far away large cities over which they have poor access.

v) Lack of specialized equipment.

vi) Absence of fabrication facilities such as forging, heat treatment and surface treatment which are required for manufacture of high value added products, but are too expensive for any one small unit to set up.

vii) Lack of capital investment and absence of credit facilities.

III. OVERCOMING THE CONSTRAINTS: INDUSTRIAL SUPPORT CENTRES (ISC's), FOR RURAL INDUSTRIALIZATION

1. The Concept

The concept of the Industrial Support Centres (ISC) is to provide the institutional basis for overcoming the constraints to rapid rural industrialization. The ISC which would be located in selected growth nodes in each province of Pakistan, would constitute a decentralized system which ensures continuous easy access to a comprehensive package of support services such as credit, skill training, managerial advice, marketing and technical assistance. The ISC's would also be linked up with national research centres and donor agencies for drawing upon technical expertise and financial resources of these agencies in the service of rapid growth of small-scale industries.

The Industrial Support Centres could be set up with financial and technical support of those donor countries who have some experience in this field and who may be willing to

provide the funds and expertise on a bilateral basis. The ISC since it would be providing critical services for small scale industries, could quickly become financially autonomous.

2. Functions of ISC

The Industrial Support Centres would have the following functions:

i) Marketing

Provision of orders from LSM sector for components, and from farmers for farm implements. These orders would then be subcontracted to the cluster of small scale industrial units that the ISC is supposed to serve. The individual order would be sub-contracted to the SSI on the basis of the skills and potential of the unit concerned.

ii) Monitoring and Quality Control

Having given the sub-contract, the ISC would then monitor the units closely and help pinpoint and overcome unit specific bottlenecks to the timely delivery and quality control of the manufactured products. These bottlenecks may be specialized skills, equipment, good quality raw material or credit.

iii) Skill Training, and Product Development

The ISC would provide specialized supplementary skill training on its premises to workers in the satellite SSI units when required. At the same time, it would provide advice on jigs, fixtures, special tools and product development where required.

iv) Forging and Heat Treatment Facilities.

The ISC's would establish at their premises plants for forging, heat treatment and surface treatment. The SSI units could come to the ISC to get such fabrication done on the products they are manufacturing on sub-contract, and pay a mutually agreed price for this job to the ISC.

v) Credit

The ISC would provide credit to the SSI's for purchase of new equipment and raw materials. In cases where raw materials are available in bulk supply, the ISC could buy it from the source, stock it on its premises and sell at a reasonable price to units as and when they need the raw materials.

NOTES: The proposed locations of the Industrial Support Centres, the specific technical facilities they should have, the product groups they could support the machines and equipment requirements of these centres and finally the financial costs of the machines are all given in the appendix to the paper.

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RURAL INDUSTRIALIZATION:
ECONOMIC LOGIC AND INSTITUTIONAL REQUIREMENTS

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Introduction

Since the crop sector still absorbs the majority of Pakistan's population, there is a commonly held view that the key to the employment problem lies in accelerating agricultural growth. While faster growth of crop output is desirable on a number of grounds, the analysis in this study shows that the crop sector cannot be expected to absorb more than 25 percent of the estimated increase in Pakistan's population over the next decade. In the absence of a major policy intervention, there is of course, a trend towards concentration of the growing population in large cities. However, given the prohibitive cost of even basic amenities in large cities, and extremely high cost of employment generation, the present trends of urbanization are not sustainable from an employment perspective. This study argues that the critical role of employment generation and population absorption will have to be performed by a new rural industrialization drive, i.e., the non-crop sector in the rural areas, focussed on a set of growth nodes located in the smaller towns of Pakistan.

The present study examines first the existing trends in population growth and urbanization, then presents a critical appraisal of the employment issue as it is dealt with by the NCA and the Planning Commission. Section III present the results of our estimates of labour absorption capability in the crop sector over the period 1988 to 2000. In Section IV trends in labour absorption in the non-crop sector are indicated and in Section V analysis based on existing field survey data is presented to explain the paradox of localized labour shortages at peak seasons in agriculture in a "labour surplus" economy. In Sections VI and VII a detailed set of recommendations are made regarding the operational aspects of a policy to induce rural industrialization.

I. TRENDS IN POPULATION GROWTH, URBANIZATION AND THE IMPERATIVE OF INCREASING LABOUR ABSORPTION IN AGRICULTURE.

PEPAC has generated three alternative forecasts of population by the year 2000, based on the Cohort-Survival Model which consists of a simulation of the real determinants of population growth, i.e., births and deaths, using the 1981 census age-structure and the 1976 PGS age-specific fertility and mortality rates.[1] The resultant forecasts are as follows:

i) If there is no change in fertility and mortality rates or mutually compensatory changes, then the population in the year 2000 will be 147.7 million.

ii) If CFR declines from the current 41/1000 to 30.3/1000, population in the year 2000 will be 133.9 million. However, if (more realistically) fertility decline occurs only after a significant decline in infant mortality, the resultant population will be 143.3 million.

iii) The highest estimate (most realistic?) of 150 or 152 million is based on the assumptions of under-enumeration in the 1981 census, substantial return migration from the Middle East and permanent settlement of Afghanistan Refugees in Pakistan.

If we use a population estimate of 143 million (ii above), then at present rates of urbanization (4.7 percent per annum) the urban population by the year 2000 is estimated at 56.7 million. The urban settlement pattern suggests that the increase in urban population would be concentrated in the large cities.

The question that now arises is, if there is no major policy intervention to increase labour absorption in agriculture, are existing urbanization trends sustainable? The answer is apparent from the fact that at current infrastructure standards, the costs of population absorption in the urban areas is 6 times the cost of rural population absorption. This is because of the greater need for road access to houses, piped water supply and sewage disposal. Estimates of resource requirement of absorbing the expected 57 million urban

population of the year 2000 at minimum current standards, even on the basis of a highly optimistic GDP growth rate of 6.9 percent per annum, turn out to be three times the resource availability over the period.[2] Thus, by the year 2000, as much as 60 percent of the urban population could be living in unserviced localities (or Kachi Abadis) compared to about 25 percent today.

It is in the context of this grim prospect of a serious resource constraint in providing the minimum conditions of civilized life to the projected urban population, that the policy imperative of increasing labour absorption in the rural sector manifests itself.

II. TRENDS IN EMPLOYMENT AND THE ISSUE OF RURAL LABOUR ABSORPTION.

The National Commission on Agriculture (NCA) in its Chapter on Manpower and Employment acknowledges the paucity of the data base in these words:

> "Employment implications of the projected course of agricultural development are difficult to estimate. Available labour force statistics are weak and subject to some doubt, which therefore permits little scope for an analysis of past trends and relationships"[3]

It is not surprising that the data base on rural employment and labour absorption in agriculture is weak. (This can be said for most developing countries.) However, what is surprising is that the National Commission on Agriculture made no attempt to work on the existing data to draw analytical conclusions. It could have used the labour force surveys, the census data and WAPDA data to do so. Yet, it merely brushes aside this task. What is worse is that the NCA then proceeds to make a number of heroic assertions that were politically comforting at the time, but served to sweep the problem of rural employment under the carpet of "agricultural growth". For example, in referring to the Green Revolution phenomenon the NCA report says: ".... The growth of the cultivated acreage required more labour, even if the amount of labour per hectare and per individual crop was declining. Also, the larger volume of output requires more labour for harvesting, transportation to the market and post harvest operations.... These

employment gains may have exceeded the negative impact from the shift in tenancy and associated demand for labour." (Emphasis mine)[4]

The fact that total output during the 1970's period was increasing especially in a situation where labour requirement "per hectare and per individual crop was declining" does not constitute adequate grounds to conclude that the overall employment effect during the Green Revolution period "may" have been positive. The net effect on employment (whether positive or negative) can only be determined by comparing a quantitative estimate of increased labour demand associated with increased cropping intensity and post harvest operations, on the one hand, with the reduced man days per acre requirement for each operation associated with the mechanization of different production, harvesting and post harvesting operations on the other. In the absence of quantitative estimates of the impact on labour demand of changes in cropping patterns, cropping intensities, and mechanization of farm operations, the NCA conclusion that the overall labour demand during the Green Revolution period "may" have increased is more a cry of hope than a scientific assessment.

In sharp contrast with the NCA treatment of the employment issue, the Planning Commission exercise for the Seventh Five Year Plan at least in its overall employment projections is based on empirical data and is also analytically sound. However, even the Seventh Five Year Plan document does not have much to say on the issue of rural labour absorption apart from a few general observations.

Assuming no significant change in the labour force participation rate, the Planning Commission estimates an annual increase in the labour force seeking domestic employment during the period 1988-1993, to be 3.3 percent. (This includes an estimated 0.4 million net returnees from abroad during the same period.)[5]

Based on a preliminary exercise of sectoral employment elasticities with respect to real output, the Planning Commission estimates an overall employment elasticity of 0.4 during the period 1988-1993.[6] The following table 1 indicates labour force and employment projections based on this elasticity estimate.

The table shows that open unemployment is expected to increase from 1 million in 1988 to 2.4 million in 1993. Apart from open unemployment the major form in which the problem manifests itself in Pakistan (as in many other developing countries) is under-employment. The Labour Force Survey (LFS) suggests that in 1986-87 under-employment affected 10.5 percent of the labour force. The Planning Commission indicates that if a more strict criterion of full employment is used then upto one-third of the labour force needs more regular additional work.

At existing trends, even to maintain open unemployment at existing levels, i.e., in order to absorb the new entrants to the labour force during the period 1988-1993, it would require an impossibly high growth rate of GDP of 8 percent. Alternatively, at a projected growth rate of 6.5 percent per annum over the period the employment elasticity would have to be increased to 0.5 percent. This would require a major new effort at a carefully formulated employment policy with an effective implementation mechanism. At a strategic level the new Employment Policy would have two interrelated dimensions: (i) Increasing the labour absorption capacity of the rural sector. This is clearly necessary in a situation where the infrastructure cost of population absorption in the urban areas is six times greater than in rural areas; (ii) The rapid development of small scale industries and associated infrastructure in small towns linked with the rural sector. The emphasis on small-scale industries within a new Employment Policy is necessary in view of the fact that the cost of an additional job in the large scale manufacturing is 80 times the cost of a job in the small scale industry.

III. TRENDS IN LABOUR ABSORPTION IN THE CROP PRODUCTION SECTOR

III.1 A Note on Method of Calculation

(i) I have attempted to estimate changes in labour absorption capability of the crop production sector under two different policy packages:

Policy I in which

(a) The growth in the number and size of tractors during 1988-2000 follows the same trend as that observed in the earlier period.

(b) Mechanized harvesting does not become a major factor in agricultural production at the all Pakistan level.

(c) The potential for 38 MAF of additional irrigation at the farm gate through improved delivery efficiency and usable ground water resources is realized. Through such a policy it is assumed that crop production sector would grow at a compound rate of 3.7 percent per year during 1988-2000.

Policy II would involve slowing down the growth of tractors to 50 percent of the rate observed during 1968-75, ceteris paribus.

ii) In estimating labour demand the agriculture census figures for cropped acreage under each crop for irrigated and unirrigated acreage respectively were combined with labour coefficient estimates for each crop for irrigated and unirrigated areas respectively, obtained from WAPDA XAES data.[7]

iii) The estimate of the overall increase in labour absorption in the crop sector associated with a trend growth rate of 3.7 percent per annum in Policy I, takes account of the labour displacement effect of tractorization which in this estimate is assumed to follow past trends. In the estimate for Policy II the negative effect of tractorization on labour demand is reduced because of the assumed slow down of the pace of tractorization.

iv) The estimates of the labour displacement effect of tractors are based on detailed crop-wise agriculture census data, tractorized and non-tractorized area under each crop and finally monthly labour requirements data for each crop obtained from WAPDA XAES data. It is interesting that my estimate of per tractor gross labour displacement through this method comes to 3,842 man days per year, i.e., 10.53 full time labourers. This estimate is remarkably close to the World Bank Sample Survey results reported by McInerney and Donaldson.[8] They estimate the gross

labour displacement effect per tractor to be 11 full-time labourers. The increase in labour demand over the period is a net effect resulting from the positive effect of increased yields and cropping intensity on the one hand and negative effect of tractorization on the other.

v) Having estimated the net increase in labour demand over the period in terms of millions of man days per year, this figure is then translated into the number of households that can be absorbed in crop production through additional labour demand. This is done by estimating the number of man-days of paid labour required to sustain a household, on the basis of minimum expenditure necessary on household food, clothing, etc., and prevailing real wage rates. The conversion figure comes to 225.11 man days of work required to sustain a household. The number of households expected to be additionally absorbed in the crop sector is easily converted into an estimate of population absorption by using the census figure of average agricultural household size (6.5).

III.2. Analyzing Results

The table shows that if a 3.7 percent growth rate of crop production is maintained over the period with associated increases in cropping intensities and yields, then in spite of the existing trend of tractorization, a net increase in labour demand of about 292.3 million, man days per year by the end of this century can be expected. This means an increase in absorption of households of around 1.297 million, or a total increase in population absorption of 8.4 million in the crop sector over the period.

The increase in labour absorption in the crop sector increases substantially to 1.6 million households or 10.4 million people, if the pace of tractorization is slowed down through withdrawal of subsidies, tax exemptions and cheap credit facilities.

The most important conclusion that emerges from these labour absorption estimates is that over the next decade the crop sector cannot be expected to bear the brunt of absorbing the projected population increase. Even with optimistic projections of labour absorption capability, the crop sector can absorb between 8 to 10 million additional

people out of a possible population increase of over 30 million people between now at the end of the century. Therefore, if sustainable levels of urbanization are to be avoided, attention will have to be given to the non-crop activities in the rural areas. These include livestock, social forestry, off-farm activities such as chicken hatcheries, fruit and food processing, cold storage, construction, infrastructure and rural industrialization.

IV. TRENDS IN LABOUR ABSORPTION IN NON-FARM ACTIVITY IN THE AGRICULTURE SECTOR

The following table 3 provides an estimate of increases in non-farm labour absorption during the period 1988-2000. The figures have been estimated by applying the WAPDA XAES ratio of non-farm to farm employment. This ratio was applied to my estimate of labour absorption in the crop sector, for each policy package to get estimates in terms of man-days per year. These were divided (in each case) by my estimates of man-days per year required to sustain a family with a standard of living just on the poverty line and with real wage rates prevailing in the rural sector in 1975. The resultant figures were multiplied by the Agriculture Census figure of the number of family members per non-farm rural household. It is important to point out that my estimates of non-farm population absorption are in the nature of "guesstimates". Since they are dependent on the WAPDA XAES ratio of farm to non-farm employment the estimates of non-farm population would be subject to the biases inherent in a ratio that assumes as temporally constant the relationship between the farm and non-farm sector. Apart from this weakness the non-farm population absorption figures is dependent on the farm absorption figure. i.e., The possibility of autonomous economic activity such as rural industries is not taken into account.

Table 3 shows that associated with the expected increase in labour absorption of the crop sector, an increase in absorption of about 2 million people can be expected in the non-farm agriculture sector. This points to the fact that a mere increase in crop production cannot be expected to generate an adequate economic activity in the non-farm sector. Autonomous initiatives may be required (such as rural industrialization), if the potential for labour absorption of the rural sector is to be realized.

V. AGRARIAN CHANGE AND THE COMPLEXITY OF THE LABOUR MARKET: A PRELIMINARY HYPOTHESIS.

V.1. The Simple Analytics of Agrarian Change and Demand for Farm Labour.

I have shown elsewhere[9] that in Pakistan's Agriculture there is a tendency towards polarization in farms and farm area, i.e., over time the percentage share of farms (and farm area) at either end of the size class scale tends to increase, while the percentage share of the medium size class tends to decline. This observed polarization phenomenon is essentially induced by the tendency of many large landowners to resume for owner cultivation some (though not necessarily all) of their land formerly rented out to tenants. Since the medium size class contains a much larger proportion of tenanted area compared to any other size class, generalized land resumption has a greater impact on medium size class then on the small size class. Consequently, when size distribution of farms (and farm area) at different points in time (1960, 1972 and 1980) are compared, the underlying process of land resumption for owner cultivation on large farms manifests itself in the form of polarization. The process of polarization in the size distribution of farms is likely to affect farm labour demand in the following way:

(a) Labour requirements on different size classes of farms have differing proportions of hired labour because of differences in production organization. Thus, for example, small farms fulfill a lower proportion of their labour requirement with hired labour compared to medium sized farms due to a relatively greater propensity of small farmers to use family labour. On the other hand, large farms while they use virtually no family labour have a greater propensity to replace human labour with machines over time in an attempt to establish greater control over the production process and reduce risk. An important reason for labour displacing mechanization on large farms is that with multiple cropping there has been both an increase in the frequency of peak season demand for labour as well as a constriction in the time period available for performing labour operations at peak season. As a result of the latter, for a given quantity of labour a larger number of labourers are required. This generates two types of pressures on the farmer to mechanize: (i) Due to imperfections in the labour market the farmer often finds it difficult to hire a large number of labourers quickly. (ii) The farmer

faces an acute supervision problem due to the difficulty of mobilizing a large number of labourers to perform work tasks to his satisfaction. During my field visits I found that the persistent explanation of large farmers for mechanization was not so much "high" wages of farm labour but the difficulty of getting hold of them in time and then ensuring that they get the job done "satisfactorily".

b) Polarization in the size distribution of farms could affect employment also because differing man days per acre are required on farms of different sizes. This effect will occur to the extent that there are differences between size classes of farms with respect to: (i) The percentage of cropped area devoted to crops with relatively higher labour requirement in each agri-climatic zone, (ii) Cropping intensities, and (iii) Crop yields per acre.

Micro survey data suggests that in some regions of the Punjab the above mentioned factors result in a lower man days per acre requirement at either end of the farm size scale that in the medium size class.

It appears then, that given the propensity of small farmers to use family labour rather than hired labour, and given the tendency of the large farmer to adopt labour displacing mechanization, a polarization in the size distribution of farms is likely to dampen the growth rate in the demand for hired labour. Moreover, in some regions variation across size classes in cropping patterns, cropping intensities and yields per acre may be such as to further reinforce this dampening in the growth of labour demand resulting from the polarization phenomenon.

V.2. The Inverse Switching Hypothesis

In Pakistan's Agriculture there is an overall supply of employable labour in excess of labour requirements in terms of cropped acreage under each crop under existing technologies. Yet, at the same time, localized labour shortages are observed during peak seasons in certain areas. The obvious reason for this paradox could be the bunching of demand for labourers at peak seasons in a situation of imperfect labour mobility. The imperfect labour mobility could be due to inadequate information available to the labour

regarding the precise time and place of job availability on the one hand and poor transport facilities within the rural sector on the other.

Yet, there could be a more complex set of interactive factors which may be accentuating the paradox of localized labour shortages within an overall situation of excess supply. These factors may be located in the changing composition of the agricultural labour force with increasing weight of tenants seeking supplementary wage labour relative to pure landless labourers. At the same time, landowners may be responding by adjusting systems of production organization which involve tied labour supply. These interactive factors may be leading to what one can call INVERSE SWITCHING of production technique in Pakistan's agriculture:

i) Landowers may refrain from complete resumption of rented out land and hence from moving into a "fully capitalist" labour process in an attempt to keep tenants as a source of tied labour.

ii) At the same time, farmers who may be experiencing "spurious" labour shortages in proximate areas due to reduced labour mobility resulting from (i) above, may be mechanizing much faster than is warranted by the overall supply of employable labour.

The combined effect of (i) and (ii) would be that for a given level of labour demand (in terms of man days/year) there would be a lowering of demand for permanent hired labourers, thereby creating a push factor for pure landless labourers to move into the cities looking for jobs. As the pure landless labourers migrate into towns there would be a further change in the composition of the agricultural labour force towards tenant-labourers. (i.e., tenants who seek wage employment as a source of supplementary income.) This changing composition of the agricultural labour force would serve to further intensify tendencies (i) and (ii) above.

While considerable research based on new surveys would be required before we can accept or reject the inverse switching hypothesis. Yet, there is some indirect data available to illustrate that such a hypothesis is worthy of being tested systematically.

In a survey of the homeless population of Lahore city, conducted in October 1987, we discovered that of the rural migrants who had moved into Lahore less than two years ago, a much larger proportion were landless labourers, compared to those who had migrated to Lahore city over 10 years ago.[10]

An important study[11] by Nomaan Majid based on a field survey in rural Sind offers illustrative evidence that while a situation of excess labour supply exists at the provincial level, there could possibly be labour shortages in the peak months of November and April at a more regionally disaggregated level. For example, Majid's estimates of the annual labour time available with the employable population of each district of Sind was greater than his estimate for the total tasks completion time requirement for the year as a whole. Yet, when tasks completion estimates were disaggregated to the district level, Majid interestingly enough found that in 6 out of 14 districts of Sind the task completion time requirement was in excess of 30 days, given the employable labour force available. These districts where a labour shortage at peak season could occur are Badin, Sanghar, Khairpur, Shikarpur, Larkana and Jacobabad. It is interesting that when the districts of Sind are ranked according to Road Density, three of these districts (Badin, Shikarpur, Jacobabad) have a rank at the lower end of the scale. This indicates that high labour demand at peak season in a situation of poor transport facilities, could create localized labour shortages.

Majid[12] suggests that there may be a tendency for landowners to simultaneously overcome the risk of peak season labour shortage and high wage rates (in case of employing permanent hired labour). This optimization strategy is manifested in the retention of some part of their tenanted land by landowners who are engaged in owner-cultivation on part of their land. This allows a source of tied labour supply, which can be hired if and when required. The field survey evidence of Majid indicates that amongst landowners reporting owner-cultivation in the ownership size class of over 1000 acres, 80 percent of the landowners have rented out as much as 50 percent of their owned areas to tenants.[13] At the same time, their field survey data suggests that landowners may be adjusting their tenancy contacts to enable the landlord to take crucial decisions regarding production and marketing. For example, 88 percent of the landlords in their sample were

taking input decisions, 83 percent were taking crop decisions, and 100 percent were marketing the cash crop of their tenant farm.[14]

The survey evidence of Majid suggests that the joint system of production organization (i.e., owner-cultivation combined with tenancy) allows the landlord the advantage of a tied labour supply while also enabling him to determine key management decisions on the tenant farm. Consequently, a "pre-capitalist" form of production organization may not switch into a specifically capitalist form, because the former has been restructured in the service of capital accumulation.

VI. RECOMMENDATIONS

This study has so far shown that given the expected increase of Pakistan population by another 30 million people over the next 11 years, and given the prohibitive cost of population absorption in the urban sector, tapping the potential for labour absorption in the rural sector has become an urgent policy imperative. My estimates of the maximum labour absorptive capacity in the crop sector over the next 11 years indicate that only about 8 million people can additionally be absorbed in this sector. Consequently, policy measures will have to focus on utilizing the labour absorption potential of the non-crop sector in the rural areas. In this regard the following measures could be considered:

VI.1. Policy Direction:

1. Development of infrastructure in small towns for accelerating the development of Small Scale Industries (SSI). Small Scale Industries could be linked with the agriculture sector on the one hand and large scale manufacturing sector in the urban areas on the other, as indicated in recommendations specified below.

2. Linkage of SSI with agriculture could be done by:

    (a) Encouraging the establishment of milk collection and cooling centres which could provide additional cash income to farmers who own livestock and also generate employment.

(b) Fruits and vegetables are currently marketed with large differentials between farm and retail prices. Cold storage facilities together with marketing infrastructure could be established through village development councils, supported by district level professional expertise and credit. Availability of cold storage and marketing facilities for the farmers would also induce them to invest in these labour intensive crops.

(c) Choice of appropriate technology in rice mills can also generate off farm employment. For example, a large number of two tons per hour labour intensive mills could be set-up instead of a small number of the large 15 tons per hour capital intensive ones.

(d) Manufacture of farm-implements, and tractor repair and maintenance facilities. The institutional mechanism required to provide credit, training and special fabrication facilities is discussed in the following section on "Institutional Framework".

3. The linkage of SSI with large scale manufacturing industries in the large towns close by needs to be established through a system of manufacture of components on a subcontract basis. Here again the institutional framework for ensuring quality control, delivery dates and provision of orders for components, and credit becomes important. (This is discussed subsequently).

4. Development of livestock and social forestry, and fruit orchards together with food processing facilities in small towns.

5. Construction of rural infrastructure, especially water-management and lining of canals to improve both delivery and application efficiencies of the irrigation system.

VI.2. Institutional Framework

1. The institutional framework that could be considered for realizing the yield potential for the small farm sector in agriculture, as well as realizing the income employment potential of the off-farm sector, is the establishment of multi-functional grassroots organizations of farmers at the village level. These village level organizations could be linked at the district level, through Support Institutions. The function of these Support Institutions would be to provide credit, technical expertise in project formulation, specification and overcoming bottlenecks to project implementation at the village level; and finally provision of support in marketing and technical training of personnel. Example of successful grassroots experiments abound in South Asia. Some of the more prominent ones being the AKRSP in Gilgit and Skardu, the Orangi Project in Karachi, Bhoomi Sena in India, Comilla and the Grameen Bank in Bengal, etc. The idea in Pakistan's context is to provide a back-up support mechanism for the rapid development and replication of such grassroots initiatives.

2. The institution for accelerating the growth of SSI in small towns and linking them with Large Scale Manufacturing enterprises could be based in the district headquarters and have the following functions:

   (a) Arranging of sub-contracts from LSM for manufacture of parts and components to SSI.

   (b) Conduct quality control and pinpoint/resolve bottlenecks in the SSI to the fulfillment of their production schedules. These bottlenecks could be financial (credit for machines or working capital), technical (training of personnel) or managerial.

   (c) Provide common facilities (at a price) such as heat treatment, forging and product design to SSI which normally does not have the financial and technical capacity for these operations.

VII. OPERATIONALIZING RURAL INDUSTRIALIZATION

VII.1. The Task

The latest survey of small scale manufacturing establishments in Pakistan shows that there were a total of 241, 896 small manufacturing establishments in Pakistan which were employing 555,497 persons (see Table 4). The growth rate of manufacturing units over the period 1976/77 to 1983/84 was 5.58 percent while the growth rate of value added in this sector was faster at 8.16 percent. This indicates that over time the composition of SSI has been changing positively in favour of higher value added units. As Table 5 shows, while the capital cost per employed person in the large scale manufacturing (LSM) is substantially higher than in SSI, the productivity of investment (value added per unit of investment) in LSM is substantially lower than in SSI.

It is the growth of SSI that needs to be not only accelerated substantially but also needs to be induced towards a geographic disposition that results in the emergence of SSI based growth nodes in the small towns of Pakistan. Such a process would enable a geographically diversified growth, that is relatively cheap in terms of infrastructural investment and also oriented towards employment generation. These growth nodes of SSI in small towns should be linked with the agriculture sector (producing farm implements and food processing) on the one hand, and with the Large Scale Manufacturing Sector in large cities (through sub-contracting of components manufacture) on the other. Such forward and backward linkages would enable both an increase in agricultural productivity and also a reduction in the import costs of the large scale manufacturing sector. This policy does not mean that SSI should grow at the expense of the LSM. In fact, establishing a heavy industrial base that imparts to Pakistan an indigenous technological change capability is essential for a self-sustaining and autonomous industrialization drive. The functions of rapid growth of SSI would be four fold, (i) to help achieve the employment objective, (ii) to enable a regionally balanced industrial growth with relatively low infrastructural investment, (iii) to reduce the foreign exchange costs of large scale industry, and (iv) to increase value added and productivity in the rural sector.

VII.2 Constraints to the Rapid Growth of SSI's

Field visits to a large number of SSI units in the Punjab and NWFP have revealed that while potential in many cases may be high, the units are producing low value added items like steel shutters or car exhaust pipes, instead of components for LSM, or high quality farm implements. This results in low profitability, low savings and slow growth. There are the following major constraints to accelerating growth of SSI's in small towns:

1) Inability of small units to get orders for components manufacture from LSM and farm implements from agriculture.

2) Inability to achieve quality control, and to meet tight delivery schedules.

3) Lack of specific skills like advanced mill work, metal fabrication, precision welding, all of which are needed for producing quality products with low tolerances and precise dimensional control. In other cases accounting and management skills may be inadequate.

4. Difficulty faced by small units in getting good quality raw materials, which often can only be ordered in bulk (for which the small entrepreneurs do not have the working capital), and from far away large cities.

5) Lack of specialized equipment.

6) Absence of fabrication facilities such as forging, heat treatment and surface treatment which are required for manufacture of high value added products, but are too expensive for any one small unit to set up.

7) Lack of capital for investment and absence of credit facilities.

VII.3 Overcoming the Constraints: Industrial Support Centres (ISC's)

The concept of the Industrial support Centres is based on the fact that small scale industrialists in Pakistan have already demonstrated a high degree of entrepreneurship, flexibility, innovation and ability to work hard. The ISC would provide an opportunity

for rapid growth to SSI through local participation in extension services, prototype development, and diffusion of improved technologies, equipment and management procedures. The ISC would constitute a decentralized system which ensures continuous easy access to a comprehensive package of support services such as credit, skill training, managerial advice and technical assistance. The ISC would also be linked up with national research centres, and donor agencies for drawing upon technical expertise and financial resources of these agencies in the service of SSI.

The ISC would be located in specified growth nodes where there exists a potential for major rural industrialization activities.

The Industrial Support Centres would have the following functional dimensions:

(a) Marketing

Provision of orders from the large scale manufacturing sector for components, and from farmers for farm implements. These orders would then be sub-contracted to the cluster of SSI units that the ISC is supposed to serve. The individual order would be sub-contracted to the SSI on the basis of the skills and potential strengths of the unit concerned.

(b) Monitoring and Quality Control

Having given the sub-contract, the ISC would then monitor the units closely and help pinpoint and overcome unit specific bottlenecks to the timely delivery and quality control of the manufactured products. These bottlenecks may be specialized skills, equipment, good quality raw material or credit.

(c) Skill Training and Product Development.

The ISC would provide specialized supplementary skill training on its premises to workers in the satellite SSI units when required. At the same time, it would provide advice on jigs, fixtures, special tools and product development where required.

(d) Forging and Heat Treatment Facilities.

The ISC's would establish at their premises plants for forging, heat treatment and surface treatment. The SSI units could come to the ISC to get such fabrication done on the products they are manufacturing on sub-contract, and pay a mutually agreed price for this job to the ISC.

(e) Credit

The ISC would provide credit to the SSI's for purchase of new equipment and raw materials. In cases where raw materials are available in bulk supply, the ISC could buy it from the source, stock it on its premises and sell at a reasonable price to units as and when they need the raw materials.

VII.4 Specific Technical Facilities at ISC's

The specific facilities that could be available at ISC's to fulfill their technology diffusion/fabrication functions are:

1. Materials testing laboratory.
2. Foundry.
3. Surface Treatment Plant:

    (a) Hot Dip Galvanizing Unit.
    (b) Paint Spray Installation.

4. Welding Workshop.

5. Sheet Metal Unit:

    (a) This metal sheet and pipe bending unit.
    (b) Thick metal sheet unit.

6. Heat Treatment Unit.

7. Tool and Die-making Shop.

8. Automotive Workshop/Garage.

9. Design and Information Centre.

VII.5 Product Groups

The product groups for which above facilities could provide support to SSI's are:

i) **Agriculture**

The ISC's could provide manufacturing support and marketing for SSI's in the following products:

a) Tools for manual work such as Hoes, Shovels, Rakes.
b) Animal traction equipment.

Inspite of rapid tractorization in Pakistan there remains a high demand for ox-drawn implements. The main technology here is the assembly of section irons and plates. Forging is essential in this field but there is also need for cast iron. The production of this equipment may consist of:

- Ploughs: (Forging and structural steel work).
- Rotary-blade harrows (Forging, casting and structural steel work).
- Bearings and other parts for animal drawn carts.

ii) **Power Traction**

Popular tractor drawn equipment contains cast as well as forged and machined parts. Welding is often necessary. Items to be produced may include:

- Spare parts for power cultivators (mainly forging);
- Ground graders (mainly plate assembly);
- Rollers (mainly plate assembly);
- Seeders, harrows and cultivators (Plate stamping, casting and structural steel work);
- Components for sprayers (aluminium casting).

iii) **Irrigation**

This equipment includes valves and pumps for industrial and household use.

More complex technologies are involved in producing irrigation equipment. Among the technologies are the casting of non-ferrous metals and production of special cast iron. Typical products are:

- Components for centrifugal pumps (all ICS workshop technologies are involved);
- Connections and bends (mainly aluminum technologies);
- Components for hand pumps (casting, machining and welding);
- Components for sprayers (casting and machining);
- Panels for water reservoirs and roof tanks (welding and sheet metal technologies).

iv) **Off-Road Transportation**

Off-road transportation includes rail transportation. Products are:

- Parts for railway cars and rail transport (forging, castings, plate);
- Bushings and covers (nodular cast iron);
- Traction components (forged or shaped metalwork);
- Brake components (cast iron);
- Hooks, turnbuckles, clamps and other fastenings (mainly forged).

v) <u>Vehicle Components Industry</u>

Vehicle components include spare parts for motorcars, trucks, buses, tractors and industrial conveying and hoisting equipment. Particular vehicle components subject to frequent breakdown, such as pulley systems, fans and traction hooks, should be considered. The following are representative items:

- Brake discs and drums (pig iron);
- Oil-tight covers, oil pumps, pistons (aluminum alloys);
- Fans (aluminum alloy and stamped plate);
- Lights and tool kits (aluminum alloy and stamped plate);
- Trolley roofing (stamped plate and structural steel work);
- Hubs for tractor and trolley wheels (cast iron);

vi) **Metalworking**

The metalworking industries require metal containers, conveyors, gears, pulleys, electric motors castings, and supplies for trucks and cars. Typical products are:

- Plate bins (shaped plates);
- Components for rolling conveyors (plate or cast-iron castings);
- Pulleys and gears (iron castings and forging);
- Equipment for ingots moulds (iron castings);
- Blacksmith or smelter equipment (uses all ISC technologies);
- Miscellaneous tools (mostly forged).

vii) Food and Related Industry

The food processing industry in NWFP is still in its infant stage. However, the scope for the production of canned fruit, fruit juices and vegetables is quite favourable. The set-up of such industries require an approach on a case-to-case basis. Among the products are:

- Containers for food liquids (normally stainless-steel stamped parts);
- Stainless steel vats, tables, containers for food-processing plants;

- Wire products (baskets, shelves, dish drainers);
- Metal hanging panels;
- Cookers, water heaters, solar heaters;
- Components for seed-oil presses;

viii **Construction**

Building yard machines are generally imported in whole or in part from abroad. Domestic production of simple castings may partly replace imports. The following are construction products:

- Building yard equipment (mostly forging);
- Scaffolding material (mostly forging);
- Mason tools (mostly forging);
- Components for building yard machines;
- Implements for rolling shutters or window screening (shaped plate, welding);
- Components for door framing and windows (cast or stamped plate);
- Drain covers, grates, road drain wells (cast iron);
- Piping elbows and unions for drains (cast iron);
- Components for valves, gate valves, unions, for portable or street and road signs, road fencing;
- Hinges and locks.

ix) **Household Appliances**

Household appliance products for the model workshops are:

- Bath tubs, showers and sanitary equipment (mostly cast iron);
- Taps (non-ferrous casting);
- Miscellaneous household fixtures and equipment (cast iron and aluminum castings and shaped sheets);
- Brassware for fittings, stop cocks, water taps.

x) **Power and Telephone Line Fittings**

Considering the ambitious plans in Pakistan for the increase in installed power capacity and electrification of rural areas, items in this category should be subject to market surveys and, if feasible, then produced. Possible ISC workshop items are:

- Connection, support and mooring clamps for power liens (cast iron and aluminum castings);
- Accessories for overhead line supports (aluminum castings and forging);
- Cable connection boxes (cast iron and aluminum castings);
- Waterproof feeder boxes (cast iron and aluminum castings).

xi) **Valves for Industrial Use**

Valves for industrial use include products that are almost exclusively nodular cast iron. Components include those of gate valves and fittings for gas and oil pipelines. Also included are components of small rotary compressors and radical fans which mostly use shaped-plate castings. Cast-iron pipes, centrifugally or statically cast, must also be considered.

VII.6. **Growth Nodes for Rural Industrialization**

The proposed growth nodes for rural industrialization where the new Industrial Support Centres (ISC's) could be located are as follows:

PUNJAB

(1) Lahore-Chunian Axis.
Centre: Bhai Pheru.

(2) Lahore-Sheikhupura Axis.
Centre: Sheikhupura

(3) Gujranwala-Sialkot Axis.
Centre: Sialkot.

(4) Rawalpindi-Mianwali Axis.
Centre: Mianwali.

(5) Bahawalpur-Bahawalnagar Axis.
Centre: Bahawalnagar.

NWFP

(1) Haripur-Abbotabad Axis and Haripur-Havelian Axis.
Centre: Haripur.

(2) Islamabad-Nowshera-Peshawar Axis.
Centre: Peshawar.

(3) Peshawar-Kohat Axis. Centre: Kohat.

BALUCHISTAN

(1) Lesbela-Quetta Axis.
Centre: Lesbela.

(2) Lesbela-Mekran Axis.
Centre: Mekran.

SIND

(1) Hyderabad-Nawabshah Axis.
Centre: Nawabshah.

(2) Nawabshah-Sanghar Axis.
Centre: Sanghar.

(3) Nawabshah-Larkana Axis.
Centre: Larkana.

(4) Larkana-Sukkur Axis.
Centre: Sukkur.

Table 1

QUANTITATIVE PROJECTIONS OF EMPLOYMENT

	Estimated July 1988	**Estimated July 1993**
Population	105.4	122.8
Domestic Labour Force	31.0	36.1
Net Returnees	-	0.4
Total Labour Force	31.0	36.5
Unemployment	1.1	2.4
Employment	29.9	34.1
Unemployment rate (% of Laboure Force)	3.5	6.6

Note: Estimates are based on crude activity rate of 29.4 percent as given in the LFS of 1986-87.

Source: Seventh Five Year Plan, Planning Commission, Government of Pakistan, Islamabad.

Table 2

ESTIMATED CHANGES IN LABOUR ABSORPTION IN CROP PRODUCTION DURING 1988-2000

		Policy 1	Policy 2
1.	Increase in Labour Demand (Man days per year)	292.291 M	361.987 M
2.	Man days of production Labour required to sustain one Farm household	225.11	225.11
3.	Increase in absorption of Farm Households	1.297 M	1.604 M
4.	Increase in absorption of Farm Population	8.431 M	10.426 M

Sources
i) Wapda XAES data on Coefficients (Unpublished).
ii) Pakistan Census of Agriculture, 1972, 1980.
iii) Report of the Farm Mechanization Committee, Ministry of Agriculture and Works, Government of Pakistan, 1970.
iv) Pakistan Census of Agriculture Machinery.

Notes:

(1) Estimates Mine.

(2) **Policy 1**

(a) Growth of tractors and size of tractors in the period 1988-2000 remains the same as in the period 1968-1975.
(b) Introduction of Mechanized harvesting does not cover more than 10 percent of the total cultivated area.
(c) Increase in delivery and application efficiencies of irrigation resulting in a growth rate of crop production of 3.7 percent per year, with associated increases in cropping intensities.

(2) **Policy 2**

(a) Growth rate of tractors during 1988-2000, slows down to half the rate observed in the period 1968-1975.
(b) Same as in Policy 1.
(c) Same as in Policy 1.

Table 3

ESTIMATED CHANGES IN LABOUR ABSORPTION IN NON-FARM ACTIVITY IN THE AGRICULTURE SECTOR 1988 - 2000

		Policy 1	Policy 2
1.	Increase in Labour Demand for crop production (Man days per year)	292.291 M	361.987 M
2.	Increase in Labour Demand for NON-FARM activity (man days/year	66.642 M	82.328 M
3.	Increase in absorption of Non-Farm Households in Agriculture Sector	0.296 M	0.366 M
4.	Increase in non-farm Population absorption in Agriculture Sector	1.835 M	2.296 M

Note: (1) Estimates Mine.

Sources:
i) Wapda XAES data on Coefficients (Unpublished).
ii) Pakistan Census of Agriculture, 1972, 1980.
iii) Report of the Farm Mechanization Committee, Ministry of Agriculture and Works, Government of Pakistan, 1970.
iv) Pakistan Census of Agriculture Machinery.

ESTIMATES 1
MAN DAYS REQUIREMENT (MDR)
FOR IRRIGATED CROP ACREAGE WITHOUT TRACTORS
(PUNJAB)

	C.A.*		MDR/ACRE**		
Wheat	9.483	x	16.4	=	156.47 Million
Rice	1.829	x	29.8	=	54.50 Million
Cotton	4.338	x	27.9	=	121.03 Million
Sugarcane	0.839	x	48.9	=	41.02 Million
Maize	0.757	x	22.5	=	17.03 Million
Oil Seeds	0.547	x	11.9	=	6.51 Million
Pulses	0.550	x	8.8	=	4.84 Million
Fodders	4.979	x	17.3	=	86.14 Million

Total man-days Requirement	=	487.54 Million
Total Irrigated Cropped Acreage	=	23.32 Million..(i)
Total Man-Days Requirement	=	487.54 Million..(ii)
MDR per year, per irrigated acre	=	487.54/23.32 = 20.91

Sources:
i) WAPDA data for Labour Coefficients
ii) Pakistan Census of Agriculture for Estimates of Cropped Acreage (irrigated) for each crop.

* Cropped Acreage.
** Man days per acre.

ESTIMATES 2

MAN DAYS REQUIREMENT (MDR)

FOR IRRIGATED CROP ACREAGE WITHOUT TRACTORS

(PUNJAB)

	C.A.*	MDR/ACRE**		
Wheat	2.28	x 11.5	=	26.22 Million
Cotton	0.051	x 19.4	=	0.989 Million
Sugarcane	0.015	x 34.1	=	0.512 Million
Maize	0.143	x 15.7	=	2.045 Million
Oil Seeds	0.250	x 8.3	=	2.075 Million
Pulses	2.097	x 7.8	=	16.356 Million
Fodders	0.792	x 9.6	=	7.603 Million

Total man-days Requirement = 55.49 Million
Total Irrigated Cropped Acreage = 5.63 Million

MDR per year, per irrigated acre = 55.49/5.63 = 9.63

Sources: i) WAPDA data for Labour Coefficients
ii) Pakistan Census of Agriculture for Estimates of Cropped Acreage (irrigated) for each crop.

* Cropped Acreage.
** Man days per acre.

ESTIMATES 3

MAN-DAYS REQUIREMENT (MDR) FOR IRRIGATED AND UNIRRIGATED CROPPED ACREAGE WITH TRACTORS

(PAKISTAN)

Assuming that average MDR/year for irrigated acreage and UNIRRIGATED acreage respectively, in Punjab and Pakistan as a whole are the same, MDR for Pakistan, taking account of differences in cropping intensities between Punjab and Pakistan, can be estimated as follows:

Total irrigated cropped acreage in Pakistan		=	37.24 million
MDR per year per irrigated acre (estimate 1)		=	20.91
(i)	Total MDR per year in Pakistan crop sector	=	37.24 x 20.91
	(Irrigated)	=	778.69 million
Total unirrigated cropped acreage in Pakistan		=	10.53 Million
MDR. per year per unirrigated acre (Estimate2)		=	9.86
ii)	Total MDR per year in Pakistan crop sector	=	10.53x9.86
	(Unirrigated)	=	103.83 Million
iii)	Total MDR/Year in Pakistan crop sector (without tractors) = (i) + (ii) = 778.69+1-3.83=		882.52 Million

ESTIMATES 4

MAN-DAYS PER ACRE PER YEAR REQUIREMENT (PAKISTAN) IN THE YEAR 2000 (WITHOUT TRACTORS AND WITH TRACTORS)

A. YEAR 1988

MDR/Year without tractors (Estimate 3 (iii)) = 882.52 Million

Total cropped acreage (Irrigated+Unirrigated) = 37.24 + 10.53 = 47.77 Million

Man days/year/acre for Pakistan crop sector= 882.52/47.77 = 18.47

B. YEAR 2000

(i) Assuming 3.7 percent per annum growth of output over the period 1988-2000 and a proportionate increase in labour demand, i.e., constant labour productivity, MDR/year/acre in year 2000 =27.51

Labour demand in crop sector in year 2000, without tractor =27.51. x 47.7 =1312.23 Million MDR

C. CHANGE IN LABOUR DEMAND DURING 1988-2000 (WITHOUT TRACTORS)

(i) Labour demand in crop sector (without tractors) in years 2000 =1312.23 Million MDR.

(ii) Labour demand in crop sector (without tractors) in year 1988 (Estimate 3 (iii)) =882.52 Million

Change during 1988 - 2000 =1312.23 -882.52 = 429.71 Million MDR.

D. CHANGE IN LABOUR 1988-2000 WITH TRACTORS

(i) Change in Labour Demand between 1988-2000 if tractorization continues at the same pace as between 1968-75, but without any change in yield = -137.64 Million

(ii) Change in Labour Demand between 1988-2000 if tractorization continues at the same pace and also with a 3.7 percent annual growth of output =292.29 million

ESTIMATES 5

INCREASE IN ABSORPTION OF HOUSEHOLDS AND POPULATION IN PAKISTAN'S CROP SECTOR 1988-2000

i) Man days of employment required to sustain one farm household, at wage rates prevailing in 1975, and just at the poverty line, (using 1975 consumer price index), comes out to be = 225.11 man days

(See A. Hussain Rural Population Estimates, PEPAC NHS Report, Appendix 2)

ii) Increase in Labour Demand between 1988-2000, if tractorization continues at the same pace and also with a 3.7 percent annual output growth (Estimates 4 D (ii) = 292.29 Million

iii) Total increase in Absorption of Households in the Crop Sector in Pakistan over the period 1988-2000 = 292.29/225.11 = 1.3 Million

(iv) Total increase in Population Absorption in the Crop Sector (using national average household size of 6.5) =8.45 million persons.

TECHNICAL AND FINANCIAL REQUIREMENTS FOR INDUSTRIAL SUPPORT CENTRES
MATERIALS TESTING LABORATORY:[15]
Equipment and budget estimate

Function: Checking incoming raw materials, determine mechanical properties of materials, verification of results of heat treatment.

Equipment: A. Microstructural analysis of metals

1. Cut-off sawing machine.
2. Laboratory press.
3. Grinding and polishing equipment.
4. Various equipment for cleaning, storage, etc., of specimen.
5. Etching facilities, including basic set of chemicals.
6. Metallurgical microscope.

B. Mechanical Testing

1. Hardness testing equipment, according to:

   - Rockwell
   - Brinell
   - Vickers

2. Testing equipment for:

   - Tensile Test
   - Compression Test
   - Bending Test

3. Impact Tester.

4. Various small Testers and tools.

C. Steel Composition Analysis

1. Set of equipment and analytical instruments for determination of alloy elements and carbon contents.

Budget: Rs. 6.984 million

FOUNDRY:
Equipment and Budget estimate

Function: Production of ferrous and non-ferrous castings.

Equipment: Machinery and tools for:

1. Melting and pouring
2. Mould production
3. Sand preparation
4. Core making
5. Finishing and fettling
6. Quality control
7. Pattern making and storage

Budget: Rs. 24.25 million

SURFACE TREATMENT UNIT:
Equipment and Budget estimate

A. HOT-DIP GALVANIZING UNIT

Function: Hot dip galvanizing, zinc, nickel and chrome, of relatively small, handy steel production. The process is comprehensive, in this way meant for application as well as demonstration purposes.

Equipment:
1.- 8. Pre-treatment bathes
9.- 16. Nickle/chrome bathes.
17.-22. Zinc bathes, design sizes:
- Active bath: 1200*1100*1000/1050 mm
  Construction: Steel, internal and external coated with rubber.
- Two barrels for nickel and zinc galvanizing included.

23. Centrifuge.
24. Six (6) rectifiers, incl. copper strip 25 m.
25. Work bench.
26. Blower and pipe system.
27. Four (4) filter pumps.
28. Titanium baskets.
29. Chemicals.
30. Lead anodes.
31. Nickel, 1000 kg.
32. Zinc, 1000 kg.
33. Accessory tolls.

Budget: Rs. 6.79 million.

SURFACE TREATMENT UNIT:
Equipment and Budget Estimate.

B. PAINT SPRAY INSTALLATION

Function: Universal spray painting unit, equipped with a blasting unit, a muffle-furnace and testing facilities.

Equipment:

1. Pre-treatment, Blasting Unit

   - 1 semi-portable compressor
   - 1 air-cooled air dryer
   - 1 after cooler
   - 1 vertical pressure tank
   - 1 blasting set.

2. Storage: racks for workplace materials, products and tools
3. Paint spray equipment

   - 4 complete airless cold spray sets
   - viscosity meter alu
   - speed coupler for air hose
   - air hose 9mm internal

4. Pain application room
   4A. -2 dry spray painting bays 3000* 1970 mm
   4B. -filter framers, 10m 2

5. Workbench
6. Racks, for drying and transportation purposes
7. Muffle furnace

   -Size: Interior:3150*1400*1980 mm
   Exterior:3400*2000*2030 mm

8. Testing devices

   - Layer thickness meter
   - Porosity tester
   - Sulphur dioxide tester

9. Accessory tools

Budget: Rs. 2.62 million

WELDING SHOP:
Equipment and Budget estimate

Function: Application and demonstration of the various kinds of welding techniques used in modern metal industry.

Equipment:A. Storage

1. Cupboards shelves, racks, electrode cabinets for welding materials.
2. Racks and shelves for work piece materials.

B. General

1. Sawing machine.
2. Set hand tools.
3. Measuring tolls.
4. Welding tables.
5. Fume extraction equipment.
6. Protective clothing.
7. Shower.
8. First aid kit.
9. Grinding machinery.
10. Testing equipment.
11. Equipment to manufacture welding jigs.
12. Welding curtains.
13. Workbenches.
14. Preheating equipment.

C. Electric arc welding

1. 5 Welding transformers AC.
2. 3 Welding rectifiers DC.
3. 2 MIG welding machines.
4. 1 TIG welding machine.
5. 1 Powder deck welding machine.
6. 2 Portable welding transformers.
7. 1 Plasma welding set.

D. Oxygen/acetylene welding/soldering

1. 5 Oxy-acetylene welding/soldering set.
2. 1 Acetylene generator.

E. Electric resistance welding.

1. 1 Pedestal spot welding machine.
2. Handheld spot welding gun.
3. 1 seam welder.

Budget: Rs. 4.365 million.

THIN SHEET METAL AND TUBE BENDING UNIT:
Equipment and Budget estimate

Function: The ability to perform various operations on thin metal sheets, like folding, bending, punching and deep-drawing, and on tubes.

Equipment: A. Thin metal sheet unit (0-3 mm)

1. Guillotine shear.
2. Hand lever operated shear.
3. Roller Machine.
4. Folding machine.
5. Plate bending rolls.
6. Circular shears.
7. Notcher.
8. Bordering machine.
9. Punching machine.
10. Press, deep drawing.
11. Metal band saw.
12. Hand electric sheet metal working tools.
13. Accessories and spare parts.

B. Tube bending unit.

1. Machinery for thin-wall pipe 2".
2. Circular Saw.
3. Angle bender.
4. Threading machinery.
5. Hand tools.
6. Accessories and spare parts.
7. Work benches.

Budget: Rs. 5.626 million

SHEET METAL UNIT FOR THICK METAL SHEETS (3MM):
Equipment and Budget Estimate

Function: The ability to perform various operations on thick metal sheets, like shearing, bending, press braking.

Equipment:
1. Guillotine shear.
2. Plate bending rolls.
3. Fusion edge milling machine.
4. Press brake
5 Hand tools.
6. Accessories and spare parts.
7. Work benches.

Budget: Rs. 4.850 million

HEAT TREATMENT UNIT:
Equipment and Budget estimate.

Function: Hardening of metal parts and components.

Equipment:
1. Shaft furnace,
   - for retorts,
   - including a controlling device.
2. Annealing furnace.
3. Carbonating retort.
4. Nitrating retort.
5. Hoisting mechanism.
6. Oil bath, including CO2-fire extinguisher.
7. Water bath.
8. Gas control for N2, H2, methanol, ammonia.

Budget: Rs. 2.425 million

TOOLS AND DIE MAKING SHOP:
Equipment and Budget Estimate.

Function: The manufacturing of tools and dies for pressing works.

Equipment:
1. Copy-milling machine.
2. Milling machine.
3. Tool Room lathe.
4. Pillar drilling machine.
5. Band sawing machine.
6. Horizontal grinding machine.
7. Tool and cutter grinder.
8. Pedestal grinder.
9. Hand tolls and measuring tools.
10. Work benches, lockers, etc.
11. Spark erosion machine.
12. Wire erosion machine.

Budget: Rs. 14.841 million

AUTOMOTIVE WORKSHOP/GARAGE:
Equipment and Budget estimate.

Function: Maintenance and repair of motor vehicles passenger cars, vans and trucks.

Equipment:

1. Hoisting equipment: car lift, jacks, workshop crane.
2. General equipment: sets hand tolls, work benches, parts cleaning.
3. Storage: Cupboard, racks for spare parts and tools.
4. Diagnoses equipment for petrol and diesel engines, electric equipment.
5. Tune-up equipment for petrol and diesel engines.
6. Lubrication equipment: oil filling, greasing.
7. Brake service equipment.
8. Tyre service equipment.
9. Body working equipment: panel beating, welding, body alignment set.
10. Wheel alignment set.
11. Paint spray booth and equipment.
12. Electric system tools and testers, battery service.

Budget: Rs. 5.335 million

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6 *Ibid.*

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13 *Ibid. Page 65.*

14 *Ibid Page 73.*

15 *The lists of machines in this section are obtained from Akmal Hussain, Henk Thomas, O.A. Khan and L. Tomeson: PHMP Phase 2.*